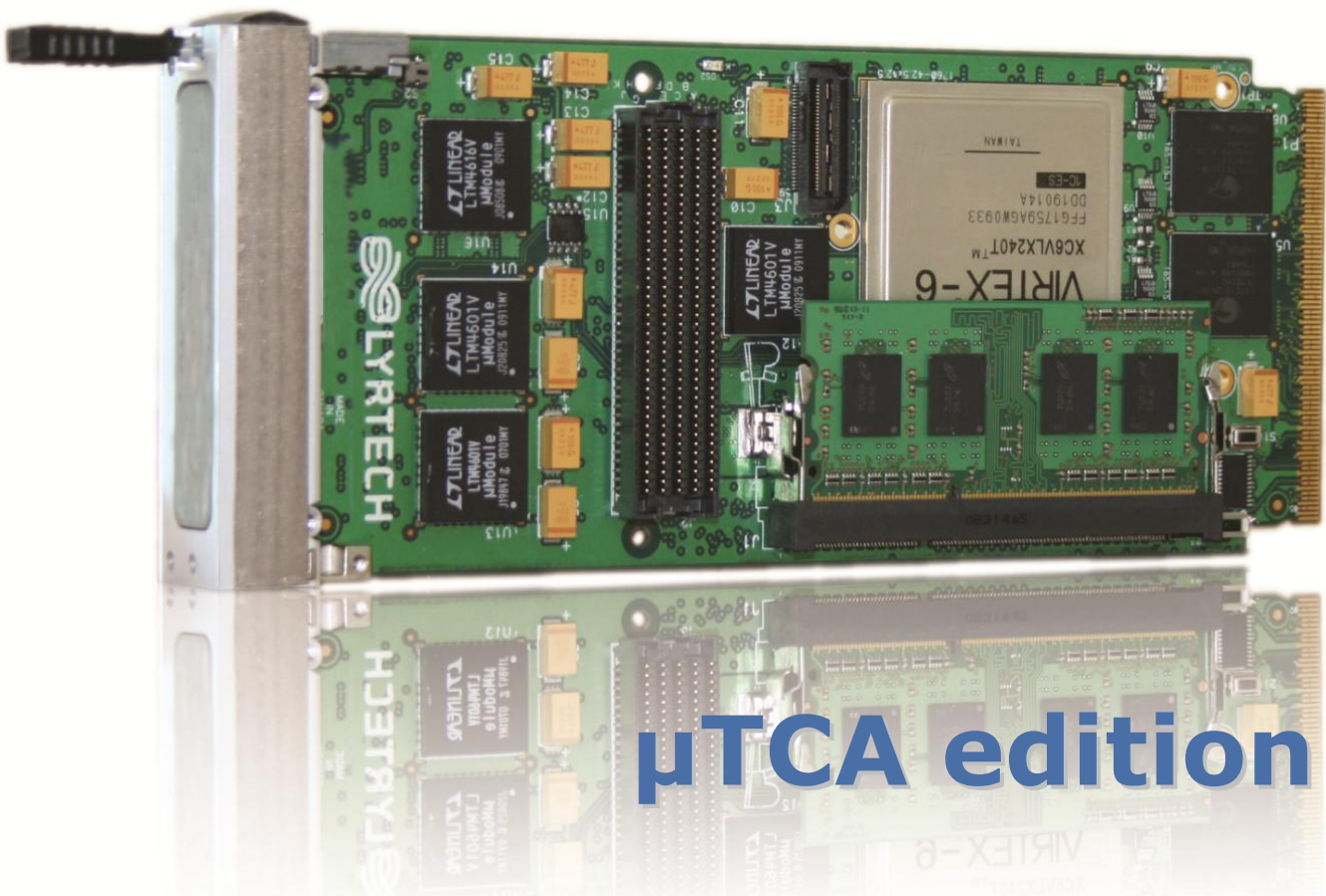


# Upgrading to BAS 7.0



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# 1 Introduction

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Release 7.0 of the Nutaq BAS (Boards and Systems) software tools introduces new third party software support and a new example architecture. This document details these changes as well as lists the changes the users will face while upgrading to version 7.0.

A new licensing method using a USB dongle is also introduced. The USB dongle protects the installation of the software tools as well as the FPGA design compilation using the MBDK flow. The new method has been chosen to solve issues with the access to our previous license server.

**Important:**

A Perseus firmware update is necessary to use the features of the new release. For a step by step procedure, check the App Note - Perseus Firmware Update document in the `\doc\app_notes` folder of the installation.

The Linux based BAS Software Tools are Kernel version dependent, especially the PCI Express driver. The software tests executed on the Linux installers were done with this kernel versions:

Linux OS	Kernel Version
Ubuntu 12.04 LTS 64-bit	3.13.0.32

For full details on the new features of Software Tools release 7.0, please consult the Release Notes document in `\doc\release`.

---

## 2 New licensing method

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As of release 7.0, the licensing method used by Nutaq for its BAS line of products is an encrypted USB dongle. The USB dongle provided with your BAS Software Tools purchase contains the license information for the product options you selected. It is also a flash drive that contains the latest BAS Software Tools version at the moment of the purchase and its documentation. You must leave the dongle connected to your computer when installing BAS Software Tools and compiling a bitstream with the MBDK toolset. BAS Software Tools can be installed on as many computers as you require, as long as they meet the minimum system requirements.

Please refer to section 1.5 of the Installation Guide in `/doc/release` for information on how to upgrade your license options or get support on the installation of BAS 7.0.

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## 3 Third-party software update

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BAS software tools Release 7.0 supports new third party software from Xilinx, The Mathworks and Microsoft.

The first step in the BAS 7.0 software upgrade process is the installation of the new third-party software on a computer running the Windows 7 64 bits operating system. BAS 7.0 requires the following third-party software to be installed on the system:

### **Essential BSDK Development Software**

- Xilinx ISE Design Suite 14.7 Embedded Edition or System Edition (essential for FPGA development)

### **Optional BSDK Development Software**

- TFTP software (necessary for firmware updates)
- Microsoft Visual Studio 2012 (for host library and application compilation and development)

### **Essential MBDK Development Software**

- MATLAB R2013B (64-bit installation)
  - Signal Processing Toolbox
  - MATLAB Simulink
- Xilinx ISE Design Suite 14.7 System Edition (essential for FPGA development)
  - Xilinx System Generator 14.7

### **Essential MBDK Development Software**

- Adobe Acrobat Reader DC (for MBDK example documentation)

---

## 4 Installation of BAS Software Tools on Windows 7 64-bit

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Once the third-party applications are present on the system, the BAS Software Tools can be installed. The installer for BAS Software Tools is located on the USB dongle provided with your purchase.

Please uninstall any prior version of ADP Software Tools before installing BAS 7.0. Make sure to back up your work correctly before performing any update.

For additional information on the installation process and a complete installation guide, please refer to the Board & Systems Software Tools - Installation Guide document located in \doc\release.

---

## 5 New Central Command Engine and Firmware Update

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To use the new functionalities of the BAS Software Tools 7.0, it is mandatory to perform a Perseus firmware update.

The firmware update will install the new Central Command Engine (3.2.0).

It is now possible to directly update the CCE from an older version to the current one using the *update\_cce* CLI command.

To update the Perseus firmware from ADP release 6.6 to BAS release 7.0, only the CCE update is necessary. If upgrading from a prior version, please execute a full firmware update.

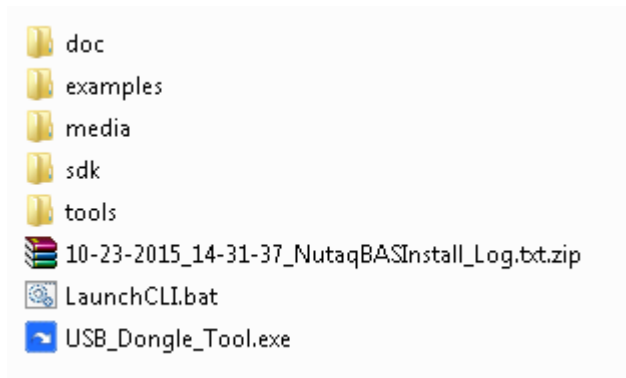
To perform the firmware update, please follow the instructions available in the *Perseus Firmware Update* document in the \doc\app\_notes folder of the Windows installation.

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## 6 New file architecture

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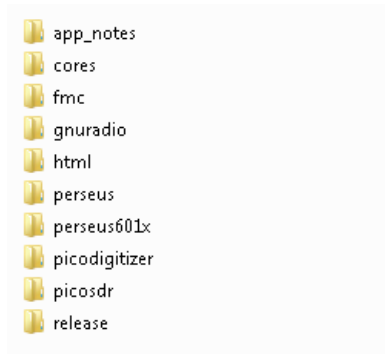
The BAS Software Tools file architecture was designed to be more intuitive and easy to navigate. It also accommodates the arrival of the Perseus 611x, our newest uTCA platform. You can reach the root directory of BAS by typing %BASROOT% in your file browser. At the root of your BAS file architecture, you should see the following:



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### Documentation directory (doc)

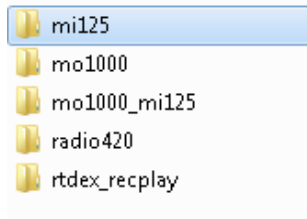
This directory contains all the documentation for both our hardware and software products supported with BAS Software Tools. You will find user's guides, quick start guides and API reference for your product, whether it is an uTCA carrier, a FMC card or a complete system.



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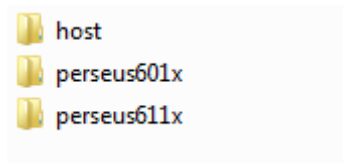
## Examples directory (examples)

This directory contains all the examples for the supported FMCs and core Perseus features with BAS 7.0. In each subfolder, you will find the FPGA designs for both BSDK and MBDK toolsets as well as the host program associated with the example.



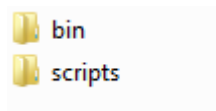
### Example sub-directory (rtdex\_recplay)

This directory contains the host programs (C language and BAS CLI, if applicable) and their associated FPGA designs for the Perseus 601x and Perseus 611x carrier boards.



### Example sub-directory (rtdex\_recplay/host)

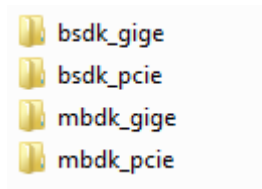
This directory contains the host examples scripts for the RTDEx Record and Playback example. Binary files generated by the example will be stored in the bin subfolder.



### Example sub-directory (rtdex\_recplay/perseus601x)

This directory contains the FPGA design examples for both the BSDK and MBDK toolsets. BSDK specific subfolders contain the Xilinx Platform Studio project and support files while the MBDK specific folders contain the Simulink model associated with the example.

The file architecture for the perseus611x is identical.





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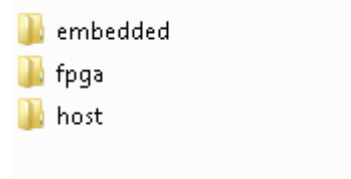
## Media directory (media)

This directory contains support files for the OFDM applicative example (if applicable).

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## API/sources directory (sdk)

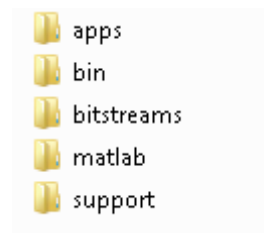
This directory contains source files and precompiled libraries for the BSDK and MBDK toolsets.



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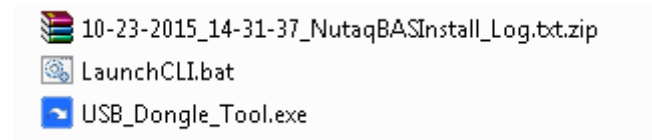
## Tools directory (tools)

This directory contains the precompiled example applications and their source files. This is also where the precompiled FPGA bitstreams are located.



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## Other files in the root directory:



The root directory also contains the following:

Installation log: you must send this archive to [support@nutaq.com](mailto:support@nutaq.com) if you are having trouble installing BAS 7.0.

LaunchCLI.bat: this batch file launches the BAS Command Line Interface.

USB\_Dongle\_Tool.exe: this program allows sending a diagnostic of your USB license dongle to [support@nutaq.com](mailto:support@nutaq.com).

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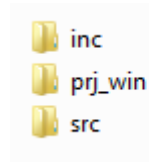
## 7 New host example design (Windows/Linux)

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In prior releases of ADP Software Tools, the prepackaged host C language examples were made as standalone applications which in turn called the precompiled EAPI libraries. This led to a lot of duplication of often used sample code and made the understanding of the example source code more difficult.

From this release version and onwards, host examples are packaged as batch (Windows) and bash (Linux) scripts which call precompiled executables called apps. These apps each represent a basic functionality of the code modules provided with the BAS Software tools installation. For example, the Radio420 module has the Radio420\_Init app which does the initialization and the calibration of the Radio420 FMC. The apps use input parameters and .ini files to define operational parameters.

The source files of the precompiled apps are provided in the /tools/apps folder. The typical file architecture for an app on a Windows installation is:



The inc directory contains additional header files to be included in the app project. The prj\_win directory contains the Visual Studio 2012 solution and Visual C project associated with the app. On a Linux installation, the folder prj\_win is replaced by prj\_linux, which contains the makefile for the application. The src directory contains the source files written in C language.

For more information on the host examples and how you can use the precompiled apps for your own applications, please refer to the Programmer's Reference Guides and Examples Guides of the code modules in the /doc directory.

---

## 8 Host libraries source files

---

In prior Software Suite releases, the host libraries used as an interface with our hardware modules came precompiled without any associated source code. As of this release, the source code for the EAPI libraries is included in the installation of BAS Software Tools. It is modifiable by the user.

The source code for the host libraries can be found in the `/sdk/host/api` directory.

**Important:**

Please note that Nutaq's support team will not support any modifications made to the host libraries. You can however propose changes to introduce in our main development path if they solve an issue you have in our product.

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## 9 New uTCA Platform: Perseus611x

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The BAS Software Tools 7.0 software release adds development tools and API support for Nutaq's newest uTCA carrier platform, the Perseus611x.

The Perseus611x is a double-width AMC carrier which packs two HPC- FMC connectors.

For more information on the Perseus611x and its features, please refer to the Perseus611x User's Guide document in `\doc\perseus611x`.

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# 10 New officially supported cores and modules

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## RTDExSync

Nutaq's RTDExSync core adds synchronous functionalities to the Gigabit Ethernet and PCIe real-time data exchange (RTDEx) data flows. The present RTDEx implementation allows a host computer to transmit and receive data to/from hardware platforms. The data can contain samples going to DACs or coming from ADCs.

The synchronous implementation of the RTDEx gives the user control over the start and stop conditions of an RTDEx transfer. The conditions that can be used to control such transfers are: immediately, after a rising-edge trigger is detected or at a specific time. These start and stop conditions can be used to synchronize the uplink and downlink channels together or to synchronize multiple channels together even across multiple hardware platforms. The RTDExSync functionalities also add a synchronization recovery mechanism so different channels can remain synchronized even when samples are lost during a transfer.

The RTDExSync module is intended to be used to synchronize the transmission and reception of samples through many hardware platform boards for MIMO and Massive MIMO systems.

---

## Timestamp

Nutaq's Timestamp core provides the user design with a free running counter that is incremented at every design clock cycle. The user logic can monitor the counter value to see the time elapsed between two events as a number of clock ticks.

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## RTDExTs

To provide absolute timestamp for RTDExSync start and stop conditions and events, a wrapper on top of RTDExSync and Timestamp host library is made available. This wrapper is the RTDExTs library. To use this library, Nutaq's RTDExSync and Timestamp modules must be present inside the platform and a PPS must be provided to the system.

RTDExTs is a host-only module which uses the RTDExSync and Timestamp FPGA cores.

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# 11 Supported FMCs and core modules

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The BAS Software Tools 7.0 software release includes support, development tools and API for the following FMCs and core modules.

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## FMC support

Module	Carrier	
	Perseus 601x	Perseus 611x
Radio420	x	Not Supported in 7.0
MI125	x	Not Supported in 7.0
MO1000	x	Not Supported in 7.0
ADAC250	Not supported in 7.0	Not Supported in 7.0
MI250	Not supported in 7.0	Not Supported in 7.0
ADC5000	Not supported in 7.0	Not Supported in 7.0
LVDS Xin Xout	Not supported in 7.0	Not Supported in 7.0

ADAC250 support on Perseus601x is planned in Release 7.1

---

## Core Support

Module	Carrier	
	Perseus 601x	Perseus 611x
Record/Playback	x	x
RTDEx	x	x
RTDExSync	x	Not Supported in 7.0
Timestamp	x	Not Supported in 7.0

---

# 12FPGA design port to BAS 7

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## BSDK – Xilinx Platform Studio

To port your current BSDK design to BAS 7, you will have to follow these general steps.

1. Copy the existing project to the new BAS example architecture.
2. Open the project in Xilinx Platform Studio from ISE 14.7. Depending on the cores used by your project, you might be prompted to update a Xilinx IP core to a new version. If you must do so, make sure you properly use the core's interface.
3. Make sure to use the new release's Nutaq cores from the *sdk/fpga/NutaqIPLib* folder.
  - The Radio420 core has been modified to simplify the input and output of data. Previously, the user had to manage the interleaving of data and there was only one data port and an IQ select port. This has been modified to two data ports (one for I, one for Q, for both RX and TX). You will have to modify the data interface connections to properly use the new Radio420 core.
4. Compile the project in the same manner as in previous releases.

---

## MBDK – MATLAB and Xilinx System Generator

To port your current MBDK design to BAS 7, you will have to follow these general steps. These are a general indication of the work to be done and your port might necessitate more steps.

1. Copy the existing model to the new BAS example architecture.
2. Open the model in MATLAB R2013B.
3. Replace all Nutaq FPGA blocks with the new version. Some blocks have been modified, either in their parameters or their signal interface.
  - FMC blocks are now associated with an FMC site and a board position (see specific documentation for your hardware for more details). This is to add support for Perseus611x dual FMC connectors. Your existing design should only use site 1. Make sure the blocks are properly configured.
  - The Radio420 block has been modified to simplify the input and output of data. Previously, the user had to manage the interleaving of data and there was only one data port and an IQ select port. This has been modified to two data ports (one for I, one for Q, for both RX and TX). You will have to modify the data interface connections to properly use the new Radio420 block.
  - Custom register block port width is now fixed to 32 bits.
  - FPGA board configuration block has been modified to support the new Perseus611x carrier. The user must select the carrier (Perseus 601x or Perseuss 611x) for which the compilation will be made. Make sure the carrier is properly selected.
4. Generate the model in the same manner as in previous releases.

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## Support

If you have trouble compiling your pre-existing project or model in either the BSDK or MBDK flow, please contact Nutaq support at [support@nutaq.com](mailto:support@nutaq.com)

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# 13 Host design port to BAS 7

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## C projects

To port your current MBDK design to BAS 7, you will have to follow these general steps.

There are two approaches to porting an existing project. The first is to start from the newly added example applications with the easy *.ini* file configurations, and to add piece by piece your configuration and processing code by customizing these applications. The design of the new OFDM example has been done by Nutaq in this manner.

The second is to modify the current project for it to compile in the new architecture and with the new tools. This approach is detailed here. These are a general indication of the work to be done and your port might necessitate more steps.

1. Copy the existing project to the new BAS example architecture.
2. The project's include and linker library paths must be modified to fit the new BAS folder architecture.
  - In Windows, open the Visual Studio project or solution. Repair any links that might have been broken by the move.
  - In Linux, edit the makefile to use the new architecture.
3. Some of the source (.c and .h) files used in the previous releases have been renamed or removed.
  - For example, all files that started with the prefixes *adp\_* and *lyr\_* have been modified with the *bas\_* prefix.  
Ex.: *lyr\_error.h* has been renamed *bas\_error.h*  
*adp\_buff\_fct.h* has been renamed *bas\_buffer.h*
  - The number of folders in which these source files can be found has been reduced and classified for a better understanding of the tools available.
4. The *BusAccess* library has been removed. This can impact your current project in the following ways.
  - Previous release examples used *BusAccess\_Ethernet\_OpenWithoutConnection* to connect to the Perseus. This function is now obsolete. Instead use *connect\_cce*. This function returns a *connection\_state* handle that must be carried throughout the application or project. Use *disconnect\_cce* to terminate the connection.
  - The RTDEx and Record/Playback library functions previously used a *BusAccess* handle in all their definitions. That handle is no longer available. Instead, the module's open functions now take the current *connection\_state* handle as an argument and return a module handle. The dedicated module functions themselves only need the module handle. Refer to the libraries .h files to validate the new function definitions and usage.

For steps 2, 3 and 4, you can refer to the sample applications present in the new release for examples of the new usage.

5. In prior releases, the RTDEx and Record/Playback libraries used a static memory map defined in a .h file to communicate with their associated FPGA cores. A new function has been added to dynamically query the core base address. Use *Carrier\_GetModuleBaseAddr\_send* instead of using *memory\_map* enums.

---

## Command Line Interface (CLI)

The following modifications have been made to the CLI commands.

1. The *ram* and *replay* classes have been replaced by *rtdex\_replay* class.

Obsolete commands	Equivalent
ram_put	LoadDataToPlaybackFromFile
ram_get	RetrieveRecordedDataToFile
replay_record	RecordData
replay_record_check_transfer_done	Embedded in RetrieveRecordedDataToFile
replay_playback_single / continuous	PlaybackData

Please refer to the CLI example scripts for a demonstration of how to use the new class.

2. The *rtdex* class has been completely removed.

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## Support

If you have trouble compiling your pre-existing project in either Visual Studio or on Linux, please contact Nutaq support at [support@nutag.com](mailto:support@nutag.com)