

Document objective

This document is provided to assist customers familiarize themselves rapidly with the software tools available. It also gives detailed instructions allowing quick and simple implementation.

This document is split into several sections:

- [Section 1: Quick start guide](#) comprising:
 - [Section 1.1: Package contents](#)
 - [Section 1.2: FLEXIm licensing software](#)
- [Section 2: Overview of ClearSpeed software](#) comprising:
 - [Section 2.1: Runtime software](#)
 - [Section 2.2: Software development kit](#)

Do I need both the Base package and Developer package to start using ClearSpeed?

The Base package is required if you simply want to run applications which are compatible with the ClearSpeed software on an Advance accelerator card.

The Developer package is provided for those users who wish to develop their own applications to run on the ClearSpeed Advance accelerator card. You will need to install the Base package before the Developer package.

If you are using the SDK then you must also install the FLEXIm license manager software and obtain a license key from ClearSpeed.

1 Quick start guide

1.1 Package contents

The software is available in two downloadable packages:

- Base package: freely downloadable from the support website.
- Developer package: only downloadable by SDK customers.

The contents of the packages are as follows:

Base package ⁽¹⁾	Runtime and drivers	Section 2.1: Runtime software
	CSXL library	Section 2.1.2: CSXL library
	Release notes	Provided in the software packages and also available from: http://support.clearspeed.com/documentation
	Installation instructions	
	Other documentation	
Developer package ⁽²⁾	SDK	Section 2.2: Software development kit
	Simulator	Section 2.2.1: Tools
	Visual profiler	
	CSDFT library	Section 2.2.3: CSDFT library
	FLEXIm license server	Section 1.2: FLEXIm licensing software
	Release notes	Provided in the software packages and also available from: http://support.clearspeed.com/documentation
	Installation instructions	
	Other documentation	

1. Available from the CD-ROM enclosed with the Advance™ Accelerator board or from the ClearSpeed Support portal.

2. Only available from the ClearSpeed Support portal.

The packages are available as tarballs for Linux or as zip files for Microsoft Windows. These can be downloaded from the ClearSpeed customer support web site: <http://support.clearspeed.com/downloads/>.

Only developers who have purchased the SDK can download the Developer package: you will be provided with a login account on the ClearSpeed support site.

Once you have downloaded the installation packages, you should use `tar` on Linux, or a suitable unzip program on Windows, to unpack the contents.

The installation instructions will be found in the top level directory and other documents in the `docs` directory. Each of the individual components can then be installed as described in the appropriate installation documents.

1.2 FLEXIm licensing software

Use of the SDK tools is controlled by a software license manager called FLEXIm from Macrovision (www.macrovision.com). In order to use the tools you must (a) have the FLEXIm license server running and (b) obtain a valid license key from ClearSpeed.

FLEXIm is a third party license manager which is provided for use with the Developer package only. This may already be on your network already so we advise you to check with your system administrator.

Please refer to the *FLEXIm Licensing End User Guide* (provided with the FLEXIm software installation and also available from <http://support.clearspeed.com/documentation/software/>) for a complete description of this software.

The FLEXIm software is installed on a machine called the license server and uses a server/client model to issue licenses. The SDK is installed on the client machine; which incidentally may be the same as the server machine. The license server machine issues a license to the SDK over the Ethernet.

The license is a single-user floating license⁽¹⁾. Therefore the SDK can be installed on any machine on an Ethernet network provided it can communicate to the license server.

You can set up your local SDK machine as the server if you do not have a central server that you wish to use.

Note: Any firewalls on the same network may have to be re-configured as appropriate.

1.2.1 FLEXIm software installation

Note: The FLEXIm license server is only required if you intend to use the SDK.

If you do not have a FLEXIm server already in your network, you must set one up to manage the software licenses for the SDK tools. You can install the FLEXIm software on the same machine as the SDK or on a central server to be used by multiple machines running the SDK tools.

The installer required to set up a FLEXIm server is provided as part of the Developer package. The *FLEXIm Licensing End User Guide* contains full instructions on setting up the FLEXIm server.

If you already have a FLEXIm server installed, you will still need the ClearSpeed vendor daemon, `clearsp`. This can be obtained by installing the FLEXIm software provided by ClearSpeed in to a temporary location and then copying the vendor daemon to your existing FLEXIm installation.

1.2.2 FLEXIm license key

To enable use of the SDK tools, a suitable *license file* must be installed. This is provided by ClearSpeed using information you provide about the machine that is acting as the license server. The license file is a text file containing information controlling the use of the SDK software. For detailed information on the contents of the license file, please refer to the *FLEXIm Licensing End User Guide*.

1. If you purchase multiple SDKs, then this will be a multiple-user floating license. For example, if you purchase three SDK licenses, then you will be issued with a three-user FLEXIm license key.

In order for ClearSpeed to be able to generate the license file, we require two pieces of information:

1. The FLEXIm server `hostname`: this is the name of your license server machine.
2. The FLEXIm `hostid`: this is a unique 12 digit hexadecimal number to identify the machine. FLEXIm uses different machine identifications for different machine architectures. For example, all Sun Microsystems machines have a unique `hostid`, whereas all DEC machines do not. For this reason, the ethernet address is used on some machine architectures as the `hostid`.

1.2.3 How do I obtain the FLEXIm hostid information?

1. Open a command window and go to the directory where the FLEXIm software is installed on the license server machine.
2. Change into the bin directory: `cd bin`
3. Type the command: `lmhostid`

This should print out a line *similar* to the one shown below (`hostid` will obviously be different as it is unique to the license server machine).

```
lmhostid - Copyright (c) 1989-2003 by Macrovision Corporation. All rights reserved.
```

```
The FLEXIm host ID of this machine is "000d598017d4"
```

1.2.4 How do I obtain the hostname information?

This is simply the host name of the license server machine. This can be obtained using the following method.

On Windows

Click on **Control Panel, System**, then the **Computer Name** tab.

The value shown as the computer name is the `hostname` to use.

Note: If the computer name includes a full domain name (for example, banana.example.org) then only the first part of this should be used for the `hostname` (banana, in this example).

Alternatively, you can open an MS-DOS command window and type the command:

```
set computername
```

This will display the name of the computer in the form:

```
COMPUTERNAME=BANANA
```

On Linux

Type the command:

```
uname -n
```

This will display the name of the host.

Alternatively, you can use the command:

```
echo $HOSTNAME
```

1.2.5 To obtain a license key

Please send the `hostname` and `hostid` to:

customer-support@clearspeed.com

Alternatively, submit these details by submitting a case on the support website:

<http://support.clearspeed.com/support/case/>

Note: Please also include details of the purchase/loan.

1.2.6 Installing the license key

Once the request has been actioned you will be sent an email with a file containing the license key. This file will have a name of the form `hostname.lic`.

1. Save the license key file in the same directory as the FLEXIm server installation.
2. To start the license server manually, use the command:

```
lmgrd -c hostname.lic -l flexim.log
```

Where `hostname.lic` is the license file provided by ClearSpeed and `flexim.log` is where the license server will write debug information.

The license server can be can be run manually or automatically at system startup.

Instructions for running the server as a daemon, so it starts automatically when the system is booted, can be found in the FLEXIm Licensing End User Guide.

The license server should not be run as root for security reasons.

2 Overview of ClearSpeed software

The ClearSpeed Advance accelerators are provided with a package of runtime software. A software development kit (SDK) is also available for programmers who need to write code for the CSX600 processor. The overall structure of the software is shown in *Figure 1*.

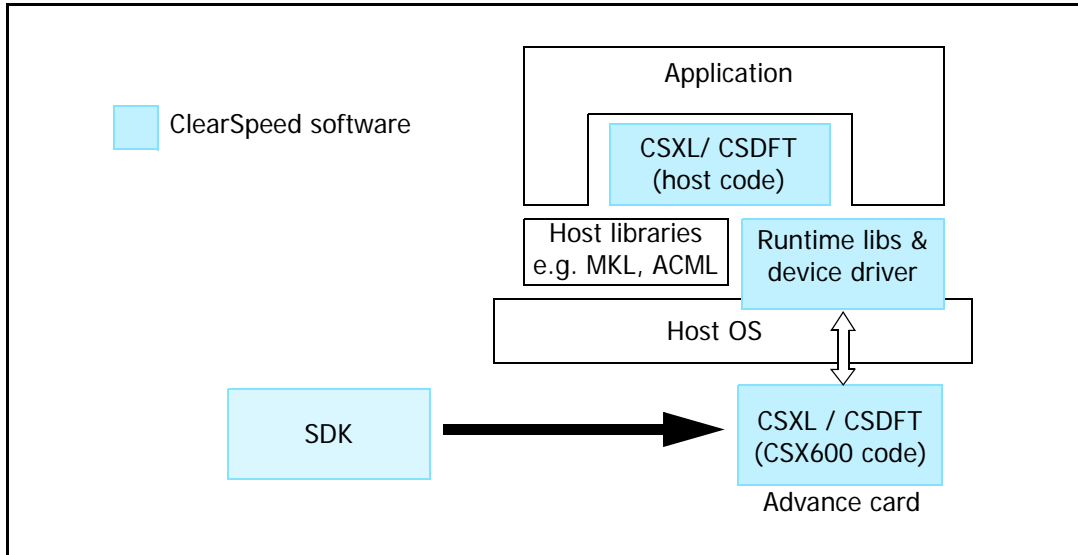


Figure 1. Software architecture

2.1 Runtime software

The runtime software includes:

- Device driver to interface between the host and the Advance card
- CSXL application acceleration library
- Libraries for communication between host code and software running on the card

The runtime software is delivered on CD-ROM with the Advance cards and is also available for download from the ClearSpeed customer support site:

<http://support.clearspeed.com/downloads/>.

2.1.1 Compatibility

See the ClearSpeed web site for the latest details of supported applications and operating systems.

<http://www.clearspeed.com/products/applicationsupport/>

2.1.2 CSXL library

The CSXL library implements a number of BLAS and LAPACK functions found in host math libraries such as MKL and ACML. When an application uses CSXL as the host library, appropriate function calls will be offloaded to the Advance card for acceleration. This allows applications which use functions such as DGEMM in these libraries to be accelerated

transparently. CSXL uses heuristics based on problem size, for example, to determine how to best share processing between the host CPU and the Advance card.

Functions supported

The following Level 3 BLAS and LAPACK functions are directly accelerated by this version of the CSXL library:

- `DGEMM`, the BLAS level-3 routine that multiplies a real double precision matrix by a real double precision matrix.
- `ZGEMM`, the BLAS level-3 routine that multiplies a complex double precision matrix by a complex double precision matrix.
- `ZGEMM3M`, an implementation of `ZGEMM` that requires three real matrix multiplications and five real matrix additions to compute the complex matrix product; `ZGEMM` uses four real matrix multiplications and two real matrix additions. See the *CSXL User Guide* for additional information. This may be faster than the standard implementation under certain circumstance.
- `DTRSM`, the BLAS level-3 routine that solves a real double precision triangular system of equations with multiple right-hand-sides. This routine constitutes a large percentage of the computation done in the LAPACK routines that factor and solve a general system of linear equations, respectively `DGETRF` and `DGETRS`.
- `DGETRF` and `DGETRS`, the LAPACK routines that factor and solve a real double precision general system of linear equations using the LU method.
- `DPOTRF` and `DPOTRS`, the LAPACK routines that factor and solve a real double precision symmetric positive definite system of linear equations using the Cholesky method.
- `DORGQR`, the LAPACK routine that generates all or part of the orthogonal matrix Q from a QR factorization computed by `DGEQRF`.
- `DORMQR`, the LAPACK routine that multiplies a matrix by the orthogonal matrix Q from a QR factorization computed by `DGEQRF`.

Card side functions

In addition to the functions that can be called from an application running on the host, CSXL includes a version of `DGEMM` which can be called directly by code written to run on the Advance card.

2.1.3 Host interface library

The API available to user programs to communicate with a CSX600 device is defined in the header file `csapi.h`. For details of the CSAPI functions see the runtime documentation. The CSAPI functions are grouped into the following functional areas.

- CSAPI create and destroy functions: to manage card-state data structures
- Card control functions: provides an API for exclusive access to a CSX600 card (connect, reset)
- Program setup functions: to load and unload programs (register application, load, unload)
- Processor control functions: controlling the state of the CSX600 processors (run, halt, start, wait, get return value)
- CSX600 register access functions
- CSX600 memory access functions

- Thread functions
- Semaphore functions: synchronization with CSX600 events
- Callback functions: to allow applications to register responses to CSX600 events
- Memory allocation functions: allowing applications to manage CSX600 memory
- Utility functions: miscellaneous operations (set parameters, number of cards/processors/PEs, get error)

2.2 Software development kit

The SDK provides a full suite of professional software development tools built around an optimizing, ANSI C-based cross compiler. This allows developers to write and debug code for the CSX600.

2.2.1 Tools

The SDK contains the following tools:

- Command line tool driver providing a standard interface to the other compilation tools
- ANSI C-based optimizing cross compiler for the CSX600
- Industry-standard GDB source-level debugger
- Visual profiling tool
- Macro assembler
- Linker
- Dynamic loader
- Object file tools (archiver/librarian, dump/disassemble, etc.)
- Instruction-set simulator

The ClearSpeed Cⁿ language is based on ANSI C with extensions to support the data-parallel architecture of the CSX600. The main addition to standard C is the addition of keywords for defining *mono* (scalar) and *poly* (parallel) data types.

The Cⁿ compiler supports inline assembler, pragmas for controlling data layout, and vector instructions.

2.2.2 Libraries

The SDK includes the following standard C libraries. Most libraries include support for mono and poly data. These libraries are based on the Newlib open-source library.

- Standard utility functions (`stdlib.h`)
- Character type functions and macros (`ctype.h`)
- Standard input and output (`stdio.h`)
- String and memory functions (`string.h`)
- Wide character strings (`wchar.h`)
- Locale functions (`locale.h`)
- Math functions (`math.h`)

Note that not all functions in these libraries are implemented as some do not make sense for a coprocessor or embedded processor.

In addition, a set of extra libraries are included which support architecture-specific features.

- Vector math functions (`vmathp.h`)
- Random number generators (`rngp.h`)
- Reduction functions (`reduction.h`)
- Debug printing functions (`dprint.h`)
- Memory transfer functions (`string_ext.h`, `async_string.h`)
- Inter-PE communication functions (`swazzle.h`)
- Thread support (`semaphore.h`)
- Other functions (`misc.h`)

The Cⁿ compiler also supports a set of intrinsics for operating on vector data to allow more efficient exploitation of the floating-point pipeline.

2.2.3 CSDFT library

The CSDFT library implements a number of common FFT-related functions. The library can be used directly by a host application calling functions which then pass the data to be processed to the Advance card and return the results. Because many applications perform an FFT then some other processing such as a convolution and then an inverse FFT, the CSDFT library can also be integrated with user code running on the CSX600. In this way, all of the processing can be performed on the accelerator card providing greater acceleration and minimizing the amount of data transfer between the host and the Advance card.

Functions supported

- Functions
 - FFT
 - Inverse FFT
 - Convolution

See the *CSDFT User Guide* for details of the functions implemented.

- 1D DFT
 - Power of two sizes from 128 to 8192
 - Single and double precision
 - Complex types
 - Complex to complex (forward and backward)
 - Interleaved only
 - Natural and optimal order (only optimal order supported by CSDFT card-side API)
- 2D DFT
 - Power of two sizes from 128 to 2048
 - Single and double precision
 - Real and complex types
 - Complex to complex (forward and backward)
 - Real to complex (forward)
 - Complex to real (backward)
 - Interleaved and split array (real and imaginary in separate arrays)
 - Natural and optimal order

2.2.4 Multicard support

The driver supports multiple Advance cards in a system. It provides access control on a per-process basis. A host process calling the CSXL or CSDFT libraries can only use a single Advance Accelerator Card (each process can be running on up to 16 host cores) as shown in *Figure 2*. In a system with, say, four Advance cards, each can be used by a separate process. These processes could be part of a single application, or could be independent application programs.

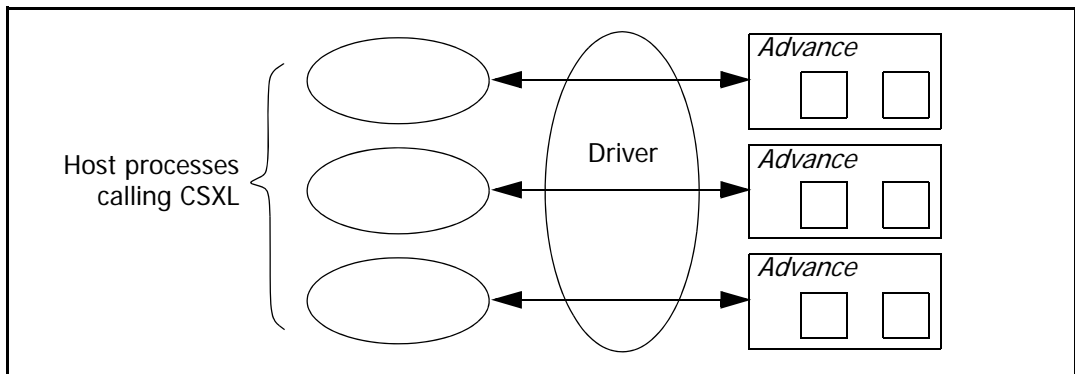


Figure 2. Using multiple Advance cards in a system

Custom host code, which does not use ClearSpeed’s application acceleration libraries, can access any number of cards from a single process.

2.2.5 Open source software

Some tools and libraries are open source. The main ones are:

- The kernel module driver for Linux and Microsoft Windows
- csgdb, the port of the GDB debugger to the CSX600
- The C standard libraries, based on the Newlib source

The source code for all open source software is provided as part of the appropriate package or is available on request from ClearSpeed.

3 Revision history

Date	Revision	Changes
September 2008	1.B	Amendment to copyright statement.
August 2008	1.A	Minor amendments to support 3.10 release also.
June 2008	1	First released version.

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