

Intel® Advisor XE 2016 for Linux* Release Notes

Installation Guide and Release Notes

31 January 2016

Contents:

[Introduction](#)

[What's New](#)

[System Requirements](#)

[Installation Notes](#)

[Issues and Limitations](#)

[Attributions](#)

[Disclaimer and Legal Information](#)

1 Introduction

Intel® Advisor XE 2016 provides two tools to help ensure your Fortran and C++ applications take full performance advantage of today's processors:

- **Vectorization Advisor** is a vectorization analysis tool that lets you identify loops that will benefit most from vectorization, identify what is blocking effective vectorization, explore the benefit of alternative data reorganizations, and increase the confidence that vectorization is safe.
- **Threading Advisor** is a threading design and prototyping tool that lets you analyze, design, tune, and check threading design options without disrupting your normal development.

This document provides system requirements, installation instructions, issues and limitations, and legal information.

To learn more about this product's:

- Documentation, help, and samples, open the get_started.html file in the following directory: <install-dir>/documentation/<locale>/welcomepage/. You can access the product help in a web browser as well by opening the index.htm file in the following directory: <install-dir>/documentation/<locale>/help/. The default <install-dir> is /opt/intel/advisor_xe_2016.

- Technical support, including answers to questions not addressed in the installed product, please visit: <http://software.intel.com/en-us/support/>

Please remember to register your product at <https://registrationcenter.intel.com/> by providing your email address. This helps Intel recognize you as a valued customer in the support forum.

2 What's New

Intel® Advisor XE 2016 Update 3

- Analysis of non-Executed code paths that allows exploring Instruction Set Architecture that is different from the host machine. E.g. you can analyze AVX-512 code paths when running on an older machine.
- New tab "Loop Analytics" in Survey view, combining several loop metrics in single place, including ISA, Traits and Instruction mix (percentage of Memory, Compute and other instructions).
- Added support for Intel® Xeon Phi™ coprocessor (codename: Knights Landing) for Survey analysis.
- Ability to filter result data by thread in Survey view to narrow down performance metrics.
- New Recommendations tab in Memory Access Patterns analysis results with actionable hints.
- New AVX512-specific traits, e.g. Scatter, Compress/Expand, etc.
- Added new recommendations:
 - Indirect function calls, that can be replaced with direct ones to allow vectorization.
 - Better utilization of FMA instructions.
 - Updated recommendation for Fortran "contiguous" attribute.
- Extended CLI snapshot feature with caching of sources and binaries. So you can make self-contained packed result snapshot on a remote server or a cluster node, which then can be easily copied to your workstation for investigation.

Intel® Advisor XE 2016 Update 2

- Support variable names for object-oriented code in MAP/Dependencies analysis.
- Extended Survey grid by adding user functions and improved SIMD-enabled function representation.

- Ability to run Trip Counts and Survey analyses in any order. Trip Counts data is kept after recollecting Survey data.
- New recommendations for scalar math functions and OpenMP function calls.
- Introduced new issue “Vector register spilling” with appropriate recommendations. Number of actually used vector registers is reported in separate column.
- List of selected loops is stored in separate file. This allows to select loops in GUI and run analysis in CLI for the same project, without markup in CLI. Loop selection is editable from CLI and persistent, so no need to specify markup list for “-collect” command every time.
- Memory footprint metric estimate
- Bug fixes

Intel® Advisor XE 2016 Update 1

- Ability to filter in Refinement report
- Packed snapshot to transfer read-only result as a single file
- Significantly improved performance and responsiveness in Survey, Trip Counts, MAP and Correctness reports data loading and finalization
- Better GUI co-existence of Threading and Vectorization Advisor layouts
- Differentiated inlined functions in the Survey top-down grid
- Improved Summary report
- Added ability to sort by loop selection in Survey report
- Separate recommendations for Fortran and C++
- Improved data representation (parent-child relationship, filtering and highlight) in Survey.
- Added new MAP problem type: uniform stride (for stride = 0), improved variable resolution for MAP
- Exposed loops with estimated max trip count of loop = 1

Intel® Advisor XE 2016

- Extended Summary to support Vectorization.
- New Memory Access Pattern (MAP) recommendations to guide MAP analysis usage
- Improved quality and the types of data available in MAP and Correctness, including limited support for variable names-centric analysis.
- More information and better configuration in Source/Assembly views

Intel® Advisor XE 2016 Beta Update 3

- Added traits information in source and assembly views for selected loop.
- Highlighted some traits for loop:
 - instruction classes (masked stores, vgather (for AVX2), horizontal instructions (for AVX and SSE));
 - small trip counts for vectorized body;
 - 128 vector width for AVX/AVX2; 128/256 vector width for AVX2.
- Correctness analysis re-named to Dependencies.
- Added variable names to Dependencies view.
- Added assembly page in product options to change assembler code representation style.
- New CLI --help: better structure, new text, more examples.
- Enabled restoration of loops selection after results re-opening.

Intel® Advisor XE 2016 Beta Update 2

- Fixed compatibility issue with Intel® Compilers 16.0 Beta Update 1

Intel® Advisor XE 2016 Beta Update 1

- Ability to set environment variables to manage collectors
- Added operand type and vector length information to the MAP Source view
- Stop/cancel for Trip Counts collection
- Improvements in command-line for MPI
- Slow scrolling in Survey fixed
- Search is now available in Source view and assembly view
- Survey finalization performance improvements

- Multiple stability and usability fixes

Intel® Advisor XE 2016 Beta

Intel Advisor XE 2016 Beta is a successor product to Intel® Advisor XE 2015. Intel Advisor XE 2016 Beta provides a set of tools that help you decide where to add threading and vectorization to your applications. The key features provided by this new major version since the Intel Advisor XE 2015 release include:

- Vectorization assistance in addition to the threading assistance available in the previous product
- Significant changes to the product workflow because of the addition of vectorization assistance

3 System Requirements

Supported Architectures and Terminology

Intel® Advisor XE supports the following architectures:

- **IA-32 Architecture** refers to systems based on 32-bit processors generally compatible with the Intel® Pentium® processors (such as, Intel® Pentium® 4 processor or Intel® Xeon® processor), or processors from other manufacturers supporting the same instruction set, running a 32-bit operating system.
- **Intel® 64 Architecture** refers to systems based on IA-32 architecture processors that have 64-bit architectural extensions (such as, Intel® Core™ processor family), running a 64-bit operating system. If the system is running a 32-bit operating system, then IA-32 architecture applies instead. Processors from other manufacturers supporting the same instruction set and running a 64-bit operating system are also supported.

Minimum System Requirements

- A system based on an IA-32 or Intel 64 architecture processor supporting the Intel® Streaming SIMD Extensions 2 (Intel® SSE2) instructions (Intel Pentium 4 processor or later, or compatible non-Intel processor)
 - Since the Intel Advisor XE requires specific knowledge of assembly-level instructions, its analysis may not operate correctly if code contains non-Intel instructions. In this case, run the analysis with a target executable that contains only Intel instructions. After you finish using the Intel Advisor XE, you can use the assembler or optimizing compiler options that provide the non-Intel instructions.
 - For the best experience, a multi-core or multi-processor system is recommended
- 2GB RAM
- 4GB free disk space for all product features and architectures

- Supported operating systems:
 - Red Hat* Enterprise Linux* 5, 6, and 7
 - CentOS* versions equivalent to Red Hat Enterprise Linux versions listed above
 - Fedora* 21 and 22 (`pangox-compat` package should be installed)
 - SUSE* Linux Enterprise Server* 11 and 12
 - Debian* 7 and 8
 - Ubuntu* 12.04, 14.04, and 15.04
- Application coding requirements:
 - Programming Language:
 - C or C++
 - Fortran
- Supported compilers:
 - Intel® C++ Compiler XE 15 and higher
 - Intel® Fortran Compiler XE 15 and higher
 - GNU* C/C++ Compiler 3.4.6 and higher
- Supported threading methodologies:
 - Intel® Threading Building Blocks (Intel® TBB)
 - Intel® Cilk™ Plus
 - OpenMP*
 - POSIX* Threads (low-level)
- To view PDF documents, you need a PDF reader, such as Adobe Reader* 6 or later

Notes:

1. Intel Advisor XE samples work with the Intel TBB by using the environment variable `TBBROOT`. Intel TBB is included with the Intel compiler and is available from <http://software.intel.com/en-us/intel-tbb/>. To build the Intel TBB applications, you will need to define the `TBBROOT` environment variable. To set the `TBBROOT` environment variable, see the Intel Advisor XE Help or Getting Started Tutorial.

4 Installation Notes

If you are installing the product for the first time, please be sure to have the product serial number available so you can type it in during installation. A valid license is required for installation and use.

To begin installation:

1. Uncompress the package: `gunzip <package-name>.tar.gz`
2. Extract the files: `tar xf <package-name>.tar`
3. Start the installation. (Note: For successful installation, you should have read and write permissions for the `/tmp` directory.)
4. To install on a local system enter the following:


```
cd <package-name>
```

```
./install.sh
```

Note: If you want to install the software for use by any user, you must do this as the root user. To install to a network-mounted drive or shared file system for multiple users, become the root user then enter:

```
cd <package-name>  
./install.sh --SHARED_INSTALL
```

5. Follow the prompts to complete the installation and activation of the software.

Activation

You must activate the product to finish installation. Use one of these methods:

- Activation using serial number. Internet connection is required;
- Remote activation using serial number. Used when your computer is not connected to the internet. You can use another computer with internet access;
- Activation using license file;
- Activation using license server.

You can also evaluate the product for 31 days.

Floating licensing service requirements

Intel® Software License Manager version 2.3, available on the [Intel® Registration Center](#) (choose the right OS and platform; only users with floating license registrations have access to this link).

For more details please refer to the <https://software.intel.com/en-us/articles/intel-software-license-manager-getting-started-tutorial>

Intel® Software Manager

Intel® Software Manager is a utility that allows users to:

- Download and install updates for your Intel® Software Development Products.
- Manage subscription status of installed software.
- Activate serial numbers.
- Find out about the latest news for Intel Software Development Products.

- Intel Software Manager requires an Internet connection to connect to a remote server for information and updates.

Intel Software Manager installs with Intel Software Development Products on Windows*, Linux*, and Mac OS* X operating systems.

To obtain more information about Intel® Software Manager, please refer to the <https://registrationcenter-ssl.intel.com/Docs/ism.htm> web-page.

Default Installation Folders

The default top-level installation folder for this product is:

- `/opt/intel/advisor_xe_2016`

A different top-level folder name can be chosen during a custom installation.

Setting Up Your Command Line Environment

Before you can use the Intel Advisor XE `advixe-cl` and `advixe-gui` commands or display the `advixe-cl(1)` man page, you must first set up your command line environment. Source the provided shell script `advixe-vars.sh` (if you are using `csh`, source `advixe-vars.csh`):

1. Locate the directory where the `advixe-vars` script file was installed. If you accepted the default location when installing the Intel Advisor XE, the location is `/opt/intel/advisor_xe_2016`.
2. Open a command window and type the following source command to execute the script file: `source /opt/intel/advisor_xe_2016/advixe-vars.sh`

The script file displays the product name and the build number. You can now use the `advixe-cl` and `advixe-gui` commands as well as display the `advixe-cl(1)` man page.

NOTE: To build the Intel Advisor XE sample applications, you need to first define the `ADVISOR_XE_2016_DIR` environment variable. Running the `advixe-vars.sh` script will do this automatically. This variable can also be set manually. For example, if you used the default path during installation, type:

```
export ADVISOR_XE_2016_DIR=/opt/intel/advisor_xe_2016
```

Removing the Product

To remove the product, execute the following commands:

Note: Replace `/opt/intel` with the chosen install folder name if the default folder was not used.

1. `cd /opt/intel/advisor_xe_2016`

2. `uninstall.sh` (as a root user or the same user who performed the install)

Known Installation and Configuration Issues

- None

5 Issues and Limitations

Known Issues and Limitations

- Only Survey analysis is supported on Intel® Xeon Phi™ coprocessor (codename: Knights Landing). Other analysis types support is subject for future updates.
- Running the Intel Advisor XE on a Fedora* 22 operating system may generate the following errors:
 - *Error: This operating systems is not supported. Suggestion: Check the Release Notes for a list of supported operating systems.*
 - *Error: [Instrumentation engine]: 4.0 is not a supported Linux release. Collection failed. The collection was not able to run.*

Do one of the following to resolve:

- Set the following environment variable:
`ADVIXE_MORE_PIN_OPTIONS='-ifeellucky'`
- If you are running a bash shell, use the following command:
`export ADVIXE_MORE_PIN_OPTIONS='-ifeellucky'`
- Running Intel Advisor XE in the linux console in background mode (`./advixe-gui &`) and profiling an application that uses input from the console (stdin) cause a product stop by linux OS that looks like product hang. Do not use background mode OR run your application with input from a file.
- There is known issue on Ubuntu* 14.10 OS where GUI controls don't work. To circumvent this start the GUI maximized. To avoid this issue upgrade the OS to a later version.
- Do not use background mode OR run your application with input from file specified in application arguments (`app < input.txt`)
- Opening links to HTML files, such as help or recommendations, is not guaranteed if the `xdm-utils` package is not installed. Possible solutions are:

- Install the xdm-utils package.
 - Use the default terminal program for KDE or Gnome desktop environments.
- For the most complete vectorization analysis results using an Intel compiler (Version 15.0 or higher), set the -qopt-report compiler option to 5. (Alternatively, you can set the -qopt-report-phase Intel compiler option to vec.)
- The Suitability tool cannot accurately measure and analyze the behavior of loops with very small task times (on the order of sub-microseconds) if those tasks are annotated with the TASK_BEGIN/TASK_END annotations. If possible, use the ITERATION_TASK annotation instead.
- The Suitability Report combines all lock data into a single lock and may not have source line information for LOCK_ACQUIRE and LOCK_RELEASE annotations.
- If your sources include huge source files that contain annotations, be aware that only the first 8 MB of each file will be parsed for annotations. If not all of your annotations are being parsed in such huge source files, consider breaking that source file into several source files each less than 8MB.
- Security-enhanced Linux* settings (SELinux) are currently not supported by the Intel Advisor XE and need to be either disabled or set to permissive for a successful tool suite installation. This product supports only "Permissive" mode. To run the product successfully you may either disable SELinux by - setting the line "SELINUX=disabled" in your /etc/sysconfig/selinux file - adding "selinux=0" kernel argument in lilo.conf or grub.conf files or make a SELinux mode adjustment by - setting the line "SELINUX=permissive" in your /etc/sysconfig/selinux file or ask your system administrator to make a SELinux mode adjustment. You may need to reboot your system after changing the system parameters. More information about SELinux can be found at <http://www.nsa.gov/research/selinux/index.shtml>.
- Intel Advisor XE samples (Tachyon sample, for example) may fail to compile Cilk and OpenMP binaries on the Ubuntu 12.04 operating system with the following error message:

```

compilation aborted for src/util.cpp (code 4)
/usr/include/features.h(324): catastrophic error: cannot
open source file "bits/predefs.h"
#include <bits/predefs.h>

```

Adding /usr/include/i386-linux-gnu directory to the CXXFLAGS environment variable helps build the samples successfully.

- When using certain HTML browsers to view the Intel Advisor XE documentation, if the Contents tab width appears truncated and hides some of the topic titles:
 - Click the Index (or Search) button

- Click the Contents button
- Navigating or interacting with the Intel Advisor XE Correctness Report while Correctness analysis is still running may cause the GUI to freeze or display empty Correctness results.
- The Intel Software Manager feature that enables automatic product updates requires Java* software version 1.6 or higher.
- The Survey Report may incorrectly report loops if a function contains calls to a non-returning function such as the `exit()` function.
- Loops within a function that does not contain debug information may not be reported as a loop in the Survey Report. For the suggested build settings, see the help topics under Choosing and Building a Target: Build Settings for C/C++ Applications or Build Settings for Fortran Applications. After you fix the build settings to specify debug information, rebuild the target and run Survey analysis again.
- After analyzing the specified target executable, the Survey tool may report that no significant hotspot areas were detected. In this case, view the collected result using the Survey Report window. The suggested build settings are described in the help topics under Choosing and Building a Target: Build Settings for C/C++ Applications or Build Settings for Fortran Applications.
- If debug information correlating an instruction to source code is not available to an Intel Advisor XE tool, the tool cannot correlate collected data with source code. In this case it will show an empty field, question mark, or broken icon. Source correlation may not be available for many different reasons, including:
 1. Omitting debug information options when building the target executable – see the help topics under Choosing and Building a Target: Build Settings for C/C++ Applications or Build Settings for Fortran Applications.
 2. A compiler error.
 3. The compiler not generating debug information for this specific source line.
 4. The compiler not generating debug information for this specific source file.
 5. The linker not copying the debug information into the debug information database.
 6. The debug information database not being found by the finalization step in the Intel Advisor XE, because it was not moved along with the executable to the location where the Intel Advisor XE is being run.
 7. When using the Intel Advisor XE GUI, insufficient project properties were specified for the Binary/Symbol Search tab. In this case, see the help topic Specifying Project Properties Using the Intel Advisor XE GUI.

- Intel Advisor XE may crash while opening results on Ubuntu 10.10 or later if a license file is not present. This is caused by checking a license with enabled trusted storage. To workaround this issue, disable the ptrace protection in the OS by using the command:
`echo 0 | tee /proc/sys/kernel/yama/ptrace_scope`
- When the Intel Advisor XE GUI is launched from a Linux OS desktop GUI (such as the KDE* or GNOME* GUI) the output of the non-GUI target application being analyzed will not be displayed. To avoid this, launch the Intel Advisor XE GUI from a command shell with the `advixe-gui` command instead of the desktop GUI, or redirect the non-GUI application output to the Intel Advisor XE output window by choosing **File > Options > Application output destination > Application output window**.
- If you encounter problems searching the Intel Advisor XE help using a certain web browser, consider using a newer version of that browser or use a different web browser as your default browser.
- Intel Advisor XE may detect which timer source to use incorrectly on extreme desktop SNB-E (e.g. Intel Core i7-3960X) processors. In Survey and Suitability collections the following message may be displayed in the command line or Debug Window:

Warning: Cannot load data file `/tmp/linux/openmp_triad/r007hs/data.0/25448-25455.0.trace' (Data file is corrupted).

To work around the problem, collect results from the command line using "-run-pass-thru" option: `advixe-cl -collect survey -run-pass-thru=-timestamp=sys -- <application>`

6 Attributions

Boost Software License - Version 1.0 - August 17th, 2003

Permission is hereby granted, free of charge, to any person or organization obtaining a copy of the software and accompanying documentation covered by this license (the "Software") to use, reproduce, display, distribute, execute, and transmit the Software, and to prepare derivative works of the Software, and to permit third-parties to whom the Software is furnished to do so, all subject to the following:

The copyright notices in the Software and this entire statement, including the above license grant, this restriction and the following disclaimer, must be included in all copies of the Software, in whole or in part, and all derivative works of the Software, unless such copies or derivative works are solely in the form of machine-executable object code generated by a source language processor.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. IN NO EVENT

SHALL THE COPYRIGHT HOLDERS OR ANYONE DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Libunwind

Copyright (c) 2002 Hewlett-Packard Co.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except where otherwise noted in the source code (e.g. the files hash.c, list.c and the trio files, which are covered by a similar licence but with different Copyright notices) all the files are:

Copyright (C) 1998-2003 Daniel Veillard. All Rights Reserved.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE DANIEL VEILLARD BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except as contained in this notice, the name of Daniel Veillard shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization from him.

wxWidgets Library

This product includes wxWindows software which can be downloaded from www.wxwidgets.org/downloads.

wxWindows Library Licence, Version 3.1

=====

Copyright (C) 1998-2005 Julian Smart, Robert Roebling et al

Everyone is permitted to copy and distribute verbatim copies of this licence document, but changing it is not allowed.

WXWINDOWS LIBRARY LICENCE
TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Library General Public Licence as published by the Free Software Foundation; either version 2 of the Licence, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Library General Public Licence for more details.

You should have received a copy of the GNU Library General Public Licence along with this software, usually in a file named COPYING.LIB. If not, write to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA.

EXCEPTION NOTICE

1. As a special exception, the copyright holders of this library give permission for additional uses of the text contained in this release of the library as licenced under the wxWindows Library Licence, applying either version 3.1 of the Licence, or (at your option) any later version of the Licence as published by the copyright holders of version 3.1 of the Licence document.
2. The exception is that you may use, copy, link, modify and distribute under your own terms, binary object code versions of works based on the Library.
3. If you copy code from files distributed under the terms of the GNU General Public Licence or the GNU Library General Public Licence into a copy of this library, as this licence permits, the exception does not apply to the code that you add in this way. To avoid misleading anyone as to the status of such modified files, you must delete this exception notice from such code and/or adjust the licensing conditions notice accordingly.

4. If you write modifications of your own for this library, it is your choice whether to permit this exception to apply to your modifications. If you do not wish that, you must delete the exception notice from such code and/or adjust the licensing conditions notice accordingly.

Modified source code and instructions for building the wxWebConnect package shipped as a part of the Intel® Advisor XE are available at the following link:

<https://software.intel.com/en-us/articles/wxwebconnect-for-intel-advisor-xe>

```
/* zlib.h -- interface of the 'zlib' general purpose compression library
   version 1.2.3, July 18th, 2005
```

Copyright (C) 1995-2005 Jean-loup Gailly and Mark Adler

This software is provided 'as-is', without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.

Permission is granted to anyone to use this software for any purpose, including commercial applications, and to alter it and redistribute it freely, subject to the following restrictions:

1. The origin of this software must not be misrepresented; you must not claim that you wrote the original software. If you use this software in a product, an acknowledgment in the product documentation would be appreciated but is not required.
2. Altered source versions must be plainly marked as such, and must not be misrepresented as being the original software.
3. This notice may not be removed or altered from any source distribution.

Jean-loup Gailly jloup@gzip.org
Mark Adler madler@alumni.caltech.edu

```
*/
```

Limxml2

Except where otherwise noted in the source code (e.g. the files hash.c, list.c and the trio files, which are covered by a similar license but with different Copyright notices) all the files are:

Copyright (C) 1998-2003 Daniel Veillard. All Rights Reserved.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE DANIEL VEILLARD BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHERIN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except as contained in this notice, the name of Daniel Veillard shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization from him.

Apache License
Version 2.0, January 2004
<http://www.apache.org/licenses/>

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.
4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or

Derivative Works a copy of this License; and

- (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
- (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
- (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

- 5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.
- 6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.
- 7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the

appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.
9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

libpng

This copy of the libpng notices is provided for your convenience. In case of any discrepancy between this copy and the notices in the file png.h that is included in the libpng distribution, the latter shall prevail.

COPYRIGHT NOTICE, DISCLAIMER, and LICENSE:

If you modify libpng you may insert additional notices immediately following this sentence.

This code is released under the libpng license.

libpng versions 1.2.6, August 15, 2004, through 1.5.11, June 14, 2012, are Copyright (c) 2004, 2006-2012 Glenn Randers-Pehrson, and are distributed according to the same disclaimer and license as libpng-1.2.5 with the following individual added to the list of Contributing Authors

Cosmin Truta

libpng versions 1.0.7, July 1, 2000, through 1.2.5 - October 3, 2002, are Copyright (c) 2000-2002 Glenn Randers-Pehrson, and are distributed according to the same disclaimer and license as libpng-1.0.6 with the following individuals added to the list of Contributing Authors

Simon-Pierre Cadieux
Eric S. Raymond

Gilles Vollant

and with the following additions to the disclaimer:

There is no warranty against interference with your enjoyment of the library or against infringement. There is no warranty that our efforts or the library will fulfill any of your particular purposes or needs. This library is provided with all faults, and the entire risk of satisfactory quality, performance, accuracy, and effort is with the user.

libpng versions 0.97, January 1998, through 1.0.6, March 20, 2000, are Copyright (c) 1998, 1999 Glenn Randers-Pehrson, and are distributed according to the same disclaimer and license as libpng-0.96, with the following individuals added to the list of Contributing Authors:

Tom Lane
Glenn Randers-Pehrson
Willem van Schaik

libpng versions 0.89, June 1996, through 0.96, May 1997, are Copyright (c) 1996, 1997 Andreas Dilger
Distributed according to the same disclaimer and license as libpng-0.88, with the following individuals added to the list of Contributing Authors:

John Bowler
Kevin Bracey
Sam Bushell
Magnus Holmgren
Greg Roelofs
Tom Tanner

libpng versions 0.5, May 1995, through 0.88, January 1996, are Copyright (c) 1995, 1996 Guy Eric Schalnat, Group 42, Inc.

For the purposes of this copyright and license, "Contributing Authors" is defined as the following set of individuals:

Andreas Dilger
Dave Martindale
Guy Eric Schalnat
Paul Schmidt
Tim Wegner

The PNG Reference Library is supplied "AS IS". The Contributing Authors and Group 42, Inc. disclaim all warranties, expressed or implied, including, without limitation, the warranties of merchantability and of fitness for any purpose. The Contributing Authors and Group 42, Inc. assume no liability for direct, indirect, incidental, special, exemplary, or consequential damages, which may result from the use of the PNG Reference Library, even if advised of the possibility of such damage.

Permission is hereby granted to use, copy, modify, and distribute this source code, or portions hereof, for any purpose, without fee, subject to the following restrictions:

1. The origin of this source code must not be misrepresented.
2. Altered versions must be plainly marked as such and must not be misrepresented as being the original source.
3. This Copyright notice may not be removed or altered from any source or altered source distribution.

The Contributing Authors and Group 42, Inc. specifically permit, without fee, and encourage the use of this source code as a component to supporting the PNG file format in commercial products. If you use this source code in a product, acknowledgment is not required but would be appreciated.

A "png_get_copyright" function is available, for convenient use in "about" boxes and the like:

```
printf("%s",png_get_copyright(NULL));
```

Also, the PNG logo (in PNG format, of course) is supplied in the files "pngbar.png" and "pngbar.jpg (88x31) and "pngnow.png" (98x31).

Libpng is OSI Certified Open Source Software. OSI Certified Open Source is a certification mark of the Open Source Initiative.

Glenn Randers-Pehrson
glennrp at users.sourceforge.net
June 14, 2012

libtiff

Copyright (c) 1988-1997 Sam Leffler
Copyright (c) 1991-1997 Silicon Graphics, Inc.

Permission to use, copy, modify, distribute, and sell this software and its documentation for any purpose is hereby granted without fee, provided that (i) the above copyright notices and this permission notice appear in all copies of the software and related documentation, and (ii) the names of Sam Leffler and Silicon Graphics may not be used in any advertising or publicity relating to the software without the specific, prior written permission of Sam Leffler and Silicon Graphics.

THE SOFTWARE IS PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EXPRESS, IMPLIED OR OTHERWISE, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT SHALL SAM LEFFLER OR SILICON GRAPHICS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER OR NOT ADVISED OF THE POSSIBILITY OF DAMAGE, AND ON ANY THEORY OF LIABILITY, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

libjpeg

We welcome the use of this software as a component of commercial products. No royalty is required, but we do ask for an acknowledgement in product documentation, as described under LEGAL ISSUES.

LEGAL ISSUES

=====

In plain English:

1. We don't promise that this software works. (But if you find any bugs, please let us know!)
2. You can use this software for whatever you want. You don't have to pay us.
3. You may not pretend that you wrote this software. If you use it in a program, you must acknowledge somewhere in your documentation that you've used the IJG code.

In legalese:

The authors make NO WARRANTY or representation, either express or implied, with respect to this software, its quality, accuracy, merchantability, or fitness for a particular purpose. This software is provided "AS IS", and you, its user, assume the entire risk as to its quality and accuracy.

This software is copyright (C) 1991-1998, Thomas G. Lane.
All Rights Reserved except as specified below.

Permission is hereby granted to use, copy, modify, and distribute this software (or portions thereof) for any purpose, without fee, subject to these conditions:

(1) If any part of the source code for this software is distributed, then this

README file must be included, with this copyright and no-warranty notice unaltered; and any additions, deletions, or changes to the original files must be clearly indicated in accompanying documentation.

(2) If only executable code is distributed, then the accompanying documentation must state that "this software is based in part on the work of the Independent JPEG Group".

(3) Permission for use of this software is granted only if the user accepts full responsibility for any undesirable consequences; the authors accept NO LIABILITY for damages of any kind.

These conditions apply to any software derived from or based on the IJG code, not just to the unmodified library. If you use our work, you ought to acknowledge us.

Permission is NOT granted for the use of any IJG author's name or company name in advertising or publicity relating to this software or products derived from

it. This software may be referred to only as "the Independent JPEG Group's software".

We specifically permit and encourage the use of this software as the basis of commercial products, provided that all warranty or liability claims are assumed by the product vendor.

ansi2knr.c is included in this distribution by permission of L. Peter Deutsch, sole proprietor of its copyright holder, Aladdin Enterprises of Menlo Park, CA.

ansi2knr.c is NOT covered by the above copyright and conditions, but instead by the usual distribution terms of the Free Software Foundation; principally, that you must include source code if you redistribute it. (See the file ansi2knr.c for full details.) However, since ansi2knr.c is not needed as part of any program generated from the IJG code, this does not limit you more than the foregoing paragraphs do.

The Unix configuration script "configure" was produced with GNU Autoconf. It is copyright by the Free Software Foundation but is freely distributable. The same holds for its supporting scripts (config.guess, config.sub, ltconfig, ltmain.sh). Another support script, install-sh, is copyright by M.I.T. but is also freely distributable.

It appears that the arithmetic coding option of the JPEG spec is covered by patents owned by IBM, AT&T, and Mitsubishi. Hence arithmetic coding cannot legally be used without obtaining one or more licenses. For this reason, support for arithmetic coding has been removed from the free JPEG software. (Since arithmetic coding provides only a marginal gain over the unpatented Huffman mode, it is unlikely that very many implementations will support it.) So far as we are aware, there are no patent restrictions on the remaining code.

The IJG distribution formerly included code to read and write GIF files. To avoid entanglement with the Unisys LZW patent, GIF reading support has been removed altogether, and the GIF writer has been simplified to produce "uncompressed GIFs". This technique does not use the LZW algorithm; the resulting GIF files are larger than usual, but are readable by all standard GIF decoders.

We are required to state that

"The Graphics Interchange Format(c) is the Copyright property of CompuServe Incorporated. GIF(sm) is a Service Mark property of CompuServe Incorporated."

7 Disclaimer and Legal Information

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

This document contains information on products, services and/or processes in development. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest forecast, schedule, specifications and roadmaps.

The products and services described may contain defects or errors known as errata which may cause deviations from published specifications. Current characterized errata are available on request.

Copies of documents which have an order number and are referenced in this document may be obtained by calling 1-800-548-4725 or by visiting www.intel.com/design/literature.htm.

Intel, the Intel logo, Cilk, Core, Intel Xeon Phi, Pentium, VTune, and Xeon are trademarks of Intel Corporation in the U.S. and/or other countries.

* Other names and brands may be claimed as the property of others.

Java is a registered trademark of Oracle and/or its affiliates.

© 2015 Intel Corporation.