



Identification and selection of large-scale migration tools and services

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1 Introduction

A preservation action is a concrete action, usually implemented by a software tool, that is performed on digital content in order to achieve some preservation goal. The execution of a preservation action has the purpose of supporting the continuous access to content or to make sure that digital preservation is being carried out effectively (Ferreira, Baptista, & Ramalho, 2006). For example, a migration of content from an obsolete format to a more up-to-date one, the replacement of a viewer application in some rendering environment, the execution of legacy software in an emulation environment, etc.

Preservation actions have been extensively analysed and employed in experimental digital preservation systems (Eld Zierau & Caroline van Wijk, 2008; Ferreira, Baptista, & Ramalho, 2007). However, current approaches are not capable of coping with real-size collections of today's preservation environments, e.g. an e-journal library may contain several thousands of documents adding up to several terabytes of information. A national-wide Web archiving service will contain a myriad of unrelated formats and can easily host Petabytes of data.

The Work package WP10 of SCAPE project (i.e. Action Services Components) is focused on the applicability of action tools and services to large collections of complex digital objects by analysing and improving interfaces and internal functionality of existing software tools, extending them and creating new functionality to cope with large-scale digital preservation scenarios. Within this work package, tools will be enhanced to deal with, not only single file formats, but also compound objects, large-sized objects and large collections of digital objects.

This document is structured as follows: Section 1 provides an introduction to this report; Section 2 presents related work in the context of preservation action tools and software quality models; Section 4 thoroughly describes the software quality model that served as a foundation for the development of the action tools evaluation framework; Section 4 presents the methodology used to identify, evaluate and select action tools; Section 5 outlines the requirements of the SCAPE project that have influenced the definition of the tool evaluation framework; Section 6 presents the evaluation framework including the criteria, metrics and selection conditions that were used to select action tools; Section 7 outlines the results of evaluating the tools; and finally, Section 8 draws the main conclusions of this report and sheds light on the future tasks to be developed in work package WP10.

1.1 Scope of this document

This deliverable constitutes a report on Task 1 of the work package WP10 of the SCAPE project – *Identification, evaluation and selection of large scale action tools & services*. The goal of this task is to compile and evaluate a list of existing action tools that are likely to be used in the SCAPE parallel execution platform, and suitable for solving to problems raised by the Testbed scenarios.

Due to the dependencies that this task maintains with other work packages, namely the Testbeds¹ (work packages WP15, WP16 and WP17) and the Platform architecture design² (WP4) this report will be written in 2 versions during the overall time of the project:

1. The first version, published in month 6, includes a list of action tools, an evaluation framework and the results of assessing those tools according to the selection conditions defined in the evaluation framework;
2. The second version of this report will be published in project month 24 and will include: a) a new evaluation framework with criteria and metrics for gauging the improvement of existing action tools during the overall time of the project; b) the results of evaluating selected tools according to the new evaluation framework (this will serve as input for deliverable D10.2 - *Gap analysis on action services tools and SCAPE platform and testbeds requirements*); and c) a list of additional criteria that may be used for evaluating action tools in the context of digital preservation. The later criteria will not be evaluated within work package WP10 but will be published as a possible evaluation framework for preservation action tools.

2 Related work

Over the last two decades, the digital preservation research community has come up with a considerable number of strategies aiming at solving the problem of digital preservation and technological obsolescence. Among these is format migration.

Format migration consists of a “(...) set of organized tasks designed to achieve the periodic transfer of digital materials from one hardware/software configuration to another or from one generation of computer technology to a subsequent generation.” (Task Force on Archiving of Digital Information., 1996).

Contrary to other preservation techniques, migration strategies do not attempt to preserve digital objects in their original formats. Alternatively, they intentionally transform objects from near obsolete formats into up-to-date encodings that most users are able to interpret using their personal computers. In order to accomplish that, preservation systems resort to off-the-shelf conversion tools to re-encode digital content into formats that more likely to be supported in the long run (Ferreira, 2005).

The major drawback in this approach is that whenever an object is converted to a new format, some of its original properties may not be adequately transferred to the target format. This may occur due to incompatibilities between the source and target formats or because the application used to do the conversion is not capable of carrying out its tasks correctly (Ferreira et al., 2006). In this context, it is important to highlight the importance of software quality models, i.e. a framework of reasoning that allows one to assess the quality of a software tool.

¹ The testbeds first definition, including representative datasets, will only be available by month 9.

² The platform work package will only deliver guidelines for deploying preservation tools and environments (D5.1) in month 14.

To better understand what software quality models are, it is necessary to address the question: *what is software quality?* (R. W. Hoyer & B. B. Y. Hoyer, 2001) There are two major paths to choose from when discussing the meaning and definition of software quality:

1. **Conformance to specification** – in this context, software quality is defined as a matter of products whose measurable characteristics satisfy a fixed specification, i.e. conformance to an in beforehand defined specification.
2. **Meeting customer needs** – software quality is identified independent of any measurable characteristics, i.e. quality is defined as the product capability to meet customer expectations (explicit or not).

The evaluation framework included in this report is focused on the first definition of software quality, i.e. *Conformance to specification*. In the context of SCAPE, the *specification*, i.e. the set of requirements that are expected to be fulfilled by the preservation action, are determined by the constraints of the project itself and, further on, by the outcome of preservation planning activities.

The following sections depict related work in the context of preservation action tools and quality assessment models.

2.1 Preservation action tools

Several projects have made use of off-the-shelf migration software as core basis for implementing preservation strategies based on format migration. In this section we present an overview of action tools used in other digital preservation projects, namely, PLANETS, CRiB and RODA, that will serve as a starting point for the work presented in this report.

2.1.1 PLANETS

Planets - Preservation and Long-term Access through Networked Services - was a four-year project co-funded by the European Union under the Sixth Framework Programme to address core digital preservation challenges. Planets started on 1st June 2006 and ended on 31 May 2010. One objective of Planets was to create an Interoperability Framework that integrated tools and services in a distributed service network (Jackson, Andrew Lindley, & Fabian Steeg, 2010).

A compendium of tools identified and integrated in the Planets project is depicted in Table 1. This table includes the tools identified in the Planets deliverable D3 – Gap analysis: a survey of PA tool provision (KB-NL, 2009) - and tools that were published in the Planets Interoperability Framework Service Registry (ARC, 2009). However, the following list of exceptions apply:

- The table will only include tools that have a particular focus on format migration. A few exceptions have been made for the sake of completeness (e.g. Microsoft Word, Photoshop).
- Tools that belong to the same software package or that depend of a common software library have been added as a single entry.
- Tools that are not attainable due to lack of support or project termination have not been included.
- Tools that depend of external software or services to perform their primary function (e.g. virtual printers, online services, add-ins) have been excluded.

- Tools that merely wrap functionality of other tools, which have already been included in the table, have been suppressed.
- Tools that are bundled with their own application environment and cannot be separated from it (e.g. tools bundled as a whole server).

Table 1 - Tools and services deployed in Planets.

| Program name | Description | Web site |
|---------------------------|---|---|
| ImageMagick | Software suite to create, edit, compose, or convert bitmap images | http://www.imagemagick.org |
| GraphicsMagick | Software suite to create, edit, compose, or convert bitmap images, forked from the ImageMagick project. | http://www.graphicsmagick.org |
| Sanselan | Pure-Java library reads and writes a variety of image formats, including fast parsing of image info and metadata | http://commons.apache.org/sanselan |
| Inkscape | Vector graphics editor, with capabilities similar to Illustrator, CorelDraw, or Xara X, using the W3C standard Scalable Vector Graphics (SVG) | http://inkscape.org |
| SoX | Command line utility that can convert various formats of computer audio files in to other formats | http://sox.sourceforge.net |
| Gimp | GNU Image Manipulation Program. It is a freely distributed piece of software for such tasks as photo retouching, image composition and image authoring. | http://www.gimp.org |
| Java ImageIO | Java library to read and write to image formats | http://java.net/projects/imageio |
| Kakadu | JPEG2000 developer toolkit | http://www.kakadusoftware.com |
| JTidy | Java port of HTML Tidy, a HTML syntax checker and pretty printer | http://jtidy.sourceforge.net |
| JasPer | Software-based implementation of the codec specified in the JPEG-2000 Part-1 standard | http://www.ece.uvic.ca/~mdadams/jasper |
| OpenJPEG | JPEG 2000 codec written in C language | http://www.openjpeg.org |
| Avidemux | Video editor designed for simple cutting, filtering and encoding tasks | http://avidemux.sourceforge.net |
| b2xtranslator | Software tool to convert documents written in Binary Formats (doc, xls, ppt) to the Office Open XML format | http://b2xtranslator.sourceforge.net |
| Microsoft Word | Text processing software | http://office.microsoft.com/word |
| Abiword | Word processing program similar to Microsoft Word | http://www.abisource.com |
| ACDSee | Photo processing software | http://www.acdsee.com |
| CZ-Doc2Pdf 2.0 | Batch PDF Converter that convert word to PDF, DOC to PDF, html to PDF, text to PDF and RTF to PDF | http://www.convertzone.com/doc2pdf/help.htm |
| Dia | Diagram creation program | http://projects.gnome.org/dia/ |
| Document2PDF Pilot | Converts JPEG, GIF, TIFF, BMP, PNG, EMF, PPT, POT, PPS, XLT, XLS, XLW, DOC, DOT, WPS, WRI, RTF, HTML documents into PDF. | http://www.colorpilot.com/document2pdf.html |
| EscapeE | Software to view and convert print streams, like PCL, PDF, Postscript, TIFF, DCX, and others. | http://escapee.redtitan.fr |
| GraphicConverter | Picture converter, editor and manager for Mac OS X | http://www.lemkesoft.com/content/188/graphicconverter.html |
| MsgText | Software for converting .msg-files to .txt-files and extracting the attachments. | http://www.enterag.ch/enterag/downloads/msgtext.shtml |
| Netpbm | Netpbm is a toolkit for manipulation of graphic images, including conversion of images between a variety of different formats. | http://netpbm.sourceforge.net/ |

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|------------------------------|---|---|
| PDF Version Converter | Convert PDF file between different versions for compatibility purpose. | http://www.nicepdf.com/products.html |
| PDF/A converter | PDF/A Converter Service converts PDF files to PDF/A conform and compliant documents, based on the international Norm ISO 19005-1. | http://www.pdfa.at/en/pdfa-converter.html |
| Apache PDFBox | Apache PDFBox™ is an open source Java PDF library for working with PDF documents. | http://pdfbox.apache.org/ |
| Photoshop | Photo editing software suite. | http://www.photoshop.com/ |
| SIARD Suite | Software package for converting relational databases into the SIARD format. | http://www.bar.admin.ch/dienstleistungen/00823/00825/index.html?lang=en |
| VisualIntegrity | Software suite to convert PDF into bitmap image, vector image or CAD. | http://www.visual-integrity.com/ |
| FFmpeg | Complete, cross-platform solution to record, convert and stream audio and video. | http://ffmpeg.org/ |
| MEncoder | Underlying framework of the media player viewer mplayer | http://www.mplayerhq.hu |

2.1.2 RODA

RODA - Repository of Authentic Digital Objects - is a digital repository capable of ingesting, managing and providing continuous access to various types of digital objects. It was developed as part of a project, with the same name, co-founded by the Portuguese National Archives with the objective of identifying and bringing together all the necessary technology, human resources and political support to carry out long-term preservation of digital materials (Faria et al., 2009).

RODA is able to ingest and preserve text documents, images, video, audio and relational databases available in several distinct formats. It automatically normalizes ingested data to formats more adequate for long-term preservation and makes data available to its consumers in various dissemination formats (including the original ingested format). To accomplish this, RODA resorts to several action tools to carry out all the necessary format migrations. The action tools deployed in RODA are outlined in Table 2.

Table 2 - Action tools deployed in RODA.

| Program name | Description | Web site |
|----------------------------------|--|---|
| ImageMagick | Software suite to create, edit, compose, or convert bitmap images | http://www.imagemagick.org |
| Gstreamer | Open source multimedia framework | http://gstreamer.freedesktop.org |
| DBML import/export module | Library of the RODA project that allows database migration of information. It supports several database management systems and also a created standard format called DBML (Marta, Librelotto, Ramalho, & P. R. Henriques, 2002). | http://redmine.keep.pt/projects/show/roda-public |
| JODConverter | The Java OpenDocument Converter, converts documents between different office formats using OpenOffice.org. | http://sourceforge.net/projects/jodconverter |
| MEncoder | Underlying framework of the media player viewer mplayer | http://www.mplayerhq.hu |
| Ghostscript | Interpreter for the PostScript language and for PDF | http://pages.cs.wisc.edu/~ghost/ |
| RODA's doc2pdf for | Executable that allows converting word | http://redmine.keep.pt/projects/show/roda- |

| | | |
|----------------|--|--------|
| Microsoft Word | documents to PDF using Microsoft Word by a command line interface. | public |
|----------------|--|--------|

2.1.3 CRiB

The CRiB platform is a set of services designed to assist cultural heritage institutions in the implementation of migration-based preservation interventions. CRiB works by assessing the quality of distinct migration paths tools and services to produce recommendations of optimal migration paths. The recommendations produced by the system take into account the specific preservation requirements of each client institution (Ramalho et al., 2008). The action tools deployed in CRiB are depicted in Table 3.

Table 3 - Action tools deployed in CRiB.

| Program name | Description | Web site |
|----------------|--|---|
| ImageMagick | Software suite to create, edit, compose, or convert bitmap images | http://www.imagemagick.org |
| OpenOffice | Open-source office software suite for word processing, spreadsheets, presentations, graphics, databases and more | http://www.openoffice.org |
| Microsoft Word | Text processing software | http://office.microsoft.com/word |
| Sam2p | Command line utility written in ANSI C++ that converts many raster (bitmap) image formats into Adobe PostScript or PDF files and several other formats | http://pts.szit.bme.hu/sam2p |

2.2 Software quality models

To evaluate the quality of software one must perform a systematic assessment of the capability that a software infolds to implement a given set of requirements. In other words, an adequate quality model should be defined that will guide the process of evaluation a given software application.

A quality model consists of several quality attributes that are used as a checklist for determining software quality (ISO 9126-1, 2001). Additionally, to properly evaluate software one will also need an evaluation framework composed of metrics, measurements and, if possible, supporting software tools to facilitate the evaluation process (Beus-Dukic & Bøegh, 2003).

There are several examples of quality models available in research literature:

1. **Factors in Software Quality** – McCall, J.A., Richards, P.K., Walters, G.F., *Factors in Software Quality*, RADC TR-77-369, 1977;
2. **Characteristics of Software Quality** – Boehm, B.W, Brown, J.R., Kaspar, J.R., et.al, *Characteristics of Software Quality*, TRW Series of Software Technology, Amsterdam, North Holland, 1978;
3. **Specification of software quality attributes** – Bowen, T. P., Wigle, G. B., Tsai, J. T. 1985. *Specification of software quality attributes*. Tech. Rep. RADC-TR- 85-37, Rome Air Development Center;
4. **ISO standard 25010:2011** – *Systems and software engineering, Systems and software Quality Requirements and Evaluation (SQuaRE)*;

These examples of software quality models are independent of the application domain. The ISO standard 25010:2011 is the most recent of these initiatives, and can be considered as a superset of the other three.

An additional framework of thought that should be considered is the taxonomy of decision criteria compiled by the Plato Preservation Planning tool (Becker & Rauber, 2011). This taxonomy of decision factors is based on quality requirements of real-world digital preservation case studies and aims at assessing the *quality* of preservation action tools.

The last two examples will be analysed in more detail in the following sections. The rest of the models were not further described in this report because they have already served as a basis for the development of the two examples selected.

2.2.1 ISO standard 25010

The ISO standard 25010 (ISO 25010, 2011) is based on the earlier ISO 9126 family (ISO 9126-1, 2001). The ISO/IEC 9126 standards provide guidance for quality models and define a hierarchy of high-level quality attributes. Quality measures are based on measurement procedures recommended in ISO 15939 (ISO 15939, 2007).

The ISO 25000 standards for Software Product Quality Requirements and Evaluation (SQuaRE) supersede the ISO 9126 models and combine a revised quality model with evaluation procedures based on ISO 14598 (ISO 14598-1, 1999). They also define requirements on the specification of software product quality criteria.

ISO/IEC 25010:2011 defines a *product quality model composed of eight characteristics (which are further subdivided into sub-characteristics) that relate to static properties of software and dynamic properties of the computer system. The model is applicable to both computer systems and software products* - Figure 1 (ISO 25010, 2011).

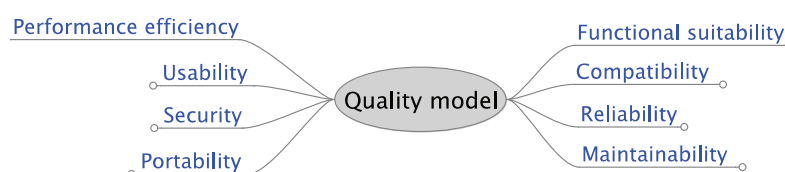


Figure 1 - ISO 25010 top product quality characteristics.

2.2.2 Decision criteria in digital preservation

In the digital preservation domain, a preservation planning process is responsible for defining criteria and evaluating preservation actions for a given identified risk or to achieve a certain preservation goal. These decision criteria have been used by a tool called Plato to assess the *quality* of competing preservation action options and to rank them according to the preservation objectives of the person or organization managing a particular preservation project. Although these criteria have been designed to assess the quality of preservation action tools, they should not be considered as a software quality model *per se* as they also take into consideration factors that are outside of the scope of software quality assessment, e.g. organisation policies, costs, etc.

In (Becker & Rauber, 2011) over 500 criteria were obtained from different case studies, and a classification of these criteria was derived (Figure 2).

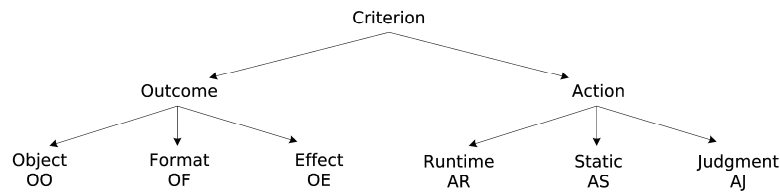


Figure 2 - Taxonomy of decision factors in digital preservation.

All criteria requiring measurement refer to either an **Action** or the **Outcome** of that action. Action criteria exhibit properties that are somewhat related to the preservation action itself, while outcome criteria can describe general effects of the outcome of the action.

A preservation objective can be composed of several measurable criteria belonging to different categories. For instance, the general objective of minimizing costs may include both a criterion for assessing the migration cost per object and one for specifying runtime characteristics such as memory usage or processor time.

Sub-characteristics of the action criterion:

- **Runtime** - This category entails runtime properties of action tools such as performance, throughput, and memory utilization. Since these properties are highly dynamic and depend on a number of factors, measurements need to be taken in a controlled environment. Examples of this category include Peak memory usage, average processing cycles consumed per MB and average memory consumed per MB (Becker & Rauber, 2011).
- **Static** - Criteria of this category refer to properties of the action components that do not vary per execution run nor show differences when evaluated by different users; i.e., they are not subject to the evaluator's perception and can be determined objectively. These criteria can thus often be obtained from trusted sources. For example, the question whether a component is open source or not should be documented in tool registries (Becker & Rauber, 2011).
- **Judgment** - This category is sometimes relevant, but decision criteria in this category should be kept to a minimum. It comprises criteria that cannot be objectively determined with reasonable effort. Usability is a prime example where judgment may be necessary. In digital preservation this does not have high influence on the decision, since the components to be evaluated are not to be applied by an end user. In other cases, this has more importance; but in any case, proper documentation of evaluation values is essential. Examples of criteria in this category include Ease of component integration into existing workflow environment and process log output is human readable (Becker & Rauber, 2011).

Sub-characteristics of the outcome criterion:

- **Object** - *This category entails all desired properties of digital objects. This includes desired properties of the objects and properties that have to be kept unchanged compared to the original object (Becker & Rauber, 2011).*
- **Format** - *This category comprises criteria that specify desirable characteristics of the formats that are used for representing digital content. As a significant portion of the risks to digital content lies in the form of representation and its understandability, this is often a central decision criterion. Typical criteria include standardization (e.g. Format is standardized by ISO), format complexity, or openness of formats (Becker & Rauber, 2011).*
- **Effect of outcome** - *This refers to any other effects caused by the application of a certain action. Typically, these effects are calculated by organization-specific models or recognized cost models such as LIFE (Ayris et al., 2008) based on measures as model inputs. For example, storage costs will depend on organizational cost structures, but strongly correlate with the file size of objects (Becker & Rauber, 2011).*

The presented taxonomy has proven to be complete in its expressiveness to cover all the criteria encountered in the case studies evaluated so far, since it models all relevant entities encountered in the decision process (Becker & Rauber, 2011).

3 Criteria for evaluating action tools

After careful examination of the quality models described in the previous sections, namely, the ISO standard 25010 and the decision criteria used by the Plato preservation planning tool, we have elected the ISO standard as being the most suitable to serve as a basis for the creation of an evaluation framework for action tools (used to aid in the objective selection of action tools to be included in the SCAPE project.). The rationale behind this decision was threefold:

1. The ISO standard is based on a well defined international standard, allowing others to easily relate to it;
2. The ISO standard is very up-to-date, as it has been published in 2011; and
3. The quality models described in Section 2.2 have already served as a basis to the development of the ISO standard, so in a way this standard reflects the vision of most quality models previously published.

The ISO 25010 is generic in the sense that it defines characteristics that relate to static properties of software products and dynamic properties of computer systems independently of its application domain. The ISO model defines eight top criteria:

- **Functional suitability** - "degree to which a product or system provides functions that meet stated and implied needs when used underspecified conditions" (*ISO 25010, 2011*);
- **Performance efficiency** - "performance relative to the amount of resources used under stated conditions" (*ISO 25010, 2011*);
- **Compatibility** - "degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment" (*ISO 25010, 2011*);

- **Usability** - "degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (*ISO 25010, 2011*);
- **Reliability** - "degree to which a system, product or component performs specified functions under specified conditions for a specified period of time" (*ISO 25010, 2011*);
- **Security** - "degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization" (*ISO 25010, 2011*);
- **Maintainability** - "degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers" (*ISO 25010, 2011*);
- **Portability** - "degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another" (*ISO 25010, 2011*).

Some of the previously described criteria have been subdivided one step further making the quality model more domain-specific and appropriate to address the specific goal of evaluating action tools. The fully expanded taxonomy of criteria is depicted in Figure 3. The third-level leaf nodes represent the domain-specific refinements, i.e. accuracy, suitability for testbeds, suitability for platform, composability, technical instability and legal constraints.

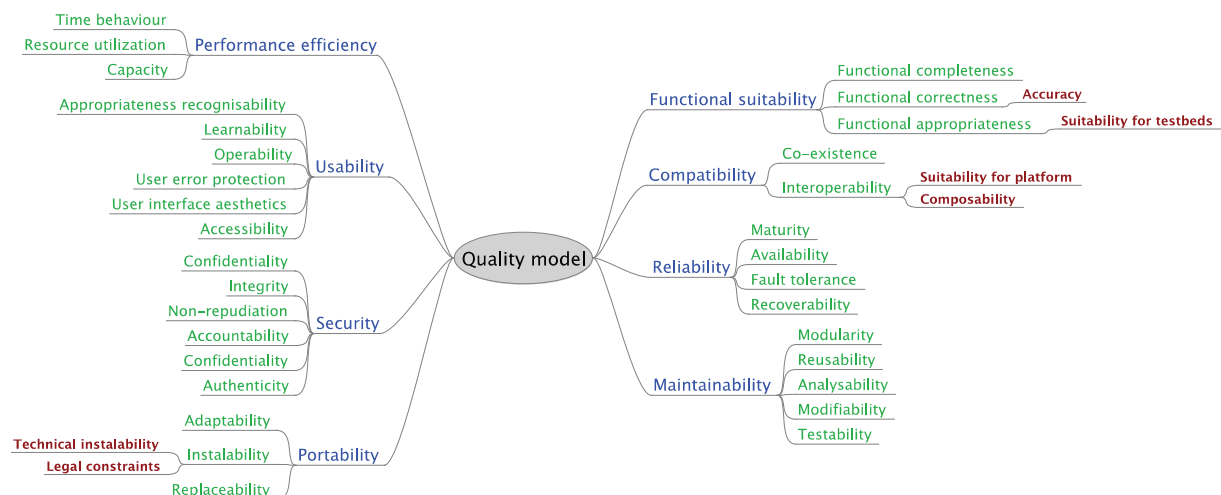


Figure 3 – Quality model with domain-specific criteria.

All of the criteria included in the quality model are explained in the following sections.

3.1 Functional suitability

Functional suitability is "degree to which a product or system provides functions that meet stated and implied needs when used underspecified conditions" (*ISO 25010, 2011*). It has the following sub-characteristics:

- **Functional completeness** - "degree to which the set of functions covers all the specified tasks and user objectives" (*ISO 25010, 2011*);

- **Functional correctness** - "degree to which a product or system provides the correct results with the needed degree of precision" (*ISO 25010*, 2011);
 - **Accuracy** - in the context of preservation action tools, accuracy is the degree of similarity between the input and the output of the action, and directly relates to the quality assurance problem (domain-specific criterion).
- **Functional appropriateness** - "degree to which the functions facilitate the accomplishment of specified tasks and objectives" (*ISO 25010*, 2011).
 - **Suitability for testbeds** - degree to which the functionality of a preservation action tool fulfils the needs of the testbeds scenarios (domain-specific criterion).

3.2 Performance efficiency

Performance efficiency is the "performance relative to the amount of resources used under stated conditions" (*ISO 25010*, 2011). It has the following sub-characteristics:

- **Time behaviour** - "degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements" (*ISO 25010*, 2011);
- **Resource utilization** - "degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements" (*ISO 25010*, 2011);
- **Capacity** - "degree to which the maximum limits of a product or system parameter meet requirements" (*ISO 25010*, 2011);

3.3 Compatibility

Compatibility is the "degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment" (*ISO 25010*, 2011). It has the following sub-characteristics:

- **Co-existence** - "degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product" (*ISO 25010*, 2011);
- **Interoperability** - "degree to which two or more systems, products or components can exchange information and use the information that has been exchanged" (*ISO 25010*, 2011);
 - **Suitability for platform** - degree of effort needed to make a tool compatible with the SCAPE platform, namely the workflow system (domain-specific criterion).
 - **Composability** - degree to which the output of an action tool is compatible with the input of another (domain-specific criterion).

3.4 Usability

Usability is the "degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (*ISO 25010*, 2011). It has the following sub-characteristics:

- **Appropriateness recognisability** - "degree to which users can recognize whether a product or system is appropriate for their needs" (*ISO 25010, 2011*);
- **Learnability** - "degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use" (*ISO 25010, 2011*);
- **Operability** - "degree to which a product or system has attributes that make it easy to operate and control" (*ISO 25010, 2011*);
- **User error protection** - "degree to which a system protects users against making errors" (*ISO 25010, 2011*);
- **User interface aesthetics** - "degree to which a user interface enables pleasing and satisfying interaction for the user" (*ISO 25010, 2011*);
- **Accessibility** - "degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use" (*ISO 25010, 2011*).

3.5 Reliability

Reliability is the "degree to which a system, product or component performs specified functions under specified conditions for a specified period of time" (*ISO 25010, 2011*). It has the following sub-characteristics:

- **Maturity** - "degree to which a system, product or component meets needs for reliability under normal operation" (*ISO 25010, 2011*);
- **Availability** - "degree to which a system, product or component is operational and accessible when required for use" (*ISO 25010, 2011*);
- **Fault tolerance** - "degree to which a system, product or component operates as intended despite the presence of hardware or software faults" (*ISO 25010, 2011*);
- **Recoverability** - "degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system" (*ISO 25010, 2011*).

3.6 Security

Security is the "degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization" (*ISO 25010, 2011*). It has the following sub-characteristics:

- **Confidentiality** - "degree to which a product or system ensures that data are accessible only to those authorized to have access" (*ISO 25010, 2011*);
- **Integrity** - "degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data" (*ISO 25010, 2011*);
- **Non-repudiation** - "degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later" (*ISO 25010, 2011*);
- **Accountability** - "degree to which the actions of an entity can be traced uniquely to the entity" (*ISO 25010, 2011*);

- **Confidentiality** - "degree to which a product or system ensures that data are accessible only to those authorized to have access" (*ISO 25010*, 2011);
- **Authenticity** - "degree to which the identity of a subject or resource can be proved to be the one claimed" (*ISO 25010*, 2011).

3.7 Maintainability

Maintainability is the "degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers" (*ISO 25010*, 2011). It has the following sub-characteristics:

- **Modularity** - "degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components" (*ISO 25010*, 2011);
- **Reusability** - "degree to which an asset can be used in more than one system, or in building other assets" (*ISO 25010*, 2011);
- **Analysability** - "degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified" (*ISO 25010*, 2011);
- **Modifiability** - "degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality" (*ISO 25010*, 2011);
- **Testability** - "degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met" (*ISO 25010*, 2011).

3.8 Portability

Portability is the "degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another" (*ISO 25010*, 2011). It has the following sub-characteristics:

- **Adaptability** - "degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments" (*ISO 25010*, 2011);
- **Instalability** - "degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment" (*ISO 25010*, 2011);
 - **Technical instalability** - degree of effectiveness and efficiency with which an action tool can be installed in the specified software and hardware (domain-specific criterion);
 - **Legal constraints** - degree to which the legal constraints of a tool are compatible with a specified environment and use (domain-specific criterion);
- **Replaceability** - "degree to which a product can replace another specified software product for the same purpose in the same environment" (*ISO 25010*, 2011).

4 Methodology

Current preservation action tools used in other digital preservation projects like PLANETS and CRiB do not cope well with all aspects of large-scale processing. Because of that, they will be evaluated and targeted for improvement in the subsequent tasks of work package WP10.

In this section we present the methodology used to identify, evaluate and select existing action tools to be improved and then used in the SCAPE platform. The methodology is composed of the following steps:

1. Analysis of requirements
2. Definition of an evaluation framework
3. Identification, evaluation and selection of action tools

The following sections provide a brief description of each of these steps.

4.1 Analysis of requirements

This step consists of the identification of requirements and constraints that should be part of the evaluation framework that will be used to assess action tools that are to be included in the SCAPE project. The two major items that need to be analysed are the requirements of the SCAPE parallel execution platform (where the action tools are expected to run) and the needs of the testbed scenarios (whose preservation problems the tools should be able to address).

4.2 Definition of the evaluation framework

This step consists of the definition of an evaluation framework based on quality criteria obtained from the software quality model previously described on Section 3 (i.e. the ISO standard 25010). This evaluation framework will be used to assess and select the action tools that will be included in the SCAPE project.

4.3 Identification, evaluation and selection of action tools

This step consists in the identification and assembly of action tools considered to be good candidates to integrate the SCAPE project. As a starting point, tools were collected by inspecting the deliverables of the digital preservation projects described in Section 2.

In addition to that, a community-driven list was created so that action tools could be registered by all partners involved in the work package based on their own background experience. The information collected about each tool is summarized in Table 4.

Table 4 – Information collected for each action tool.

| Column name | Description | Example |
|---------------------|--|-------------------|
| Tool name | The name of the tool and a link to the tool site. | ImageMagick |
| Tool version | The current version of the tool. | 6.6.7 |
| License | The tool license | GPL V3 compatible |
| Interface | The type of interfaces provided by the tool: <i>Command line</i> , | Command line |

| | | |
|-------------------------|---|-------------------------------------|
| | <i>API, Service, GUI, ...</i> | |
| Operating system | The operating systems supported: <i>GNU/Linux, Microsoft Windows, Mac OS X, ...</i> | GNU/Linux; Windows; Mac OS X; Other |
| Open-source | Is the tool open-source? | Yes |
| Object class | The type of files that the tool can handle: images, video, audio, word processor documents, spread-sheets, CAD, relational databases, ... | Images |
| Input formats | Formats that the tool can handle | JPG, TGA, PNG, ... |
| Output formats | Formats that tool can produce | PDF, ODT, DOCX, ... |

After collecting an assortment of action tools, these were assessed using the evaluation framework. The goal of this activity was to determine if a given tool was a good candidate for integration in the SCAPE project. The evaluation framework, described in Section 6, was created on top of the quality model described in Section 3.

Some sub-criteria have been added to the quality model to better evaluate preservation action tools in the context of SCAPE. However, only a subset of relevant criteria has been ported to the final evaluation framework.

For each selection criteria we have identified metrics (i.e. ways of measuring the criteria). These are described by the following attributes:

1. **Metric ID** – a unique identifier attributed to each metric;
2. **Description** – a description of the metric;
3. **Unit** – the type of the measurement values of the metric;
4. **Evaluation effort** – how much effort is needed to actually perform the measurement of a metric, or the dependencies on components provided by other work packages that hinder the assessment of the metric.

For each metric, a *selection condition* has also been defined, i.e. if a tool satisfies all the conditions, it is selected for adaptation and improvement in the SCAPE platform, otherwise it is rejected.

5 Analysis of requirements

The goals of the SCAPE project form a set of requirements that play an important role in the definition of the evaluation framework. Only tools capable of coping with those requirements should be selected for inclusion in the project. Fundamentally, these requirements are of two types:

1. Requirements of the SCAPE platform; and
2. Requirements of the testbed scenarios.

Each of these types of requirements are analysed in the following sections.



5.1 Requirements for the SCAPE platform

The SCAPE parallel execution platform has certain requirements that condition the deployment and execution of certain software tools. During the first year of the project, the Platform sub-project (PT) will develop guidelines to assist in the development and deployment of scalable preservation tools. At the time of writing, these guidelines are still at a very early stage. Nevertheless, in this report we present some information that should be taken into account when evaluating and selecting action tools for the SCAPE platform.

Existing tools may be deployed in SCAPE platform as long as they comply with the following list of requirements³.

- Graphical environments are not supported (e.g. XServer);
- Java-based tools and wrapped Linux binaries may run but must be preinstalled on the cluster nodes;
- It may be possible to run Windows applications, however this will not be investigated in the first year of the project;

5.2 Requirements of the testbed scenarios

In order to select the tools that will integrate the SCAPE platform, it was necessary to do a comprehensive analysis of the testbed scenarios. We were particularly interested in knowing what formats were inherent to the testbed scenarios to make sure that all the relevant action tools were properly evaluated.

At the time of writing of this report, only a preliminary version of the testbed scenarios was available. From the analysis of that document, assumptions on which file formats were necessary to be handled by action tools were made. In month 9, the testbed scenarios will be fully defined and representative datasets will be created. By then it will be possible to determine more accurately which formats will play an important role in the SCAPE project. For the time being we will evaluate tools based on the assumptions outlined in the following draft scenarios.

5.2.1 Scenario 1: Normalize document formats contained in the web archive

Document instances of many different file formats are referenced in web content. Many of these formats might not be renderable in a web archive viewer in the future. This relates especially to older versions of text document formats. A possible solution could be to normalize formats by migrating the document instances into an agreed standard format. For example, an institutional decision could be to migrate all document formats (Plain text, DjVu, PS, ODF, DOC, DOCX, RTF, etc.) to PDF. In this context, quality assurance could play a major role. Also on-the-fly/on demand migration for document formats is an option in order to avoid changing the original web archive content.

³ Please note that these restrictions only apply to preservation tools that are intended to run on the platform scalable environment. They do not apply to tools that will be deployed in other application contexts (e.g. rendering environments for quality assurance).

Related file formats: Plain text, DjVu, PS, ODF, DOC, DOCX, RTF, PDF, HTML, ARC, WARC

5.2.2 Scenario 2: Deep characterisation of huge media files

This scenario is about determining technical dependencies of large MPEG2 streams in order to identify preservation risks and ensure render/extraction services can continue to be supported.

At SB, data from broadcasters contain huge media files like MPEG2 videos, for example. There is an agreement that only allows streaming this data, but not distribution of copies of the archived content. SB captures broadcast radio and television as complex MPEG2 streams. The video content is accompanied by metadata, typically used to support the production of TV guides. SB preserves the MPEG2 streams as the preservation masters. Chunks of this data that relate to specific programmes are extracted, migrated and served to users as streaming Flash video.

Related file formats: MPEG2, MP3, AAC, Flash Video, possibly other video and audio encodings

5.2.3 Scenario 3: Migrate digitised TIFFs to JPEG2000

The master files from legacy digitised image collections are typically TIFF files that can be costly to store due to large file sizes. Preservation planning exercises have indicated that migration to JPEG2000 would reduce storage size and costs while at the same time facilitating enhanced user access via JPEG2000 functionality. It is therefore assumed that preservation planning has been completed, and this scenario focuses on the migration of TIFF files to JPEG2000 and associated quality assurance of the migration.

Related file formats: TIFF, JPEG2000

5.2.4 Scenario 4: Migrate archive to new archiving system?

A typical characteristic of digital archives that aim for “long-term preservation” is that the life cycle of the technical infrastructure on which they are based is much shorter than the period for which their contained materials should be preserved. This means that migrations from one archival system to another are inevitable. In the simplest case this could be nothing more than a migration of AIPs from one storage medium to another. However, in most cases this will also involve the migration of metadata, and the contents of each AIP from the source system may need to be taken apart and re-assembled on the destination system. This will result in changes to the AIP’s internal structure that must be accounted for in the migrated (structural) metadata. Finally, such migrations may also involve one or more metadata enrichment steps (for example, because the availability of new or improved characterisation tools makes it possible to automatically extract technical and preservation metadata that couldn’t be established within the old system).

At the most basic level this scenario would like to ensure that the system migration does not result in the loss or alteration of any archived objects. In the case of a pure medium migration this could be realised very easily using checksums. More sophisticated mechanisms are needed for migrations where, as an example, AIPs that are held together in a physical container (e.g. a TAR file) on the source system need to be taken apart and subsequently re-assembled on the destination system. In

that case we will need to check the integrity of each single file within the AIP, before and after the migration.

Related file formats: TAR, ZIP

5.2.5 Scenario 5: RAW to NEXUS migration

AT STFC, scientific data sets have been stored in the RAW format, and there is a method to migrate the RAW format to the XML-based NEXUS format. Currently, there is only a simple format conversion in place that does not record any provenance information about why and by whom information items have been changed.

Related file formats: RAW, XML/Nexus

6 Evaluation framework

In this section, we describe the evaluation framework that has been devised to assess and select action tools to be adapted and improved within the SCAPE project. To enable a systematic evaluation of the tools, metrics and selection conditions have been defined for each quality criterion included in the evaluation framework.

Figure 4 depicts the complete taxonomy of criteria that compose the evaluation framework.

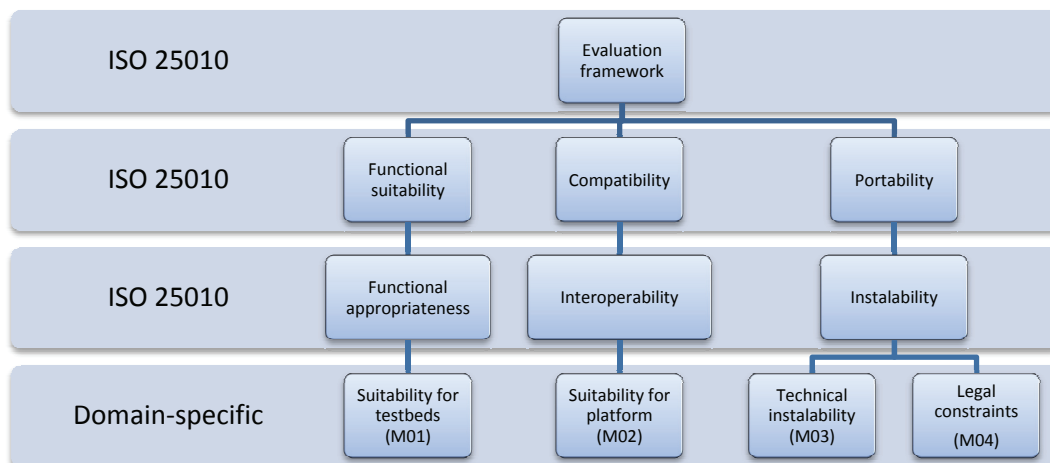


Figure 4 - Evaluation framework.

Not all of the criteria in the ISO 25010 were included in the evaluation framework. Some will be used afterwards, on version 2 of this report, to appraise the need for improvement and serve as a basis for validating task 3 of this work package - *Improve functionality and coverage of preservation action tools*. Such criteria will be used to assess the *dynamic qualities* of tools before and after the improvement activities.

The criteria, metrics and conditions that are part of this evaluation framework are described in the following sections:

6.1 Suitability for testbeds

In order to be selected, a tool should be aligned with the objectives of the SCAPE project. This relates particularly to its suitability to solve the problems depicted by the testbed scenarios and is determined by the quality criterion **suitability for testbeds**, under **functional appropriateness** (Section 3.1).

For a tool to be selected, at least one of the formats it supports should be part of the testbed scenarios related file formats.

| | |
|--------------------------|---|
| Metric ID | M01 |
| Criterion | Suitability for testbeds |
| Description | Number of input or output formats the tool supports (directly or transitively by composing other tools) that exist in the testbed scenarios related file formats. |
| Unit | Number |
| Evaluation effort | Low |

6.2 Suitability for platform

A second requirement is based on the fact that the tool should be compatible with the SCAPE parallel execution platform. By compatible we mean that the effort needed to install and make the tool run in the SCAPE platform, and in the workflow engine, is not beyond the level of resources available in the project. This requirement is determined by the criterion **suitability for platform**, under **interoperability**.

For a tool to be selected, it must provide a way to access its functionality programmatically or the effort to make it so should be equal or less than medium.

| | |
|--------------------------|--|
| Metric ID | M02 |
| Criterion | Suitability for platform |
| Description | Effort necessary to make the tool interface compatible with the SCAPE platform: <ol style="list-style-type: none"> 1. the tool has a command-line interface, effort is close to none 2. a small effort is necessary to adapt the tool (e.g. a wrapper needs to be developed) 3. a medium effort is necessary (e.g. the tool is a software library or has an API) 4. a high effort is needed to adapt the tool 5. the effort is very high or nearly impossible (e.g. the tool has a graphical user interface and no command-line or programming interface) |
| Unit | 1 to 5 scale |
| Evaluation effort | Low |

6.3 Technical instalability

One must ensure that it is possible to install the tool in the SCAPE parallel execution platform. This relates to the **instalability** criterion, which has been further refined by **technical instalability**.

For a tool to be selected, it must be feasible, using available resources in SCAPE, to make it runnable in the SCAPE platform. This means that the effort necessary to install the tool or to make it compatible with platform should be equal or less than medium.

| | |
|-------------------|---|
| Metric ID | M03 |
| Criterion | Technical instalability |
| Description | Effort necessary to make the tool supported by the SCAPE platform. The level of effort to install a tool is defined by: <ol style="list-style-type: none"> 1. the tool is directly supported (an installer is available for the Operating System) 2. a small effort is necessary to make the tool supported (the tools requires some configuration) 3. a medium effort is necessary to make the tool supported 4. a high effort is necessary to make the tool supported 5. it is nearly impossible to support the tool |
| Unit | 1 to 5 scale |
| Evaluation effort | Low |

6.4 Legal constrains

For a tool to be selected its license must enable it to be used in the context of the SCAPE platform and it should be free of charge since the SCAPE project does not include a budget for acquiring software licenses. This means that the end-user license agreement that accompanies the tool should allow one to run it on a server environment and be invoked by a random number of anonymous users, and the tool should be open-source or free to be used in a research context.

In order to be selected a tool should not have any constraints that hinder its use from the legal point-of-view.

| | |
|-------------------|--|
| Metric ID | M04 |
| Criterion | Legal constraints |
| Description | Whereas the license of the tool allows it to be run as a server-side service and the tool is free of charge for use in a research context. |
| Unit | Boolean |
| Evaluation effort | Low |

6.5 Summary

A summary of the metrics and conditions included in the evaluation framework is presented in Table 5.

Table 5 - Metrics and conditions for tool selection.

| Criterion | Metric | Selection condition |
|--------------------------|--|---|
| Suitability for testbeds | M01 - Number of input or output formats the tool supports (directly or transitively by composing other tools) that exist in the testbed scenarios. | Must be greater than zero (>0) |
| Suitability for platform | M02 - Level of effort needed to make the tool interface compatible with the ones supported by the SCAPE platform. | Effort must be equal or less than medium (≤ 3) |
| Technical instability | M03 - Level of effort to make the tool supported in the SCAPE platform. | Effort must be equal or less than medium (≤ 3) |
| Legal constraints | M04 - Whereas the license of the tool allows it to be run as a server-side service and the tool is free of charge for use in a research context.. | Must be true (=true) |

7 Results

7.1 Identification of candidate tools

As previously mentioned, a list of candidate action tools has been assembled by inspecting the outcomes of reference digital preservation projects and by collecting information from preservation experts involved in work package activities.

This section presents a summary of all the off-the-shelf action tools that have been identified. The complete list of tools with detailed information is presented in Appendix 10.1.

Table 6 - Identified action tools.

| Tool | Interface | Operating system | Open-source | Object class |
|---------------------------|------------------|------------------------|-------------|-------------------|
| ImageMagick | Command-line | Linux; Win; Mac; Other | Yes | Bitmap |
| Mencoder | Command-line | Linux; Win; Mac | Yes | Video; Audio |
| HandBrake | Command-line;GUI | Linux; Win; Mac | Yes | Video |
| FFmpeg | Command-line;API | Linux; Win; Mac | Yes | Video; Audio |
| SoX | Command-line | Linux; Win; Mac | Yes | Audio |
| GStreamer | Command-line;API | Linux; Win | Yes | Video; Audio |
| Microsoft Office | API;GUI | Win; Mac | No | Text; Spreadsheet |
| OpenOffice (JODConverter) | Command-line | Linux; Win; Mac; Other | Yes | Text; Spreadsheet |
| Teigha File Converter | Command-line;GUI | Linux; Win; Mac | No | CAD |
| Kakadu | API | Linux; Win | Yes | Bitmap |
| Apache Sanselan | API | Linux; Win; Mac; Other | Yes | Bitmap |
| OpenJPEG | API | Linux; Win; Mac | Yes | Bitmap |
| SIARD Suite | Command-line | Linux; Win; Mac | No | Database |
| GIMP | Command-line;GUI | Linux; Win; Mac | Yes | Bitmap |
| Inkscape | Command-line;GUI | Linux; Win; Mac | Yes | Bitmap; Vector |
| Avidemux | Command-line;GUI | Linux; Win | Yes | Video |
| PDFBox | API | Linux; Win; Mac; Other | Yes | Other |

| | | | | |
|---------------------------|-------------------|------------------------|-----|----------------------|
| JTidy | Command-line;API | Linux; Win; Mac; Other | Yes | Other |
| JasPer | API | Linux; Win; Mac; Other | Yes | Bitmap |
| Aware AccuRad J2KSuite | API | Linux; Win; Mac | No | Bitmap |
| Luratech LuraWave | Command-line | Linux; Win | No | Bitmap |
| b2xtranslator | Command-line | Linux; Win; Mac; Other | Yes | Text; Spreadsheet |
| warc-tools | Command-line | Linux; Win; Mac; Other | Yes | Web archive |
| NedlibToArc | Command-line; API | Linux; Win; Mac; Other | Yes | Web archive |
| Heritrix (org.archive.io) | API | Linux; Win; Mac; Other | Yes | Web archive |
| Java Image I/O | API | Linux; Win; Mac; Other | Yes | Bitmap |
| GraphicsMagick | Command-line | Linux; Win; Mac; Other | Yes | Bitmap |
| ACDSee | GUI | Win; Mac | No | Bitmap; Audio; Video |
| CZ-Doc2Pdf | GUI | Win | No | Text |
| Dia | Command-line; GUI | Linux; Win | Yes | Vector |
| Document2PDF Pilot | GUI | Win | No | Text |
| EscapeE | Command-line; GUI | Win | No | Text |
| GraphicConverter X | API; GUI | Mac | No | Bitmap |
| MsgText | Command-line | Win | Yes | Email |
| Tesseract-ocr | Command-line | Linux; Win; Mac | Yes | Bitmap |
| AbiWord | Command-line; GUI | Linux; Win; Mac | Yes | Text |
| VisualIntegrity | Command-line | Linux; Win; Mac | No | Text |
| Photoshop | GUI | Win; Mac | No | Bitmap; Vector |
| PDF Version converter | Command-line; GUI | Win | No | Text |
| Netpbm | Command-line | Linux; Win; Mac | Yes | Bitmap |

7.2 Evaluation and selection of tools

This section presents the results of the tool evaluation (Table 7). For each tool, the selection conditions presented in Section 6 are evaluated.

Table 7 is composed of the following information:

1. **Tool name** - the name of the tool;
2. **Criterion M01** - Number of input or output formats the tool supports (directly or transitively by composing other tools) that exist in the testbed scenarios. Number must be greater than 0;
3. **Criterion M02** - Level of effort needed to make the tool interface compatible with the ones supported by the SCAPE platform. Number must be less or equal to 3;
4. **Criterion M03** - Level of effort to make the tool supported in the SCAPE platform. Number must be less or equal to 3;
5. **Criterion M04** – Whereas the license of the tool allows it to be run as a server-side service and the tool is free of charge for use in a research context.. Value must be *True*;
6. **Selected?** - The value is *Yes* if the tool is selected for use in the SCAPE project or *No* otherwise.

Table 7 - Evaluation of action tools.

| Criterion | M01 | M02 | M03 | M04 | Selected? |
|----------------------------------|---|---------------------|-------|--------------|-----------|
| Selection condition | (>0) | (<=3) | (<=3) | (True/False) | (Yes/No) |
| ImageMagick | 4 (JP2, HTML, TIFF, DjVu, TXT) | 1 (Command line) | 1 | True | Yes |
| Mencoder | 1 (MPEG2) | 1 (Command line) | 1 | True | Yes |
| HandBrake | 4 (MPEG2, FLV, AAC, MP3) | 1 (Command line) | 1 | True | Yes |
| FFMpeg | 7 (FLV, MP3, AAC, MPEG2, TXT, JP2, TIFF) | 1 (Command line) | 1 | True | Yes |
| SoX | 3 (MP3, AAC, MPEG2) | 1 (Command line) | 1 | True | Yes |
| GStreamer | 8 (JP2, FLV, MP3, AAC, MPEG2, TXT, JP2, TIFF) | 1 (Command line) | 1 | True | Yes |
| Microsoft Office | 9 (DOCX, DOC, RTF, TXT, ODF, HTML, XML, PDF, TIFF) | 3 (API) | 3 | False | No |
| OpenOffice (JODConverter) | 6 (ODF, DOC, RTF, TXT, HTML, PDF) | 1 (Command line) | 5 | True | Yes |
| TeighaFileConverter | 0 | 1 (Command line) | 3 | True | No |
| Kakadu | 2 (JP2, TIFF) | 3 (API) | 1 | False | No |
| Apache Sanselan | 1 (TIFF) | 3 (API) | 1 | True | Yes |
| OpenJPEG | 1 (JP2, TIFF) | 3 (API) | 1 | True | Yes |
| SIARD Suite | 0 | 1 (Command line) | 3 | True | No |
| GIMP | 5 (PS, TIFF, PDF, HTML, TXT) | 1 (Command line) | 1 | True | Yes |
| Inkscape | 1 (PDF, TIFF, PS) | 1 (Command line) | 1 | True | Yes |
| Avidemux | 4 (FLV, MPEG2, MP3, AAC) | 1 (Command line) | 1 | True | Yes |
| PDFBox | 2 (PDF, TXT) | 3 (API) | 1 | True | Yes |
| JTidy | 1 (HTML) | 1 (Command line) | 1 | True | Yes |
| JasPer | 1 (JP2) | 3 (API) | 1 | True | Yes |
| Aware AccuRad J2KSuite | 2 (JP2, TIFF) | 3 (API) | 3 | False | No |
| Luratech LuraWave | 2 (JP2, TIFF) | 1 (Command line) | 3 | False | No |
| b2xtranslator | 2 (DOC, DOCX) | 1 (Command line) | 1 | True | Yes |
| warc-tools | 2 (ARC, WARC) | 1 (Command line) | 1 | False | No |
| NedlibToArc | 1 | 1 | 1 | True | Yes |

| | (ARC) | (Command line) | | | |
|----------------------------------|---------------------------------------|---------------------|---|-------|-----|
| Heritrix (org.archive.io) | 2 (ARC, WARC) | 3 (API) | 1 | True | Yes |
| Java Image I/O | 1 (TIFF) | 3 (API) | 1 | True | Yes |
| GraphicsMagick | 6 (HTML, JP2, PDF, PS, TIFF, TXT) | 1 (Command line) | 1 | True | Yes |
| ACDSee | 4 (AAC, DJVU, JP2, TIFF) | 5 (GUI) | 3 | False | No |
| CZ-Doc2Pdf | 5 (DOC, HTML, PDF, TXT, RTF) | 5 (GUI) | 5 | False | No |
| Dia | 0 | 1 (Command line) | 1 | True | No |
| Document2PDF Pilot | 5 (TXT, RTF, HTML, DOC, PDF) | 5 (GUI) | 5 | False | No |
| EscapeE | 5 (PDF, PS, TIFF, RTF, PDF) | 1 (Command line) | 3 | False | No |
| GraphicConverter X | 2 (PDF, TIFF) | 3 (API) | 5 | False | No |
| MsgText | 2 (PDF, TIFF) | 1 (Command line) | 3 | True | Yes |
| Tesseract-ocr | 2 (TIFF, TXT) | 1 (Command line) | 1 | True | Yes |
| AbiWord | 6 (DOC, RTF, TXT, HTML, ODF, DOCX) | 1 (Command line) | 1 | True | Yes |
| VisualIntegrity | 3 (PDF, TIFF, TXT) | 1 (Command line) | 1 | False | No |
| Photoshop | 3 (JP2, PDF, TIFF) | 5 (GUI) | 5 | False | No |
| PDF Version converter | 1 (PDF) | 1 (Command line) | 3 | False | No |
| Netpbm | 1 (TIFF) | 1 (Command line) | 1 | True | Yes |

8 Conclusions

In the SCAPE description of work it was indicated that action tools would be evaluated against four criteria: 1) Suitability for deployment on the distributed SCAPE platform; 2) the effort required to make them compatible with the use case scenarios determined by the testbeds; 3) their scalability in terms of their ability to migrate a large set of objects, complex objects composed of multiple bit streams of different types and/or large-sized files and 4) their robustness in terms of reliability and accuracy.

After a careful analysis of the objectives of this task, we came to conclusion that its main goal was to identify and select action tools and services that were suitable for SCAPE integration. That being said, we believe that no tools should be discarded based on the fact that they are not capable of coping with large-sized digital objects or complex objects. Some tools may not be able to handle large-sized files, but be extremely efficient in handling small objects – and that may be exactly what an institution is looking for when planning the preservation of a certain collection of files.

The decision on whether an action tool is suitable or not to preserve a collection of objects is something that should be addressed by a Preservation Planning service. This type of judgment varies according to the preservation needs of the collection, the stakeholders and/or the infrastructure in place (just to name a few of the possible influence factors). Any attempt to evaluate tools on the grounds that their scalability, reliability or accuracy would potentially result in an inaccurate decision based on poor assumptions or incomplete testing results.

The tools have been evaluated using an evaluation framework based on an international standard for software quality assessment (i.e. the ISO/IEC 25010:2011) that focus on the requirements of suitability for the testbed scenarios, compatibility with the SCAPE parallel execution platform and the license of use that accompanies the tool. The selected tools are appropriate for solving the problems depicted by the testbed scenarios, meet the minimum requirements to run on the SCAPE platform and can be used freely without breaking any legal constraints established by the SCAPE agreement or the tools licenses. An overall of 40 tools, ranging from image converters to database migration suites, have been identified and evaluated. After the assessment procedure, 16 of these tools have been considered inadequate to be used in the SCAPE project (40% rejection rate). The main reasons for rejection were licensing constraints and format incompatibility with the testbed scenarios.

Following the work developed in task 1 and reported here, task 2 will focus on adapting the selected action tools to fully support the SCAPE platform and take full advantage of the benefits that a scalable computational platform has to offer, such as enhanced computational power and fault tolerance. Additionally, the tools will need to be adapted to play along with the workflow engine being developed, which will be responsible for executing the plans produced by the Preservation Planning service.

9 References

- ARC. (2009). Guidelines for Creating and Installing IF Preservation Workflows and Templates (Deliverable No. IF5-D1). Planets. Obtido de http://www.planets-project.eu/docs/reports/Planets_IF5-D1_Creating&Install_IF_Pres_Workflows.pdf
- Ayris, P., Davies, R., McLeod, R., Miao, R., Shenton, H., & Wheatley, P. (2008). The LIFE2 final project report. Obtido de <http://eprints.ucl.ac.uk/11758/>
- Becker, C., & Rauber, A. (2011). Decision criteria in digital preservation: What to measure and how. *Journal of the American Society for Information Science and Technology*, n/a-n/a. doi:10.1002/asi.21527
- Beus-Dukic, L., & Boegh, J. (2003). COTS Software Quality Evaluation. ICCBSS (pp 72-80).
- Eld Zierau, & Caroline van Wijk. (2008). The Planets Approach to Migration Tools. Apresentado na IS&T Archiving 2008, Bern, Switzerland.
- Faria, L., Ferreira, M., Castro, R., Barbedo, F., Henriques, C., Corujo, L., & Ramalho, J. C. (2009). RODA: a service-oriented repository to preserve authentic digital objects. Apresentado na

- International Conference on Open Repositories, Atlanta, USA. Obtido de <http://hdl.handle.net/1822/9408>
- Ferreira, M. (2005). Automatic evaluation of migration quality in distributed networks of converters. Apresentado na European Conference on Digital Libraries (ECDL), Vienna. Obtido de <http://hdl.handle.net/1822/3340>
- Ferreira, M., Baptista, A. A., & Ramalho, J. C. (2006, Julho). A foundation for automatic digital preservation, (48). Obtido de <http://hdl.handle.net/1822/5571>
- Ferreira, M., Baptista, A. A., & Ramalho, J. C. (2007). CRIb: preservation services for Digital Repositories. Apresentado na International Conference Open Repositories, San Antonio, Texas, United States of America. Obtido de <http://hdl.handle.net/1822/6195>
- Hoyer, R. W., & Hoyer, B. B. Y. (2001, Julho). What Is Quality?, 34(7), 10.
- ISO/IEC 14598-1:1999, Information technology -- Software product evaluation -- Part 1: General overview. (1999). (p 19). International Organization for Standardization. Obtido de http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=24902
- ISO/IEC 15939:2007, Systems and software engineering -- Measurement process. (2007). . International Organization for Standardization. Obtido de http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44344
- ISO/IEC 25010:2011, Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models. (2011). (p 34). International Organization for Standardization. Obtido de http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=35733
- ISO/IEC 9126-1:2001, Software engineering - Product quality - Part 1: Quality model. (2001). . International Organization for Standardization. Obtido de http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=22749
- Jackson, A., Andrew Lindley, & Fabian Steeg. (2010). Consolidated Release and Documentation (Deliverable No. IF-D11). Planets. Obtido de http://www.planets-project.eu/docs/reports/Planets_IF-D11_ConsolidatedReleaseDocumentation.pdf
- KB-NL. (2009). Gap analysis: a survey of PA tool provision (Deliverable No. D3). Planets. Obtido de <http://www.planets-project.eu/docs/reports/PA2D3gapanalysis.pdf>
- Marta, M. H., Librelotto, G. R., Ramalho, J. C., & Henriques, P. R. (2002). Bidirectional conversion between XML documents and relational data bases, 6.
- Ramalho, J. C., Ferreira, M., Faria, L., Castro, R., Barbedo, F., & Corujo, L. (2008). RODA and CRIb a service-oriented digital repository (p 7). Apresentado na iPRESS 2008, London. Obtido de <http://hdl.handle.net/1822/8226>



Task Force on Archiving of Digital Information. (1996). Preserving digital information: report of the Task Force on Archiving of Digital Information. Washington D.C.: Commission on Preservation and Access.

10 Appendix

10.1 List of identified action tools

| | |
|-------------------------|--|
| Tool | ImageMagick ⁴ |
| Tool version | 6.6.7 |
| License | GPL V3 compatible ⁵ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | AAI, ART, ARW, AVI, AVS, BMP, CALS, CGM, CIN, CMYK, CMYKA, CR2, CRW, CUR, CUT, DCM, DCR, DCX, DIB, DJVU, DNG, DOT, DPX, EMF, EPDF, EPI, EPS, EPS2, EPS3, EPSF, EPSI, EPT, EXR, FAX, FIG, FITS, FPX, GIF, GPLT, GRAY, HPGL, HRZ, HTML, ICO, INFO, INLINE, JBIG, JNG, JP2, JPC, JPEG, MAN, MAT, MIFF, MONO, MNG, M2V, MPEG, MPC, MPR, MRW, MSL, MTV, MVG, NEF, ORF, OTB, P7, PALM, PAM, PBM, PCD, PCDS, PCL, PCX, PDB, PDF, PEF, PFA, PFB, PFM, PGM, PICON, PICT, PIX, PNG, PNG8, PNG24, PNG32, PNM, PPM, PS, PS2, PS3, PSB, PSD, PTIF, PWP, RAD, RAF, RGB, RGBA, RLA, RLE, SCT, SFW, SGI, SHTML, SID, MrSID, SUN, SVG, TGA, TIFF, TIM, TTF, TXT, UIL, UYVY, VICAR, VIFF, WBMP, WMF, WPG, X, XBM, XCF, XPM, XWD, X3F, YCbCr, YCbCrA, YUV |
| Output formats | AAI, AVS, BMP, CIN, CMYK, CMYKA, DCX, DIB, DPX, EPDF, EPI, EPS, EPSF, EPSI, EPT, EXR, FAX, FITS, FPX, GIF, GRAY, HRZ, HTML, INFO, JBIG, JNG, JP2, JPC, JPEG, MIFF, MONO, MNG, M2V, MPEG, MPC, MPR, MSL, MTV, MVG, OTB, P7, PALM, PBM, PCD, PCDS, PCX, PDB, PDF, PFM, PGM, PICON, PICT, PNG, PNG8, PNG24, PNG32, PNM, PPM, PS, PS2, PS3, PSB, PSD, PTIF, RGB, RGBA, SGI, SHTML, SUN, SVG, TGA, TIFF, TXT, UIL, UYVY, VICAR, VIFF, WBMP, X, XBM, XPM, XWD, YCbCr, YCbCrA, YUV |

| | |
|-------------------------|---|
| Tool | Mencoder ⁶ |
| Tool version | 1.0rc4-4.4.5 |
| License | GPL V2 ⁷ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Video; Audio |
| Input formats | (S)VCD (Super Video CD), CDRwin's .bin image file, DVD, including encrypted DVD, MPEG-1/2 (ES/PS/PES/VOB), AVI file format, ASF/WMV/WMA format, QT/MOV/MP4 format, RealAudio/RealVideo format, Ogg/OGM files, Matroska, NUT, NSV (Nullsoft Streaming Video), VIVO format, FLI format, NuppelVideo format, yuv4mpeg format, FILM (.cpk) format, RoQ format, PVA format, streaming via HTTP/FTP, RTP/RTSP, MMS/MMST, MPST, SDP, TV grabbing |
| Output formats | avi - Microsoft Audio/Video Interleaved; mpeg - MPEG-1/2 system stream format; lavf - FFmpeg libavformat muxers; rawvideo - (video only, one stream only) raw stream, no muxing; rawaudio - (audio only, one stream only) raw stream, no muxing; |

| | |
|---------------------|------------------------|
| Tool | HandBrake ⁸ |
| Tool version | 0.9.5 |

⁴ <http://www.imagemagick.org/>

⁵ <http://www.imagemagick.org/script/license.php>

⁶ <http://www.mplayerhq.hu/>

⁷ <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

⁸ <http://handbrake.fr>

| | |
|------------------|--|
| License | GPL V2 ⁹ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Video |
| Input formats | Any DVD or Bluray-like source: VIDEO_TS folder, DVD image, real DVD or bluray (unencrypted -- removal of copy protection is not supported), and some .VOB, .TS and M2TS files; Most any multimedia file it can get libavformat to read and libavcodec to decode. |
| Output formats | File format: MP4(M4V) and MKV; Video: MPEG-4(ffmpeg), H.264(x264), or Theora(libtheora); Audio: AAC, CoreAudio AAC (OS X Only), MP3, or Vorbis. AC-3 pass-through, DTS pass-thorough (MKV only) |

| | |
|------------------|--|
| Tool | FFmpeg ¹⁰ |
| Tool version | 0.6.1 |
| License | GPL v2 ¹¹ or GPL v2.1 ¹² |
| Interface | Command-line; API |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Video; Audio |
| Input formats | File formats: 4xm 8088flex TMV Adobe Filmstrip Audio IFF (AIFF) American Laser Games MM 3GPP AMR Apple HTTP Live Streaming ASF AVI AVISynth AVS Beam Software SIFF Bethesda Softworks VID Bink Bitmap Brothers JV Brute Force & Ignorance Interplay C93 Delphine Software International CIN CD+G Core Audio Format Creative Voice CRYO APC D-Cinema audio Deluxe Paint Animation DFA DV video |

⁹ <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

¹⁰ <http://www.ffmpeg.org>

¹¹ <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

¹² <http://www.gnu.org/licenses/old-licenses/lgpl-2.1.html>

| | |
|--|--|
| | DXA |
| | Electronic Arts cdata |
| | Electronic Arts Multimedia |
| | FFM (FFserver live feed) |
| | Flash (SWF) |
| | Flash 9 (AVM2) |
| | FLI/FLC/FLX animation |
| | Flash Video (FLV) |
| | FunCom ISS |
| | GXF |
| | id Quake II CIN video |
| | id RoQ |
| | IEC61937 encapsulation |
| | IFF |
| | Interplay MVE |
| | IV8 |
| | IVF (On2) |
| | LMLM4 |
| | LXF |
| | Matroska |
| | FFmpeg metadata |
| | MAXIS XA |
| | MD Studio |
| | Mobotix .mxg |
| | Monkey's Audio |
| | Motion Pixels MVI |
| | MOV/QuickTime/MP4 |
| | MP2 |
| | MP3 |
| | MPEG-1 System |
| | MPEG-PS (program stream) |
| | MPEG-TS (transport stream) |
| | MPEG-4 |
| | MSN TCP webcam |
| | MTV |
| | Musepack |
| | Musepack SV8 |
| | Material eXchange Format (MXF) |
| | Material eXchange Format (MXF), D-10 Mapping |
| | NC camera feed |
| | NTT TwinVQ (VQF) |
| | Nullsoft Streaming Video |
| | NuppelVideo |
| | NUT |
| | Ogg |
| | Playstation Portable PMP |
| | TechnoTrend PVA |
| | QCP |
| | raw ADTS (AAC) |
| | raw AC-3 |
| | raw Chinese AVS video |

| | |
|--|---|
| | raw CRI ADX |
| | raw Dirac |
| | raw DNxHD |
| | raw DTS |
| | raw E-AC-3 |
| | raw FLAC |
| | raw GSM |
| | raw H.261 |
| | raw H.263 |
| | raw H.264 |
| | raw Ingenient MJPEG |
| | raw MJPEG |
| | raw MLP |
| | raw MPEG |
| | raw MPEG-1 |
| | raw MPEG-2 |
| | raw MPEG-4 |
| | raw video |
| | raw Shorten |
| | raw TrueHD |
| | raw VC-1 |
| | raw PCM A-law |
| | raw PCM mu-law |
| | raw PCM signed 8 bit |
| | raw PCM signed 16 bit big-endian |
| | raw PCM signed 16 bit little-endian |
| | raw PCM signed 24 bit big-endian |
| | raw PCM signed 24 bit little-endian |
| | raw PCM signed 32 bit big-endian |
| | raw PCM signed 32 bit little-endian |
| | raw PCM unsigned 8 bit |
| | raw PCM unsigned 16 bit big-endian |
| | raw PCM unsigned 16 bit little-endian |
| | raw PCM unsigned 24 bit big-endian |
| | raw PCM unsigned 24 bit little-endian |
| | raw PCM unsigned 32 bit big-endian |
| | raw PCM unsigned 32 bit little-endian |
| | raw PCM floating-point 32 bit big-endian |
| | raw PCM floating-point 32 bit little-endian |
| | raw PCM floating-point 64 bit big-endian |
| | raw PCM floating-point 64 bit little-endian |
| | RDT |
| | REDCODE R3D |
| | RealMedia |
| | Redirector |
| | Renderware TeXture Dictionary |
| | RL2 |
| | RPL/ARMovie |
| | Lego Mindstorms RSO |
| | RTMP |
| | RTP |

RTSP
 SAP
 SDP
 Sega FILM/CPK
 Sierra SOL
 Sierra VMD
 Smacker
 Sony OpenMG (OMA)
 Sony PlayStation STR
 Sony Wave64 (W64)
 SoX native format
 SUN AU format
 Text files
 THP
 Tiertex Limited SEQ
 True Audio
 VC-1 test bitstream
 WAV
 WavPack
 WebM
 Windows Television (WTV)
 Wing Commander III movie
 Westwood Studios audio
 Westwood Studios VQA
 xWMA
 YUV4MPEG pipe
 Psygnosis YOP

Image formats:

.Y.U.V
 animated GIF
 BMP
 DPX
 JPEG
 JPEG 2000
 JPEG-LS
 PAM
 PBM
 PCX
 PGM
 PGM_YUV
 PIC
 PNG
 PPM
 PTX
 SGI
 Sun Rasterfile
 TIFF
 Truevision Targa

Video codecs:

4X Movie
 8088flex TMV
 8SVX exponential
 8SVX fibonacci
 American Laser Games MM
 AMV Video
 ANSI/ASCII art
 Apple MJPEG-B
 Apple QuickDraw
 Asus v1
 Asus v2
 ATI VCR1
 ATI VCR2
 Auravision Aura
 Auravision Aura 2
 Autodesk Animator Flic video
 Autodesk RLE
 AVS (Audio Video Standard) video
 Beam Software VB
 Bethesda VID video
 Bink Video
 Bitmap Brothers JV video
 Brute Force & Ignorance
 C93 video
 CamStudio
 CD+G
 Chinese AVS video
 Delphine Software International CIN video
 Cinepak
 Cirrus Logic AccuPak
 Creative YUV (CYUV)
 DFA
 Dirac
 Deluxe Paint Animation
 DNxHD
 Duck TrueMotion 1.0
 Duck TrueMotion 2.0
 DV (Digital Video)
 Feeble Files/ScummVM DXA
 Electronic Arts CMV video
 Electronic Arts Madcow video
 Electronic Arts TGV video
 Electronic Arts TGQ video
 Electronic Arts TQI video
 Escape 124
 FFmpeg video codec #1
 Flash Screen Video v1
 Flash Video (FLV)
 Fraps
 H.261
 H.263 / H.263-1996

H.263+ / H.263-1998 / H.263 version 2
 H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
 H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10 (VDPAU acceleration)
 HuffYUV
 HuffYUV FFmpeg variant
 IBM Ultimotion
 id Cinematic video
 id RoQ video
 IFF ILBM
 IFF ByteRun1
 Intel H.263
 Intel Indeo 2
 Intel Indeo 3
 Intel Indeo 5
 Interplay C93
 Interplay MVE video
 Karl Morton's video codec
 Kega Game Video (KGV1)
 Lagarith
 LCL (LossLess Codec Library) MSZH
 LCL (LossLess Codec Library) ZLIB
 LOCO
 lossless MJPEG
 Microsoft RLE
 Microsoft Video 1
 Mimic
 Miro VideoXL
 MJPEG (Motion JPEG)
 Mobotix MxPEG video
 Motion Pixels video
 MPEG-1 video
 MPEG-1/2 video XvMC (X-Video Motion Compensation)
 MPEG-1/2 video (VDPAU acceleration)
 MPEG-2 video
 MPEG-4 part 2
 MPEG-4 part 2 Microsoft variant version 1
 MPEG-4 part 2 Microsoft variant version 2
 MPEG-4 part 2 Microsoft variant version 3
 Nintendo Gamecube THP video
 NuppelVideo/RTjpeg
 On2 VP3
 On2 VP5
 On2 VP6
 VP8
 planar RGB
 Q-team QPEG
 QuickTime 8BPS video
 QuickTime Animation (RLE) video
 QuickTime Graphics (SMC)
 QuickTime video (RPZA)
 R10K AJA Kona 10-bit RGB Codec

| | |
|--|---|
| | R210 Quicktime Uncompressed RGB 10-bit |
| | Raw Video |
| | RealVideo 1.0 |
| | RealVideo 2.0 |
| | RealVideo 3.0 |
| | RealVideo 4.0 |
| | Renderware TXD (TeXture Dictionary) |
| | RL2 video |
| | Sierra VMD video |
| | Smacker video |
| | SMPTE VC-1 |
| | Snow |
| | Sony PlayStation MDEC (Motion DECoder) |
| | Sorenson Vector Quantizer 1 |
| | Sorenson Vector Quantizer 3 |
| | Sunplus JPEG (SP5X) |
| | TechSmith Screen Capture Codec |
| | Theora |
| | Tiertex Limited SEQ video |
| | V210 Quicktime Uncompressed 4:2:2 10-bit |
| | VMware Screen Codec / VMware Video |
| | Westwood Studios VQA (Vector Quantized Animation) video |
| | Windows Media Video 7 |
| | Windows Media Video 8 |
| | Windows Media Video 9 |
| | Wing Commander III / Xan |
| | Wing Commander IV / Xan |
| | Winnov WNV1 |
| | WMV7 |
| | YAMAHA SMAF |
| | Psygnosis YOP Video |
| | ZLIB |
| | Zip Motion Blocks Video |
| | Audio codecs: |
| | 8SVX audio |
| | AAC |
| | AC-3 |
| | ADPCM 4X Movie |
| | ADPCM CDROM XA |
| | ADPCM Creative Technology |
| | ADPCM Electronic Arts |
| | ADPCM Electronic Arts Maxis CDROM XS |
| | ADPCM Electronic Arts R1 |
| | ADPCM Electronic Arts R2 |
| | ADPCM Electronic Arts R3 |
| | ADPCM Electronic Arts XAS |
| | ADPCM G.722 |
| | ADPCM G.726 |
| | ADPCM IMA AMV |
| | ADPCM IMA Electronic Arts EACS |

ADPCM IMA Electronic Arts SEAD
 ADPCM IMA Funcom
 ADPCM IMA QuickTime
 ADPCM IMA Loki SDL MJPEG
 ADPCM IMA WAV
 ADPCM IMA Westwood
 ADPCM ISS IMA
 ADPCM IMA Duck DK3
 ADPCM IMA Duck DK4
 ADPCM Microsoft
 ADPCM MS IMA
 ADPCM Nintendo Gamecube THP
 ADPCM QT IMA
 ADPCM SEGA CRI ADX
 ADPCM Shockwave Flash
 ADPCM SMJPEG IMA
 ADPCM Sound Blaster Pro 2-bit
 ADPCM Sound Blaster Pro 2.6-bit
 ADPCM Sound Blaster Pro 4-bit
 ADPCM Westwood Studios IMA
 ADPCM Yamaha
 AMR-NB
 AMR-WB
 Apple lossless audio
 Atrac 1
 Atrac 3
 Bink Audio
 CELT (Opus)
 Delphine Software International CIN audio
 COOK
 DCA (DTS Coherent Acoustics)
 DPCM id RoQ
 DPCM Interplay
 DPCM Sierra Online
 DPCM Sol
 DPCM Xan
 DSP Group TrueSpeech
 DV audio
 Enhanced AC-3
 FLAC (Free Lossless Audio Codec)
 GSM
 GSM Microsoft variant
 IMC (Intel Music Coder)
 MACE (Macintosh Audio Compression/Expansion) 3:1
 MACE (Macintosh Audio Compression/Expansion) 6:1
 MLP (Meridian Lossless Packing)
 Monkey's Audio
 MP1 (MPEG audio layer 1)
 MP2 (MPEG audio layer 2)
 MP3 (MPEG audio layer 3)
 MPEG-4 Audio Lossless Coding (ALS)

| | |
|-----------------------|---|
| | <p> Musepack SV7 Musepack SV8 Nellymoser Asao PCM A-law PCM mu-law PCM 16-bit little-endian planar PCM 32-bit floating point big-endian PCM 32-bit floating point little-endian PCM 64-bit floating point big-endian PCM 64-bit floating point little-endian PCM D-Cinema audio signed 24-bit PCM signed 8-bit PCM signed 16-bit big-endian PCM signed 16-bit little-endian PCM signed 24-bit big-endian PCM signed 24-bit little-endian PCM signed 32-bit big-endian PCM signed 32-bit little-endian PCM signed 16/20/24-bit big-endian in MPEG-TS PCM unsigned 8-bit PCM unsigned 16-bit big-endian PCM unsigned 16-bit little-endian PCM unsigned 24-bit big-endian PCM unsigned 24-bit little-endian PCM unsigned 32-bit big-endian PCM unsigned 32-bit little-endian PCM Zork QCELP / PureVoice QDesign Music Codec 2 RealAudio 1.0 (14.4K) RealAudio 2.0 (28.8K) RealAudio 3.0 (dnet) RealAudio SIPR / ACELP.NET Shorten Sierra VMD audio Smacker audio SMPTE 302M AES3 audio Sonic Sonic lossless Speex True Audio (TTA) TrueHD TwinVQ (VQF flavor) Vorbis WavPack Westwood Audio (SND1) Windows Media Audio 1 Windows Media Audio 2 Windows Media Audio Pro Windows Media Audio Voice </p> |
| Output formats | File formats: |

| | |
|--|--|
| | Adobe Filmstrip |
| | Audio IFF (AIFF) |
| | 3GPP AMR |
| | ASF |
| | AVI |
| | Core Audio Format |
| | CRC testing format |
| | Creative Voice |
| | D-Cinema audio |
| | DV video |
| | FFM (FFserver live feed) |
| | Flash (SWF) |
| | Flash 9 (AVM2) |
| | Flash Video (FLV) |
| | framecrc testing format |
| | GIF Animation |
| | GXF |
| | id RoQ |
| | IEC61937 encapsulation |
| | IVF (On2) |
| | Matroska |
| | Matroska audio |
| | FFmpeg metadata |
| | MOV/QuickTime/MP4 |
| | MP2 |
| | MP3 |
| | MPEG-1 System |
| | MPEG-PS (program stream) |
| | MPEG-TS (transport stream) |
| | MPEG-4 |
| | MIME multipart JPEG |
| | Material eXchange Format (MXF) |
| | Material eXchange Format (MXF), D-10 Mapping |
| | NUT |
| | Ogg |
| | raw ADTS (AAC) |
| | raw AC-3 |
| | raw Chinese AVS video |
| | raw CRI ADX |
| | raw Dirac |
| | raw DNxHD |
| | raw DTS |
| | raw E-AC-3 |
| | raw FLAC |
| | raw H.261 |
| | raw H.263 |
| | raw H.264 |
| | raw MJPEG |
| | raw MPEG-4 |
| | raw NULL |
| | raw video |

raw id RoQ
 raw TrueHD
 raw PCM A-law
 raw PCM mu-law
 raw PCM signed 8 bit
 raw PCM signed 16 bit big-endian
 raw PCM signed 16 bit little-endian
 raw PCM signed 24 bit big-endian
 raw PCM signed 24 bit little-endian
 raw PCM signed 32 bit big-endian
 raw PCM signed 32 bit little-endian
 raw PCM unsigned 8 bit
 raw PCM unsigned 16 bit big-endian
 raw PCM unsigned 16 bit little-endian
 raw PCM unsigned 24 bit big-endian
 raw PCM unsigned 24 bit little-endian
 raw PCM unsigned 32 bit big-endian
 raw PCM unsigned 32 bit little-endian
 raw PCM floating-point 32 bit big-endian
 raw PCM floating-point 32 bit little-endian
 raw PCM floating-point 64 bit big-endian
 raw PCM floating-point 64 bit little-endian
 RealMedia
 Lego Mindstorms RSO
 RTMP
 RTP
 RTSP
 SAP
 SoX native format
 SUN AU format
 VC-1 test bitstream
 WAV
 WebM
 YUV4MPEG pipe

Image formats:

.Y.U.V
 animated GIF
 BMP
 DPX
 JPEG
 JPEG 2000
 JPEG-LS
 LJPEG
 PAM
 PBM
 PCX
 PGM
 PGMYUV
 PNG
 PPM

SGI
TIFF
Truevision Targa

Video codecs:

A64 multicolor
Asus v1
Asus v2
Chinese AVS video
Dirac
DNxHD
DV (Digital Video)
FFmpeg video codec #1
Flash Screen Video v1
Flash Screen Video v2
Flash Video (FLV)
H.261
H.263 / H.263-1996
H.263+ / H.263-1998 / H.263 version 2
H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10 (VDPAU acceleration)
HuffyUV
HuffyUV FFmpeg variant
id RoQ video
LCL (LossLess Codec Library) ZLIB
lossless MJPEG
MJPEG (Motion JPEG)
MPEG-1 video
MPEG-2 video
MPEG-4 part 2
MPEG-4 part 2 Microsoft variant version 2
MPEG-4 part 2 Microsoft variant version 3
VP8
QuickTime Animation (RLE) video
Raw Video
RealVideo 1.0
RealVideo 2.0
Snow
Sorenson Vector Quantizer 1
Theora
V210 Quicktime Uncompressed 4:2:2 10-bit
Windows Media Video 7
Windows Media Video 8
WMV7
YAMAHA SMAF
ZLIB
Zip Motion Blocks Video

Audio codecs:

AAC
AC-3

| | |
|--|---|
| | ADPCM G.722 |
| | ADPCM G.726 |
| | ADPCM IMA QuickTime |
| | ADPCM IMA WAV |
| | ADPCM Microsoft |
| | ADPCM MS IMA |
| | ADPCM QT IMA |
| | ADPCM SEGA CRI ADX |
| | ADPCM Shockwave Flash |
| | ADPCM Yamaha |
| | AMR-NB |
| | AMR-WB |
| | Apple lossless audio |
| | DCA (DTS Coherent Acoustics) |
| | DPCM id RoQ |
| | Enhanced AC-3 |
| | FLAC (Free Lossless Audio Codec) |
| | GSM |
| | GSM Microsoft variant |
| | MP2 (MPEG audio layer 2) |
| | MP3 (MPEG audio layer 3) |
| | Nellymoser Asao |
| | PCM A-law |
| | PCM mu-law |
| | PCM 32-bit floating point big-endian |
| | PCM 32-bit floating point little-endian |
| | PCM 64-bit floating point big-endian |
| | PCM 64-bit floating point little-endian |
| | PCM D-Cinema audio signed 24-bit |
| | PCM signed 8-bit |
| | PCM signed 16-bit big-endian |
| | PCM signed 16-bit little-endian |
| | PCM signed 24-bit big-endian |
| | PCM signed 24-bit little-endian |
| | PCM signed 32-bit big-endian |
| | PCM signed 32-bit little-endian |
| | PCM unsigned 8-bit |
| | PCM unsigned 16-bit big-endian |
| | PCM unsigned 16-bit little-endian |
| | PCM unsigned 24-bit big-endian |
| | PCM unsigned 24-bit little-endian |
| | PCM unsigned 32-bit big-endian |
| | PCM unsigned 32-bit little-endian |
| | PCM Zork |
| | RealAudio 1.0 (14.4K) |
| | RealAudio 3.0 (dnet) |
| | Sonic |
| | Sonic lossless |
| | Vorbis |
| | Windows Media Audio 1 |
| | Windows Media Audio 2 |

| | |
|-------------------------|---|
| Tool | SoX ¹³ |
| Tool version | 14.3.2 |
| License | GPL v2 ¹⁴ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Audio |
| Input formats | Raw files in various binary formats; Raw textual data; Amiga 8svx files; Apple/SGI AIFF files; SUN .au files: PCM, u-law, A-law, G7xx ADPCM files, mutant DEC .au files, NeXT .snd files; AVR files, CDDA (Compact Disc Digital Audio format); CVS and VMS files (continuous variable slope); Grandstream ring-tone files; GSM files; HTK files; LPC-10 files; Macintosh HCOM files; Amiga MAUD files; AMR-WB & AMR-NB (with optional libamrwb & libamrnb libraries); MP3 (with optional libmad and libmp3lame libraries); MP4, AAC, AC3, WAVPACK, AMR-NB files (with optional ffmpeg library); AVI, WMV, Ogg Theora, MPEG video files (with optional ffmpeg library); Ogg Vorbis files (with optional Ogg Vorbis libraries); FLAC files (with optional libFLAC); IRCAM SoundFile files; NIST SPHERE files; Turtle beach SampleVision files; Sounder & Soundtool (DOS) files; Yamaha TX-16W sampler files; SoundBlaster .VOC files; Dialogic/OKI ADPCM files (.VOX); Microsoft .WAV files: PCM, u-law, A-law, MS ADPCM, IMA ADPCM, GSM, RIFX (big endian); WavPack files (with optional libwavpack library); Psion (palmtop) A-law WVE files and Record voice notes; Maxis XA Audio files: EA ADPCM |
| Output formats | Raw files in various binary formats; Raw textual data; Amiga 8svx files; Apple/SGI AIFF files; SUN .au files: PCM, u-law, A-law, mutant DEC .au files, NeXT .snd files; AVR files, CDDA (Compact Disc Digital Audio format); CVS and VMS files (continuous variable slope); Grandstream ring-tone files; GSM files; HTK files; LPC-10 files; Macintosh HCOM files; Amiga MAUD files; AMR-WB & AMR-NB (with optional libamrwb & libamrnb libraries); MP3 (with optional libmad and libmp3lame libraries); MP4, AAC, AC3, WAVPACK, AMR-NB files (with optional ffmpeg library); AVI, WMV, Ogg Theora, MPEG video files (with optional ffmpeg library); Ogg Vorbis files (with optional Ogg Vorbis libraries); FLAC files (with optional libFLAC); IRCAM SoundFile files; NIST SPHERE files; Turtle beach SampleVision files; Sounder & Soundtool (DOS) files; Yamaha TX-16W sampler files; SoundBlaster .VOC files; Dialogic/OKI ADPCM files (.VOX); Microsoft .WAV files: PCM, u-law, A-law, MS ADPCM, IMA ADPCM, GSM, RIFX (big endian); WavPack files (with optional libwavpack library); Psion (palmtop) A-law WVE files and Record voice notes |

| | |
|-------------------------|--|
| Tool | GStreamer ¹⁵ |
| Tool version | 0.10.28 |
| License | LGPL v3 ¹⁶ |
| Interface | Command-line; API |
| Operating system | GNU/Linux; Windows |
| Open-source | Yes |
| Object class | Bitmap; Vector; Video; Audio |
| Input formats | NSF, PNM, Musepack, BZ2, DTS, SVG, CELT, |

¹³ <http://sox.sourceforge.net/>

¹⁴ <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

¹⁵ <http://gstreamer.freedesktop.org>

¹⁶ <http://www.fsf.org/licenses/lgpl.html>

JPEG2000,
 TTA audio,
 Bayer,
 XviD,
 ADPCM,
 AAC,
 VMnc,
 GSM,
 AMR-WB,
 MPEG1,
 MPEG 2,
 DVD LPCM,
 AMR-NB,
 Sid,
 MP3,
 ATSC A/52,
 Vorbis,
 A Law,
 DV,
 PNG,
 Mu Law,
 Speex,
 Wavpack,
 FLAC,
 Theora,
 CMMML,
 JPEG,
 Smoke,
 FLX,
 Bluetooth SBC

From FFMpeg library:

File formats:

4xm
 8088flex TMV
 Adobe Filmstrip
 Audio IFF (AIFF)
 American Laser Games MM
 3GPP AMR
 Apple HTTP Live Streaming
 ASF
 AVI
 AVISynth
 AVS
 Beam Software SIFF
 Bethesda Softworks VID
 Bink
 Bitmap Brothers JV
 Brute Force & Ignorance
 Interplay C93

| | |
|--|--|
| | Delphine Software International CIN |
| | CD+G |
| | Core Audio Format |
| | Creative Voice |
| | CRYO APC |
| | D-Cinema audio |
| | Deluxe Paint Animation |
| | DFA |
| | DV video |
| | DXA |
| | Electronic Arts cdata |
| | Electronic Arts Multimedia |
| | FFM (FFserver live feed) |
| | Flash (SWF) |
| | Flash 9 (AVM2) |
| | FLI/FLC/FLX animation |
| | Flash Video (FLV) |
| | FunCom ISS |
| | GXF |
| | id Quake II CIN video |
| | id RoQ |
| | IEC61937 encapsulation |
| | IFF |
| | Interplay MVE |
| | IV8 |
| | IVF (On2) |
| | LMLM4 |
| | LXF |
| | Matroska |
| | FFmpeg metadata |
| | MAXIS XA |
| | MD Studio |
| | Mobotix .mxg |
| | Monkey's Audio |
| | Motion Pixels MVI |
| | MOV/QuickTime/MP4 |
| | MP2 |
| | MP3 |
| | MPEG-1 System |
| | MPEG-PS (program stream) |
| | MPEG-TS (transport stream) |
| | MPEG-4 |
| | MSN TCP webcam |
| | MTV |
| | Musepack |
| | Musepack SV8 |
| | Material eXchange Format (MXF) |
| | Material eXchange Format (MXF), D-10 Mapping |
| | NC camera feed |
| | NTT TwinVQ (VQF) |
| | Nullsoft Streaming Video |

NuppelVideo
 NUT
 Ogg
 Playstation Portable PMP
 TechnoTrend PVA
 QCP
 raw ADTS (AAC)
 raw AC-3
 raw Chinese AVS video
 raw CRI ADX
 raw Dirac
 raw DNxHD
 raw DTS
 raw E-AC-3
 raw FLAC
 raw GSM
 raw H.261
 raw H.263
 raw H.264
 raw Ingenient MJPEG
 raw MJPEG
 raw MLP
 raw MPEG
 raw MPEG-1
 raw MPEG-2
 raw MPEG-4
 raw video
 raw Shorten
 raw TrueHD
 raw VC-1
 raw PCM A-law
 raw PCM mu-law
 raw PCM signed 8 bit
 raw PCM signed 16 bit big-endian
 raw PCM signed 16 bit little-endian
 raw PCM signed 24 bit big-endian
 raw PCM signed 24 bit little-endian
 raw PCM signed 32 bit big-endian
 raw PCM signed 32 bit little-endian
 raw PCM unsigned 8 bit
 raw PCM unsigned 16 bit big-endian
 raw PCM unsigned 16 bit little-endian
 raw PCM unsigned 24 bit big-endian
 raw PCM unsigned 24 bit little-endian
 raw PCM unsigned 32 bit big-endian
 raw PCM unsigned 32 bit little-endian
 raw PCM floating-point 32 bit big-endian
 raw PCM floating-point 32 bit little-endian
 raw PCM floating-point 64 bit big-endian
 raw PCM floating-point 64 bit little-endian
 RDT

REDCODE R3D
 RealMedia
 Redirector
 Renderware TeXture Dictionary
 RL2
 RPL/ARMovie
 Lego Mindstorms RSO
 RTMP
 RTP
 RTSP
 SAP
 SDP
 Sega FILM/CPK
 Sierra SOL
 Sierra VMD
 Smacker
 Sony OpenMG (OMA)
 Sony PlayStation STR
 Sony Wave64 (W64)
 SoX native format
 SUN AU format
 Text files
 THP
 Tiertex Limited SEQ
 True Audio
 VC-1 test bitstream
 WAV
 WavPack
 WebM
 Windows Television (WTV)
 Wing Commander III movie
 Westwood Studios audio
 Westwood Studios VQA
 xWMA
 YUV4MPEG pipe
 Psygnosis YOP

Image formats:

.Y.U.V
 animated GIF
 BMP
 DPX
 JPEG
 JPEG 2000
 JPEG-LS
 PAM
 PBM
 PCX
 PGM
 PGMYUV
 PIC

PNG
 PPM
 PTX
 SGI
 Sun Rasterfile
 TIFF
 Truevision Targa

Video codecs:
 4X Movie
 8088flex TMV
 8SVX exponential
 8SVX fibonacci
 American Laser Games MM
 AMV Video
 ANSI/ASCII art
 Apple MJPEG-B
 Apple QuickDraw
 Asus v1
 Asus v2
 ATI VCR1
 ATI VCR2
 Auravision Aura
 Auravision Aura 2
 Autodesk Animator Flic video
 Autodesk RLE
 AVS (Audio Video Standard) video
 Beam Software VB
 Bethesda VID video
 Bink Video
 Bitmap Brothers JV video
 Brute Force & Ignorance
 C93 video
 CamStudio
 CD+G
 Chinese AVS video
 Delphine Software International CIN video
 Cinepak
 Cirrus Logic AccuPak
 Creative YUV (CYUV)
 DFA
 Dirac
 Deluxe Paint Animation
 DNxHD
 Duck TrueMotion 1.0
 Duck TrueMotion 2.0
 DV (Digital Video)
 Feeble Files/ScummVM DXA
 Electronic Arts CMV video
 Electronic Arts Madcow video
 Electronic Arts TGV video

Electronic Arts TGQ video
 Electronic Arts TQI video
 Escape 124
 FFmpeg video codec #1
 Flash Screen Video v1
 Flash Video (FLV)
 Fraps
 H.261
 H.263 / H.263-1996
 H.263+ / H.263-1998 / H.263 version 2
 H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
 H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10 (VDPAU acceleration)
 HuffYUV
 HuffYUV FFmpeg variant
 IBM Ultimotion
 id Cinematic video
 id RoQ video
 IFF ILBM
 IFF ByteRun1
 Intel H.263
 Intel Indeo 2
 Intel Indeo 3
 Intel Indeo 5
 Interplay C93
 Interplay MVE video
 Karl Morton's video codec
 Kega Game Video (KGV1)
 Lagarith
 LCL (LossLess Codec Library) MSZH
 LCL (LossLess Codec Library) ZLIB
 LOCO
 lossless MJPEG
 Microsoft RLE
 Microsoft Video 1
 Mimic
 Miro VideoXL
 MJPEG (Motion JPEG)
 Mobotix MxPEG video
 Motion Pixels video
 MPEG-1 video
 MPEG-1/2 video XvMC (X-Video Motion Compensation)
 MPEG-1/2 video (VDPAU acceleration)
 MPEG-2 video
 MPEG-4 part 2
 MPEG-4 part 2 Microsoft variant version 1
 MPEG-4 part 2 Microsoft variant version 2
 MPEG-4 part 2 Microsoft variant version 3
 Nintendo Gamecube THP video
 NuppelVideo/RTjpeg
 On2 VP3
 On2 VP5

On2 VP6
 VP8
 planar RGB
 Q-team QPEG
 QuickTime 8BPS video
 QuickTime Animation (RLE) video
 QuickTime Graphics (SMC)
 QuickTime video (RPZA)
 R10K AJA Kona 10-bit RGB Codec
 R210 Quicktime Uncompressed RGB 10-bit
 Raw Video
 RealVideo 1.0
 RealVideo 2.0
 RealVideo 3.0
 RealVideo 4.0
 Renderware TXD (TeXture Dictionary)
 RL2 video
 Sierra VMD video
 Smacker video
 SMPTE VC-1
 Snow
 Sony PlayStation MDEC (Motion DECoder)
 Sorenson Vector Quantizer 1
 Sorenson Vector Quantizer 3
 Sunplus JPEG (SP5X)
 TechSmith Screen Capture Codec
 Theora
 Tiertex Limited SEQ video
 V210 Quicktime Uncompressed 4:2:2 10-bit
 VMware Screen Codec / VMware Video
 Westwood Studios VQA (Vector Quantized Animation) video
 Windows Media Video 7
 Windows Media Video 8
 Windows Media Video 9
 Wing Commander III / Xan
 Wing Commander IV / Xan
 Winnov WNV1
 WMV7
 YAMAHA SMAF
 Psygnosis YOP Video
 ZLIB
 Zip Motion Blocks Video

Audio codecs:

8SVX audio
 AAC
 AC-3
 ADPCM 4X Movie
 ADPCM CDROM XA
 ADPCM Creative Technology
 ADPCM Electronic Arts

ADPCM Electronic Arts Maxis CDROM XS
 ADPCM Electronic Arts R1
 ADPCM Electronic Arts R2
 ADPCM Electronic Arts R3
 ADPCM Electronic Arts XAS
 ADPCM G.722
 ADPCM G.726
 ADPCM IMA AMV
 ADPCM IMA Electronic Arts EACS
 ADPCM IMA Electronic Arts SEAD
 ADPCM IMA Funcom
 ADPCM IMA QuickTime
 ADPCM IMA Loki SDL MJPEG
 ADPCM IMA WAV
 ADPCM IMA Westwood
 ADPCM ISS IMA
 ADPCM IMA Duck DK3
 ADPCM IMA Duck DK4
 ADPCM Microsoft
 ADPCM MS IMA
 ADPCM Nintendo Gamecube THP
 ADPCM QT IMA
 ADPCM SEGA CRI ADX
 ADPCM Shockwave Flash
 ADPCM SMJPEG IMA
 ADPCM Sound Blaster Pro 2-bit
 ADPCM Sound Blaster Pro 2.6-bit
 ADPCM Sound Blaster Pro 4-bit
 ADPCM Westwood Studios IMA
 ADPCM Yamaha
 AMR-NB
 AMR-WB
 Apple lossless audio
 Atrac 1
 Atrac 3
 Bink Audio
 CELT (Opus)
 Delphine Software International CIN audio
 COOK
 DCA (DTS Coherent Acoustics)
 DPCM id RoQ
 DPCM Interplay
 DPCM Sierra Online
 DPCM Sol
 DPCM Xan
 DSP Group TrueSpeech
 DV audio
 Enhanced AC-3
 FLAC (Free Lossless Audio Codec)
 GSM
 GSM Microsoft variant

IMC (Intel Music Coder)
 MACE (Macintosh Audio Compression/Expansion) 3:1
 MACE (Macintosh Audio Compression/Expansion) 6:1
 MLP (Meridian Lossless Packing)
 Monkey's Audio
 MP1 (MPEG audio layer 1)
 MP2 (MPEG audio layer 2)
 MP3 (MPEG audio layer 3)
 MPEG-4 Audio Lossless Coding (ALS)
 Musepack SV7
 Musepack SV8
 Nellymoser Asao
 PCM A-law
 PCM mu-law
 PCM 16-bit little-endian planar
 PCM 32-bit floating point big-endian
 PCM 32-bit floating point little-endian
 PCM 64-bit floating point big-endian
 PCM 64-bit floating point little-endian
 PCM D-Cinema audio signed 24-bit
 PCM signed 8-bit
 PCM signed 16-bit big-endian
 PCM signed 16-bit little-endian
 PCM signed 24-bit big-endian
 PCM signed 24-bit little-endian
 PCM signed 32-bit big-endian
 PCM signed 32-bit little-endian
 PCM signed 16/20/24-bit big-endian in MPEG-TS
 PCM unsigned 8-bit
 PCM unsigned 16-bit big-endian
 PCM unsigned 16-bit little-endian
 PCM unsigned 24-bit big-endian
 PCM unsigned 24-bit little-endian
 PCM unsigned 32-bit big-endian
 PCM unsigned 32-bit little-endian
 PCM Zork
 QCELP / PureVoice
 QDesign Music Codec 2
 RealAudio 1.0 (14.4K)
 RealAudio 2.0 (28.8K)
 RealAudio 3.0 (dnet)
 RealAudio SIPR / ACELP.NET
 Shorten
 Sierra VMD audio
 Smacker audio
 SMPTE 302M AES3 audio
 Sonic
 Sonic lossless
 Speex
 True Audio (TTA)
 TrueHD

| | |
|----------------|---|
| | TwinVQ (VQF flavor) Vorbis WavPack Westwood Audio (SND1) Windows Media Audio 1 Windows Media Audio 2 Windows Media Audio Pro Windows Media Audio Voice |
| Output formats | PNM, BZ2, CELT, Jasper JPEG2000, XviD video, ADPCM, GSM audio, mp3, AMR-NB audio, mp2, Vorbis, A Law, YUV4MPEG, PNG, Mu Law, Speex, Wavpack, FLAC, Cairo, Theora, CMML streams, JPEG, Smoke video, Bluetooth SBC From FFMpeg library: File formats: Adobe Filmstrip Audio IFF (AIFF) 3GPP AMR ASF AVI Core Audio Format CRC testing format Creative Voice D-Cinema audio DV video FFM (FFserver live feed) Flash (SWF) Flash 9 (AVM2) Flash Video (FLV) framecrc testing format |

| | |
|--|--|
| | GIF Animation |
| | GXF |
| | id RoQ |
| | IEC61937 encapsulation |
| | IVF (On2) |
| | Matroska |
| | Matroska audio |
| | FFmpeg metadata |
| | MOV/QuickTime/MP4 |
| | MP2 |
| | MP3 |
| | MPEG-1 System |
| | MPEG-PS (program stream) |
| | MPEG-TS (transport stream) |
| | MPEG-4 |
| | MIME multipart JPEG |
| | Material eXchange Format (MXF) |
| | Material eXchange Format (MXF), D-10 Mapping |
| | NUT |
| | Ogg |
| | raw ADTS (AAC) |
| | raw AC-3 |
| | raw Chinese AVS video |
| | raw CRI ADX |
| | raw Dirac |
| | raw DNxHD |
| | raw DTS |
| | raw E-AC-3 |
| | raw FLAC |
| | raw H.261 |
| | raw H.263 |
| | raw H.264 |
| | raw MJPEG |
| | raw MPEG-4 |
| | raw NULL |
| | raw video |
| | raw id RoQ |
| | raw TrueHD |
| | raw PCM A-law |
| | raw PCM mu-law |
| | raw PCM signed 8 bit |
| | raw PCM signed 16 bit big-endian |
| | raw PCM signed 16 bit little-endian |
| | raw PCM signed 24 bit big-endian |
| | raw PCM signed 24 bit little-endian |
| | raw PCM signed 32 bit big-endian |
| | raw PCM signed 32 bit little-endian |
| | raw PCM unsigned 8 bit |
| | raw PCM unsigned 16 bit big-endian |
| | raw PCM unsigned 16 bit little-endian |
| | raw PCM unsigned 24 bit big-endian |

raw PCM unsigned 24 bit little-endian
 raw PCM unsigned 32 bit big-endian
 raw PCM unsigned 32 bit little-endian
 raw PCM floating-point 32 bit big-endian
 raw PCM floating-point 32 bit little-endian
 raw PCM floating-point 64 bit big-endian
 raw PCM floating-point 64 bit little-endian
 RealMedia
 Lego Mindstorms RSO
 RTMP
 RTP
 RTSP
 SAP
 SoX native format
 SUN AU format
 VC-1 test bitstream
 WAV
 WebM
 YUV4MPEG pipe

Image formats:

.Y.U.V
 animated GIF
 BMP
 DPX
 JPEG
 JPEG 2000
 JPEG-LS
 LJPEG
 PAM
 PBM
 PCX
 PGM
 PGMYUV
 PNG
 PPM
 SGI
 TIFF
 Truevision Targa

Video codecs:

A64 multicolor
 Asus v1
 Asus v2
 Chinese AVS video
 Dirac
 DNxHD
 DV (Digital Video)
 FFmpeg video codec #1
 Flash Screen Video v1
 Flash Screen Video v2

Flash Video (FLV)
H.261
H.263 / H.263-1996
H.263+ / H.263-1998 / H.263 version 2
H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10 (VDPAU acceleration)
HuffyUV
HuffyUV FFmpeg variant
id RoQ video
LCL (LossLess Codec Library) ZLIB
lossless MJPEG
MJPEG (Motion JPEG)
MPEG-1 video
MPEG-2 video
MPEG-4 part 2
MPEG-4 part 2 Microsoft variant version 2
MPEG-4 part 2 Microsoft variant version 3
VP8
QuickTime Animation (RLE) video
Raw Video
RealVideo 1.0
RealVideo 2.0
Snow
Sorenson Vector Quantizer 1
Theora
V210 Quicktime Uncompressed 4:2:2 10-bit
Windows Media Video 7
Windows Media Video 8
WMV7
YAMAHA SMAF
ZLIB
Zip Motion Blocks Video

Audio codecs:

AAC
AC-3
ADPCM G.722
ADPCM G.726
ADPCM IMA QuickTime
ADPCM IMA WAV
ADPCM Microsoft
ADPCM MS IMA
ADPCM QT IMA
ADPCM SEGA CRI ADX
ADPCM Shockwave Flash
ADPCM Yamaha
AMR-NB
AMR-WB
Apple lossless audio
DCA (DTS Coherent Acoustics)
DPCM id RoQ

| | |
|--|---|
| | Enhanced AC-3 FLAC (Free Lossless Audio Codec) GSM GSM Microsoft variant MP2 (MPEG audio layer 2) MP3 (MPEG audio layer 3) Nellymoser Asao PCM A-law PCM mu-law PCM 32-bit floating point big-endian PCM 32-bit floating point little-endian PCM 64-bit floating point big-endian PCM 64-bit floating point little-endian PCM D-Cinema audio signed 24-bit PCM signed 8-bit PCM signed 16-bit big-endian PCM signed 16-bit little-endian PCM signed 24-bit big-endian PCM signed 24-bit little-endian PCM signed 32-bit big-endian PCM signed 32-bit little-endian PCM unsigned 8-bit PCM unsigned 16-bit big-endian PCM unsigned 16-bit little-endian PCM unsigned 24-bit big-endian PCM unsigned 24-bit little-endian PCM unsigned 32-bit big-endian PCM unsigned 32-bit little-endian PCM Zork RealAudio 1.0 (14.4K) RealAudio 3.0 (dnet) Sonic Sonic lossless Vorbis Windows Media Audio 1 Windows Media Audio 2 |
|--|---|

| | |
|-------------------------|---|
| Tool | Microsoft Office ¹⁷ |
| Tool version | 2010 |
| License | Comercial ¹⁸ |
| Interface | API; GUI |
| Operating system | Windows; MacOS X |
| Open-source | No |
| Object class | Word Processor; Documents; Spreadsheets |
| Input formats | Text Formats Word Documents (*.docx) |

¹⁷ <http://office.microsoft.com>

¹⁸ <http://www.microsoft.com/downloads/en/details.aspx?FamilyID=2b37ad5e-dc64-400b-a00d-88d982292b07>

| | |
|--|--|
| | Word 97-2003 Documents (*.doc) |
| | Rich Text Format (*.rtf) |
| | Text Files (*.txt) |
| | Open Document Text (*.odt) |
| | Word Macro-Enabled Documents (*.docm) |
| | All Web Pages (*.html) |
| | WordPerfect 5.x (*.wp5) |
| | WordPerfect 6.x (*.wp6) |
| | XML (*.xml) |
| | Works 6-9 Document (*.wps) |
| | Spreadsheet Formats |
| | Excel Workbook (*.xlsx) |
| | Excel Macro-Enabled Workbook (*.xlsm) |
| | Excel Binary Workbook (*.xlsb) |
| | Excel 97-2003 Workbook (*.xls) |
| | Web Pages (*.htm) |
| | Text Files (*.txt) |
| | CSV (Comma delimited) (*.csv) |
| | DIF (Data Interchange Format) (*.dif) |
| | SYLK (Symbolic Link) (*.slk) |
| | Open Document Spreadsheet (*.ods) |
| | XML (*.xml) |
| | Access (*.accdb) |
| | dBase Files (*.dbf) |
| | Presentation Formats |
| | All PowerPoint Presentations (*.pptx, *.pptm, *.ppt) |
| | Presentations and Shows (*.ppsx, *.ppsm, *.pps) |
| | All Web Pages (*.html) |
| | OpenDocument Presentation (*.odp) - may not support all features |

| | |
|----------------|--|
| Output formats | Text Formats |
| | Word Documents (*.docx) |
| | Word 97-2003 Documents (*.doc) |
| | Rich Text Format (*.rtf) |
| | Text Files (*.txt) |
| | Open Document Text (*.odt) |
| | Word Macro-Enabled Documents (*.docm) |
| | Web Pages (*.htm) |
| | WordPerfect 5.x (*.wp5) |
| | WordPerfect 6.x (*.wp6) |
| | Word XML Document (*.xml) |
| | Works 6-9 Document (*.wps) |
| | PDF (*.pdf) |
| | XPS Document (*.xps) |
| | Spreadsheet Formats |
| | Excel Workbook (*.xlsx) |
| | Excel Macro-Enabled Workbook (*.xlsm) |
| | Excel Binary Workbook (*.xlsb) |
| | Excel 97-2003 Workbook (*.xls) |
| | Web Pages (*.htm) |
| | Text Files (*.txt) |
| | CSV (Comma delimited) (*.csv) |
| | DIF (Data Interchange Format) (*.dif) |
| | SYLK (Symbolic Link) (*.slk) |
| | PDF (*.pdf) |
| | XPS Document (*.xps) |
| | Open Document Spreadsheet (*.ods) |
| | Presentation Formats |
| | PowerPoint Presentation (*.pptx) |
| | PowerPoint Macro-Enabled Presentation (*.pptm) |
| | PowerPoint 97-2003 Presentation (*.ppt) |
| | PDF (*.pdf) |
| | XPS Document (*.xps) |
| | PowerPoint Show (*.ppsx) |
| | PowerPoint Macro-Enabled Show (*.ppsm) |
| | PowerPoint 97-2003 Show (*.pps) |
| | Windows Media Video (*.wmv) |
| | GIF Graphics Interchange Format (*.gif) |
| | JPEG File Interchange Format (*.jpg) |
| | PNG Portable Network Graphics Format (*.png) |
| | TIFF Tag Image File Format (*.tiff) |
| | Device Independent Bitmap (*.bmp) |
| | Windows Metafile (*.wmf) |
| | Enhanced Windows Metafile (*.emf) |
| | Outline/RTF (*.rtf) |
| | OpenDocument Presentation (*.odp) - may not support all features |

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|-------------------------|--|
| Tool | OpenOffice ¹⁹ with JODConverter ²⁰ |
| Tool version | 3.2.1 (JODConverter 2.2.2) |
| License | LGPL v3 ²¹ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Word Processor; Documents; Spreadsheets |
| Input formats | <p>Text Formats</p> <p>OpenDocument Text (*.odt) OpenOffice.org 1.0 Text (*.sxw) Rich Text Format (*.rtf) Microsoft Word (*.doc) WordPerfect (*.wpd) Plain Text (*.txt) HTML (*.html)</p> <p>Spreadsheet Formats</p> <p>OpenDocument Spreadsheet (*.ods) OpenOffice.org 1.0 Spreadsheet (*.sxc) Microsoft Excel (*.xls) Comma-Separated Values (*.csv) Tab-Separated Values (*.tsv)</p> <p>Presentation Formats</p> <p>OpenDocument Presentation (*.odp) OpenOffice.org 1.0 Presentation (*.sxi) Microsoft PowerPoint (*.ppt)</p> <p>Drawing Formats</p> <p>OpenDocument Drawing (*.odg)</p> |
| Output formats | <p>Text Formats</p> <p>Portable Document Format (*.pdf) OpenDocument Text (*.odt) OpenOffice.org 1.0 Text (*.sxw) Rich Text Format (*.rtf) Microsoft Word (*.doc) Plain Text (*.txt) HTML2 (*.html) MediaWiki wikitext (*.wiki)</p> <p>Spreadsheet Formats</p> <p>Portable Document Format (*.pdf) OpenDocument Spreadsheet (*.ods)</p> |

¹⁹ <http://openoffice.org>

²⁰ <http://www.artofsolving.com/opensource/jodconverter>

²¹ <http://www.gnu.org/licenses/lgpl.html>

| | |
|--|---|
| | OpenOffice.org 1.0 Spreadsheet (*.sxc) Microsoft Excel (*.xls) Comma-Separated Values (*.csv) Tab-Separated Values (*.tsv) HTML (*.html) |
| | Presentation Formats |
| | Portable Document Format (*.pdf) Macromedia Flash (*.swf) OpenDocument Presentation (*.odp) OpenOffice.org 1.0 Presentation (*.sxi) Microsoft PowerPoint (*.ppt) HTML (*.html) |
| | Drawing Formats |
| | Scalable Vector Graphics (*.svg) Macromedia Flash (*.swf) |

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|-------------------------|-----------------------------------|
| Tool | TeighaFileConverter ²² |
| Tool version | 3.4.1 |
| License | Comercial ²³ |
| Interface | Command-line; GUI |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | No |
| Object class | CAD |
| Input formats | DWG, DXF |
| Output formats | DWG, DXF |

| | |
|-------------------------|--|
| Tool | Kakadu |
| Tool version | 6.4.1 |
| License | Kakadu SDK Evaluation/Commercial/Public/Non Commercial Licence |
| Interface | API |
| Operating system | GNU/Linux; Windows |
| Open-source | Yes |
| Object class | Bitmap images |
| Input formats | JP2, TIFF (if compiled against libtiff) |
| Output formats | JP2, TIFF (if compiled against libtiff) |

| | |
|-------------------------|-------------------------------|
| Tool | Apache Sanselan ²⁴ |
| Tool version | 0.97 |
| License | Apache 2 |
| Interface | API |
| Operating system | GNU/Linux; Windows; Other |

²² <http://www.opendesign.com/>

²³ <http://www.opendesign.com/join>

²⁴ <http://commons.apache.org/sanselan/>

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|-----------------------|--|
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | PNG, GIF, TIFF, JPEG/JFIF, JPEG/JFIF EXIF Metadata, JPEG/JFIF IPTC Metadata, BMP, ico, PNM/PGM/PBM/PPM Portable Pixmap, PSD/Photoshop, XMP |
| Output formats | PNG, GIF, TIFF, JPEG/JFIF, JPEG/JFIF EXIF Metadata, BMP, PNM/PGM/PBM/PPM Portable Pixmap, XMP |

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|-------------------------|--|
| Tool | OpenJPEG ²⁵ |
| Tool version | 1.4 |
| License | BSD ²⁶ |
| Interface | |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | J2K, J2C, JP2, JPT, bmp, tif, raw, tga, pnm, pgm, ppm, pgx |
| Output formats | j2k, jp2, j2c, BMP, TIF, RAW, TGA, PGM, PPM, PNM, PGX |

| | |
|-------------------------|--|
| Tool | SIARD Suite ²⁷ |
| Tool version | |
| License | "SIARD Suite" Software License Agreement ²⁸ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | No |
| Object class | Relational database |
| Input formats | Oracle, SQL Server, Microsoft Access |
| Output formats | SIARD |

| | |
|-------------------------|-----------------------------|
| Tool | GIMP ²⁹ |
| Tool version | 2.6.11 |
| License | GPL V3 ³⁰ |
| Interface | Command-line; GUI |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Bitmap image |

²⁵ <http://www.openjpeg.org/>

²⁶ <http://www.openjpeg.org/BSDlicense.txt>

²⁷ <http://www.bar.admin.ch/dienstleistungen/00823/00825/index.html?lang=en>

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<http://www.bar.admin.ch/dienstleistungen/00823/00825/index.html?lang=en&download=M3wBPgDB/8ull6Du36WenQ1NTTjaXZnqWfVp3Uhmfnapmmc7Zi6rZnqCkklN1gXt+bKbXrZ6lhuDZz8mMps2gpKfo>

²⁹ <http://www.gimp.org/>

³⁰ <http://www.gnu.org/licenses/gpl-3.0.html>

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| Input formats | <p> GIMP XCF, the native format (.xcf, or compressed as .xcf.gz or .xcf.bz2) GIMP brush (.gbr, .gpb, and animated as .gih) GIMP pattern (.pat) GIMP compressed XJT image (.xjt, .xjtgz, .xjtbz2) Alias Wavefront PIX image (.pix, .matte, .mask, .alpha, .als) Scalable vector graphics for exporting paths (.svg) Autodesk flic animations (.fli) Digital Imaging + Communications in Medicine (.dcm or .dicom) PostScript documents (.ps, .eps, or compressed as .ps.gz) FITS astronomical images (.fits, or .fit) Scalable vector graphics for exporting paths (.svg) Microsoft Windows icon (.ico) Microsoft Uncompressed AVI Video (.avi) Windows bitmap (.bmp) Paintshop Pro image (.psp or .tub) Adobe Photoshop PSD (.ps) PNM image (.pnm, .ppm, .pgm, and .pbm) Compuserve GIF images and animations (.gif) JPEG photos (.jpeg, .jpg, or .jpe) PNG (.png) KISS CELL (.cel) Tagged Image File Format (.tiff or .tif) TARGA (.tga) Silicon Graphics IRIS image (.sgi, .rgb, .bw, .icon) Sun Rasterfile image (.im1, .im8, .im24, .im32, .rs, .ras) X bitmap image (.xpm, .icon, or .bitmap) X pixmap image (.xpm) X window dump (.xwd) Zsoft PCX (.pcx) PDF document (.pdf) G3 Fax (.g3) Windows WMF file (.wmf, .apm) </p> |
| Output formats | <p> GIMP XCF, the native format (.xcf, or compressed as .xcf.gz or .xcf.bz2) GIMP brush (.gbr, .gpb, and animated as .gih) GIMP pattern (.pat) GIMP compressed XJT image (.xjt, .xjtgz, .xjtbz2) Alias Wavefront PIX image (.pix, .matte, .mask, .alpha, .als) Scalable vector graphics for exporting paths (.svg) Autodesk flic animations (.fli) Digital Imaging + Communications in Medicine (.dcm or .dicom) PostScript documents (.ps, .eps, or compressed as .ps.gz) FITS astronomical images (.fits, or .fit) Scalable vector graphics for exporting paths (.svg) Microsoft Windows icon (.ico) Microsoft Uncompressed AVI Video (.avi) Windows bitmap (.bmp) Paintshop Pro image (.psp or .tub) Adobe Photoshop PSD (.ps) PNM image (.pnm, .ppm, .pgm, and .pbm) Compuserve GIF images and animations (.gif) JPEG photos (.jpeg, .jpg, or .jpe) PNG (.png) KISS CELL (.cel) </p> |

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| | <p>Tagged Image File Format (.tiff or .tif) TARGA (.tga) Silicon Graphics IRIS image (.sgi, .rgb, .bw, .icon) Sun Rasterfile image (.im1, .im8, .im24, .im32, .rs, .ras) X bitmap image (.xpm, .icon, or .bitmap) X pixmap image (.xpm) X window dump (.xwd) Zsoft PCX (.pcx)</p> <p>HTML as a table with coloured cells (.html) C source files as an array (.c or .h) MNG animations (like animated GIFs, but using PNGs) (.mng) gzip compressed image (.xcf, .gz.gz, .xcfgz) bzip compressed image (.xcf, bz2.bz2, .xcfbz2) ascii image (if aalib is present) (.txt, .ansi, .text)</p> <p>If Perl support is present the following: DATAURL (embed image into HTML, best looking of the embedded variety, works great in Firefox and Opera, but not IE) (.dataurl) COLORHTML, COLORXHTML (interesting but useless) (.colorhtml, .colorxhtml)</p> |
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|-------------------------|--|
| Tool | Inkscape ³¹ |
| Tool version | 0.48.1 |
| License | GPL v2 ³² |
| Interface | Command-line; GUI |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Bitmap image; Vector image |
| Input formats | <p>Scalable Vector Graphics (*.svg) Compressed Inkscape SVG (*.svgz) Adobe PDF (*.pdf) Adobe Illustrator 9.0 and above (*.ai) Enhanced Metafiles (*.emf) Windows Metafiles (*.wmf) WordPerfect Graphics (*.wpg) GIMP Gradient (*.ggr) Adobe Illustrator SVG (*.ai.svg) Adobe Illustrator 8.0 and below (*.ai) Corel DRAW Compressed Exchange files (*.ccx) Corel DRAW 7-X4 files (*.cdr) Corel DRAW 7-13 template files (*.cdt) Computer Graphics Metafile files (*.cgm) Corel DRAW Presentation Exchange files (*.cmx) AutoCAD DXF R13 (*.dxf) HP Graphics Language Plot file (*.plt) sK1 vector graphics files (*.sk1) Microsoft XAML (*.xaml) ani (*.ani) png (*.png) wbmp (*.wbmp) pnm (*.pnm *.pbm *.pgm *.ppm)</p> |

³¹ <http://inkscape.org/>

³² <http://www.gnu.org/licenses/gpl-2.0.html>

| | |
|-----------------------|--|
| | ras (*.ras) xpm (*.xpm) xbm (*.xbm) tga (*.tga *.targa) pcx (*.pcx) icns (*.icns) ico (*.ico) cur (*.cur) Aldus Placeable Metafiles (*.apm) bmp (*.bmp) gif (*.gif) jpeg (*.jpeg *.jpe *.jpg) tiff (*.tiff *.tif) |
| Output formats | Inkscape SVG (*.svg) Plain SVG (*.svg) Compressed Inkscape SVG (*.svgz) Compressed Plain SVG (*.svgz) Adobe PDF (*.pdf) Cairo PNG (*.png) PostScript (*.ps) Encapsulated PostScript (*.eps) Enhanced Metafiles (*.emf) PovRay (*.pov) (paths and shapes only) JavaFX (*.fx) OpenDocument drawing (*.odg) LaTeX With PS Tricks macros (*.tex) Desktop Cutting Plotter (R13) (*.dxf) GIMP Palette (*.pgl) HP Graphics Language file (*.hpgl) JessyInk zipped pdf or png output (*.zip) HP Graphics Language Plot file [AutoCAD] (*.plt) Optimized SVG (*.svg) sK1 vector graphics file (*.sk1) Microsoft XAML (*.xaml) Compressed Inkscape SCG with media (*.zip) Windows Metafile (*.wmf) |

| | |
|-------------------------|---|
| Tool | Avidemux ³³ |
| Tool version | 2.5.4 |
| License | GPL v2 ³⁴ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows |
| Open-source | Yes |
| Object class | Video |
| Input formats | AVI, OpenDML, MPEG, ASF, NuppelVideo, Images, H.263(+), |

³³ <http://fixounet.free.fr/avidemux/>

³⁴ <http://www.gnu.org/licenses/gpl-2.0.html>

| | |
|----------------|---|
| | <p>MPEG-4, QuickTime, 3GP, MP4, OGM, Matroska, Flash Video</p> <p>Video decoders: Cinepak DV CRAM FFV1 H.263 H.264 (MPEG-4 AVC) HuffyUV MJPEG MPEG-1, MPEG-2 MPEG-4 SP/ASP (encoded e.g. with DivX, Xvid, FFmpeg MPEG-4 etc.) MS MPEG-4 (used in DivX ;-) 3.11 Alpha) Raw RGB Raw YV12 SVQ3/Sorenson Video Codec 3 VP3 VP6 WMV2, WMV3 (VC-1), both in ASF and AVI containers Y800</p> <p>Audio decoders: MP3, MP2 A52 aka AC3 DTS aka DCA Vorbis AMR Narrow Band AAC</p> |
| Output formats | <p>AVI, MPEG video, MPEG PS A+V, MPEG TS A+V, OGM, MP4, Matroska, Flash Video</p> <p>Video encoders: libavcodec MPEG-1 (VCD) libavcodec MPEG-2 (DVD, SVCD) mpeg2enc MPEG-2 (DVD, SVCD) libavcodec FFHuffyUV libavcodec FFV1 libavcodec H.263 libavcodec H.263+ libavcodec HuffyUV libavcodec MJPEG libavcodec MPEG-4 libavcodec Snow x264</p> |

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| | Xvid Y800 Audio encoders: LAME, libvorbis, FAAC, FFmpeg MP2, FFmpeg AC3, TwoLAME, WAV PCM, WAV LPCM |
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|-------------------------|------------------------------------|
| Tool | PDFBox ³⁵ |
| Tool version | 1.5.0 |
| License | Apache License v2 ³⁶ |
| Interface | API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Other |
| Input formats | PDF, plain text |
| Output formats | PDF, plain text, image |

| | |
|-------------------------|------------------------------------|
| Tool | JTidy ³⁷ |
| Tool version | r938 |
| License | Custom license ³⁸ |
| Interface | Command-line; API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Other |
| Input formats | HTML |
| Output formats | HTML |

| | |
|-------------------------|--|
| Tool | JasPer ³⁹ |
| Tool version | 1.900.1 |
| License | JasPer License Version 2.0 ⁴⁰ |
| Interface | API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Bitmap image |

³⁵ <http://pdfbox.apache.org/>

³⁶ <http://www.apache.org/licenses/LICENSE-2.0>

³⁷ <http://jtidy.sourceforge.net/>

³⁸ <http://jtidy.sourceforge.net/license.html>

³⁹ <http://www.ece.uvic.ca/~mdadams/jasper/>

⁴⁰ <http://www.ece.uvic.ca/~mdadams/jasper/LICENSE>

| | |
|-----------------------|--|
| Input formats | bmp Windows BMP jp2 JPEG-2000 JP2 jpc JPEG-2000 Code Stream jpg JPEG pgx PGX pnm PNM/PGM/PPM mif My Image Format ras Sun Rasterfile |
| Output formats | bmp Windows BMP jp2 JPEG-2000 JP2 jpc JPEG-2000 Code Stream jpg JPEG pgx PGX pnm PNM/PGM/PPM mif My Image Format ras Sun Rasterfile |

| | |
|-------------------------|---|
| Tool | Aware AccuRad J2KSuite |
| Tool version | 3.19.0 |
| License | Commercial |
| Interface | Command-line; API |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | No |
| Object class | Bitmap image |
| Input formats | JP2, J2K (JPEG 2000 code stream), JPG, PPM, PGM, PGX, BMP, TGA, TIFF, DICOM |
| Output formats | JP2, J2K (JPEG 2000 code stream), JPG, PPM, PGM, PGX, BMP, TGA, TIFF, DICOM, PDF, RAW |

| | |
|-------------------------|--|
| Tool | Luratech LuraWave Command Line Tool |
| Tool version | |
| License | Commercial |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows |
| Open-source | No |
| Object class | Bitmap image |
| Input formats | TIFF, PNM (PPM+PGM), BMP, JPG, LWF (LuraWave file format), RAW, JP2, JPX, J2K (JPEG 2000 codestream) |
| Output formats | JP2, JPX, J2K (JPEG 2000 codestream), TIFF, PNM (PPM+PGM), BMP, JPG, RAW |

| | |
|-------------------------|--|
| Tool | Office Binary (doc, xls, ppt) Translator to Open XML ⁴¹ (b2xtranslator) |
| Tool version | Phase III Milestone 5 |
| License | BSD-like ⁴² |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Word Processor Document; Spreadsheet |
| Input formats | DOC, XLS, PPT |
| Output formats | DOCX, XLSX, PPTX |

⁴¹ <http://b2xtranslator.sourceforge.net/>

⁴² <http://b2xtranslator.sourceforge.net/index.html#license>

| | |
|-------------------------|------------------------------------|
| Tool | warc-tools ⁴³ |
| Tool version | |
| License | Unknown |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Web archive |
| Input formats | ARC |
| Output formats | WARC |

| | |
|-------------------------|------------------------------------|
| Tool | NedlibToARC ⁴⁴ |
| Tool version | 1.0 |
| License | LGPL 2.1 ⁴⁵ |
| Interface | Command-line; API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Web archive |
| Input formats | Nedlib |
| Output formats | ARC |

| | |
|-------------------------|---|
| Tool | Heritrix (org.archive.io) ⁴⁶ |
| Tool version | 1.14.4 |
| License | LGPL 2.1 ⁴⁷ |
| Interface | API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Web archive |
| Input formats | ARC,WARC |
| Output formats | ARC,WARC |

| | |
|-------------------------|---------------------------------------|
| Tool | Java Image I/O with JAI ⁴⁸ |
| Tool version | Java SE 1.4+ (JAI 1.1) |
| License | Oracle JDK BCL ⁴⁹ |
| Interface | API |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Bitmap image |

⁴³ <http://code.hanzoarchives.com/warc-tools>

⁴⁴ <http://nwatoolset.sourceforge.net/docs/NedlibToARC/>

⁴⁵ <http://www.gnu.org/licenses/lgpl-2.1.html>

⁴⁶ <http://crawler.archive.org/>

⁴⁷ <http://www.gnu.org/licenses/lgpl-2.1.html>

⁴⁸ <http://download.oracle.com/javase/6/docs/technotes/guides/imageio/index.html>

⁴⁹ <http://www.oracle.com/technetwork/java/javase/downloads/jdk-6u21-license-159167.txt>

| | |
|-----------------------|--|
| Input formats | JPEG, PNG, BMP, WBMP, GIF, FlashPix, PNM, TIFF, WBMP |
| Output formats | JPEG, PNG, BMP, WBMP, GIF, PNM, TIFF, WBMP |

| | |
|-------------------------|---|
| Tool | GraphicsMagick ⁵⁰ |
| Tool version | 1.3.12 |
| License | MIT style license and other mixed open-source licenses ⁵¹ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | ART, AVI, AVS, BMP, CALS, CGM, CMYK, CUR, CUT, DCM, DCX, DIB, DPX, EMF, EPDF, EPI, EPS, EPSF, EPSI, EPT, FAX, FIG, FITS, FPX, GIF, GPLT, GRAY, HPGL, HTML, ICO, JBIG, JNG, JP2, JPC, JPEG, MAN, MAT, MIFF, MONO, MNG, MPEG, M2V, MPC, MSL, MTV, MVG, OTB, P7, PALM, PAM, PBM, PCD, PCDS, PCX, PDB, PDF, PFA, PFB, PGM, PICON, PICT, PIX, PNG, PNM, PPM, PS, PS2, PS3, PSD, PTIF, PWP, RAS, RAD, RGB, RGBA, RLA, RLE, SCT, SFW, SGI, SUN, SVG, TGA, TIFF, TIM, TTF, TXT, UYVY, VICAR, VIFF, WBMP, WPG, XBM, XCF, XPM, XWD, YUV |
| Output formats | ART, AVS, BMP, CMYK, DCX, DIB, DPX, EPDF, EPI, EPS, EPS2, EPS3, EPSF, EPSI, EPT, FAX, FITS, FPX, GIF, GRAY, HTML, JBIG, JNG, JP2, JPC, JPEG, MAT, MIFF, MONO, MNG, MPEG, M2V, MPC, MSL, MTV, MVG, OTB, P7, PALM, PAM, PBM, PCD, PCDS, PCX, PDB, PDF, PGM, PICON, PICT, PNG, PNM, PPM, PS, PS2, PS3, PSD, PTIF, RGB, RGBA, SGI, SHTML, SUN, SVG, TGA, TIFF, TXT, UIL, UYVY, VICAR, VIFF, WBMP, XBM, XPM, XWD, YUV |

| | |
|-------------------------|--|
| Tool | ACDSee ⁵² |
| Tool version | Pro 4 |
| License | Comercial |
| Interface | GUI |
| Operating system | Windows; MacOS X |
| Open-source | No |
| Object class | Bitmap images; Audio; Video |
| Input formats | 3G2, 3GP, 3GP2, 3GPP, AAC, ABR, AC3, ADTS, AIF, AIFC, AIFF, AMC, AMR, ANI, APD, ARW, ASF, AU, AVI, BMP, BW, BWF, CAF, CDDA, CEL, CNV, CR2, CRW, CS1, CUR, DCR, DIF, DJVU, DNG, DVM, EMF, EPS, ERF, FLC, FLI, FPX, GIF, GSM, HDR, ICL, ICN, ICO, IFF, JBR, JFIF, JIF, JP2, JPC, JPE, JPEG, KAR, KDC, M15, M1A, M1V, M2A, M3U, M4A, M4B, M4P, M4V, M75, MEF, MIDI, MOV, MOS, MP2, MP2V, MPV, MPV2, MRW, NEF, NRW, ORF, PBM, PBR, PCD, PCT, PCX, PEF, PGM, PIC, PICS, PICT, PIX, PNG, PPM, PSD, PSPBRUSH, PSPIMAGE, QCP, QT, QTPF, RAF, RAS, RAW, RGB, RGBA, RSB, RW2, RWL, SFIL, SGI, SMI, SMIL, SML, SR2, SRF, SRW, SWA, TGA, THM, TIF, TIFF, TTC, TTF, ULW, V40PO, V40PP, V40PPF, VFW, WBM, WAV, WBMP, WMF, WMV, XBM, XIF, XMP |
| Output formats | BMP, GIF, IFF, JP2, JPEG, PCX, PNG, PSD, RAS, RSB, SGI, TGA, TIFF, WBMP |

| | |
|-------------------------|--------------------------|
| Tool | CZ-Doc2Pdf ⁵³ |
| Tool version | 2.0 |
| License | Comercial |
| Interface | GUI |
| Operating system | Windows |
| Open-source | No |

⁵⁰ <http://www.graphicsmagick.org>

⁵¹ <http://www.graphicsmagick.org/Copyright.html>

⁵² <http://dioscuri.sourceforge.net/>

⁵³ <http://www.convertzone.com/doc2pdf/help.htm>

| | |
|-----------------------|---------------------------|
| Object class | Word processing documents |
| Input formats | DOC, HTML, TXT, RTF |
| Output formats | PDF |

| | |
|-------------------------|-------------------------------|
| Tool | Dia ⁵⁴ |
| Tool version | 0.96.1 |
| License | GPL v2 ⁵⁵ |
| Interface | Command-line; GUI |
| Operating system | GNU/Linux; Windows |
| Open-source | Yes |
| Object class | Vector image |
| Input formats | XML |
| Output formats | XML, EPS, SVG, XFIG, WMF, PNG |

| | |
|-------------------------|---|
| Tool | Document2PDF Pilot ⁵⁶ |
| Tool version | 2.16.108 |
| License | Comercial |
| Interface | GUI |
| Operating system | Windows |
| Open-source | No |
| Object class | Word processing documents |
| Input formats | TXT, RTF, HTML, SHTML, CHM, DOC, MCW, XLS, XLW, WRI, WPS, WPT |
| Output formats | PDF |

| | |
|-------------------------|------------------------------|
| Tool | EscapeE ⁵⁷ |
| Tool version | 9.10 |
| License | Comercial |
| Interface | Command-line; GUI |
| Operating system | Windows |
| Open-source | No |
| Object class | Word processing documents |
| Input formats | PCL, PDF, PS, TIFF, DCX, RTF |
| Output formats | PDF |

| | |
|-------------------------|----------------------------------|
| Tool | GraphicConverter X ⁵⁸ |
| Tool version | 7 |
| License | Comercial |
| Interface | API, GUI |
| Operating system | Mac OS X |

⁵⁴ <http://projects.gnome.org/dia/>

⁵⁵ <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

⁵⁶ <http://www.colorpilot.com/document2pdf.html>

⁵⁷ <http://escapee.redtitan.fr>

⁵⁸ <http://www.lemkesoft.com/content/188/graphicconverter.html>

| | |
|----------------|--|
| Open-source | No |
| Object class | Bitmap Images |
| Input formats | .D , 8BIM, Acorn Sprite, AFP, ALIAS, AMBER ARR, ANI, ANI, ANPA, Apple Preferred, ART, ASCII, Atari Portfolio, B3D, BioRad, BLD, BMP, BUF, BUM, c4, CAM, CALS, CEL, CGM, CRW, CR2, csource, , CLP, CT, CVG, DCR, DCX, DDS, DeltaVision, DESR VFF, DICOm, DJ100DL, Doodle, DPX, Dr. Halo, DrawIT, ECW, ElectronicImage, EPSF, ESM, FAX, FaxSTF, FireViewer PDB, FITS, FLH/FLI/FLC, FPX, Freehand 1FUJI, GATAN, GEM, GFX, GIF, GrayPaint, GRP, HAM, HDR, HP-GL/2, IBM - PIC, IC ? - Imagic, ICo/ICN, IFF/LBM, IM, , ImageLab/PrintTechnic, IMG/XIMG, IMQ, IPLab, IRIS, ISS, j6i, JBI, JIF, JPEG/JFIF, JPEG 200KDC, KISS CEL, Koala, KoNTroN, LDF, Lotus-PIC, LWF (LuraWave), MacDraw I, MacPaint, MAG, MAYA-IFF, MBM (Psion 5), Meteosat 5, MDC, MHT, MonkeyLogo, MonkeyCard, Mov, MRC, MrSID, MRW, MSP, MSX - MSX2, MSX+ - MSX2+, NASA Raster Metafile, NEF, NEO, NGG/NCG, NIF, NoL, oNCoR, ORF, OTA, P ? ? - Degas, , PAC - STAD, PaperPort (MAX), PBM/PGM/PPM, PCD, PCX, PIC (32K), PIC, PIC, PIC, PICS, PICT, PICT resource, PDB, PDF, PEF, PGPF, PGC/PGF, Photo Raw, PM, PNG, PoRST, Ppat, PSD, PSP, QDV, QNT, QTIF, RAF, RAW, RDC, RIFF, RLA, RLE, RSB, , SCR, SCX, SFF, SFW, SGI, SHP, Sinclair QL, SIXEL, SKETCH, SMV, SNX, SoFTIMAGE, SPC, SRF, ST - X - SBIG, StartupScreen, SUN, Super-Hi-Res 320SVG, TBC, TCL, TealPaint PDB, TGA, TIFF, TIM PSX, Tiny Viewer PDB, TN ?, TRS-8VBM, VFF, VGS-8, VITRoNIC, VoXEL, VPB, VPM, WBIN, WBMP, Winfax (FXM), WMF, WPG, X11, X3F, XBM, XCF, XFIG, X-Face, XPM, XWD, YUV |
| Output formats | ASCII, Atari Portfolio, BLD, BMP, BUM, CEL, csource, System 7 clip, DDS, ECW, ElectronicImage, EPSF, FITS, GIF, HP-GL/2, ICo/ICN, IFF/LBM, Image ->Finder, IMG/XIMG, JIF, JPEG/JFIF, JPEG 200, KISS CEL, LWF (LuraWave), MacPaint, MBM (Psion 5), MonkeyLogo, MonkeyCard, Mov, NGG/NCG, NoL, OTA, Palette, PBM/PGM/PPM, PCX, PIC, PICS, PICT, PICT resource, PDB, PDF, PGPF, PNG, Ppat, PSD, RAW, RSB, RTF, SCR, SFW, SoFTIMAGE, StartupScreen, SVG, TGA, TIFF, TRS-8, VPB, WBIN, WBMP, WMF, XBM, XCF, XFIG, X-Face, XPM, XWD |

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|------------------|---------------------------------|
| Tool | MsgText ⁵⁹ |
| Tool version | 1.0.0 |
| License | GNU GPL |
| Interface | Command-line |
| Operating system | Windows |
| Open-source | Yes |
| Object class | Email |
| Input formats | MSG |
| Output formats | TXT, HTML (and any attachments) |

| | |
|------------------|----------------------------------|
| Tool | tesseract-ocr ⁶⁰ |
| Tool version | 3.00 |
| License | Apache license 2.0 ⁶¹ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | TIFF, PNG, JPEG |
| Output formats | TXT |

⁵⁹ <http://www.enterag.ch/enterag/downloads/msgtext.shtml>

⁶⁰ <http://code.google.com/p/tesseract-ocr/>

⁶¹ <http://www.apache.org/licenses/LICENSE-2.0>

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|-------------------------|--|
| Tool | AbiWord ⁶² |
| Tool version | 2.8.6 |
| License | GPL ⁶³ |
| Interface | Command-line; GUI |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | Yes |
| Object class | Word Processor Document |
| Input formats | AbiWord Documents (.abw, .awt, .azbw) Microsoft Word (.doc, .dot) Rich Text Format (.rtf) Text (.txt, .text) Encoded Text (.txt, .text) HTML (.html, .htm, .xhtml) Applix Word (.aw) ClarisWorks/AppleWorks 5 (.cwk) Collaborative File Descriptor (.abicollab) DocBook (.dbk, .xml) ISCII Text (.isc, .iscii) OpenDocument (.odt, .ott) OpenOffice Writer (.stw, .sxw) Office Open XML (.docx, .dotx, .docm, .dotm) OPML (.opml) StarWriter up to 5.x (.sdw) T602 (.602, .txt) WML (.wml) WordPerfect (.wpd, .wp) XSL-FO (.fo) |
| Output formats | AbiWord (.abw, .zabw, .abw.gz) AbiWord Template (.awt) Microsoft Word (.doc) HTML/XHTML (.html) Multipart HTML (.mht) Rich Text Format (.rtf) Rich Text Format for old apps (.rtf) Text (.txt, .text) Encoded Text (.txt, .text) Applix Word (.aw) DocBook (.dbk, .xml) Outlook Express Email (.eml) Newsgroup Formatted Text (.nws) ISCII Text (.isc, .iscii) LaTeX (.latex) OpenDocument (.odt) OpenOffice Writer (.sxw) Office Open XML (.docx) WML (.wml) XSL-FO (.fo) |
| Tool | VisuallIntegrity ⁶⁴ |

⁶² <http://www.abisource.com/>

⁶³ <http://www.fsf.org/copyleft/gpl.html>

⁶⁴ <http://www.flysdk.com/>

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|-------------------------|--|
| Tool version | 8.0 |
| License | Commercial ⁶⁵ |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X |
| Open-source | No |
| Object class | Word Processor Document |
| Input formats | PDF |
| Output formats | JPEG, GIF, PNG, BMP, WMF, EMF, SVG, TIFF, TXT, DXF |

| | |
|-------------------------|--|
| Tool | Photoshop ⁶⁶ |
| Tool version | 8.0 |
| License | Commercial ⁶⁷ |
| Interface | GUI |
| Operating system | Windows; MacOS X |
| Open-source | No |
| Object class | Bitmap image |
| Input formats | 3D Studio Max (.3DS) Adobe Illustrator (.ai) Alias PIX* (.pix) Amiga IFF* (.iff, .tdi) AVI (.avi) BMP (.bmp, .rle, .dib) Camera Raw (.tif, .crw, .nef, .raf, .orf, .mrw, .dcr, .mos, .raw, .pef, .srf, .dng, .x3f, .cr2, .erf, .sr2, .kdc, .mfw, .mef, .arw, .srw) Cineon (.cin, .spdx, .dpx, .fido) Collada (.dae) CompuServe GIF (.gif) Dicom (.dcm, .dc3, .dic) Digital Negative (.dng) ElectricImage* (.img, .ei, .eiz, .eizz) EPS (.eps, .epsf, .eps) EPS with JPEG Preview (.eps) EPS with PICT Preview (.eps) EPS with TIFF Preview (.eps) Filmstrip (.flm) Google Earth 4 (.kmz) JPEG (.jpg, .jpeg, .jpe) JPEG 2000* (.jpf, .jpx, .jp2, .j2c, .j2k, .jpc) Kodak Photo CD (.pcd) Large Document Format (.psb) MacPaint* (.mpt, .mac) OpenEXR (.exr) PCX (.pcx) PDF (.pdf, .pdp) Photoshop (.psd, .pdd) Photoshop DCS 1.0 and 2.0 (.eps) Photoshop Raw (.raw) PICT (.pct, .pict) |

⁶⁵ <http://www.flysdk.com/fly-sdk-01.htm>

⁶⁶ <http://www.photoshop.com/>

⁶⁷ http://www.adobe.com/products/eulas/pdfs/gen_wwcombined_20091001_1604.pdf

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|----------------|---|
| | Pixar (.pxr) PixelPaint* (.px1) PNG (.png) Portable Bitmap (.pbm, .pgm, .ppm, .pnm, pfm, .pam) QuickTime Movie** (.mov, .avi, .mpg, .mpeg, .mp4, .m4v) Radiance (.hdr, .rgbe, .xyze) Scitex CT (.sct) SGI RGB* (.sgi, .rgb, .rgba, .bw) SoftImage* (.pic) Targa (.tga, .vda, .icb, .vst) TIFF (.tif) U3D (.u3d) Wavefront OBJ (.obj) Wavefront RLA* (.rla) Wireless Bitmap (.wbm, .wbmp) |
| Output formats | Adobe Illustrator Paths (.ai) Alias PIX* (.pix) Amiga IFF* (.iff, .tdi) AVI (.avi) BMP (.bmp, .rle, .dib) Cineon (.cin, .spdx, .dpx, .fido) CompuServe GIF (.gif) Dicom (.dcm, .dc3, .dic) Digital Negative (.dng) ElectricImage* (.img, .ei, .eiz, .eizz) EPS (.eps, .epsf, .eps) EPS with TIFF Preview (.eps) Filmstrip (.flm) Google Earth 4 (.kmz) JPEG (.jpg, .jpeg, .jpe) JPEG 2000* (.jpf, .jpx, .jp2, .j2c, .j2k, .jpc) Large Document Format (.psb) OpenEXR (.exr) PCX (.pcx) PDF (.pdf, .pdp) Photoshop (.psd, .pdd) Photoshop DCS 1.0 and 2.0 (.eps) Photoshop Raw (.raw) PICT (.pct, .pict) Pixar (.pxr) PNG (.png) Portable Bitmap (.pbm, .pgm, .ppm, .pnm, pfm, .pam) QuickTime Movie** (.mov, .avi, .mpg, .mpeg, .mp4, .m4v) Radiance (.hdr, .rgbe, .xyze) Scitex CT (.sct) SGI RGB* (.sgi, .rgb, .rgba, .bw) SoftImage* (.pic) Targa (.tga, .vda, .icb, .vst) TIFF (.tif) Wavefront OBJ (.obj) Wavefront RLA* (.rla) Wireless Bitmap (.wbm, .wbmp) ZoomView (.mtx) |

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|-------------------------|-------------------------------------|
| Tool | PDF Version converter ⁶⁸ |
| Tool version | 2.01 |
| License | Commercial ⁶⁹ |
| Interface | Command-line; GUI |
| Operating system | Windows |
| Open-source | No |
| Object class | Word Processor Document |
| Input formats | PDF (1.0 to 1.7) |
| Output formats | PDF (1.0 to 1.7) |

| | |
|-------------------------|--|
| Tool | Netpbm ⁷⁰ |
| Tool version | 10.35.80 |
| License | Artistic license ⁷¹ , GPL ⁷² |
| Interface | Command-line |
| Operating system | GNU/Linux; Windows; MacOS X; Other |
| Open-source | Yes |
| Object class | Bitmap image |
| Input formats | Portable Bitmap File Format (PBM), Portable Graymap File Format (PGM), Portable Pixmap File Format (PPM), Portable Arbitrary map File Format (PAM), JPEG, BMP, ICO, GIF, PNG, Palm pixmap (PALM), JBIG BIE (compressed bitmap), Fiasco highly compressed format (WFA), Photo CD (HPCD), Wireless Bitmap (WBMP), Atari Neochrome (NEO), Microdesign (for Amstrad PCWs) (MDA), Andrew Toolkit raster object (ATK), Xerox doodle brushes (BRUSH), CMU Window Manager format (CMUWM), Group 3 FAX (G3), Sun icon (ICON), GEM .img format (GEM), MacPaint (MACP), MGR format (MGR), Atari Degas .pi3 (PI3), X10 or X11 bitmap (XBM), Bennet Yee "Face" (YBM), ASCII character graphic (TXT), HP PaintJet file (PJ), |

⁶⁸ <http://www.nicepdf.com/products.html>

⁶⁹ <http://www.nicepdf.com/purchase.html>

⁷⁰ <http://netpbm.sourceforge.net/>

⁷¹ <http://www.opensource.org/licenses/artistic-license-1.0>

⁷² <http://www.gnu.org/licenses/gpl.html>

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|----------------|--|
| | <p> HP Thinkjet printer stream (thinkjet), FITS format (FITZ), USENIX FaceSaver(tm) format (FS), HIPS format (HIPS), Lisp Machine bitmap (LISPM), Postscript (PS), Postscript "image" data (PSID), RAW grayscale bytes (RAW), Gould scanner file (GOULD), IFF ILBM (ILBM), Img-whatnot (IMG), MTV ray-tracer output (MTV), PC Paintbrush format (PCX), Atari Degas .pi1 (PI1), Macintosh PICT (PICT), QRT ray-tracer output (QRT), RAY RGB bytes (RAW), AutoCAD slide file (SLD), Atari compressed Spectrum (SPC), Atari uncompressed Spectrum (SPU), TrueVision Targa file (TGA), Xim (XIM), XPM format (XPM), Abekas YUV format (YUV), Encoder/Berkeley YUV format (EYUV), 3 subsampled ray YUV files (YUVSPLIT), Sun raster file (RAST), TIFF file (TIFF), X10 or X11 window dump (XWD), 411 (Sony Mavica) (411), Santa Barbara Instrument Group CCD (SBIG), Parallax XVideo JPEG (VID), UTAH Raster Toolkit (urt/rle) (RLE), Interleaf (LEAF), Biorad confocal image (BIORAD), Packed format font (PK) </p> |
| Output formats | <p> Portable Bitmap File Format (PBM), Portable Graymap File Format (PGM), Portable Pixmap File Format (PPM), Portable Arbitrary map File Format (PAM), MPEG, JPEG, BMP, ICO, GIF, PNG, Palm pixmap (PALM), JBIG BIE (compressed bitmap), Fiasco highly compressed format (WFA), Nokia Smart Messaging Format (SMF), Wireless Bitmap (WBMP), Atari Neochrome (NEO), Microdesign (for Amstrad PCWs) (MDA), Andrew Toolkit raster object (ATK), CMU Window Manager format (CMUWM), Group 3 FAX (G3), Sun icon (ICON), </p> |

MacPaint (MACP),
 MGR format (MGR),
 Atari Degas .pi3 (PI3),
 X11 bitmap (XBM),
 X10 bitmap (X10BM),
 Bennet Yee "Face" (YBM),
 Gemini 10x printer graphics (10X),
 ASCII Graphic form (TXT),
 BBN BitGraphic graphics (BBNBG),
 Epson printer graphics (EPSON),
 GEM .img file (GEM),
 GraphOn graphics (GO),
 HP LaserJet black and white graphics (LJ),
 HP LaserJet color graphics (PCL) (LJ),
 HP PaintJet file (PJ),
 UNIX plot (PLOT),
 Printronix graphics (PTX),
 Zinc interface library icon (ZINC),
 FITS format (FITZ),
 USENIX FaceSaver(tm) format (FS),
 HIPS format (HIPS),
 Lisp Machine bitmap (LISPM),
 PostScript using lines (LPS),
 Encapsulated Postscript preview bitmap (EPSI),
 IFF ILBM (ILBM),
 Atari Degas .pi1 (PI1),
 Macintosh PICT (PICT),
 TrueVision Targa file (TGA),
 XPM format (XPM),
 Abekas YUV format (YUV),
 Encoder/Berkeley YUV format (EYUV),
 3 subsampled ray YUV files (YUVSPLIT),
 AutoCAD database or slide (ACAD),
 NCSA ICR graphics (ICR),
 PC Paintbrush format (PCX),
 X11 "puzzle" file (PUZZ),
 Sun raster file (RAST),
 TIFF RGB file (TIFF),
 TIFF CMYK file (TIFFCMYK),
 X11 window dump (XWD),
 DEC sixel format (SIXEL),
 Motif UIL icon (UIL),
 UTAH Raster Toolkit (urt/rle) (RLE),
 Interleaf (LEAF),
 Dec LN03+ Sixel image (LN03),
 Packed format font (PK)