Technical Note
n.3904
April 2009

Automate your business processes

Intelligent information management at low cost

Scalable and intelligent information processing.

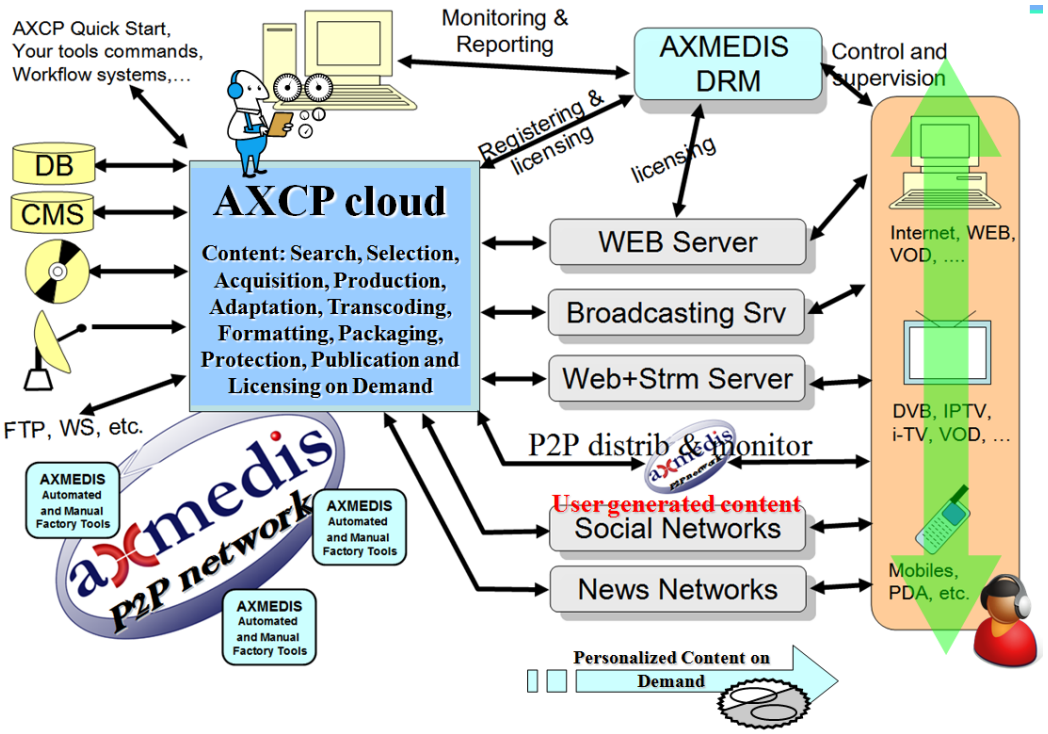
Cloud computing, industrial scalable massive parallel processing platform.

On-demand computing and processing.

Applications:
- cloud computing
- data processing
- data reconciliation
- distributed processing
- automated content management
- automated content adaptation
- content repurposing
- simulation
- computational intensive applications
- Multi-channel production and distribution: broadcasting, IP/Internet, WEB sites, P2P, mobile, PDA, IPTV, interactive TV and channels, etc.
- Video on Demand (VOD), production on demand
- P2P Control and monitoring
- WEB control and monitoring
- social network profiling
- recommendations and advertising
- digital rights management and licensing

AxMediaTech AXMEDIS Content Processing, AXCP

The AXMEDIS content processing is an open solution to set up your architectures of cloud computing, personal grid, for massive information management following your business rules, growth and integration demands. It supports a large range of possible applications, databases, back offices, workflows, data collectors, and web servers. AXCP reduces costs and increase efficiency by an automated information, media and content management. It is much more than an automated CMS, DMS, or grid. AXCP is a tool to set up your scalable cloud computing, at your disposal, at low costs, reliable and simple to install and use on your applications.

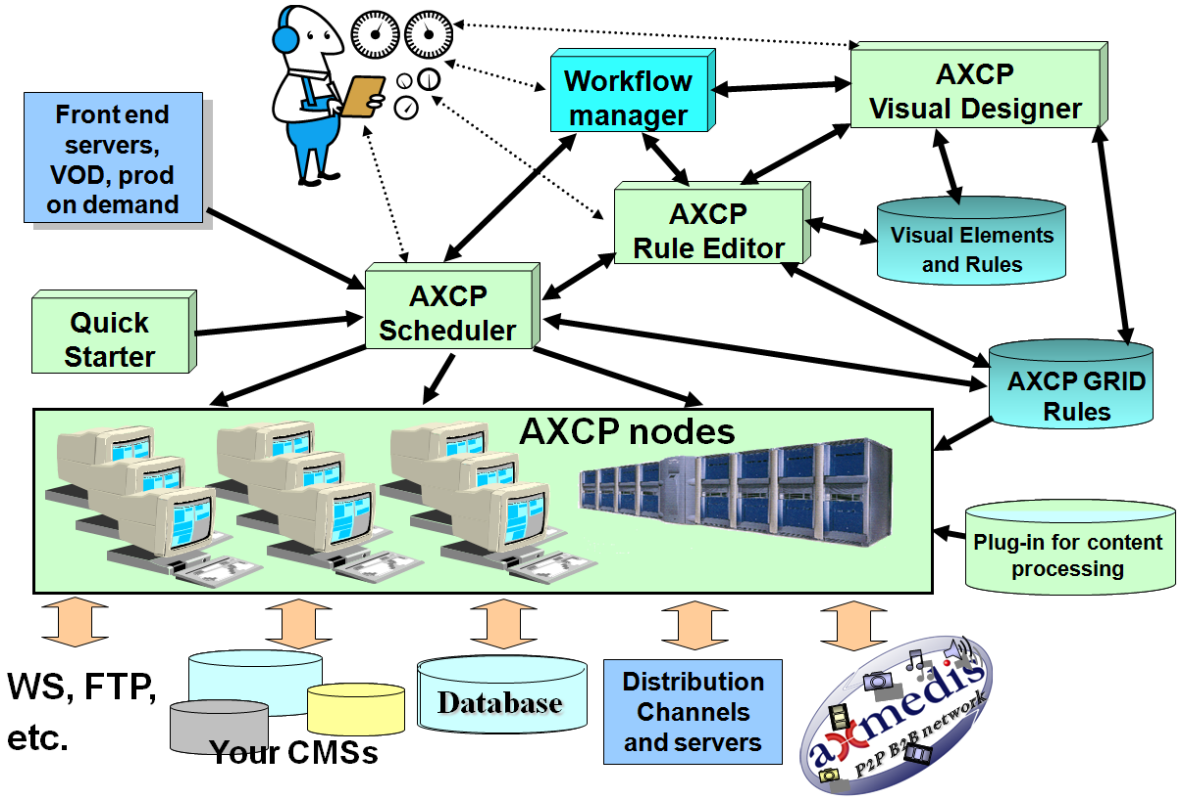


AXCP is an integrated solution to set up scalable architectures of cloud computing, industrial grid, which can be functional to several kinds of applications:

- massive cloud computing;
- data massive and computational intensive parallel processing;
- intelligent information management with semantic processing;
- services for content production and/or distribution on demands;
- event collection, GIS data management, sensors, internet of things, RFIDs, ..;
- medical applications for data collection and processing;
- biomedical application in DNA and epidemiological analysis and prediction;
- social network back office management, content processing, user and content profile processing, recommendations;
- user generated content processing and formatting;
- monitoring event and status of: WEB/internet, P2P networks, databases, ftp sites, …;
- content management for production and distribution channels: VOD, IPTV, WEBTV, DVB-T, web, P2P, FTP, WebServices, etc.;
- interoperable trust and security rule processing, also DRM (digital rights management) MPEG-21 and OMA;
- processing business models, single and multiple distribution channels: pay per play, subscription, counting, renting, billing, etc., for B2B and B2C;
- content management system: DMS, CMS, and/or archives;
- data fingerprint and watermark extraction and insertion.

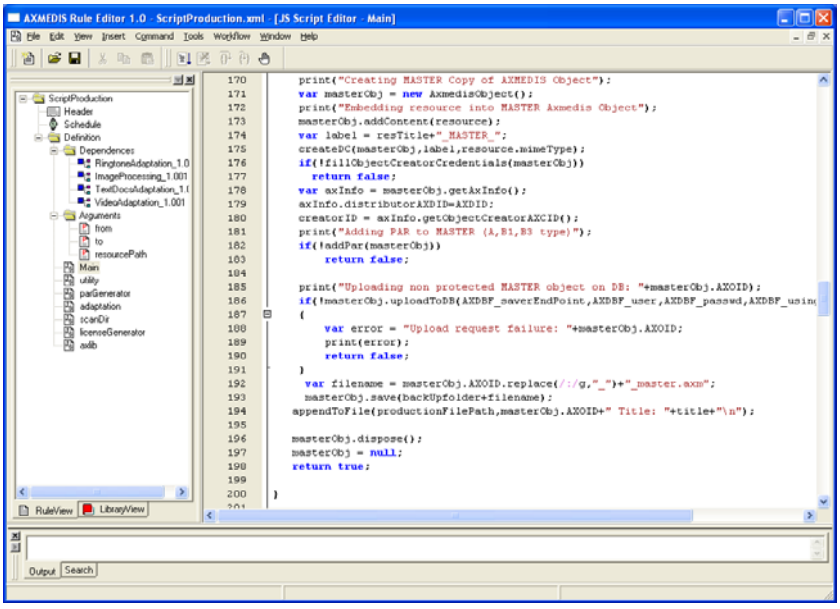
AXCP Main Architecture

The AXCP is a general purpose solution to set up personal/industrial massive parallel architecture for cloud and/or grid computing. Both data and computational intensive problems can be allocated in easily manner.

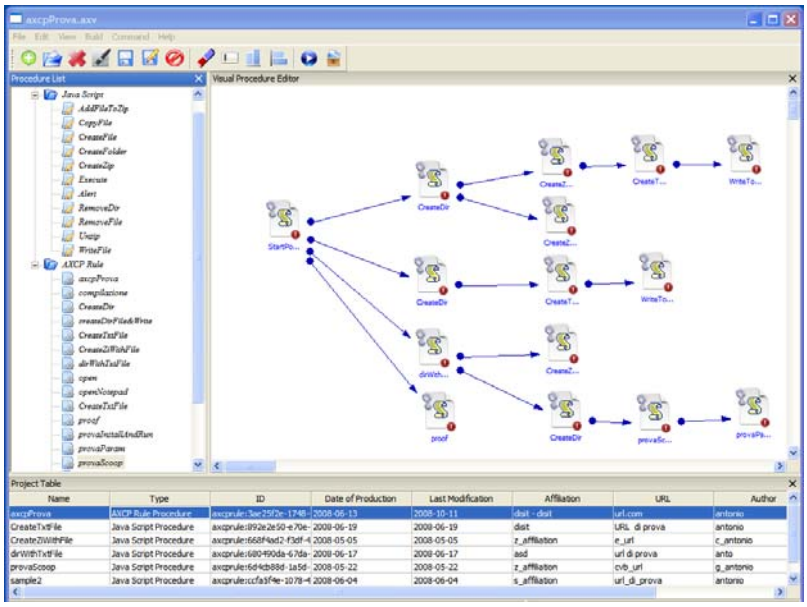


The above figure reports AXCP solution for massive computing in which an AXCP Scheduler put in execution processes on AXCP Nodes. The AXCP Nodes can be industrial or desktop computers in intranet and/or internet, connected with the AXCP Scheduler via IP. The AXCP solution is grounded on the concept of Rule. A Rule formalizes an activity of processing on a single processor and may activate other rules on the same or other processors/computers in the cloud computing architecture. AXCP Rules are formalized in an Extended JavaScript language to formalize jobs, logic, deadlines, periodicity, parameters, communication, storage, time, capabilities, etc. The functionalities of the AXCP are reported later in this document and can be recovered in the manual and in the help provided with the tools.

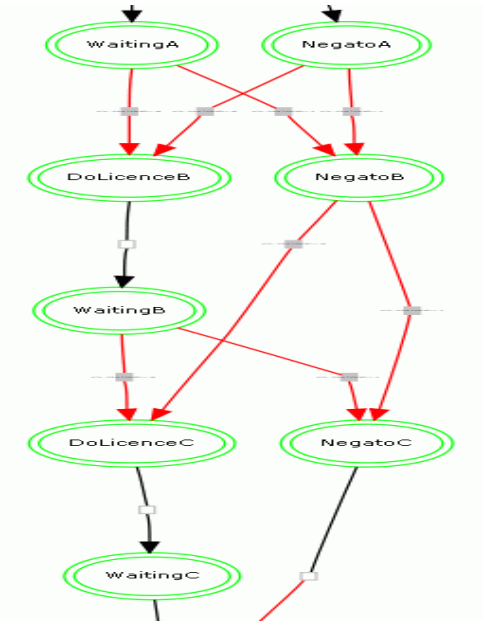
The AXCP Rules can be produced by the AXCP Rule Editor (via java script editing and debug, see on the figure on the right side) or by the AXCP Visual Designer (visual design, editing and verification). Once produced, a Rule can be put in the pool of Rules of the AXCP Scheduler (data base of AXCP GRID Rules) for its execution on the AXCP Nodes. The Rules can be activated (put in execution) in several manners. The Rules uses may write any process exploiting the functionalities of the Extended Java Script and those provided by the Plug ins (see in the following). They include access to databases, information and data processing, communication, storage, security, semantic processing, security, etc.



AXCP Rule Editor is used to produce, debug, test, activate and validate AXCP Rules to execute them on AXCP Nodes via AXCP Scheduler. Assisted development with intellisense (word completion, suggestion, user and java script function list, etc.). The AXCP Rule editor can access to the database or Rule of a Scheduler and change them on the fly without stopping the tools, Hot replacements of Rules.



The AXCP Rules can be also produced by using the **AXCP Visual Designer**, AXVD. A visual tool for creating sequences of Rule segments and/or Full Rules to define flows that can be compounded and activated by the AXCP Scheduler. The AXVD permits to program the AXCP in a very simple and accessible manner for non expert users. Libraries of components can be created with the AXCP Rule Editor and by us on demand according to your needs.



The AXCP solution is flexible and open, it can be customized in several manners. For example by:

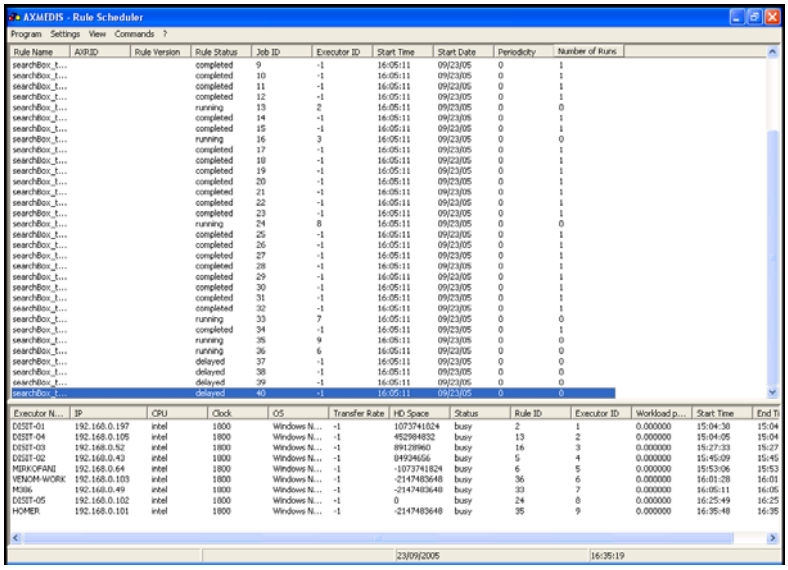
- creating/customizing AXCP Rules to be executed on AXCP Nodes;
- creating hierarchies/meshes/networks of cloud computing in which a Scheduler control a number of nodes/peers, and those nodes may activate other Schedulers as well via web services and direct communications;
- setting up fail over and fault tolerant solutions, creating chains of Schedulers/Nodes in fail over, redundant nodes, etc.
- customizing, realizing and installing additional AXMEDIS plug-ins to add new formats, encoders, decoders, adapters and converters, etc. The AXMEDIS Plug-in technology is open, well documented and supported by a development tool kit;
- organizing AXCP GRID Nodes in a hierarchical/meshes/net manner. An AXCP Node may control one or more AXCP Schedulers which in turn may control other AXCP Nodes, etc.;
- dynamically creating rules with other processes, and activating them on the Scheduler;
- executing operating system processes, passing them parameters/files and getting eventual errors;
- reporting and managing errors, setting ups recovery by error policies, rules.

The AXCP architecture is Service Oriented Architecture (SOA); fully documented APIs for all the JavaScript functionalities, and WEB Services for accessing and controlling tools, and for distributing produced content towards your front-end distribution servers. This means that the Distribution Servers and solutions may very easily interact with the AXCP GRID via web services. All the services may lead to put in execution processes, to create licenses, content, etc.

AXCP GRID solution main elements:

- **AXCP Rules can be:**
  - executed on any AXCP Node, single computer, virtual machine;
  - parameterized for automating management activities;
  - activated according to different policies: periodic, sporadic or on demand;

  - activated in synchronous and asynchronous manner and by other AXCP Rules;
  - activated to return back any kind of results and error codes;
  - activated by other AXCP Rules, third parties external tools, web services, …;
  - dynamically produced and activated by other tools;
  - set up to detect changes in the file system, local database, in the P2P, etc.;
  - activated by Workflow Management Systems (Open Flow and BizTalk), PHP, JSP, JAVA, Web Service clients, etc.;
  - used to schedule other AXCP Rules and AXCP Schedulers;
- **AXCP Nodes** are controlled by the AXCP Scheduler, and can be
  - industrial computers or desktop computers in your offices delegating at the AXCP a part of their CPU along the day profile, detailing the CPU portion along the 24 hours in the week;
  - executed alone (with the AXCP standalone node) for executing sporadic AXCP Rules for ad-hoc processing and activation without demanding their allocation to the AXCP Scheduler;
- **AXCP Standalone Node** allows putting in execution a single AXCP Rule from your applications and servers via a simple shell command, it is an AXCP Rule which can be used without the AXCP Scheduler. It is an easy way to access to the whole functionalities of the AXCP language for executing an asynchronous processes without calling the Web Service AXCP Scheduler.
- **AXCP Scheduler allow to allocate and manage AXCP Rules on GRID Nodes:**
  - scheduling and balancing jobs/processes on AXCP Nodes according to the content production and processing needs in terms of time and resources: balancing nodes workloads, Deadline Monotonic, starting time, optimization;
  - activating jobs as sporadic and periodic tasks, controlled by other tools and/or web services;
  - monitoring progress of production processes and their status, etc.;



- **AXCP Quick Start** permits to activate AXCP Rules in a very simple manner by passing them parameters; for examples a collection of objects, a path, a database, a query, a list of files, etc., or just a click;
- **AXCP Standalone Node** allows putting in execution a single AXCP Rule from your applications and servers via a simple shell command. This solution is an easy way to access to the whole functionalities of the AXCP for executing an asynchronous process without calling the Web Service AXCP Scheduler.

AXCP for Cross Media, Rich Media and Multimedia Content Processing

The AXCP has been used several times for the intelligent and integrated management of content distribution channels, formats, devices, business models, services, etc. AXCP can be used for the automated management, of pre-/post-production processing and for distribution of a large range of content formats, for automatically producing, processing, packaging, adapting, transcoding, formatting, and/or repurposing content, metadata, files, user registrations, profiles, licensing, etc., of content and data of any kind.

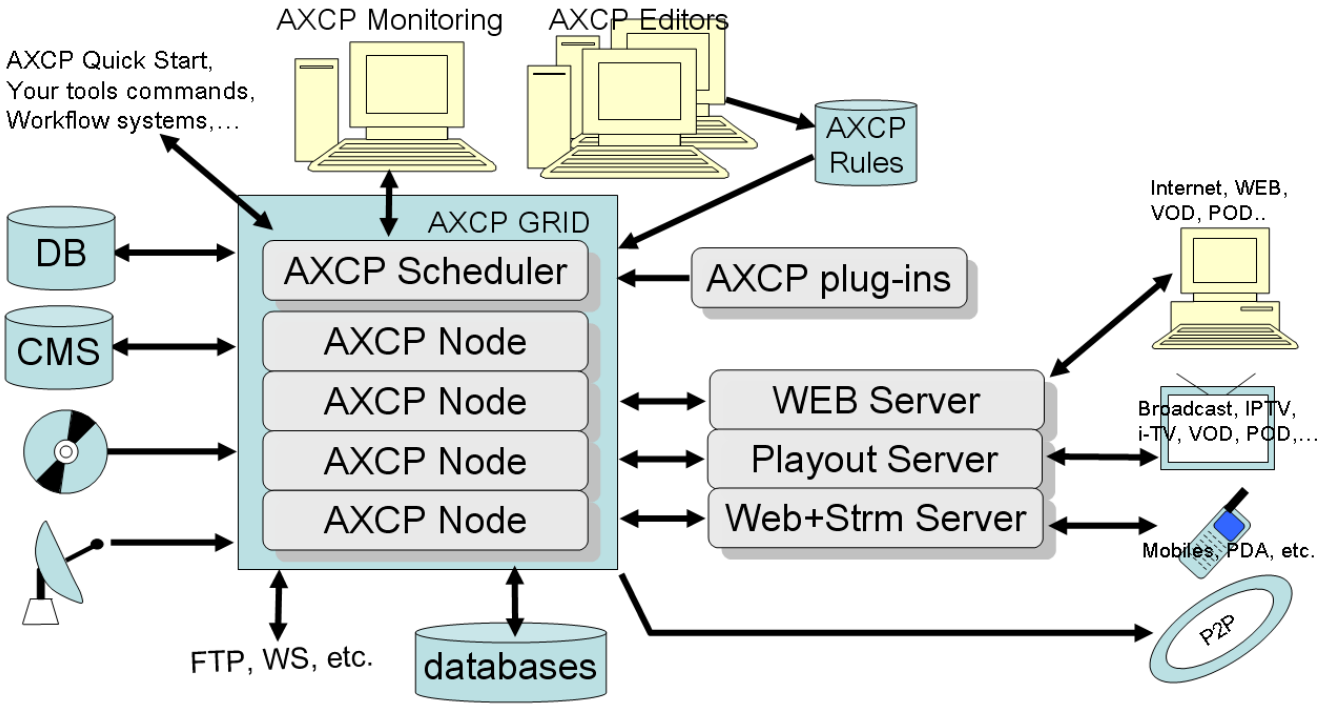
AXMEDIS reduces the costs of content management, supports the whole value chain and makes real the convergence of media, and the interoperability of content enabling multi-channel distribution (e.g., mobile, satellite, kiosk, iTV, web, P2P, interactivity, etc), and provides a flexible and interoperable DRM, for both B2B and B2C across traditional and P2P distribution platforms.

The AXCP offers functionalities to support and set up integrated activities of:

- content Ingestion and gathering, database management, crawling, indexing, archiving, gathering from

OAI, etc.;

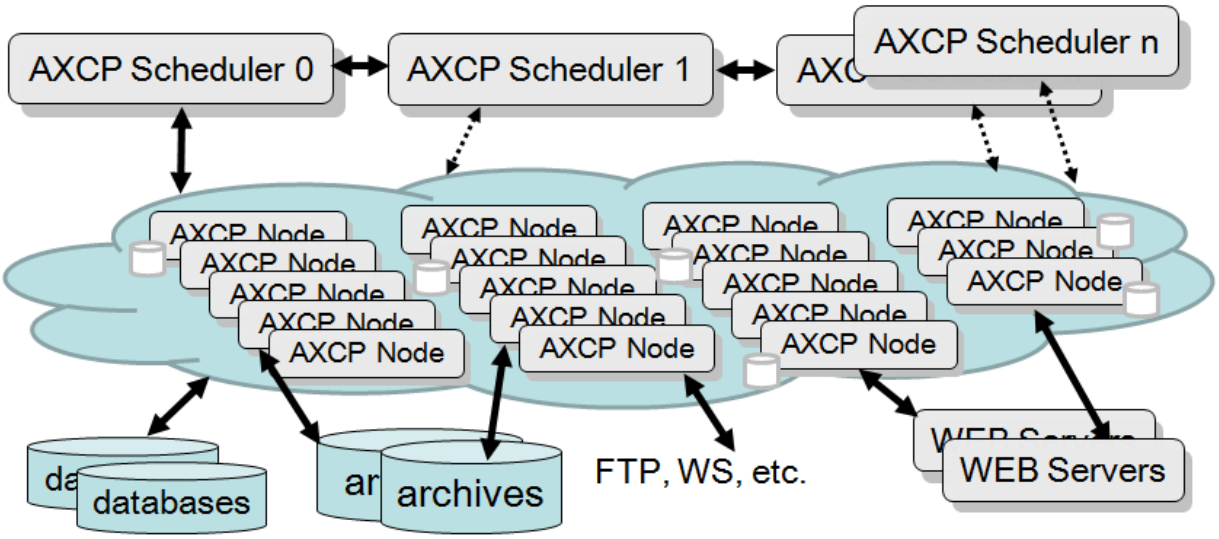
- query, download and publication on social networks: YouTube, Flickr, XMF (http://xmf.axmedis.org);
- content storage and retrieval, active querying;
- content processing, repurposing, adaptation, transmoding, transcoding for text, docs, images, audio, video, multimedia, XML, SMIL, HTML, styles, MXF, newsML, MPEG-4, MPEG-21, etc.;
- metadata repurposing, adaptation, transcoding, integration, enrichment, validation;
- content descriptors, extraction and comparison, fingerprint, MPEG-7, MPEG-21, etc.;
- content composition, formatting, layout, styling;
- communication with databases, FTP, HTTP, P2P and distribution servers via several protocols;
- content packaging: MPEG-21, MXF, OMA, newsML, ZIP, etc.;
- content protection via several algorithms;
- content DRM with MPEG-21 and OMA, with tracking and reporting rights exploitation;
- content licensing, licensing the production of licenses;
- content publication and distribution toward multiple channels;
- workflow management integration with BizTalk and OpenFlow;
- user management: registration, licensing, profiling, advertising.



AXCP Solution Reliability and Redundancy

The AXCP solution is scalable in terms of number of AXCP Nodes and Schedulers. The AXCP solution is highly reliable, scalable and fault tolerant. It may be used to create redundant architectures in which multiple Schedulers and multiple Nodes are organized in clusters and fail over in chain, passing the witness to the next computer in the case of failure or for rotation. Each elements of a an AXCP organized the reliable solution can be put off line for maintenance without stopping the processes and at no risk for the running jobs.

AXCP can run multiple copies of the same rules on different Nodes making possible the set up of fault tolerant solutions. AXCP Nodes automatically reconnect to the AXCP Scheduler after a lack of connection. They can be located in the local network as well as remotely. The status of the AXCP scheduler is continuously saved allowing disaster recovery, thus to set up fault tolerant solutions and failover tolerant proof.



Each AXCP solution may be set up on a single computer with all inside as well as on thousands of industrial or desktop computers (that may put at disposal a part of their CPU power and file system). Each node may share file systems and access independently on the network and thus on databases. Thus, solutions with large numbers of distributed databases are possible; to realize data and/or computational GRID solutions with shared or partitioned databases and data sources.
The AXCP can be used to set up hierarchical solutions, in which multiple AXCP Schedulers with their nodes are activated by other nodes and Rules.

Other AXMEDIS Integrated Solutions

The AXCP solution can be used an independent tool, but it has also been designed to be used with:

- **AXMEDIS P2P Controlled Network**, for content distribution via P2P, B2B and B2C BitTorrent Technology with queries and catalogue, for protected content or not, automating content publication/distribution, controlling the P2P network, extracting statistical data and reports. AXMEDIS P2P network has P2P clients for PC and Mobiles.
  http://www.axmedis.org/documenti/view_documenti.php?doc_id=3612
- **AXMEDIS DRM**, is a solution to adopt MPEG-21 DRM with other DRM solutions, includes servers and licensing tools and allows DRM, detection of attacks, black list management, collection of actions logs containing traces about the rights exploitation, tools for administrative management, etc. http://www.axmedis.org/documenti/view_documenti.php?doc_id=3616
- **AXMEDIS Cross Media Finder**: an integrated portal for demonstrating AXMEDIS content and distribution: http://xmf.axmedis.org/, for PC, PDA and mobile devices
- **AXMobile**: the end-to-end solution for mobile content production and distribution
- **AXMEDIS Editor and players, tools for MPEG-21 and AXMEDIS authoring** (SMIL, HTML, MPEG-4, and of any kind of digital resource), DRM, licensing, protection, packaging, workflow, playing, etc. AXMEDIS authoring on Windows. AXMEDIS players for: MS Windows, Linux as core, Windows Mobile 5 and 6, and java mobiles, java for PC, STB/PVR/HDR, Media Centers, PDA, and mobiles. They can be customized as GUI and functionalities. Examples of customizations are available.
  http://www.axmedis.org/documenti/view_documenti.php?doc_id=3634

AXCP Rules Functionalities

The language is an evolution of the standard JavaScript language. The following functionalities area accessible as additional native operators and/or new Plug ins. The addition of new functionalities according to your needed is possible by adding new plug ins, or by creating Javascript functionalities. Most of the following capabilities are available on the basic light version of the AXCP tools, while a few of them are only accessible in the full professional version, see on the portal for details. Please note that every week new functionalities are added.

Firing and control activities

- Activation via AXCP scheduler web service
- Activation via AXCP Quick Start tool
- Activation via Workflow tools
- Activation via your Applications, Java, C++, PHP, JSP, CGI, etc.
- Activation via detection of files changing, changing in databases, etc.
- Cross activation of a rule via another rule
- Time periodic activation
- Time sporadic activation
- Dynamic production, allocation and activation or rules

Content and metadata access, ingestion and gathering from

- CMSs and databases:
  - ODBC, MySQL,
  - XML databases, Tamino, eXact
  - Lobster®, MSSQL, HP DMP, ..
- OAI, Open Archive based accesses;
- Main communication protocols:
  - SQL, Web Services, FTP, HTTP,
  - SFTP, HTTPS
  - WebDAV, SMB, Gopher, NNTP
- operating systems files:
  - MS Windows
- Rich media formats:
  - MXF, NewsML, IMS SCORM, MPEG-21, etc.
- Focuseek crawling tool:
  - file system DB2, Oracle, MySQL, ODBC,
  - IMAP4, POP3, WebDAV, RSS, etc.

Content and metadata management and retrieval

- from multi-archive content crawling, extraction and aggregation with metadata
- from any databases via HTTP and/or ODBC, etc.
- from AXMEDIS database (MPEG-21 database) or from others
- actualizing the queries into the scripts, definition of active/dynamic queries
- from P2P AXMEDIS network
- integration with HP DMP, Digital Media Platform
- integration with GIUNTI mobile distribution platform
- Integration with TISCALI Media Club VOD distribution platform
- Integration with other solutions for content distribution see http://WWW.AXMEDIS.ORG

Metadata models and processing

- metadata models and extensions:
  - Dublin Core full set
  - complex metadata such as: EAD, DC
  - multiple Unique IDs and descriptors: UUID, ISBN, ISRC, ISAN, ISMN, etc., your IDs
  - business metadata such as: AXInfo
  - Potentially Available Rights, PAR, Licensing information in MPEG-21 REL
  - any custom metadata
  - Workflow information
  - Protection information
  - Content descriptors as Metadata
  - MPEG-7 descriptors
  - Content fingerprint for recognition and monitoring distribution channels
- metadata manipulation and processing:
  - mapping via XSLT (production of mapping with specific editor)
  - filtering via XSLT, processing via XSLT

Content Processing for audio videos, document, images, and any files:

- digital resources adaptation and transcoding
- extraction of descriptors and/or fingerprints
- watermarking
- indexing, classification
- summarization
- filtering
- repurposing
- recognition
- search and retrieval
- MIME type description and access of files

Semantic processing

- Data Clustering
- Production of recommendations: user and content
- Processing of ontologies
- Distances of profiles: users and media
- Processing of Taxonomies

Text/Document processing, adaptation and transcoding:

- text processing with regular expressions and other techniques
- text language detection
- text transcoding by format:
  - PDF-TXT, HTML, PS, RTF,
  - MS-Word, Plain text,
  - Etc.
- text keywords Multilanguage:
  - Extraction from comparison (corpus based)
  - Extraction from semantic analysis
- text fingerprint:
  - Extraction
  - Plagiarism detection

Audio Processing, adaptation and transcoding:

- Audio transcoding:

  - WAV, WMA, MPEG, VORBIS, AC3, DV,
  - MACE, ADPCM, AAC, real audio, AIFF,
  - PARIS, NIST, SVX, IRCAM, W64, SD2, MP3,
  - etc.
- RingTones:
  - Operations of: resample, clip, etc.
- Audio descriptors:
  - Low level descriptors extractor: waveform, spectrum, centroid, MFE, MFCC, ZCR, Spectral Flatness, onset and offsets, etc.
  - High level descriptors extractor: audio segmentation, music genre, rhythm, silence detection, spoken/music content, noise
- Audio fingerprint:
  - M2Any fingerprint algorithm and recognition
  - Philips fingerprint algorithms
  - AudioID fingerprint algorithm
  - extractors and comparison of fingerprints
  - detection of plagiarism

Video Processing, adaptation and transcoding:

- Video transcoding
  - FFMPEG and other libraries
  - MPEG-1, MPEG-2, MPEG-4, VC1, H.261,
  - RealVideo 1.0, RealVideo 2.0, MJPEG,
  - RAW, lossless MJPEG, FLV,
  - H.263, WMV, ASF, ASUS, DV, YUV, ASV1,
  - ASV2, SVQ1, SVQ2, AVI, FLAC, DAUD, AVS,
  - H.264, VP3, FFW, Flash, VCR1, VCR2,
  - CLJR, Apple, DXA, THP, AASC, DVD, 3GPP,
  - etc.
- Video descriptors MPEG-7
  - GoF/GoP color
  - Dominant color
  - Homogeneous Texture
  - Color Structure
- Video fingerprint:
  - extractors and comparison of fingerprints
  - detection of plagiarism

Image Processing, adaptation and transcoding:

- Image conversions of more than 100 different formats:
  - JPG, GIF, PNG, BMP, TIF, SVG, PS, PDF, MPEG, PCX, PGH, PICT, PIX, RGB, TGA, TXT,
  - WMF, XPM, YUV, YCbCr, YcbCrA,
  - etc.
- text to image conversion
- Image processing algorithms:
  - Contrast, edge, blur, media, mirror, equalize,
  - magnify, resize, roll, scale, shade,
  - negate, noise, filtering, rotate, past, spread,
  - extract, overlap, replace, shear,
  - etc.

Digital File Fingerprint and recognition

- Estimation of fingerprint of digital files:
  - MD5, SHA-1, base64, ascii-bin, etc.
- Recognition of fingerprint by similarity

Content Composition Presentation and Interactive models

- creation of cross media and multimedia content combining raw assets such as text, images, audio, video, animation, metadata, descriptors, licenses, and other
- multimedia objects in formats
  - MPEG-4
  - HTML
  - SMIL
  - MPEG-21 (supported by AXMEDIS Editor and players for MPEG-21)
  - NewsML (load)
  - MXF (load and save)

Multimedia and cross media adaptation/processing

- Create MPEG-4
- Create MPEG-4 SMR (Symbolic Music representation)
- Audio visual processing:
  - concatenation, delay, extract
- MPEG-4 remove tracks
- conversions:
  - MPEG-4 to 3gp
  - MPEG-4 to AVI
  - MPEG-4 to ISMA
  - SMIL to HTML

General Information Processing of:

- Load/import, production and saving of XML files for commands and/or metadata
  - based on E4X model
- Load/save any file from/to the operating system, server, FTP etc.
- Production of custom, template and/or behavior-based, HTML pages
- Production of custom, template and/or behavior-based, SMIL scenes
- Processing XSLT with XALAN

Distribution and control of P2P network

- Monitoring of P2P nodes and network status
- Automatic publication of content into the P2P network
- Automatic download of content from the P2P network
- Control the seeding capabilities
- Accessing to reporting and statistics
- Remote control of P2P network
- Removing obsolete content from P2P network

Integration with Social Networks

- YouTube: query, download and upload, processing
- Flickr: query, download and upload, processing
- XMF social network tool to make your social network: query, download and upload, processing, http://xmf.axmedis.org

Communication Capabilities:

- Content ingestion
- Access via a large range of databases

- Access via Web Services; dynamic client generator based on WSDL
- Access via FTP/SFTP sites, GET/PUT, etc.
- Access via operating system, activating shells, etc.
- Sending commands HTTP, HTTPS
- Sending Mails, with attachments and/or HTML
- Sending SMS
- Creating reports in:
  - TXT, CSV, HTML, XML, XHTML, …

Workflow management Production Process

- integration of the AXCP tools with OpenFlow and BizTalk Workflow Management systems
  - receive commands
  - activate scripts passing parameters
  - returning values and results
- definition of full customized solution for workflow management
- WEB based interfaces for creating GUI to control AXCP GRID processing
- WEB based interface for monitoring AXCP reports and results
- Collaborative Workflow solutions

Content Packages, Media Containers and DRM

- MPEG-21 file read and production, with any digital resource inside, from other MPEG-21 to HTML, SMIL, groups of files and related resources
- MPEG-21 to keep joined your metadata and digital resources as well as to package and delivering them as unique chunks of information with DRM
- OMA files production
- IMS SCORM ingestion
- ZIP ingestion and production
- production of MPEG-2 TS streams
- RSS ingestion and production
- ATOM ingestion and production (in progress)
- MXF ingestion and production
- newsML ingestion and production

WEBtv, IPTV

- ingestion and processing of EPG, XML EPG for DVB-T, DVB-S, ..
- Integration from Sky EPG server

Content Formatting

- structuring and styling content elements by means of SMIL based templates
- applying style-sheets to define the usage interface (format, layout) of the whole collection of content elements and the interested content usage paradigms
- Genetic Algorithms for best time fitting, etc.

Profiling and their management

- Reading and manipulating:
  - user profiles
  - network profiles
  - context profiles
  - device profiles
- Recommendations, favorites, voting, etc.
- Reasoning based on Clustering: K-Means and other algorithms
- Reasoning based on profile distances.

Content Adaptation Process

- Digital Item Adaptation based on MPEG-21 DIA
- Decision taking engine for DIA based on the above mentioned profiles.
  - Rule based
  - Ontology and inferential engine based
- Scripting capabilities for expanding DIA and decision taking engine

Content Protection and DRM

- Content registration (unique IDs) and verification
- Content and digital files signature
- Content fingerprints and watermarks
- Protection of digital resources and objects with MPEG-21 IPMP, OMA
- protection/encryption:
  - AES, DES, 3-DES, blowfish, Cipher, CAST
- Tracking exploited rights and reporting actions performed to the content owner, distributors, collecting societies, etc.
- Manipulating MPEG-21 protected objects according to AXCP Node license
- Open to integrate other DRM solutions

Content Licensing and DRM

- generating license from license model and additional information, storing licenses, and posting to license server automatically
- supporting transcoding/translating licenses (MPEG-21 REL, OMA ODLR);
- posting licenses on license server
- verification of licenses
- resolving nationality from IPs

Content Publication and Distribution

- supporting distribution towards multiple channels, for one or more: Internet, satellite, mobile, P2P distributions
- producing, monitoring and editing programmes and schedules
- controlling P2P AXMEDIS network in downloading and publishing reducing the seeding time to zero
- connecting other AXMEDIS Factories of content integrators, producers, and distributors
- posting content on the EUTELSAT Carousel for broadcasting.

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