**Technical Note
n.3901
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Automate your business processes, manage your content at lower costs:

Multi-channel production and distribution: broadcasting, IP/Internet, WEB sites, P2P, mobile, PDA, IPTV, interactive TV and channels, etc.

Multi-channel experience for your customers

Exploit Video on Demand (VOD), and production on demand solutions

Control of P2P content sharing and distribution, involving your customers in distribution (super-distribution)
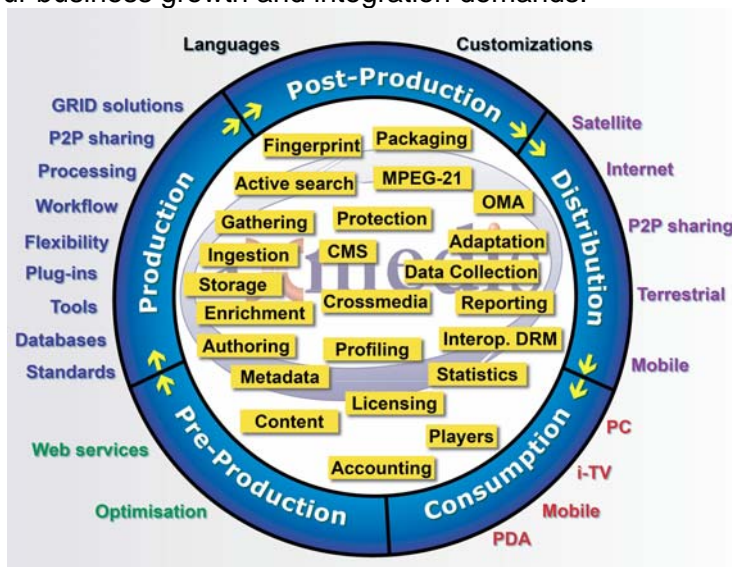
Involve your customers and final users in content production and social networking

Integrate interoperable DRM into your business (MPEG-21, OMA, etc.)

Exploit different business models and/or transactions on the same distribution channels: pay per play, monthly rate, preview, renting, advertising, etc.

Exploit interactivity with cross media models

Adopt advertising (customized and/or real time personalized advertising)

AXMEDIS Content Processing GRID, AXCP

An open, integrated, distributed, and scalable solution for automating content production, management and protection for multichannel distribution.
AXCP allows an integrated content management of pre- and post-production, following your business growth and integration demands.

Main capabilities

AXCP GRID solution allows automated management of: content, metadata and licensing information, etc., with the operations of ingestion, crawling, database management, indexing, processing, adaptation, transcoding, encoding, decoding, descriptor extractor, recognition, filtering, production, archiving, storing, packaging, preview, extracting fingerprint, licensing, DRM, profiling, protection, encryption, accounting, enrichment, network management, etc. AXCP tools can be integrated and controlled by your applications and/or workflow management systems.
AXMEDIS allows you to reduce costs and increase efficiency of your content management. AXMEDIS supports the whole value chain and makes real and simple the convergence of media, the media transcoding, 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.

Adoption and Affiliation

AXMEDIS has been adopted and is under trial by many industrial partners, who have expressed their appreciations, (see http://www.axmedis.org/ibc2007/). AXMEDIS is open and allows you to access source code, reports, technical support, training days, etc., by means of the affiliation program. AXMEDIS consists of over 35 partners (such as: TISCALI, EUTELSAT, Telecom Italia, TEO, ELION, HP, BBC, Giunti Labs, ACIT, EXITECH, XIM, SIAE, SDAE, etc.). It allows you to exploit innovative research results with new tools and solutions for your needs.

Open Architecture and Solution

AXCP solution is based on AXCP Rules formalized in JavaScript and XML to define jobs, processes and their features (deadlines, needs, etc.). An AXCP solution is open since it can be expanded and/or customized for your needs by:
o   creating and customizing AXCP Rules to be executed on AXCP Nodes
o   entering in execution Rules according to different policies such as: periodic, sporadic or on demand from third parties, external tools, web services, etc.
o   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
o organizing AXCP GRID Nodes in a hierarchical manner. An AXCP Node may control one or more AXCP Schedulers which in turn may control other AXCP Nodes, etc.
o executing operating system processes, passing them parameters/files and getting eventual errors.
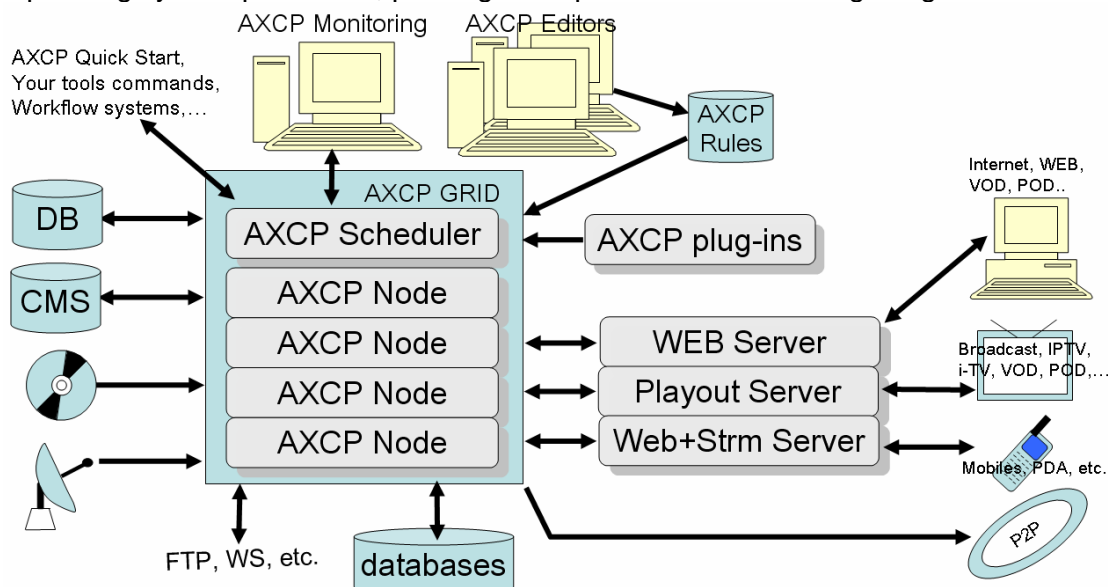
The AXCP tools are based on a Service Oriented Architecture (SOA); fully documented APIs for all the JavaScript functionalities, and WEB Services for accessing and controlling tools, and for distributing produced content towards your front-end distribution servers. The above figure depicts an integrated AXCP solution for automated content processing and multichannel distribution.

AXCP GRID solution consists of:
- **AXCP Rules which can be:**
  - activated for content processing on any AXCP Node as well as on a single computer
  - used/parameterized to produce content on demand or to be integrated in your content factory
  - activated from your Workflow Management System or from any other application
  - activated by changes in remote objects and queries in the local database and on the P2P network.
- **AXCP Nodes** allow to be controlled by an AXCP Scheduler. The stand alone version of the AXCP Node can be used for executing AXCP Rules for ad-hoc processing and activation without demanding their allocation and scheduling to the AXCP Scheduler.
- **AXCP Scheduler to allocate and manage AXCP Rules on Nodes:**
  - scheduling and balancing jobs/processes on AXCP Nodes according to the content production and processing needs in terms of time and resources: (i) balancing nodes workloads, (ii) Deadline Monotonic, (iii) starting time, (iv) optimization with Taboo Search (the latter is in progress)
  - 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 Rule Editor** allows you to produce, debug, test and validate AXCP Rules to execute them on AXCP Nodes (industrial computers or computers in your offices delegating a part of their CPU).
- **AXCP Quick Start** allows you to activate Rules in 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.

Reliability and Redundancy
The AXCP solution is reliable, scalable and fault tolerant and can grow with your needs. AXCP nodes can run multiple copies of the same rules on the same content making possible the set up of fault tolerant solutions and recovery in case of server or disk failure. AXCP nodes are capable to 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 of the last stable situation, thus to set up fault tolerant solutions.

Scalability

The AXCP solution is scalable in terms of number of AXCP Nodes and Schedulers. It may work on a single computer with all inside as well as on hundreds/thousands of industrial or desktop computer (putting at disposal a part of their CPU power and file systems).

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.

Technical Information

The AXCP solution is based in MS Windows XP. AXCP Scheduler and Nodes can be executed on high performance multi CPUs computers or single low resources computers depending on your needs in terms of performances. AXCP is provided as software or as hardware/software solution ready to be integrated in your company according to your needs. Training, integration and maintenance services are available.

AXMEDIS Integrated Solutions

The AXCP solution is independent, 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.
- **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.
- **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, Apple OS X, Linux, Windows Mobile 5, and java mobiles, for PC, STB/PVR/HDR, Media Centers, PDA, and mobiles. They can be customized as GUI and functionalities. Examples of customizations are available.
- **AXMEDIS COPOP**, content posting solution, to involve your final users, to collect their content and redistributed it for social networking, content enrichment and/or integrating it in your content business solutions.
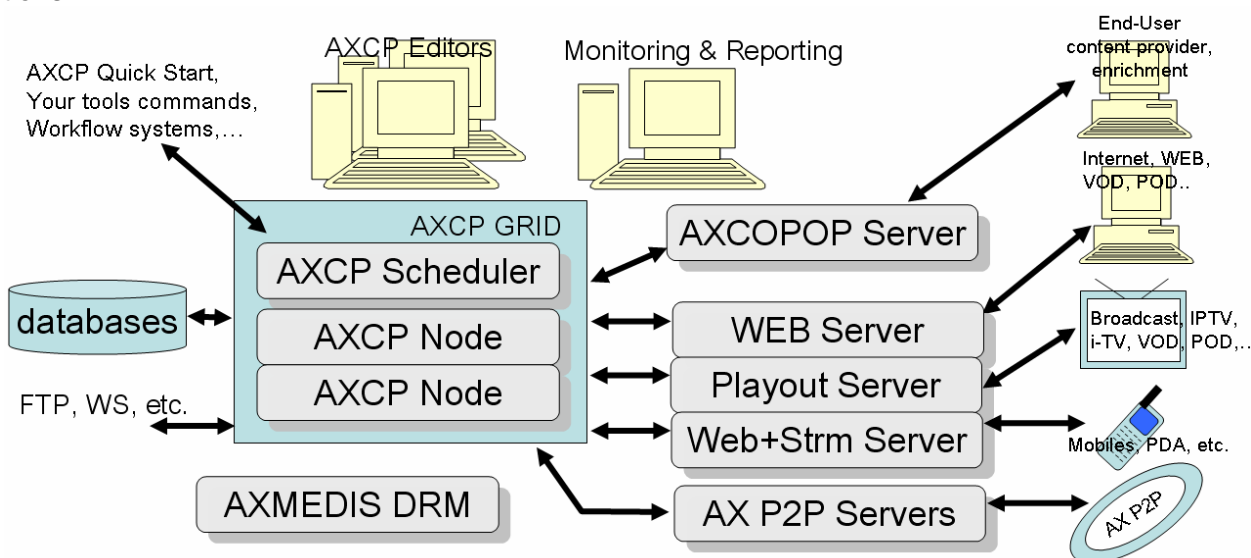
The above example describes an AXCP based solution in which AXMEDIS COPOP has been used to collect content provided by final users, to use it (when processed, adapted, protected, etc.) integrated into the traditional multichannel distribution and distributing it also with AXMEDIS P2P controlled network for PC and Mobiles.

The following example presents an AXCP solution for automated production, protection and distribution of content with DRM. Thus allowing the reduction of costs for content post-production and management for DRMed distribution. In this case, the DRM can be MPEG-21 or OMA to distribute content according to several different business models (pay per play, monthly rate, etc.), setting up different rights (play, print, etc.), with different conditions (times of play, duration, ..). The AXCP allows (i) producing content on demand on the basis of final user profiles (device, network,..); (ii) producing licenses on demand for pay per play and new subscriptions; (iii) managing black list of terminals and/or users.
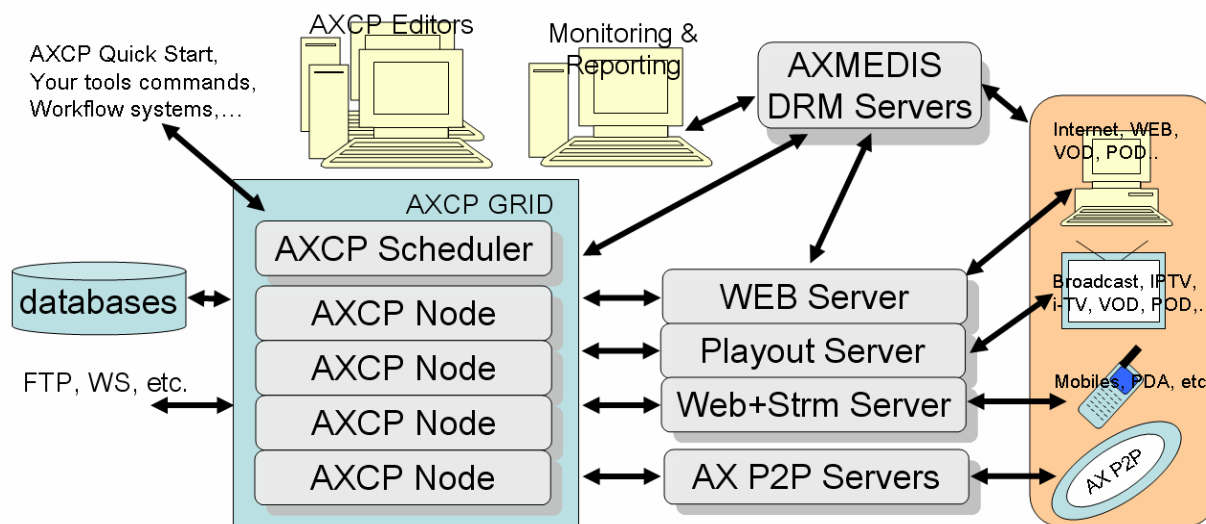
AXMEDIS tools (AXCP, AXMEDIS DRM, AXCOPOP, AXP2P, etc.) have been designed on the basis of a large set of requirements collected by AXMEDIS Consortium partners. They are modular components which can be reused to set up a large range of different configurations. They are open to be customized to cover your needs and business ideas.

AXCP Rules Activities

Content and metadata access, ingestion and gathering from
- CMSs and databases:
  - ORACLE, XML databases, Tamino, eXact Lobster®, MySQL, MSSQL, HP DMP, ODBC, etc.
- file system: MS Windows
- protocols:
  - SQL, Web Services, FTP, HTTP, WebDAV, SMB, Gopher, NNTP
- Focuseek crawling tool:
  - file system DB2, Oracle, MySQL, ODBC, IMAP4, POP3, WebDAV, RSS, etc.

Content and metadata management and retrieval
- from AXMEDIS database (MPEG-21 database) or from others
- actualizing the queries into the scripts, definition of active/dynamic queries
- from P2P AXMEDIS network
- multi-archive content crawling, extraction and aggregation with metadata
- any databases via HTTP and/or ODBC, etc.
- 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 WWW.AXMEDIS.ORG/IBC2007

Metadata models and processing
- metadata models and extensions:
  - Dublin Core full set
  - complex metadata such as: EAD
  - 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)

- o filtering via XSLT
- o processing via XSLT

Content Processing for audio videos, document, images, and any files:
- digital resources adaptation and transcoding
- extraction of descriptors
- extraction of fingerprints
- watermarking
- indexing
- summarization
- filtering
- recognition
- MIME type description and access of files

Text/Document processing, adaptation and transcoding:
- text language detection
- text transcoding by format:
  - o PDF-TXT, HTML, PS, RTF, MS-Word, Plain text
- text keywords Multilanguage:
  - o Extraction from comparison (corpus based)
  - o Extraction from semantic analysis
- text fingerprint:
  - o Extraction
  - o Plagiarism detection

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

Video Processing, adaptation and transcoding:
- Video transcoding:
  - o MPEG-1, MPEG-2, MPEG-4, VC1, H.261, RealVideo 1.0, RealVideo 2.0, MJPEG,
  - o RAW, lossless MJPEG, H.263, WMV, ASF, ASUS, DV, YUV, ASV1, ASV2, SVQ1, SVQ2,
  - o H.264, VP3, FFW, Flash, VCR1, VCR2, CLJR, Apple, DXA, THP, AASC, DVD, 3GPP,
  - o etc.
- Video descriptors MPEG-7
  - o GoF/GoP color

- o Dominant color
- o Homogeneous Texture
- o Color Structure
- Video fingerprint:
  - o extractors and comparison of fingerprints
  - o detection of plagiarism

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

Digital File Fingerprint and recognition
- Estimation of fingerprint of digital files:
  - o 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
  - o MPEG-4
  - o HTML
  - o SMIL
  - o MPEG-21 (supported by AXMEDIS Editor and players for MPEG-21)

Multimedia and cross media adaptation/processing
- Create MPEG-4
- Create MPEG-4 SMR (Symbolic Music representation)
- Audio visual processing:
  - o concatenation, delay, extract
- MPEG-4 remove tracks
- conversions:
  - o MPEG-4 to 3gp
  - o MPEG-4 to AVI
  - o MPEG-4 to ISMA
  - o 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

Communication Capabilities:
- Accessing to Web Services; dynamic client generator based on WSDL
- Accessing FTP sites, GET/PUT
- 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
- MXF files read and production (in short future)
- 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
- ingestion of IMS SCORM files
- production of MPEG-2 TS streams

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, and device profiles

Content Adaptation Process
- Digital Item Adaptation (DIA) based on MPEG-21 DIA
- Decision taking engine for DIA based on the above mentioned profiles.
- 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

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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