**Technical Note
n.4001
January 2009**

Set up and maintain you P2P network at lower costs:

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

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

Control 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

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)

AXMediaTech

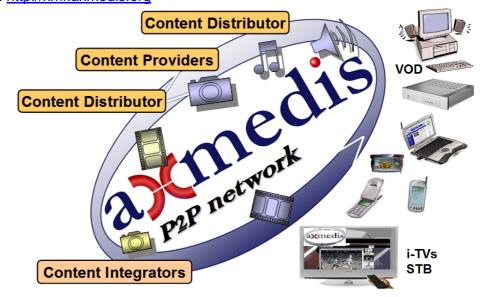# AXMEDIS P2P: for legal, flexible and controllable P2P

Content sharing via P2P is regarded by many content owners as one of the major reasons for lack of revenues. This opinion has grown on the basis of the way users exploit some P2P applications. However, P2P technology can be used in profitable manners. P2P networks have been proven to be controllable, profitable and efficient for commercial content distribution. It should be noted that currently more than 80% of data downloaded by final users/consumers are obtained via P2P protocols.

P2P implies (i) large scale and scalable content distribution, (ii) creation and management of a collectivity of consumers for advertising and profiling, (iii) lower costs for content distribution since the front end distribution servers do not have to provide all the amount of bytes downloaded by final users. These are the main reasons behind the usage of the P2P protocol for WebTV, IPTV and also for content distribution in general.

The AXMEDIS P2P is an open and scalable solution for setting up P2P networks for content distribution and sharing which can be used among business actors or consumers, or for creating thematic or mixed P2P networks for B2B/B2C content distribution and sharing. Content in this case, can be any kind, from video to audio, games, documents, etc.

AXMEDIS P2P solution allows content owners and distributors to exploit the capabilities of P2P protocols to create efficient, controllable, legal and secure P2P networks for content distribution and sharing. By using the AXMEDIS P2P solution a distributor may automatically publish content in the P2P network; and the content may freely navigate among peers with the supervision and control of the AXMEDIS DRM and monitoring tools.

Content distributors may use the AXMEDIS P2P solution to set up legal P2P services for content distribution towards and among their customers, thus reducing their direct costs for distribution and infrastructure. Final users can be profiled and may be stimulated by advertising, and/or promotions of content to acquire licenses to play the content (e.g., pay per play). Other business models such as the monthly rate or the renting for a period are also possible, see for example the Cross Media Portal show case: http://xmf.axmedis.org

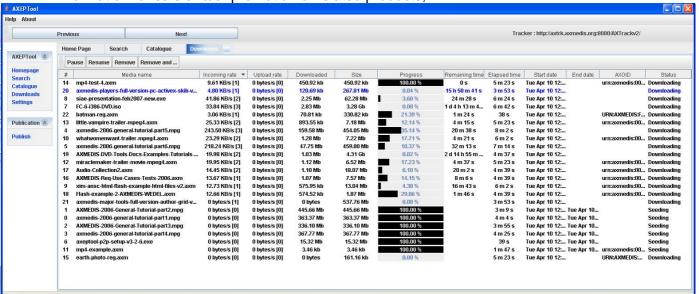## AXMEDIS P2P Main Capabilities

The AXMEDIS P2P solution allows to:

- share any kind of content (digital files) or limit the content sharing to particular types/formats of content, protected or not;
- publish/distribute content with DRM or not (for example with MPEG-21 REL DRM,

but other DRMs are also supported). In the case of AXMEDIS DRMed content, different business models can be supported on the same P2P network and on the same content at the same time: pay per play, monthly subscription, renting, etc.

- publish and distribute content in a fast and reliable manner on the P2P network,
  - o "immediate seeding" of P2P network, in direct connection with your Content Management Systems;
  - o automated publication of content for controlling P2P distribution;
- monitor P2P activity of your peer node
  - o upload and download traffic report, etc.
- create a community of users/actors, for distributing/sharing content and tools among:
  - o business partners: B2B solution;
  - o consumers: C2C solution;
  - o mixed community of business partners and consumers: B2B2C. In this case, both of them may enjoy the sharing of files (faster download) for different purposes;
- control the activity of the P2P network by including
  - o monitoring and measuring performances in particular points of the geographical P2P network;
  - o balancing the workload of seeding servers;
  - o information regarding the status and profile of the P2P control nodes and of peers;
  - o statistic analysis about the status of the whole P2P network;
  - o detailed reporting about the activity related to each content/object on the P2P network;
- filter content that is not
  - o authorized to be shared on the network, for example when a content has infringed some Intellectual Property. The filtering can be based on detection of content on the basis of fingerprint or watermark solutions, or of simple IDs. This feature allows to implement monitoring systems for P2P bittorrent networks;
  - o conformant to some format(s);
- control the activity of the P2P network
  - o automated content publication and/or download;
  - o managing black lists of P2P clients and content;
  - o strategies for the publication, polishing and maintenance of the P2P network;
- be easily integrated with WEB portals and services for content distribution and sale;
  - o starting the download with P2P client tools with just a click from any WEB page by using the BitTorrent file or the AXOID, which is the unique ID of the AXMEDIS objects;
  - o promoting new content to the final users, top/premium content, performing advertising towards the users connected with the P2P network via P2P Clients;
  - o bringing users to a specific WEB page for each AXMEDIS DRMed content to provide additional information for sale and/or promotion of related products;

#	Media name	Incoming rate	Upload rate	Downloaded	Size	Progress	Remaining time	Elapsed time	Start date	End date	AXOID	Status
14	mp4-test-4.axm	9.61 KB/s [1]	0 bytes/s [0]	450.92 kb	450.92 kb	100.00 %	0 s	5 m 23 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
20	axmedis-players-full-version-pc-activex-skib-v...	4.80 KB/s [1]	0 bytes/s [0]	120.69 kb	267.81 Mb	0.04 %	15 h 50 m 41 s	3 m 53 s	Tue Apr 10 12:...			Downloading
8	siae-presentation-feb2007-new.exe	41.86 KB/s [2]	0 bytes/s [0]	2.25 Mb	62.28 Mb	3.60 %	24 m 28 s	6 m 24 s	Tue Apr 10 12:...			Downloading
7	FC-6-i386-DVD.iso	33.84 KB/s [3]	0 bytes/s [0]	2.83 Mb	3.28 Gb	0.08 %	1 d 4 h 13 m 4...	6 m 42 s	Tue Apr 10 12:...			Downloading
22	batman-reg.axm	3.06 KB/s [1]	0 bytes/s [0]	70.81 kb	330.82 kb	21.39 %	1 m 24 s	38 s	Tue Apr 10 12:...		URN:AXMEDIS:F...	Downloading
13	little-vampire-trailer-mpeg4.axm	25.33 KB/s [2]	0 bytes/s [0]	893.55 kb	7.18 Mb	12.14 %	4 m 15 s	5 m 23 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
4	axmedis-2006-general-tutorial-part5.mpg	243.50 KB/s [3]	0 bytes/s [0]	159.58 Mb	454.05 Mb	35.14 %	20 m 38 s	8 m 2 s	Tue Apr 10 12:...			Downloading
10	whatwomenwant-trailer-mpeg4.axm	23.29 KB/s [2]	0 bytes/s [0]	1.28 Mb	7.22 Mb	17.71 %	4 m 21 s	6 m 2 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
5	axmedis-2006-general-tutorial-part6.mpg	218.24 KB/s [3]	0 bytes/s [0]	47.75 Mb	459.80 Mb	10.37 %	32 m 13 s	7 m 14 s	Tue Apr 10 12:...			Downloading
19	AXMEDIS-DVD-Tools-Docs-Examples-Tutorials-...	19.98 KB/s [2]	0 bytes/s [0]	1.03 Mb	4.31 Gb	0.02 %	2 d 14 h 55 m ...	4 m 37 s	Tue Apr 10 12:...			Downloading
12	miraclemaker-trailer-movie-mpeg4.axm	19.95 KB/s [2]	0 bytes/s [0]	1.12 Mb	6.52 Mb	17.23 %	4 m 37 s	5 m 23 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
17	Audio-Collection2.axm	14.45 KB/s [2]	0 bytes/s [0]	1.10 Mb	18.07 Mb	6.10 %	20 m 2 s	4 m 39 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
16	AXMEDIS-Req-Use-Cases-Tests-2006.axm	13.67 KB/s [1]	0 bytes/s [0]	1.07 Mb	7.57 Mb	14.15 %	8 m 6 s	4 m 39 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
9	xim-ansc-html-flash-example-html-files-v2.axm	12.73 KB/s [1]	0 bytes/s [0]	575.95 kb	13.04 Mb	4.30 %	16 m 43 s	6 m 2 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
18	Flash-example-2-AXMEDIS-WEDEL.axm	12.66 KB/s [1]	0 bytes/s [0]	574.52 kb	1.87 Mb	29.86 %	1 m 46 s	4 m 39 s	Tue Apr 10 12:...		urn:axmedis:00...	Downloading
21	axmedis-major-tools-full-version-author-grid-v...	0 bytes/s [1]	0 bytes/s [0]	0 bytes	537.76 Mb	0.00 %		3 m 53 s	Tue Apr 10 12:...			Downloading
1	AXMEDIS-2006-General-Tutorial-part2.mpg	0 bytes/s [0]	0 bytes/s [0]	445.66 Mb	445.66 Mb	100.00 %		3 m 9 s	Tue Apr 10 12:...	Tue Apr 10...		Seeding
0	axmedis-2006-general-tutorial-part1.mpg	0 bytes/s [0]	0 bytes/s [0]	363.37 Mb	363.37 Mb	100.00 %		4 m 4 s	Tue Apr 10 12:...	Tue Apr 10...		Seeding
2	AXMEDIS-2006-General-Tutorial-part3.mpg	0 bytes/s [0]	0 bytes/s [0]	336.10 Mb	336.10 Mb	100.00 %		3 m 55 s	Tue Apr 10 12:...	Tue Apr 10...		Seeding
3	axmedis-2006-general-tutorial-part4.mpg	0 bytes/s [0]	0 bytes/s [0]	367.77 Mb	367.77 Mb	100.00 %		4 m 25 s	Tue Apr 10 12:...	Tue Apr 10...		Seeding
6	axeptool-p2p-setup-v3-2-6.exe	0 bytes/s [0]	0 bytes/s [0]	15.32 Mb	15.32 Mb	100.00 %		39 s	Tue Apr 10 12:...	Tue Apr 10...		Seeding
11	mp4-example.axm	0 bytes/s [0]	0 bytes/s [0]	3.46 kb	3.46 kb	100.00 %		1 m 47 s	Tue Apr 10 12:...	Tue Apr 10...	urn:axmedis:00...	Seeding
15	earth-photo-reg.axm	0 bytes/s [0]	0 bytes/s [0]	0 bytes	161.16 kb	0.00 %		5 m 23 s	Tue Apr 10 12:...		URN:AXMEDIS:...	Downloading

Tracker : http://axtrk.axmedis.org:8080/AXTrackv2/

Download interface of the P2P clients

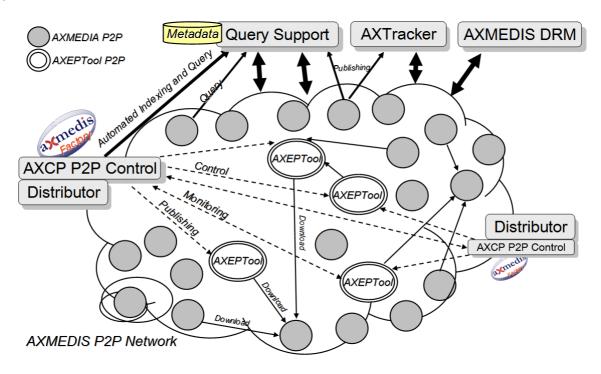With the AXMEDIS P2P solution, it is also possible to

- make queries into the P2P network. This search facility is provided for MPEG-21 objects and it is based on Dublin Core metadata and classification model plus additional business information such as licensing information, distributor information, etc.;
- expose the whole content catalogue to your P2P network clients;
- have a direct integration of P2P tools with your content/media management systems, CMS, DMS;
- have a direct integration of P2P tools with your workflow management systems, WFMS;
- get statistics/report data from the P2P tracker and from the your clients and probe clients into the whole geographical network.

AXMEDIS P2P is fully integrated with the AXMEDIS GRID for Content Processing, AXCP. It is an open and scalable solution for automating content production, management and protection for multichannel distribution. AXCP allows setting up integrated and automated content management systems for pre- and post-production, following your business growth and integration demands. The AXMEDIS P2P solution provides the above mentioned capabilities of control and monitoring when it is integrated with the AXCP tools and facilities. Direct integration with your existing factory and tools is also possible, see technical note:
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3624

AXMEDIS P2P Architecture and Solution

AXMEDIS P2P is based on the BitTorrent technology for P2P distribution and sharing. The AXMEDIS P2P technology enhances the classical BitTorrent solution with several innovations (still remaining fully compatible with standard BitTorrent protocols and tools) to realize the possibilities of:

- monitoring and controlling the network,
- creating P2P networks for e-commerce at business and consumer levels, managing DRMed content, managing protected and non protected content,
- making queries to search for shared content,
- deriving statistics from the tracker and from the client tools,
- distributing MPEG-21 objects,
- automating publication and download processes,
- accelerating the publication up the immediate distributed seeding of content in the network,
- integrating easily the P2P into WEB pages of content distribution servers,
- filtering content on the P2P network, and more.

A minimal AXMEDIS P2P network is based on:
- one AXTracker that manages and defines the P2P community. Multiple AXTrackers can be used to manage large communities with millions of users and files;
- an unlimited number of AXMEDIS P2P clients, called AXMEDIA tools. The P2P clients in the hands of final users with the above mentioned capabilities of publishing, downloading, receiving advertising, etc. They are Java-based applications which are easy to be installed on a large range of systems. Simplified versions are also available for mobiles and STB/PVR.

Please note that in this minimal configuration the P2P network is free to evolve, and the performance in download cannot be controlled and optimized. A minimal P2P network can be managed with a single server including an AXTracker and an AXEPTool for seeding on the same Linux computer. This solution can be provided as appliance or as a virtual machine ready to be used.

An AXMEDIS P2P network may have **optionally**:
- **Query Support** to allow indexing content published in the P2P network thus making available a query portal for your users. The indexing is based on Dublin Core plus other additional information depending on the MPEG-21 model. In principle any kind of metadata can be added;
- **AXEPTool P2P super nodes,** which are points of control in the P2P network directly managed by one or more content Distributors or by whom is devoted to monitoring the correctness of the content shared on the P2P; for example, by filtering unauthorized content. AXEPTools should be installed by your business and/or affiliated partners. These control nodes of the P2P network can be controlled and monitored by one or more AXCP P2P Control servers;
- **AXCP P2P Control** servers to control and exploit the P2P network which includes monitoring files, automatic publication, automatic download, accelerating seeding, etc. These are the engines to control one or all the super node AXEPTools in the network. Specific policies can be set up according to your needs for seeding and controlling the network. A set of predefined rules is provided, while additional rules can be easily defined in Javascript; **AXMEDIS AXCP** to automate your content production, protection and distribution as stated above and in more details into the technical note:
  http://www.axmedis.org/documenti/view_documenti.php?doc_id=3624
- **AXMEDIS DRM** server to set up and manage digital rights management policies on protected objects shared on the P2P network or directly distributed from your servers (it works mainly according to the MPEG-21 standard, other DRM models can be integrated). Protected content is licensed to the user defining the rights that he/she can exploit on the content. The DRM server allows to authorize the final users' players and to keep trace of activities performed by the users on the content for accounting and reporting them in details to the Distributors and/or content owners.
  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

AXCP Open Architecture and Solution to control P2P networks

AXCP P2P Control of the P2P network is realized by using the so called AXMEDIS GRID solution which allows automated management of content, metadata and licensing information, and so on, with the operations of ingestion, crawling, database management, indexing, processing, adaptation, transcoding, encoding, decoding, description extraction, recognition, filtering, production, archiving, storing, packaging, preview, extracting fingerprint, licensing, DRM, profiling, protection, encryption, accounting, enrichment, network management, and much more. Additionally, the AXCP tools can be integrated and controlled by your applications and/or workflow management systems. The AXCP is an optional and can be reduced to a single server controlling a number of AXEPTools geographically distributed. The local AXEPTools for publication can host also the AXCP control system for the network.

The AXCP control solution for P2P 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:
- creating and customizing AXCP Rules to be executed;
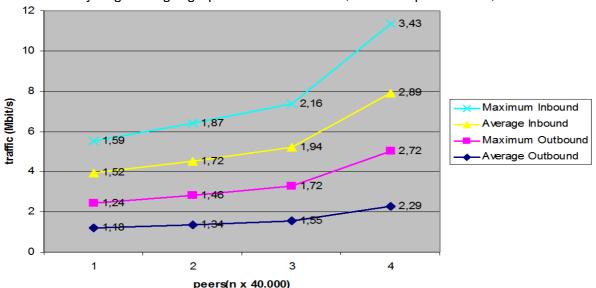- entering in execution Rules according to different policies such as: periodic, sporadic or on demand from

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; etc.

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 distributing produced content towards your front-end distribution servers. *For additional details see the last technical note on AXCP: http://www.axmedis.org/documenti/view_documenti.php?doc_id=3624*

AXMEDIS P2P Reliability, Scalability and Technical details

The AXMEDIS P2P solution is reliable, scalable and fault tolerant and can grow according to the P2P network size in terms of users, peers, and files on the network. The AXMEDIS P2P solution is scalable in terms of number of P2P clients, AXTracker, AXEPTools and AXMEDIA tools. It may work with small networks or with a very large and geographic number of users, with multiple trackers, etc.

AXCP nodes can run multiple copies of the same rules on the same content making possible the setting up of fault tolerant solutions and recovery solutions in case of server or disk failure. The single AXTracker can support more than 160.000 connections with peers. Large networks of millions of users and threads can be realized with a cluster of trackers, similarly to other large P2P networks.

The AXMEDIS P2P servers (Query Support, AXTracker) run both on Linux servers, while P2P clients are mainly for MS Windows, but also for Linux and Mac. AXMEDIS P2P Solution is fully scalable according to your needs, with or without DRM support, with or without AXCP, as software or as an integrated hardware-software solution ready to be included in other distribution models and solutions and in different contexts.

Testing a Trial AXMEDIS P2P Network

A TRIAL AXMEDIS P2P network can be accessed by downloading and installing your AXEPTool P2P Client from the following link: http://www.axmedis.org/documenti/view_documenti.php?doc_id=3611 After the installation, it is possible to download and publish files, observing them on the catalogues, etc. If you are interested in the fast seeding capabilities, please contact us to see a demo of the P2P network controlled by an AXCP. In the AXEPTool it is possible to see in folder of the P2P user interface, the Cross Media Portal with integrated AXMEDIS player for web pages, etc.

AXMEDIS Adoption

AXMEDIS has been adopted and is under trial by many industrial partners, who have expressed their appreciations (see http://www.axmedis.org/ibc2008/). AXMEDIS is open and allows you to access source code, reports, technical support, training days, etc., by means of the affiliation program. AXMEDIS consists
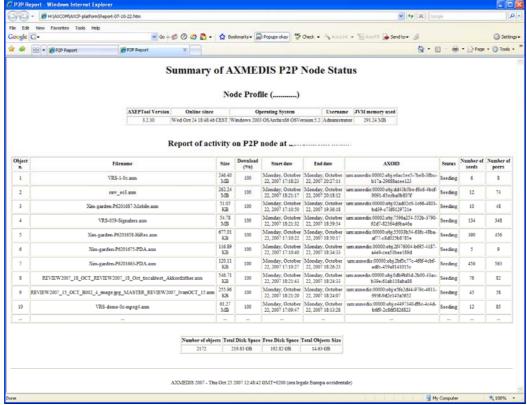
of over 43 partners (such as: TISCALI, EUTELSAT, Telecom Italia, TEO, ELION, HP, BBC, Giunti Labs, AFI, ACIT, EXITECH, XIM, SIAE, SDAE, etc.). It allows you to exploit innovative results with new tools and solutions for your needs.

Customization of AXMEDIS P2P Architecture and Tools

AXMEDIS P2P tools can be fully customized in all its parts: filtering, publication, monitoring, query, classification, indexing, profiling, advertising, user interface, integration with other tools, etc., plus all the AXCP details to control and monitoring the network. AXMEDIS P2P clients (AXEPTools and AXMEDIA P2P) can be customized to present a different look and feel, disabling buttons, changing initial web pages on main folder, adding more folders with other web pages, changing the directories of work, changing the trackers, changing the bitTorrent parameters, activating/deactivating custom menus, etc.

Summary reporting page of a AXEPTool P2P client

AXMEDIS Integrated Solutions

The described solution can also be integrated with:

- **AXMEDIS DRM,** a solution to adopt MPEG-21 DRM, or other DRM solutions, including servers and licensing tools which allow digital rights management, 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 Editor and Players, tools for MPEG-21 and AXMEDIS authoring** (SMIL, HTML, MPEG-4, or any other kinds of digital resources), DRM, licensing, protection, packaging, workflow, playing, etc. AXMEDIS authoring on Windows. AXMEDIS players running on: MS Windows, Mac OS X, Linux, Windows Mobile 5, and java mobiles, are available for PC, STB/PVR/HDR, Media Centers, PDA, and mobiles. Their GUI and functionalities can be customized (examples of customizations are available). http://www.axmedis.org/documenti/view_documenti.php?doc_id=3634
- **AXMEDIS Cross Media Finder:** an integrated portal for demonstrating AXMEDIS content and distribution: http://variazioni.axmedis.org:8080/CrossMediaFinder/
- **AXMEDIS COPOP**, to involve final users, to collect their content and metadata, to automatically transcoding, packing and redistributing user content for social networking and content enrichment. http://www.axmedis.org/com/index.php?option=com_content&task=view&id=79&Itemid=50

The above example presents an AXCP solution for automated production, protection and distribution of content with DRM. This solution allows the reduction of costs for content post-production and management for DRMed distribution. In this case, the DRM technology 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, etc.).

The AXCP allows (i) producing content on demand on the basis of final user profiles (device, network, etc.); (ii) producing licenses on demand for pay per play and new subscriptions; and (iii) managing black lists of terminals and/or users.

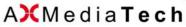## AXMEDIS Tools for your download

AXMEDIS Tools can be downloaded from http://www.axmedis.org

- Available PC players, AXMEDIS stand alone PC player; AXMEDIS Skin based PC player; AXMEDIS Active X, for usage into HTML pages and simple VB and/or .NET applications, AXMEDIS plug in for Mozilla Firefox 2 and 3.
- o AXMEDIS Mobile: (i) PDA Windows Mobile 5 and 6 player, supporting: SMIL, HTML, MPEG-4, video, audio, documents, images, etc.; Java based fro mobile phones.
- o Many other production tools of AXMEDIS from.

AXMEDIS Technical Notes

On http://www.axmedis.org you can find a set of other technical notes on:

- o How to integrate the AXMEDIS DRM into a e-Commerce portal for digital content
- o The show case of TEO (Telecom Lithuania) in adopting AXMEDIS DRM into their VOD service to STB based on Kreatel
- o The show case of ELION (Telecom Estonia) in adopting AXMEDIS DRM for content distribution service towards PC
- o The show case of EUTELSAT in adopting AXMEDIS for satellite data broadcast of AXMEDIS content towards PC and STB
- o The show case of TISCALI in adopting AXMEDIS Model, P2P and DRM for content distribution service towards PC.
- o The show case of ILABS in adopting AXMEDIS solution for the automated production of content and distribution towards PDA and java enabled mobiles
- o The show case of BBC in adopting the AXMEDIS tools for distributing content that is created on the user side by recoding free on air DVB-T and integrating additional content and information coming from internet and AXMEDIS P2P.
- o The show case of TI, Telecom Italia, about the usage of AXMEDIS as back office management and interoperable platform among AXMEDIS MPEG-21 DRM and OMA
- o The show case of SIAE for content collection from the users.
- o The show case of VARIAZIONI about the usage of AXMEDIS DRM for content enrichment and distribution, mainly video, images and audio, etc.

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