Automating Production of Cross Media Content for Multi-channel Distribution

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AXMEDIS-ELTEO Requirements

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Abstract: this part includes the description of conceptual business model for applying AXMEDIS Framework in IPTV and broadband PC environments and possible use cases and scenarios, and includes AXMEDIS-ELTEO Demonstrator architecture and specific requirements

Keyword List: IPTV, Middleware, DRM, ADSL, B2C network, STB, VOD server, P2P, Headend, video network, asset management, content storage

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1 Executive Summary and Report Scope

TEO is responsible for the completion of the present document. Other technical partners (KTU, Elion and VRS) have also provided their contributions.

TEO and Elion are major providers of telecommunications services in Lithuania and Estonia. The two Telcos operate country-wide IP networks, providing broadband internet, IPTV and VoIP services. The companies have joined AXMEDIS project as partners and are interested in adopting the AXMEDIS Framework by integrating a working AXMEDIS solution into TEO IPTV and Elion's internet multimedia platforms. Non-telco partners Kaunas Technological University (KTU) has a wealth experience in developing commercial middleware solutions, and VRS is a local media content producer and aggregator.

This document describes the business context of the two operators, which are dealing with several distribution platforms (broadband over DSL, IPTV and mobile) and a disparate array of proprietary tools and media formats. It then sets the stage for conceptual business model that AXMEDIS Framework could enable, should major issues and limitations (technical, commercial, political) be lessened or removed. New set of specific real-life user scenarios and AXMEDIS use cases have been identified through our research, a knowledge that can enhance certain areas and/or functionalities of the AXMEDIS Framework and be useful for further AXMEDIS compliant IPTV implementations. The document describes a number of hypothetical user scenarios for IPTV environment, as well as revenue models most suitable for PC and IPTV platforms. Since the project scope is limited, only a basic functionality and limited number of use cases have been chosen to create an AXMEDIS demonstrator.

This document then specifies the demonstrator's architecture and specific use cases to be adopted by both demonstrators, it sets the requirements for specific system components, such as VoD portal and VOD servers, Middleware, set-top-box, storage requirements, requirements for QoS and access network and asset management infrastructure (digital asset protection and management).

Functional and business requirements for TEO and Elion demonstrators are also specified, in terms of user and provider requirements for the system functionality, and revenue models point of view. This document is a prerequisite for creating system and new development component specifications.

By creating requirements and specifications and eventually integrating AXMEDIS Framework into our Partners IPTV and PC delivery systems, as well as into content production environment of an SME, the partners will create new knowledge in the IPTV-specific area of content management and delivery for streaming environment.

2 Introduction

2.1 Business Context

2.1.1 Business context for 2 Baltic Telco's: TEO (Lithuania) and Elion (Estonia)

TEO and Elion are both owners of IP core and access networks in Lithuania and Estonia, besides traditional POTS services providing broadband access and IPTV services to their customers.

Broadband internet penetration in Lithuania has been rising rapidly and by the end of 2006 reached 26%. By the end of 2006, TEO had approximately 5,000 IPTV and 165,000 broadband subscribers. In its quest to offer value added services to its customers, TEO operates its own internet multimedia content portal Zebra (www.zebra.lt). TEO IPTV service was launched in October 2006, offering 40 linear broadcasting channels and several premium channel services as add-on packages. A number of interactive applications have been launched since beginning of IPTV service, including IPTV-ready portal, e-mail capability on TV, and enhanced EPG. Future plans include offering near-VOD services and eventually true VOD, with more interactive applications planned further down the road.

Elion is a member of Estonian Telecom Group, with its parent company owning a mobile subsidiary - EMT (Estonian Mobile Telephone). Both companies (Elion and EMT) are developing multimedia services, mainly in 3 areas:

1. IPTV over ADSL with MPEG-2 Amino STB-s (Elion)
2. Windows Media based service for PC over Internet (Elion)
3. H.264 service for 3G networks and mobile clients (EMT)

IPTV service is available in Elion ADSL network and it provides typical TV and VOD services to residential broadband customers. There are several channel packages available (85 channels in total), also radio channels, EPG etc. Middleware is made in house and also integration is done with Concurrent VOD servers and Widevine CAS/DRM. IPTV service was launched in April 2006 and it was very successful – Elion signed up 25 000 customers during 9 month of 2006.

Elion has garnered a lot of experience also with Windows Media based applications. First VOD service portal iTV was launched already in 2003 in cooperation with biggest state owned TV channel ETV who has biggest archive of national TV and movie content. Now this service is renamed as ETVPLUSS (www.etvpluss.ee).

Elion`s "sister company" EMT is developing streaming media services over mobile network (3G). Streaming video service "Mobiil-TV" is available in EMT network and more content will be added in cooperation with national TV companies.

Elion has been committed to provide best possible multimedia solutions to its clients since the year 2000, when Multimedia service department was formed to provide streaming solutions over internet and first live event broadcasts were started using Real Media. Each year the

platform was revised to match technological progress and to extend platform reach. Here is a quick overview of project's progress over the years:

- 2002 Technology is swapped to Windows Media. First ever live internet broadcast is made out of Eurovision Song Contest. Elion uses first time the mixed streaming delivery system allowing both unicast and multicast delivery. Platforms serves 3500 concurrent unicast streams and over 150 000 multicast sessions.
- 2003 ITV.EE video rental service is launched. In co-operation with national TV channel and content producers we launch first online video rental service for local content where Estonian people can rent content from movies to TV series and watch them real time. Project uses Windows Media platform with its DRM technology as well as Microsoft.NET as basis for service environments. Since format is based on client needing at least 1500 Kbps line the access to service is limited at start up.
- 2004 ADSL technology boom allows removing access limitations on ITV.EE as broadband speed and availability skyrockets across the country. Service model is revised, opened up and extended at the same time local radio stations are starting to make switch in broadcasting model and are being housed from our streaming platform.
- 2005 Service model is yet again extended by allowing more payment channels to be included in the platform.
- 2006 launch of IPTV project. Due to standard conflicts integration of old content is not possible as such IPTV and multimedia platform continue as two parallel media solutions. ITV.EE is reformed in co-operation with national TV channel as ETVPLUSS.EE; website is renovated to use new more open technologies including flash video technology.

No small goal is also integration of IPTV as a channel into Elion's media platform, in a quest for making Elion's media capabilities more streamlined and unified. As such Elion is facing a technological challenge of having three totally unique delivery channels with each of them needing different approach. Since joining the AXMEDIS project Elion has seen a way to ease the content production and distribution challenges and make one more unified approach to it in both conversion and DRM.

In the longer run, TEO and Elion intend to position themselves not only as content delivery platforms but inevitably as a 'content aggregators' in the delivery of quality programming. In simple terms, currently, the two Telcos provide the access, security and CPE and cover the end user relationship for billing. In the short term, they are taking a 'transparent' broadcast and on-demand strategy with a multiple content providers' partnership approach, providing a 'delivery' type service, with content providers setting prices and release dates. However, the ultimate objective is that in the long run, the two Baltic Telecoms will 'indirectly', and in partnership with current content providers, be involved in the actual acquisitions and content production. At the same time, with the increasing degree of customer independence over the choice of the type, timing and cost of content, TEO and Elion will offer solutions that enable the end-users to easily obtain and share affordable content, including content produced by the end-user himself.

As content distributors today, TEO and Elion are dealing with a disparate array of proprietary tools and media formats, and are often forced to retrieve/request transformed content for their respective distribution platform, often requiring massive parallel or overlapping duplicated effort on the part of content producers. This results in low availability of quality content, and good content is expensive and inaccessible due to lack of interoperable access management tools. Adoption of MPEG 21, a standard aimed at improving systems and applications

interoperability, is particularly relevant for players operating multiple platforms, as is the case of the partners of Baltic Telcos.

AXMEDIS Framework with its objectives of reducing the costs of cross media production and distribution, providing algorithms and tools for innovative and flexible Digital Rights Management, and through MPEG 21 achieving interoperability between systems and applications, is a Framework that appeared to be in line with Baltic Telco's above objectives on embarking on interactive media quest.

After detailed analysis of AXMEDIS Framework, both operators hope that the potential widespread adoption of the Framework in Europe should foster and enable the creation of new functionality, new solutions and new products in the emerging new world of interactive television. Users will be able to view additional data related to the content, select from a menu of video feeds, interact in a show with other viewers of the program, and initiate transactions of goods or services featured in video programming.

Interactive TV enables the service provider to offer many personalized interactive services. Individual and multiplayer games, additional program suggestions to the subscriber based upon their previous viewing, and access to supplemental online content to support a video stream (such as player statistics for a sports event shown in a separate window) form the basis for a more customized video experience.

IPTV should dispense with broadcast concepts such as a daily schedule or other time-oriented parameters for video content. Instead, IPTV focuses on titles, directories, descriptions, ratings, and promotions as the commercially relevant attributes of a video stream. In this sense, IPTV operates more according to the principles of retailing than it does to broadcasting.

In addition, IPTV paradigm challenges many of the precepts that underpin traditional advertising, such as the 30-second spot included in a broadcast TV schedule. The rich interactivity and community applications enabled by IPTV platforms offer advertisers and sponsors new scope for targeted advertising.

2.2 Scope

2.2.1 Project Objectives

Project objectives address the tasks within the first and second topics of the AXMEDIS Call for Take up Actions, specifically:

1) the application of the AXMEDIS framework and tools to support IPTV and internet (PC) distribution channels, in order to make evident interoperability of content and tools between different AXMEDIS distribution channels and tools (PC, STB, portable video player), and

2) application of AXMEDIS framework to support coordinated production, aggregation of cross media content, by collaboration of vertically integrated actors in production and distribution value chain.

The demonstration activities will focus on integration of AXMEDIS Framework into IPTV infrastructures of the two Telcos, the setup and operation of a prototype distribution channel of AXMEDIS objects (primarily video) via PC and STB. Through the involvement of an

SME, AXMEDIS tools will be applied in the content transformation and modeling process in order to integrate this content as part of the Telco's IPTV demonstration.

The objectives of the Baltic AXMEDIS Demonstration Project (ELTEO) are:

No.	Objective	Measure of achievement/verification
1.	Through detailed analysis of AXMEDIS Framework and tools, obtain expertise in AXMEDIS and pioneer its application in Baltic Telco's IPTV platforms in two separate national markets (Lithuania and Estonia)	4 teams of engineers and non-technical staff in each project partner organizations having working knowledge in AXMEDIS framework and tools.
2.	Develop a conceptual business model for AXMEDIS object distribution via two specific IPTV platforms in Lithuania and Estonia	1. Report on the conceptual business model will be produced Part of this Deliverable). 2. Specifications for integration of AXMEDIS tools into IPTV value chain, as well as 3. Specifications for development components will be completed
3.	Apply and integrate the AXMEDIS framework and tools by creating integrated Prototypes in the two Baltic Telco's IPTV platforms, to support the diverse functionality in IPTV distribution channels.	Two integrated AXMEDIS prototypes developed in the two Baltic Telco's IPTV platforms, supporting functionality as specified in the objectives.
4.	Apply the AXMEDIS tools in the content modeling process of an SME, and integrate this content as part of TEO IPTV service offering.	Project partner VRS Grupe, as content aggregator, will demonstrate the application of AXMEDIS tools in the content adaptation and modeling process and integrate this content into TEO IPTV service offering as a trial service.
5.	Become the AXMEDIS Excellence Centers in our respective countries (Lithuania and Estonia), as well as in the Nordic region.	Through a) creation of a body of knowledge in two largest national Telco's in Lithuania and Estonia and b) undertaking dissemination of knowledge in the region, two AXMEDIS Excellence Centers will be created in these countries.

By applying the tools of the AXMEDIS framework, we intend to demonstrate real-life scenarios where the AXMEDIS framework will be applied for content distribution via IPTV and Internet, with end-user employing STB and PC for viewing the AXMEDIS content.

2.2.2 List of indexes to measure the objectives

The achievement of objectives of the project will be measured as follows:

- Number of people familiar with AXMEDIS Framework and tools – TEO – not less than 10, Elion – not less than 10, KTU – not less than 7, VRS – 2.
- Number of AXMEDIS installations – 3 (TEO, Elion, VRS Grupe)
- Number of industry players in production and distribution value chain – 3 (TEO, Elion – distributors, VRS Grupe – producer)
- Number of transactions – not less than 200 from each of the providers

- Number of AXMEDIS objects produced by VRS Grupe – not less than 20 video clips
- Number of final users involved in the demonstrator – 8 for viewing of AXMEDIS content on TV via STB (in Lithuania) and not less than 30 for viewing content on PC from Elion's subscriber base (Estonia).

3 Use cases and scenarios

3.1 Introduction

The central theme of a business model for AXMEDIS content distribution via IPTV or broadband media center service is the ability of IPTV or broadband service provider to offer additional or enhanced content and content services to its clients, either as a means of earning additional revenue or as a differentiator service provided free of charge, in addition to the main offering of linear channel broadcasting (IPTV), broadband access (Internet) and other services (e-mail, internet via TV, pay-per-view, movies on-demand, etc.). It is foreseen that the potential commercial application of AXMEDIS business model in IPTV and Internet, at least from a technical perspective, could include both premium on-demand content services (i.e. movies provided as AXMEDIS objects) or auxiliary content services (i.e. public content, such as digital museum item viewing as AXMEDIS objects, or semi-professional or amateur content). Most importantly, the key objective would be to enhance user experiences as well as provider business opportunities not only by providing more quality and quantity, but also new business associated with **interactivity** discussed in Business Context.

The most immediate possibility of **adopting AXMEDIS is for the purpose of enhanced video on demand (VOD) service**. AXMEDIS object model with its digital resources (provided it becomes a de facto standard for the VoD value chain players) can enhance the possibilities of VoD experience by providing additional functionality typically available in DVD technology: movie language, subtitle, scene selection, trailers, embedded advertising, etc.

Another possible application of **peer to peer (P2P) sharing of AXMEDIS objects between IPTV users**. Although this functionality encompasses a number of additional requirements (such as having an expensive STB with significant memory capacity), in theory a case could be made for the user receiving and sending multimedia objects from his TV to another user's TV using AXEPTool environment. For example, my personal TV concept could be made a reality by enabling the users to upload personal video footage as AXMEDIS objects onto providers VOD servers and make it available to friends and family. In another example, a user purchases semi-professional video greeting from a content producer, modifies and personalizes the content to include personalized greeting to his friend on a birthday occasion, and sends it over the P2P network to another user's STB, for viewing on his TV. Similarly, a video greeting could be sent across a different platform– PC user.

The third area where AXMEDIS Framework could be employed to enhance distribution of digital content is in the context of the emergence of ProdUser. Subject to the widespread adoption of AXMEDIS Framework, a host of semi-professional and amateur video material currently on the world-wide-web has a real chance of becoming a critical mass of a video-wide-web, accessible on user's multiple cross-platform devices. AXMEDIS features of automatic format conversion and infinite possibilities for indexing AXMEDIS objects would make available for the user a host of special interest video material constantly produced and used worldwide.

An analysis of many potential IPTV service provision scenarios and use cases in light of AXMEDIS Framework capability was undertaken. For demonstrator purposes, a number of specific Use Cases have been chosen, which are documented further in this section.

3.2 System actors

TEO AXMEDIS demonstrator has three actors: End User, TEO IPTV Administrator and TEO VOD Manager.

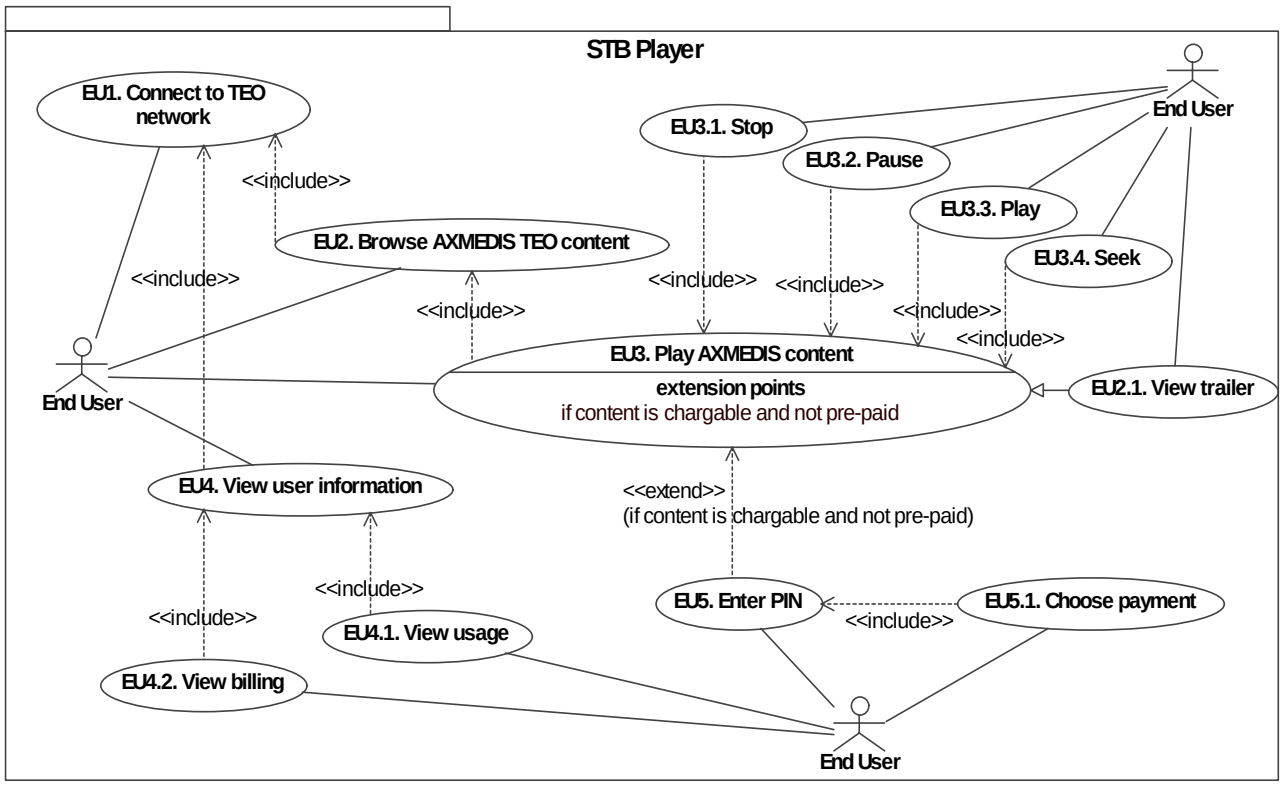
End User viewing IPTV and VOD via AXSTB Player is the key figure in the demonstrator. End User is a subscriber to TEO IPTV service, has a certified STB and is connected to IPTV network for watching AXMEDIS video content. End User interface allows the End User to browse through the local AXDB and play selected objects. If selected object is chargeable, End User is prompted to enter his PIN and choose the payment method. End User can view his usage and billing information using his AXSTB Player.

Another important actor in TEO IPTV network is TEO VOD Manager, which is responsible for content management in TEO AXMEDIS IPTV network. This actor downloads AXMEDIS objects from global AXMEDIS network and prepares them for streaming in VOD server. TEO VOD Manager downloads objects according to End User requests or to the business plan.

TEO IPTV Administrator is responsible for user management. He can add, delete and modify user information.

3.3 Use cases and scenario models

3.3.1 Use Case model describing End User actions



In this Use Case model End User actions are described. End User can:

- connect to TEO IPTV network;
- browse and see metadata of AXMEDIS video content (if video object has a trailer, user can watch it for free);
- play AXMEDIS video content:
  - stop playing video;
  - pause video;
  - continue playing;
  - seek to desired point of video;
- view user information:
  - view usage information;
  - view billing information.

The specific End User Use cases are:

EU1 End User connects to TEO AXMEDIS network
EU2 End User browses TEO AXMEDIS content
EU2.1 End User views trailers
EU3. End User plays AXMEDIS content
EU3.1 End User stops playing AXMEDIS object video
EU3.2 End User pauses playing AXMEDIS object video
EU3.3 End User continues playing AXMEDIS object video
EU3.4 End User seeks AXMEDIS object video

EU4 End User selects to view his information

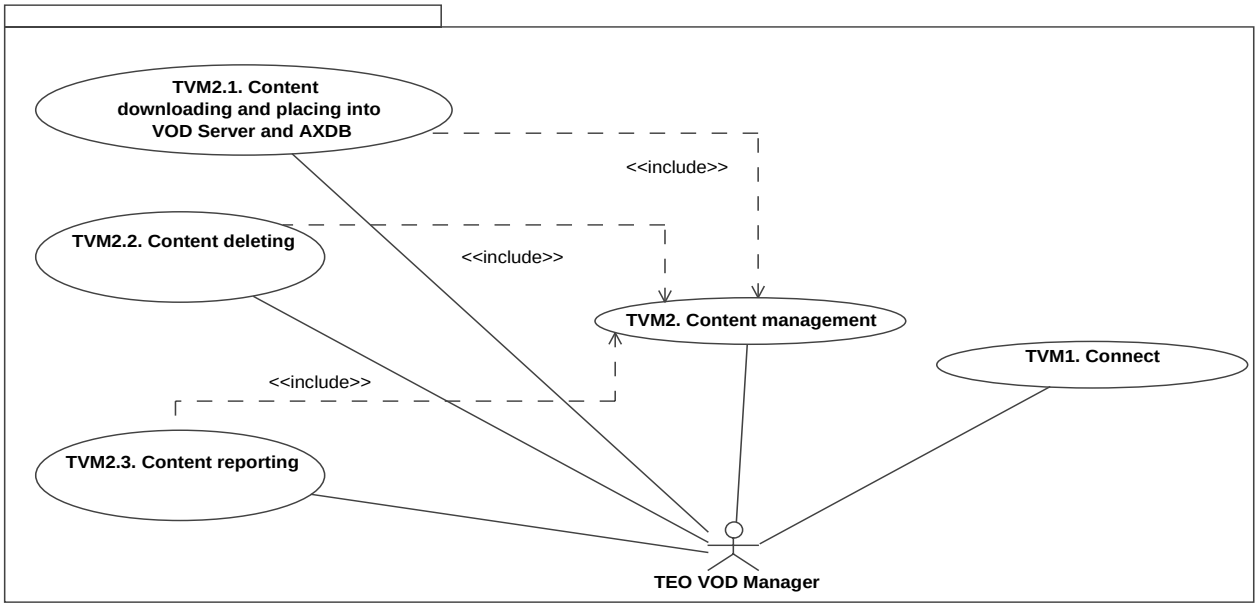
EU4.1 End User selects to view his usage information

EU4.2 End User selects to view his billing information

EU5 End User enters his PIN

EU5.1 End User chooses payment method

3.3.2 Use Case model describing TEO VOD Manager actions



In this Use Case model TEO VOD Manager actions are described. TEO VOD Manager can:

- Connect to TEO Content & User Management Portal;
- Manage TEO AXMEDIS content:
  - Download AXMEDIS content from global AXMEDIS DB, using AXEPTool and place into VOD Server and AXDB;
  - Delete content from local TEO AXDB;
  - Make and view reports about usage of AXMEDIS content in TEO IPTV network.

The specific VOD Manager Use Cases are:

TVM1 TEO VOD Manager connects to TEO Content & User Management Portal

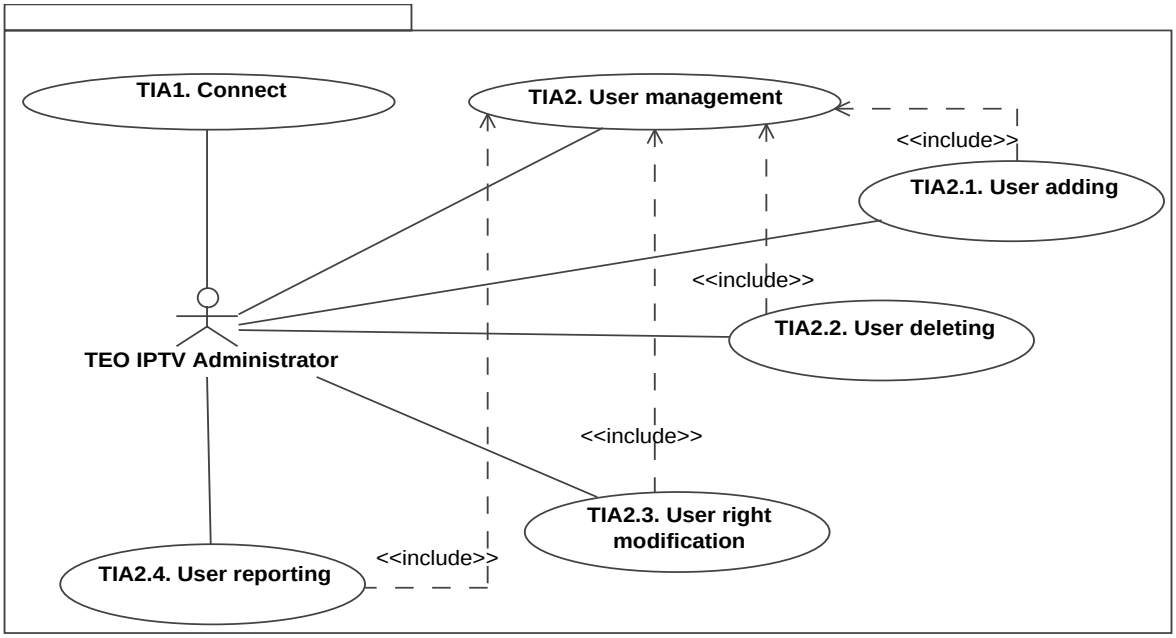
TVM2 TEO VOD Manager selects content management

TVM2.1 TEO VOD Manager downloads content from global AXMEDIS network to local DB

TVM2.2 TEO VOD Manager deletes content from local DB

TVM2.3 TEO VOD Manager makes content report

3.3.3 Use Case model describing TEO IPTV Administrator actions



In this Use Case model TEO IPTV Administrator actions are described. TEO IPTV Administrator can:

- Connect to TEO Content & User Management Portal;
- Manage TEO AXMEDIS users:
  - Add user to TEO AXMEDIS DB;
  - Delete user from TEO AXMEDIS DB;
  - Set user rights to use AXMEDIS content in TEO IPTV network;
  - Make and view reports about user actions in TEO AXMEDIS DB.

The specific IPTV Administrator Use Cases are:

TIA1 TEO IPTV Administrator connects to TEO Content & User Management Portal
TIA2 TEO IPTV Administrator selects user management
TIA2.1 TEO IPTV Administrator adds new user
TIA2.2 TEO IPTV Administrator deletes user
TIA2.3 TEO IPTV Administrator modifies user rights
TIA2.4 TEO IPTV Administrator makes user report

3.4 Revenue models

3.4.1 B2B revenue models

AXMEDIS compliant IPTV system should enable content producers, aggregators, distributors content administrators (and in certain cases, even the User) to negotiate and implement the following automatic payment schemes for content with the content producer or another distributor:

- Revenue share, where distributor pays the content provider a percentage of revenue from each object sold;
- Access fee based, where provider negotiates a fixed fee for the distributor's ability to access defined content within a defined domain.

3.4.2 B2C revenue models

3.4.2.1 Elion revenue models/payment channels

A number of mechanisms could be implemented for the payment at point of sale from the internet PC user (e.g. credit cards, SMS, premium rate telephony, etc), regardless of which service provider the user is using for access. Elion distinguishes the following revenue models/payment channels for its multimedia services:

Bank transfer

This payment method allows making a payment over internet banking solution. Three commercial banks in Estonia currently support this function.
Procedure itself is quite simple; after desired media is chosen user clicks appropriate bank logo, enters the internet banking solution where a transfer form is shown then user confirms the transfer and clicks on the link that sends him back to our billing interface witch then issues the DRM ticket for the media.

Mobile payment

Mobile payment is hybrid between bank and post pay services. In basics the charge is added to user's mobile phone service bill in similar way as the banking charge is done, main difference is that instead of confirming internet form user is required to call a certain phone number to make the transaction.

Mobile payment is also only payment available to a user when using the service over the mobile device.

Elion pricing model

Pricing model and behaviour patterns on PC device are as follows:

- Flat fee from 0 to x EEK, price is integral number, freely definable by administrator
- 24 Hour licence on purchase, user can stream media unlimited times during that period but is limited to use the pc, installation and account what was used for licence purchasing.

3.4.2.2 TEO revenue models/payment channels

For TEO IPTV services, pay-per-media to non-subscriber solutions are impractical to implement, because only provider service subscribers can be activated within the network, specific equipment (IPTV compatible modem and STB) issues are also at play. These

payment solutions are also rarely economical to implement until large economies of scale are achieved.

Because IPTV service provider already has a model of monthly billing system, all on-demand payTV content transactions can be aggregated, itemized and provided to the user for payment as part of a monthly bill.

Revenue from content distribution to consumers could be earned based on three basic models:

1. Advertiser pays to the distributor for ads shown to consumers;
2. Consumer pays to the distributor for paid content; or
3. A combination of the two.

TEO pricing model

An example pricing/payment scenario could be as follows. Before the user views a piece of video content on demand (or at the point of replay), he is given the choice of different pricing models or other incentives to watch this content. These could include:

- watch for free, but also view 5' non-skippable ads embedded into a piece
- Pay EUR 1 but watch 2' non-skippable ads before the start of the programme
- Pay EUR 2 and watch the movie with no ads.
- Buy a "special" version of a programme (such as the director's cut of a movie) by agreeing to watch non skippable adverts.

4 System Requirements

4.1 TEO System requirements

4.1.1 General System Description

4.1.1.1 System context

TEO AXMEDIS content distribution system will be based on integrated content distribution value chain relationship between AXMEDIS content producer VRS and content distributor via IPTV channel – TEO. The development of architecture of the TEO Demonstrator and specifications for integration of AXMEDIS into IPTV will follow the logic of distinct yet inter-related components of IPTV infrastructure (see Figure 1): end user applications, middleware, servers, asset management systems, data and content storage systems, video network infrastructure and finally backbone and access network infrastructure.

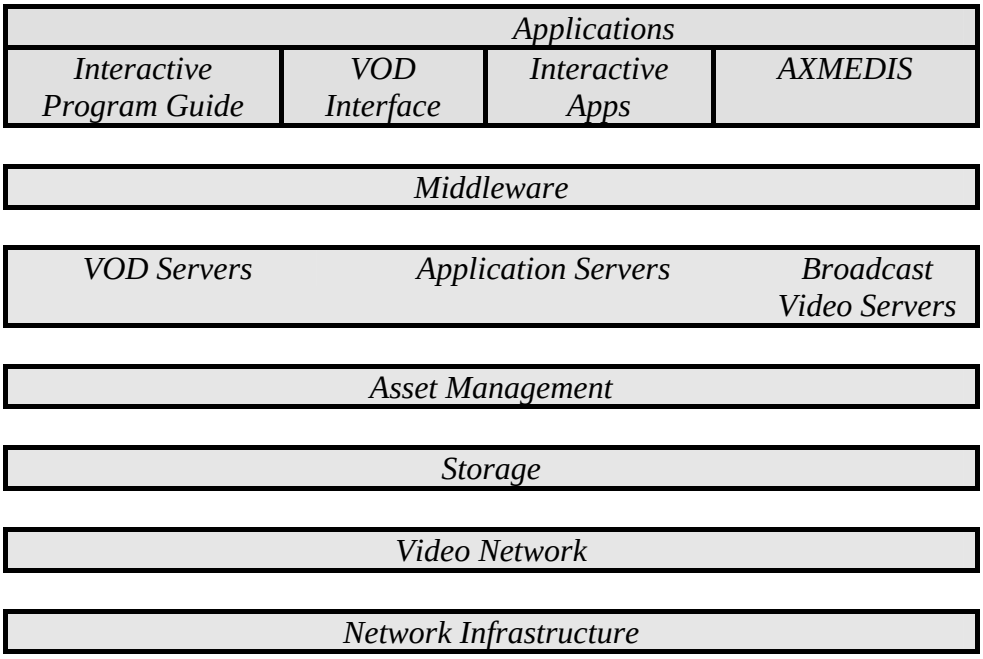


Figure 1: IPTV architecture value chain

Requirements for all of these major components are detailed further in this document.

4.1.1.2 System Architecture and Components

The objective is to bring architectures of the provider systems (VRS, ELION and TEO) in line with AXMEDIS Framework and implement the necessary components to achieve the desired functionality. TEO system will require development of certain new components, specified in Specifications Deliverable.

The users of the IPTV system will be:

- **End users** of IPTV services having STB with AXMEDIS STB Player installed;
- **TEO VOD Manager**, working in accordance with B2B model. The administrator works with AXEPTool system, by making queries (see Figure 2) in the AXMEDIS network for the necessary video and audio content. Having located the needed content, he places it in the TEO VOD server, while the respective metadata (descriptors, DRM info, etc.) is placed into AXDB database, with the help of Content downloader P2P client, to be developed as a new component;
- **TEO IPTV Administrator**, who administers the system, implements introduction of new services, and performs user administration, reporting and billing.

Here below on Figure 2 is shown the basic structure for AXMEDIS content distribution toward IPTV network that will be detailed in the following chapters.

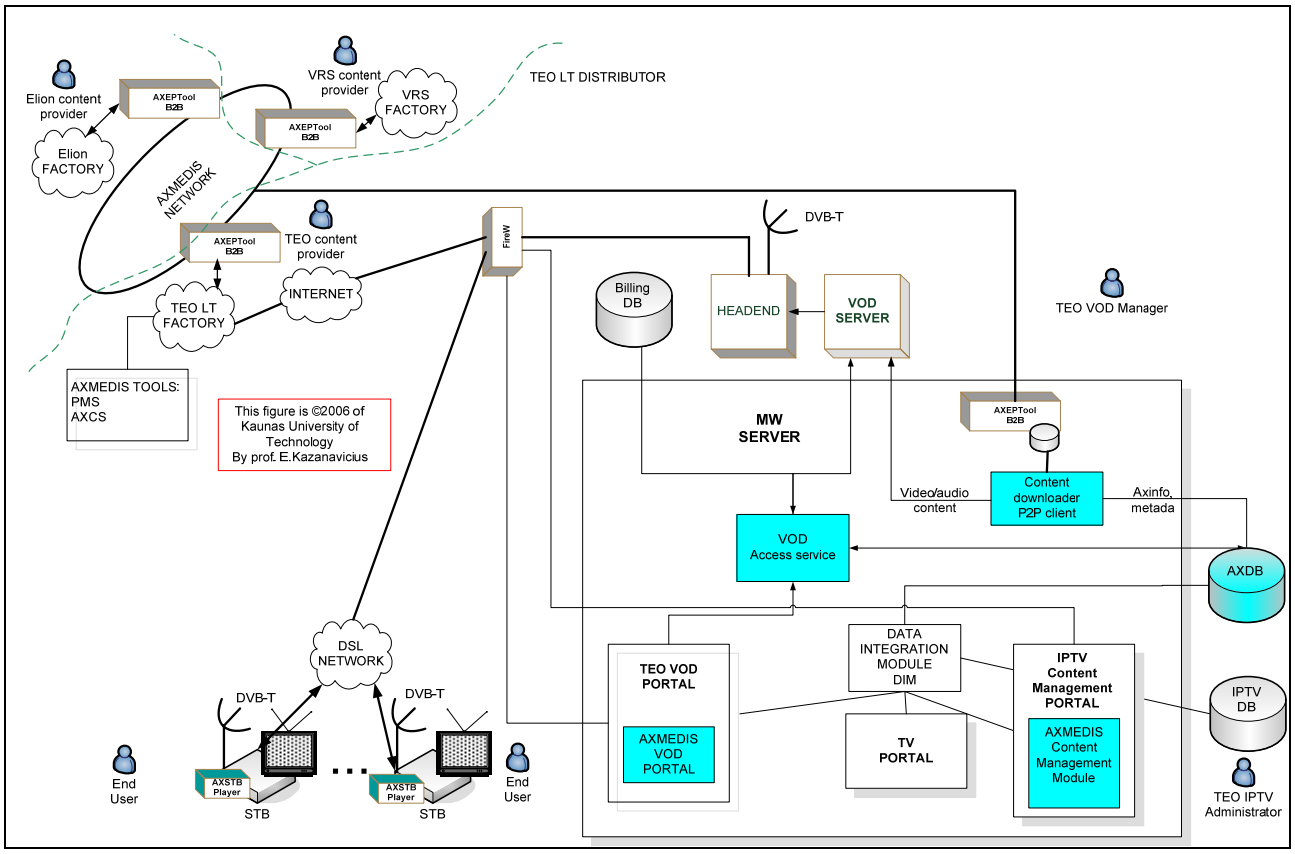


Figure 2: AX-ELTEO Demonstrator architecture (development components are depicted in blue).

TEO IPTV system is comprised of (see Figure 2):

- MW server and related components, as follows:
    1. Database of the content management system IPTVDB and newly created AXMEDIS metadata base AXDB and system management web-services, as well as their data integration module (DIM).
    2. TV Portal (TEO Middleware server)
    3. AXMEDIS VOD PORTAL (part of Middleware server), to be developed on TEO Middleware platform
    4. AXMEDIS Content Management Module, to be developed on IPTV Content Management Portal platform
    5. VOD access service – selection of designated video content and transport initiation service. VOD access service with the RTSP protocol adopter to be developed, will be exploited as an abstraction to VOD server.
    6. AXEPTool B2B module for connecting Middleware server with AXMEDIS NETWORK and downloading AXMEDIS data from it.
    7. Content downloader P2P client, for placing downloaded AXMEDIS object to VOD server and updating AXMEDIS object metadata and placing it into AXDB.

- VOD SERVER – VOD content storage server.

- Headend server – IPTV content distribution and broadcasting server, used for transferring MPEG-4 designated content via TCP/IP or DBV-T network.

IPTV DB stores information about clients, services and accounting information. Content administrator and program manager is using IPTV Content management portal, which enables him to place multimedia into content storage.

AXMEDIS STB player will be integrated into IPTV portal as a plug-in for playing AXMEDIS content. Clients will connect to TV Portal through the internet browser. The portal provides content search, retrieval, VOD and IPTV broadcast services. The purpose of **Middleware (MW) Server** is to enable services in accordance with end user equipment format, as well as provide authentication, authorization and rights management capability. One of the main functions of this server is the provision of information to the client via STB and through embedded STB Internet browser.

4.1.2 Requirements for TEO system components

4.1.2.1 Requirements for VoD Portal in Middleware server

VOD portal will be developed as a part of existing Middleware server, which is currently used for GALA IPTV network in TEO. When STB is turned on or User presses Home button on remote control, STB connects to Middleware homepage, which is the front door to all possible functions in GALA IPTV. AXMEDIS button (see Figure 9) will drive User to VOD portal, where user can browse, search and play AXMEDIS object content, as described in paragraph 5.1.3 (AXMEDIS STB User Use Case).

VOD portal will be created using standard Microsoft Windows 2003 platform components. Portals will be developed using Microsoft .NET framework technologies ASP.NET, ADO.NET and MS-SQL. For integration with other CRM and billing systems, web-services and integration module and DIM module will be used.

All screens in VOD portal server must be developed to be correctly displayed on a TV set using PAL standard 720x576 pixels. Working place in this screen must use only 90% of picture, because TV set could cut this picture. Working panel in this picture must fit in 460x480 pixels. Pin code window and all others popup windows must be developed to apply 500x108 pixels.

4.1.2.2 Requirements for VoD Server

For AXMEDIS Demonstration purposes TEO requires for VoD server to stream Video or Audio content from AXMEDIS objects to STB's. VoD system hardware and software should be based on modular design enabling extension and functional adaptations without structural changes or replacement of important parts of the equipment. Systems software upgrade should not change the existing formats or interface specification(s). All licenses for software/hardware usage must be included with VoD server with appropriate usage rights.

The VOD system shall be compatible with existing network resources (Kreatel Application platform). The VOD system has to be capable of streaming DVB-CSA encrypted streams. In

addition, VOD server response time must be predictable; the server should support a large scale of simultaneous streams (up to 50 for demonstration purposes).

There are a list of additional hardware, software and streaming requirements for VoD server:

General requirements for software:

- The software should be based on newest software generations which are implemented and available in the market;
- System software should be based on modular design enabling extension and functional adaptations without structural changes or replacement of important parts of the equipment.

Supported protocols:

- IPv4 (IPv6 support, optional)
- TCP
- UDP
- RTSP (pause and seek functions required, other – optional)
- ICMP
- DHCP

Supported media formats:

- MPEG-2 (MP@ML, MP@HL)
- H.264 (MP@L3, MP@L4, HP@L4) support is optional
- CBR & VBR

The demonstration VOD system must support MPEG-2 Transport Streaming over RAW UDP socket. VOD server has to be capable of streaming scrambled video and audio content, for this purpose special transport frames containing MPEG Program Clock Reference (PCR) will be left unscrambled. VOD server has to use this information for clock synchronization and accurate streaming. The packet jitter cannot exceed 250ms limit. VOD server has to support streaming of both MPEG-2 and MPEG-4 video content encapsulated in MPEG-2 Transport Stream. Demonstration VOD system has to support RTSP protocol for streaming session control.

The test server in accordance with the above requirements will be developed by TEO and KTU. This server will be based on some freely available solutions such as Videolan player.

4.1.2.3 Requirements for Middleware

Gala TV middleware solution is an in-house solution developed by TEO engineers. The middleware is developed on Microsoft .NET 2.0 technologies. It is a HTML based solution which utilizes Microsoft ASP.NET and AJAX.NET technologies. Key features of Gala TV middleware:

- Portability – since Gala TV is based on HTML, JavaScript and ANSI C++ technologies it is portable across different provider STBs.
- Motorola VIP-15xx and VIP-17xx series STB support
- Easy integration with third parity systems – middleware provides open interfaces and utilizes XML web services. IPTV Integration Agents technology enables smooth

integration with third parity transaction processing systems and ensures data consistency without need of proprietary distributed transaction controller.

- Subscriber management system allows tracking of users, subscriptions and their network equipment. The system is integrated with TEO Network Information System.
- Component based IPTV portals development framework provides basic building blocks for end-user portals. Framework enhances component reuse which reduces the system development time.
- End-user self service functionality. Users can subscribe to different channel packages, individualize the order in channel list, and lock selected channels from children.
- EPG service is integrated with several local EPG content providers. TEO provides EPG for one month ahead which is automatically updated each 12 hours.
- Periodic job management system allows to hot-plug new IPTV modules without the need of middleware upgrade with zero-downtime. All jobs are monitored and their status is reported through Management Portal, SNMP or SMTP protocols.

Gala TV middleware is deployed in Windows 2003 Cluster. All session data is synchronized between nodes and in case of one node failure the failed services are migrated to other nodes. End-user and other systems do not experience any service interruption. The cluster is based on HP servers and storage solutions.

The key requirements for successful integration of AXMEDIS Framework Demonstrator for Middleware are as follows:

- The Middleware should enable integration with AXEPTool.
- Middleware should enable customization of its components for AXMEDIS demonstrator
- Middleware should have a suitable and enabling Graphical User interface for IPTV Administrator and TEO VOD Manager ;
- Middleware should enable integration of newly developed AXMEDIS components.

4.1.2.4 Requirements for STB

General requirements

For AXMEDIS demonstration purposes requirements for STB's are as follows:

- Widely accepted, deployable in commercial environment, affordable to the consumer
- Integrate able with GALA IPTV solution
- Functionality development should be possible with ADK (application development kit), but without the proprietary SDK (software development kit)
- Technical documentation and support should be available from the manufacturer/distributor

When considering the choice of end user STB device for interactive TV applications, the scope of interactivity is a function of processing memory and storage space available on the STB. The higher the processing memory and storage capacity of the STB, the more expensive and complex it becomes, making deployment of narrow interest services

unfeasible. Therefore, the objective is to find solutions for an STB that is used in massive deployment of traditional IPTV services.

Specific requirements

- Support of MPEG-2 and MPEG-4 TS over IP streaming;
- STB should support media player APIs and RTSP protocol for streaming;
- Porting of AXMEDIS tools should be possible on the STB, i.e. STB should be Linux based since AXMEDIS tools are Windows/Linux-based;
- STB must be integrateable with VoD server, from which the stream will be performed.
- STB has to support hardware DVB-CSA descrambler for decrypting MPEG Transport streams
- STB should support and integrate with commercial CAS & DRM system (e.g. Conax), for protecting Video and Audio streams over the network.

After detailed analysis of available STB technologies, undertaken by TEO, Elion and KTU in WP4, Research on enabling technologies, two STB options for the TEO demonstrator were identified:

- Motorola/Kreatel STB.
- PC-based x86 experimental STB.

Kreatel STB

This hybrid IPTV/DBV-T STB (See Figure 3) is successfully used as a commercial solution by TEO since the launch of its IPTV services.

Figure 3: Kreatel Set-top-box

This STB already supports CAS for encryption of the transmitted stream. However, a number of issues have been identified during the analysis and research:

1. AXFW porting to Kreatel STB may be complicated:
    - Kreatel development tools provide GNU C++ compiler 3.6 which is strict to C++ standard violations.
    - Some portions of AXOM violate C++ standards and does not compile with latest compilers
2. The AXMEDIS code has multiple C++ coding styles
    - It is very difficult to adapt headers to the C++ standard, since two coding styles are used. Intervention to AXFW source code and manual harmonization of coding styles is needed.

3. The basic AXOM library size is at least 35 MB, which is too large for embedded environment. Code optimization and removal of unnecessary parts will be required.

A number of working solutions are being tested to address these issues, and additional efforts are needed to review AXFW code porting to possibilities to Kreatel STB.

If during the analysis it turns out that commercial STB is not suitable for the AXMEDIS demonstrator, custom experimental x86 based STB will be considered as an option. KTU has developed a prototype of IP STB boards. This STB is based on x86 1GHz CPU with 256MB of RAM at minimum. This STB developed with Linux based OS and can be developed with Hard disk. There are also included Hardware MPEG2/4 playback and AES, 3DES hardware accelerators. This STB has no big hardware limitation as Kreatel.

After analysis of available STB options, the Kreatel 1720 STB was chosen. The facts that supported the decision were:

- The issues with AXOM module are more related to the usage of different compilers. Those issues may be solved by fixing incompatible parts of code. Some work has been already done by MBI, however, several open compilation problems left.
- After code optimization and striping of debug symbols, the AXOM size was reduced to less than 4MB which is reasonable for Kreatel STB.
- STB has built-in hardware DVB-CSA descrambler which makes usage of protected AXMEDIS object resource streams feasible.

4.1.2.5 Storage requirements for server applications

The server applications are introduced into Microsoft Windows 2003 platform servers. Windows Media Services package is installed into VoD and IPTV application servers. Microsoft ASP.NET server is needed for Web-services and other components.

AXMEDIS compliant VoD and IPTV services will be created using standard Microsoft Windows Media Services technologies, which are acquired together with Windows 2003 platform. Internet portals and middleware server will be developed using Microsoft .NET framework technologies ASP.NET, ADO.NET and MS-SQL. For integration with billing systems, web-services and integration module based on Microsoft BizTalk and DIM module will be used.

The main storage will be required for VoD server to store AXMEDIS audio/video content. For demonstration purposes VRS group will prepare 20 clips approximately 5 minutes long in MPEG-2 format. These clips will be prepared in MPEG-2 format and optimized for STB with encoding speed 4500 Mbit/s. For this reason VoD Server will require a minimum 10 GB disk space for demonstration purposes.

For any commercial deployment, VoD server storage requirements will need to be dramatically larger. VoD storage for 1 hour video for different formats is presented in Figure 4 below:

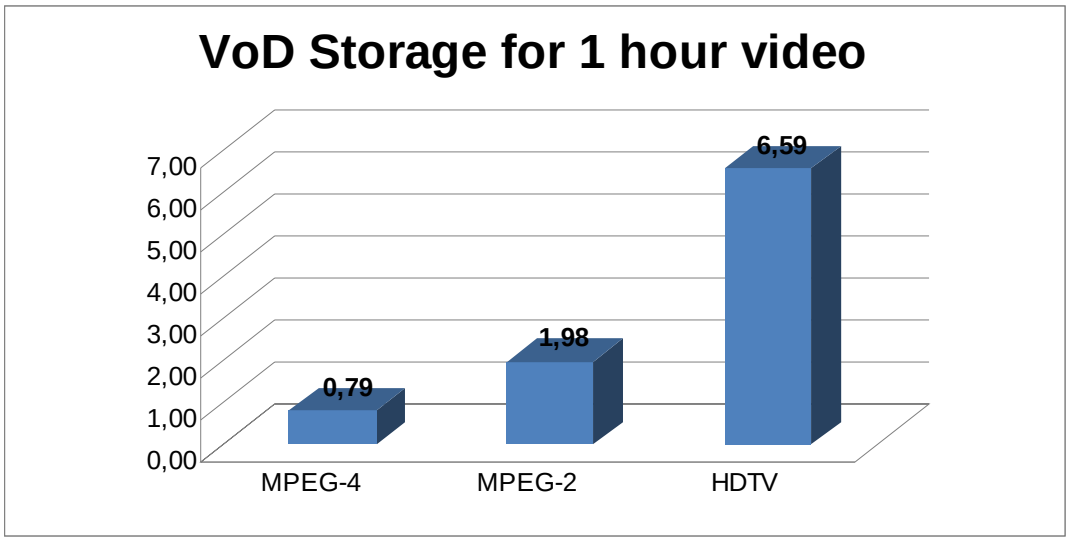


Figure 4: VoD storage requirements for 1 hour of video material

4.1.2.6 Storage requirements for client applications

AXMEDIS Player (or client application, which will be installed in STB) will be developed for Set-top-box by Porting AXMEDIS Player onto an STB. The storage requirements will depend on compiled code, which will be determined later. It must be noted, that STB's hardware limitation could limit the functionality of AXMEDIS player, which potentially is among the key challenges for AXMEDIS suitability for mass-market IPTV environment. See paragraph 4.1.2.3 (Requirements for Middleware) for details.

4.1.2.7 AXMEDIS STB Player requirements

The AXSTB Player will be developed for porting onto the Set-top-box. Functional requirements for the AXSTB Player are as follows:

- Should have an attractive user interface integrated with GALA TV screenshot system;
- STB Remote control enabled user functionality;
- Should enable the user to Play, Stop, Pause and Seek the digital content being played;
- Digital formats to be supported by the AXSTB Player:
  - MPEG -2
  - MPEG -4.

STB's hardware limitation could limit the functionality of AXMEDIS player. The STB storage requirements will depend on the compiled code, which will be determined during the development stage.

AxSTBPlayer is a STB player which has to be developed. This player shall utilize AXOM to access the AXMEDIS object residing in TEO AXDB by providing AXOID. In TEO AXDB the AXMEDIS object metadata and stream information (AxStreamResource) have to be stored and the MPEG-2 TS resources must be excluded due to storage efficiency.

AxSTBPlayer has to access AxStreamResource in AXMEDIS object via AXOM so that protection processor is executed to deprotect the object according to the issued license by

AXOM. If the user has bought the object and has valid license, AxStreamResource is decoded from object and AxSTBPlayer gains access to the following information:

1. Elementary audio/video streams composing MPEG-2 Transport Stream
2. How to access MPEG-2 Transport Stream
3. Hardware DVB-CSA Descrambler Control Words for each Elementary Stream

Therefore AxSTBPlayer can initiate the streaming of AXMEDIS Object MPEG-2 TS resource other network towards STB. AxSTBPlayer has access to utilize the hardware DVB-CSA descrambler via Hardware abstraction layer and setup hardware to process required streams by providing adequate descrambling Control Words. After initiation of MPEG-2 TS streaming from VOD server, STB starts receiving live scrambled video/audio stream. This stream is forwarded from multicast/unicast source element to DVB-CSA descrambler. The descrambled streams have to be fed to Hardware MPEG decoder (Media decoder) and the decoded video is multiplexed with VOD portal view and sent to video output of STB towards TV.

AxSTBPlayer has to be controlled by AXMEDIS VOD Portal which receives user's directions from remote control unit.

STB player has to utilize AXMEDIS Object Model and Manager to access and play resources. The video content reaches client STB in scrambled and untouched form. In order to be able to decrypt the scrambled audio/video content, AxSTBPlayer has to utilize AxObjectManager and protection processor to gain Control Words. Without control words it is not possible to gain access to scrambled stream data. This solution has to utilize hardware to achieve max performance and AXOM to achieve max AXMEDIS DRM compliance.

4.1.2.8 Requirements for asset management infrastructure

AXMEDIS Certifier and Supervisor is the AXMEDIS certification module that enables Content Provider and Distributor to verify, authorize and monitor the Clients and their activity. AXMEDIS Certifier and Supervisor database structure should be designed with the aim of scalable architecture capable of supporting a large amount of transactions in a short amount of time. The transactions that occur in a DRM system can be separated into two general categories based on the type of information accessed, acquired, or manipulated:

- Content Access Transactions involve direct access to or manipulation of media content or other sensitive information protected by the DRM system. Examples of content access transactions include rendering a protected AXMEDIS object, burning a copy of a protected audio track to a compact disc, or moving a protected file to a portable device. Content access transactions involve direct access to a content protection key and are performed at the point of consumption under the direction of a user. In TEO and Elion demonstrators' case, these types of transactions will be performed at the Content administrator and program manager level. This DRM functionality is not applicable to STB streaming scenario, since the user will not be able to capture content onto removable media.
- Object Transactions are transactions in which a user or system acquires or interacts with objects defined by the DRM system that in some way govern access to protected content. Such objects include DRM licenses, membership tokens, revocation lists, and so forth. One or more object transactions are usually required before all of the collateral necessary to perform a content access transaction is available. Object

transactions are typically characterized by the use of some type of communications network to assemble DRM objects at the point of consumption.

DRM systems require that both content access and object transactions are performed in a manner that prevents unauthorized access to content and creation of objects that protect the AXMEDIS content.

If centralized certification and supervision is not available from a single Central AXMEDIS Certifier and Supervisor is set up for the whole network, TEO Demonstrator will install a stand-alone distinct Certifier and Supervisor dedicated for three value chain actors in the demonstrator – TEO, ELION and VRS. It will be installed on TEO application servers.

In a commercial environment, the architecture of the AXMEDIS Certifier and Supervisor should be scalable and the internal services should be flexible to cope with large traffic for the certification and supervision of users and to allow the decentralization of some of the services in an easy and reconfigurable manner.

Most content suppliers require commercial pay-TV delivery systems (regardless of the platform) to use a reliable conditional access system at a transport level. In TEO demonstrator AXMEDIS DRM will be used.

The content must be protected from end-to-end, from the VoD server to STB. All users on STB are registered in IPTV DB. For this reason we don't need to register users with login and password. User will be registered in AXMEDIS Certifier and Supervisor on the fly and receive unique global ID, which will be stored in IPTV DB. This step is only required when logging into AXMEDIS Portal for the first time. If user is already registered, then unique global ID will be requested from IPTV DB. Every user in IPTV DB will have STB unique information and AXMEDIS global unique ID.

The process of STB Player registration in AXMEDIS is started once – upon first usage of player. If the player is not registered it will issue registration request to VOD access service which will be forwarded to AXMEDIS Certifier and Supervisor.

However, AXMEDIS DRM cannot be implicitly applied to TEO architecture. Current AXMEDIS DRM solution is oriented towards protection of downloadable content that is being played locally from user's device. TEO architecture restrictions impose that AXMEDIS object cannot be downloaded to STB due to storage limitations. Solution based on streaming object or its MPEG resources is necessary. We are proposing to use the VOD server for streaming MPEG Transport Stream resources of AXMEDIS Object.

In AXELTEO architecture VRS prepares video clips – AXMEDIS objects that contain metadata with resources. The resources are MPEG-2 Transport Stream video/audio content. First the produced content has to be adapted to streaming requirements at VRS Factory using AXMEDIS Editor or AXCP. For this purpose the AXCP MPEGTSAdaptationPlugin has to be developed. This plug-in shall perform two tasks:

- Scramble MPEG-2 Transport Stream (TS) resource using DVB-CSA algorithm. The MPEGTSAdaptationPlugin must encrypt all video and audio channels of stream and leave unencrypted frames containing Program Clock Reference (PCR) which is critical for streaming control. Each scrambled frame of transport stream has to be marked as scrambled according to ISO13818-1 standard.

- The second task of plug-in is to collect information about all scrambled elementary MPEG-2 TS streams (ES). This task associates each ES with DVB-CSA Control Word (CW) which was used for scrambling the ES. This information is returned by the plug-in as a new RESOURCE which is appended to the transformed AXMEDIS Object.

After adoption the transformed AXMEDIS Object must consist of:

1. Scrambled MPEG-2 Transport Stream
2. Information about scrambled MPEG-2 TS elementary streams and DVB-CSA CWs in resource AxMPEGStreamInfo.

This transformed AXMEDIS Object is protected using AXOM and has to be put to VRS AXDB.

TEO VOD Manager can download the AXMEDIS objects from VRS factory using AXEPTool via Content Downloader P2P Client. The downloaded AXMEDIS object has to be ingested to TEO architecture in two data paths:

1. The scrambled resources shall be removed from AxObject and the remaining data along with AxMPEGStreamInfo is put to TEO AXDB.
2. The original AXMEDIS Object is ingested directly into VOD server using FTP protocol.

TEO demonstrator raises the following requirements for DRM features and rules:

DRM features requirements:

- implemented on IPTV platform
- licensing information separate from encoded file (i.e., no re-encoding necessary for new business
- rules/licenses)
- low footprint (memory/CPU)
- short and text-encoded authorization requests/messages on TV screen during the licensing phase
- as few steps as possible
- offline licensing (pre-delivery) for *TEO VOD Manager*

DRM rules requirements:

- distinction by country
- expiration of rights after X days/hours from license delivery
- expiration of rights after X days/hours from first play
- expiration of rights at a fixed date
- counted number of plays (N=1 only once)
- unlimited play
- free trailers preview

4.1.2.9 Requirements for QoS and Access Network

Introduction

From the customer's perspective, quality of service (QoS) is the proper operation of his applications and delivery of his services across the network. This is what is often called the Quality of Experience, and is the user's expectation when purchasing a triple-play or business Ethernet service. The user does not purchase QoS per-se and, in most cases, could care less about terminology such as delay, jitter and packet loss. What he does care about is whether his video, voice and data applications operate properly between sites or whether his carrier is offering a triple-play service worth paying for.

Factors that impact the user's overall experience include network traffic engineering, the hardware and software reliability of the individual network elements, and the QoS capabilities of these network elements. Like every other evolving technology, there are various approaches for the delivery of IPTV across the core network and its transmission to the customer premises over an ADSL2+ connection. TEO ingests the broadcast channels from designated satellites into its own head-end in digital formats (MPEG-2 or MPEG-4) and decodes them using proprietary decoder cards. The signal is transrated for DSL speeds at the head-end, and is scrambled using Conax CAS 7 keys. Then, the video content is ready to be distributed by streaming IP packets using the user-datagram protocol (UDP), which is the preferred method of IP packet delivery when offering video due to its low latency. Once at its final destination, the subscriber's house, the video stream is decoded by a set-top box (STB) and played on the TV.

A typical IPTV configuration from the digital subscriber line access multiplexer (DSLAM) to the customer premises is shown in Figure 5. As shown, the video stream is delivered using ADSL2+ from the IP-based DSLAM to the user's ADSL2+ broadband router. The router, while supporting voice and Internet service, passes the video stream to the STB for decoding. The STB converts the video stream into required signals for displaying on the consumer's TV.

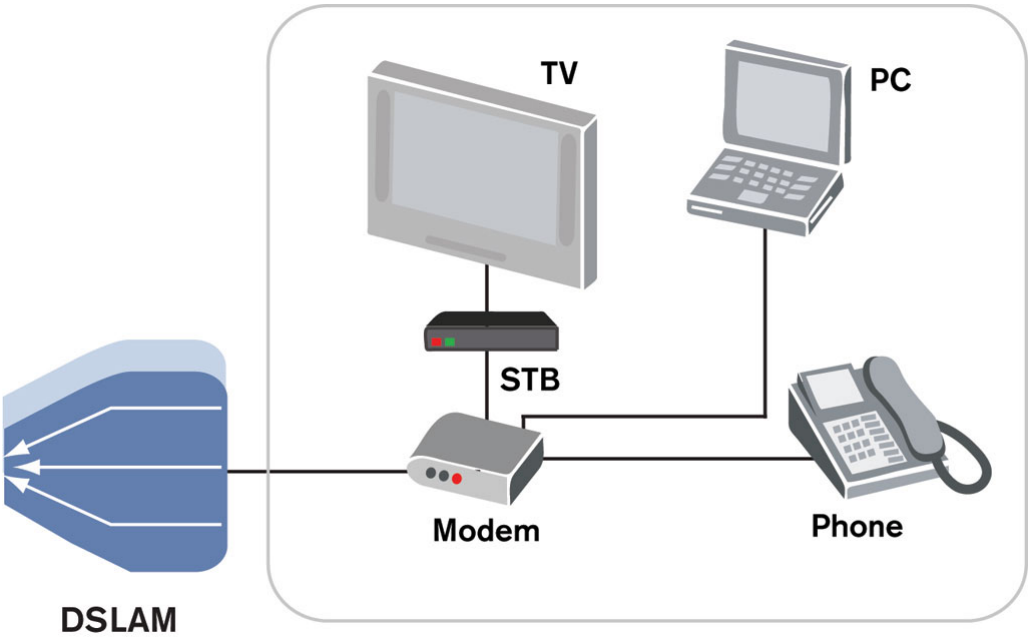


Figure 5: Typical IPTV configuration

Factors Affecting Service:

1. **Encoding and Compression**

The quality of the video being distributed across the network can be affected right at the source; i.e., at the video head end. The encoding and compression process usually creates a trade-off between the quality of the video and the desired compression level. In addition, depending on the encoding and compression technique used the amount of video information per IP packet will vary. Therefore, an IP packet loss can represent a single unnoticeable missing point of the video sequence or a large period of degraded, pixilated or unavailable image.

2. **Jitter**

A typical IP packet carrying MPEG-2 video-streaming data consists of seven MPEG transport stream packets, each containing 184 bytes of payload and 4 bytes of header. This results in 1316 bytes, plus the packet overhead—8 bytes for the UDP header, 20 bytes for the IP header, 14 bytes for the Ethernet header and 10 bytes for ATM overhead—for a total frame size of 1368 bytes.

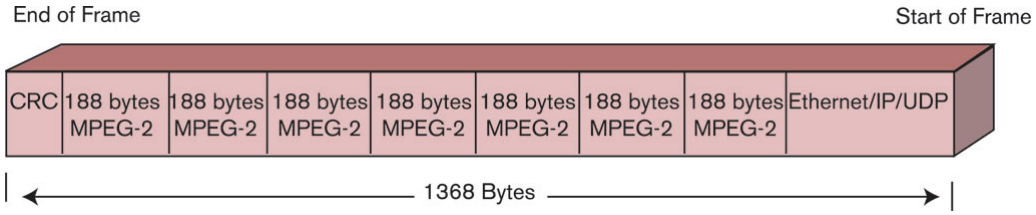


Figure 6: Frame for MPEG-2 Video

Jitter is defined as a short-term variation in the packet arrival time, typically caused by network or server congestion. If the Ethernet frames arrive at the STB at a rate that is slower or faster, as determined by the network conditions, buffering is required to help smooth out the variations. Based on the size of the buffer, there are delivery conditions that can make the buffer overflow or underflow, which results in a degradation of the perceived video. Based on the characteristics of Kreatel STB, TEO characterizes the maximum jitter supported by the IPTV network as 512 ns, before noticing a considerable video degradation. This value is a decisive factor when analyzing the video QoS at the customer premises.

3. **Limited Bandwidth**

The total amount of video-stream data that can be sent is limited ultimately by the customer's actual ADSL/ADSL2+ rate. TEO and Elion core IP infrastructure is based on optical networks with a low level of congestion; therefore, bandwidth limitations are commonly located only within the access network or the customer's home network. When traffic levels hit the maximum bandwidth available, packets are discarded, leading to video quality degradation. ADSL2+ rates may be temporarily affected by external factors, which in turn can generate pixelization of the image.

Another situation might occur when, in addition to the IPTV service, a high amount of data is downloaded simultaneously to a PC and the traffic priorities have not been assigned correctly by the service provider; in these cases, video streaming packets are lost. A less common but important case is when video is streamed in variable-rate mode, in which considerable

changes in the video sequences lead to an increase in the bandwidth requirement. This can generate packet loss and hence quality degradation.

Bandwidth limitation is one of the main factors to be evaluated during the AXMEDIS VoD network design stage.

4. **Packet Loss**

Loss of IP packets may occur for multiple reasons—bandwidth limitations, network congestion, failed links, and transmission errors. Packet loss usually presents a bursty behavior, commonly related to periods of network congestion. Depending on the type of transport protocol used for the video streaming, a packet loss will have different impact on the quality of the perceived video. When UDP is used, the lost packets will directly affect the image, as the information cannot be recovered and the image will simply be corrupt or unavailable. When using TCP, a packet loss will generate a retransmission, which can produce a buffer underflow and, consequently, a possible frozen image.

QoS requirements for quality IPTV service provision

ADSL/ADSL2+ link rates

Data rates for the downstream and upstream must be high enough to support IPTV. Even with MPEG-2 or MPEG-4 video compression, a speed of at least 3 Mb/s per channel is required in the downstream direction—and much more if multicast services, such as VoD are contemplated.

Stability of DSL rates

Signal-to-noise ratio margin (SNRm) must be better than 6 dB and preferably more than 10 dB. Some DSL modems and DSLAMs are pre-configured to operate at the highest possible rate with longest reach by trimming the SNRm. Although this trimming would produce a higher rate, it would introduce errors. This situation was somewhat tolerable for data being delivered in TCP/IP when dealing only with Internet traffic, but it is highly detrimental to IPTV quality. Typically, errors manifest themselves in a pixelization of the video or a complete loss of video feed.

Consistently low ATM errors

Presence of impulse noise can generate multiple errors at the DSL layer, especially if the SNRm is low, as previously indicated. Some other loop issues can also affect the ATM payload directly. These errors are most likely related to the local loop, and therefore a thorough narrowband and wideband evaluation of the cooper loop is recommended.

IP and MPEG video layers

Once the ADSL or ADSL2+ link has been tested for rates, SNRm and ATM-layer errors, the next step is to test the IP and MPEG video layers. If a video channel is being streamed over the DSL line, the IP and video transport stream can also be evaluated for rates and errors. Any existing correlation between errors and sudden variations of the stream data rate may be an indication that the video is exceeding the available bandwidth; therefore, some adjustments will be needed at the video streaming source.

On the other hand, the user must ensure that Internet Group Management Protocol (IGMP) requests, used to join and leave IPTV channels, are being properly handled by the network. Channels must change correctly and under a certain amount of time, as determined by the target zapping time.

QoS indicators like jitter, packet-loss percentage and zapping time must be monitored during this service provision, as they will provide an objective confirmation that the video being received complies with the minimum standard of quality as set by the IPTV service provider. Due to the different network topologies and network environments, thresholds for these parameters are often defined by each service provider.

4.1.3 Identification of AXMEDIS components to be used in TEO Demonstrator architecture

The following AXMEDIS tools will be used for TEO Demonstrator:

Table 1: AXMEDIS tools used by TEO

AXMEDIS Component/Tool	Motivation
AXMEDIS Query User Interface and Query on-Demand	Enable *TEO VOD Manager* search for multimedia content in global AXMEDIS database and prepare content for viewing via STB
AXMEDIS Certifier and Supervisor (AXCS)	Provide a single point for user registration and certification at Subscriber and Provider level. It will be used as single point for user registration for ELION and TEO
AXMEDIS Accounting and Reporting Tool	Enable efficient accounting and reporting and importing accounting information about content usage to content distributors and producer. VRS group could generate reports and analyze content usage
AXEPTool and AXMEDIA tool	Enable *TEO VOD Manager* to safely share, search and load content over a network using P2P protocols and access content coming from all the other connected business partners endowed by AXEPTools
AXMEDIS Object Model	For organization, protection and delivery of cross media digital resources and their metadata. AXMEDIS Object Model will be exploited in STB player. The necessary additions to streaming AXMEDIS object will be encapsulated into an AXMEDIS object resource, therefore keeping object compatible with existing AXMEDIS Tools.

AXMEDIS Component/Tool	Motivation
AXMEDIS Content Production & Processing tools	The AXMEDIS Content Processing tools will be needed for VRS to create the script for automating content production and processing, specifically, for: • Content Ingestion and Gathering • Content Retrieval • Content Storage • Content Processing • Content Composition • Content Formatting • Content Protection • Content Licensing • Content Publication and Distribution through IPTV providers' network AXMEDIS Editor will be used for the manual production of AXMEDIS Objects, including the use of such features as DRM editing, file conversion, etc. AXCP framework will be extended using AXMEDIS plug-in technology. The MPEGTSAdaptation plug-in will be developed. The plug-in will be responsible for: • pre-scrambling of MPEG-TS stream inside AXMEDIS Object; • enhancing AXMEDIS Object with the new resource containing necessary streaming and descrambler control information.
Content Adaptation facilities	AXMEDIS objects will be created to be distributed over heterogeneous networks (such as TEO and Elion Networks) and towards different kind of terminals (in IPTV case: STB's, PC's), client tools/devices. Content adaptation facilities tools will be used to adapt content specifically to the TV environment and TV user's behavior and preferences, in order to achieve achieving interoperable transparent access to (distributed) advanced multimedia content by shielding Users from network and terminal installation, management and implementation issues.
AXMEDIS Protection Tools	The protection model of AXMEDIS is based on the combination of protection techniques together with the use of DRM technology. Protection tools will be needed for enabling service providers to manage IPR and access rights.
AXMEDIS Players, AXMEDIS Object Manager	The AXMEDIS Player will be used at *TEO VOD Manager's* end to play AXMEDIS objects. On the user end, AXMEDIS Player's source code will be used for Porting the Player to STB, to create an AXMEDIS STB Player.

4.2 Elion System Requirements

4.2.1 General System Description

4.2.1.1 System context

ELION AXMEDIS content distribution system will use integrated distribution tools to enable content placement into Elion's delivery system, content can then be published for PC delivery. System will use existent end delivery points but will have its own dedicated CMS and conversion solutions, middleware and other necessary components.

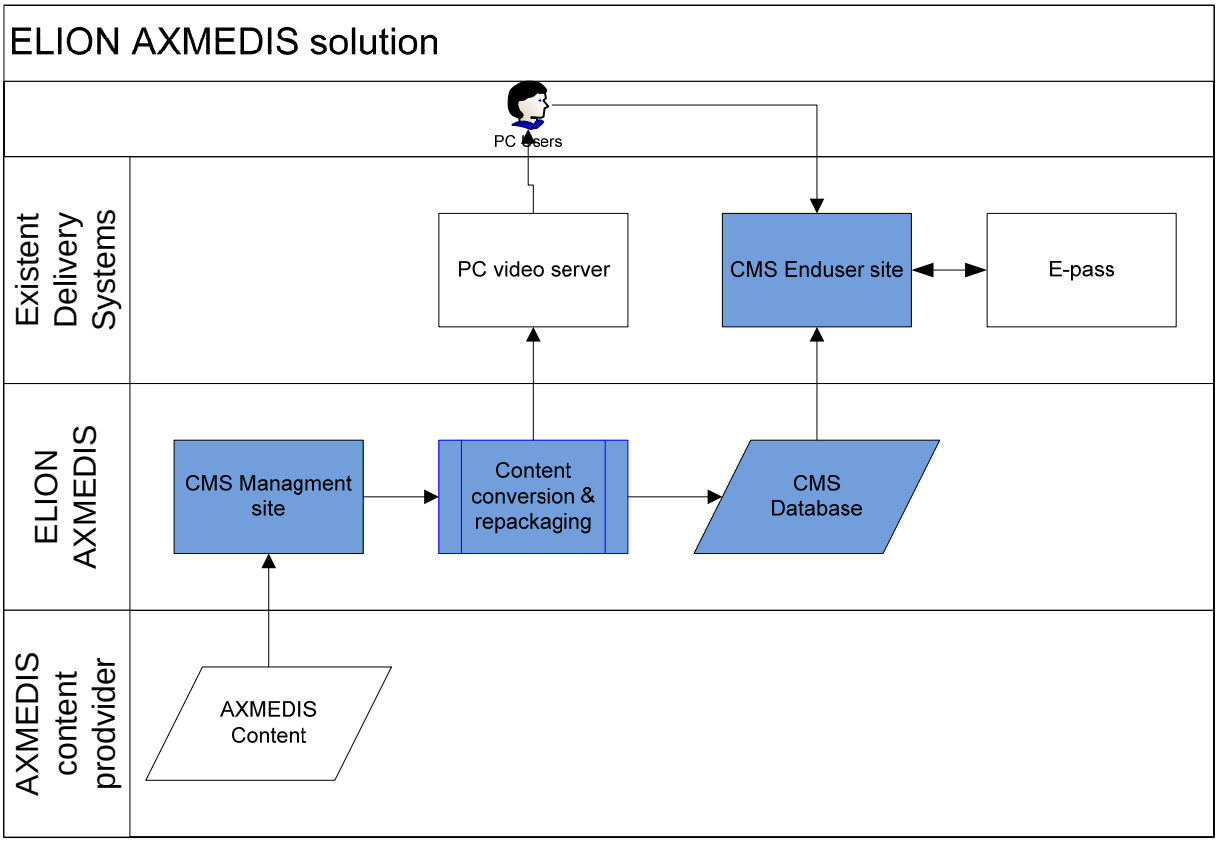


Figure 7: Schematic architecture of Elion AXMEDIS Demonstrator (components needing development are marked with blue)

Detailed schema will follow in 4.2.1.2

4.2.1.2 System Architecture and Components

The objective is to bring architectures of the provider systems (VRS, ELION and TEO) in line with AXMEDIS Framework and implement the necessary components to achieve the desired functionality.

The users of the system will be:

- End users of service by PC device with windows media player
- ELION AXMEDIS administrator. The administrator works with AXEPTool to find content and to place it into conversion unit, after that administrator uses conversion UI to queue conversion, DRM protection and material delivery to appropriate channel server and CMS.
- conversion, DRM protection and material delivery to appropriate channel server and CMS.

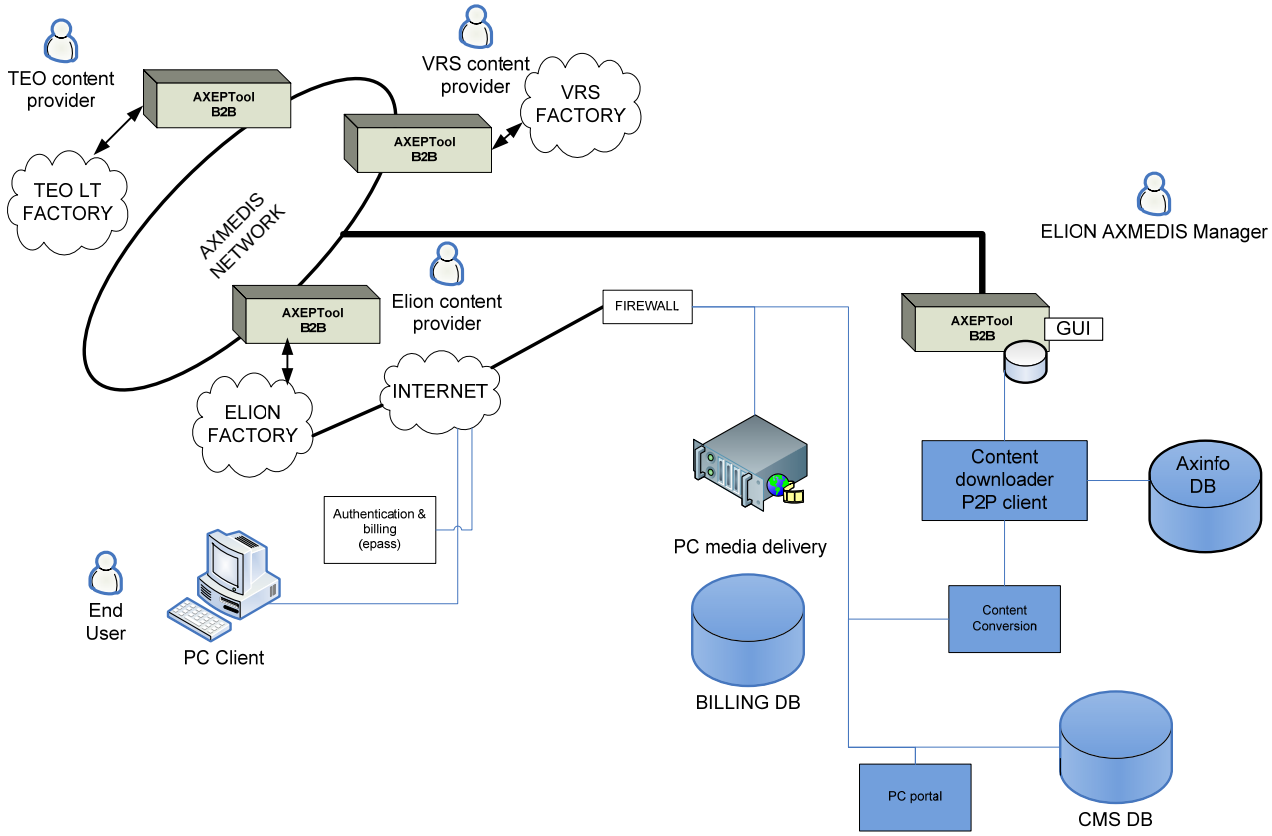


Figure 8: Detailed architecture of Elion AXMEDIS Demonstrator

ELION AXMEDIS system is comprised of

- Databases for CMS, AXMEDIS metadata and Billing systems
- PC portal (Elion middleware server)
- PC streaming server (Elion middleware server)
- Content conversion system (Elion middleware server)

ELION solution uses general authentication & billing system E-Pass to perform all authentications and billing actions, including user profiling. E-Pass works similarly to Microsoft Passport.

4.2.2 Requirements for Elion system components

4.2.2.1 Requirements for PC and CMS portals

All portals are built on middleware server running Windows Server 2003 using Microsoft.NET technologies such as ASP.NET, ADO.NET and MS SQL. PC portal will function as media extension of HOT.EE community portal. PC systems will have no limitations with preferred minimum scale of 640 x 480 (4:3 aspect ratio)

4.2.2.2 Requirements for Media Delivery servers

VoD bandwidth consumption in the IP network can be minimized by locating on-demand servers as near to the subscribers as possible (i.e., in distribution hubs). However, as the volume of available on-demand content increases, replicating all content at every distribution hub becomes impractical. Therefore, it is likely that ELION as a distributor will set-up an architecture that supports a combination of centralized servers for low-demand content and distributed servers for high-demand content.

The key requirements for VoD transport over the IP network are:

- Highly scalable backbone bandwidth;
- End-to-end QoS in the IP network;
- High service availability;

For AXMEDIS Demonstration purposes Elion requires for VoD server to stream Video or Audio content from AXMEDIS objects to pc users. VoD system hardware and software should be based on modular design enabling extension and functional adaptations without structural changes or replacement of important parts of the equipment. Systems software upgrade should not change the existing formats or interface specification(s). All licenses for software/hardware usage must be included with VoD server with appropriate usage rights.

There are a list of additional hardware, software and streaming requirements for VoD server:

General requirements for software:

- All software is expected to be provided with the V0D server) vendor's system components and functionality assurance, including non-exclusive software licenses;
- The software should be based on newest software generations which are implemented and available in the market;
- System software should be based on modular design enabling extension and functional adaptations without structural changes or replacement of important parts of the equipment.

Supported protocols:

- IPv4 (Ipv6 support, optional)
- TCP
- UDP
- RTSP
- IGMP v2, v3

- ICMP
- RTCP
- ATM
- DHCP
- TFTP

Supported media formats :

- MPEG-1
- MPEG-2 (MP@ML, MP@HL)
- H.264 (MP@L3, MP@L4, HP@L4)
- WM9/VC1
- MPEG-1 Layer 2
- MPEG-1 Layer 3 (MP3)
- AC-3 (Dolby Digital)
- PCM
- AAC, ACC+
- VBR & CBR

4.2.2.3 Requirements for middleware

All middleware solutions have been developed by ELION development teams or partners. System base tools are on Microsoft.NET technology branch. Key features are:

- Technological standards due to utilization of Microsoft guidelines on .NET
- Ability for cross platform utilization through .NET port's (like MONO for Linux)
- Data awareness and expandability through active usage of web services and XML

The key requirements for successful integration of AXMEDIS Framework Demonstrator for Middleware are as follows:

- Middleware should enable customization of its components for AXMEDIS demonstrator
- Middleware should have a suitable and enabling Graphical User interface for Administrator;
- Middleware should enable integration of newly developed AXMEDIS components.

4.2.2.4 Requirements for PC client

For AXMEDIS demonstration purposes requirements are as follows:

- Microsoft Windows Vista
- Microsoft Internet Explorer 7
- AXMEDIS Player Plug-in
- Windows Media Player 11 (optional)
- Broadband connection of no less than 2 Mbps

Windows Media Player may be required for native playback of some elements; AXMEDIS browser plug-in player is required for consuming AXMEDIS format media objects.

4.2.2.5 Storage requirements for server applications

All application storages are handled by local servers and are minimal spaces with exception of media storage in delivery systems and conversion unit. For PC distribution system, there the capacity can be variable and depends on format as well as the length. TEO has shown some format demands in the specification. For demonstrative purposes a slice of space will be assigned from general housing to accommodate the necessary content.

4.2.3 Identification of AXMEDIS components to be used in Elion Demonstrator architecture

The following AXMEDIS tools will be used for the Elion Demonstrator:

Table 2: AXMEDIS tools used by ELION

AXMEDIS Component/Tool	Motivation
AXMEDIS Query User Interface and Query on-Demand	Enable users search for multimedia content
AXMEDIS Certifier and Supervisor (AXCS)	Provide a single point for user registration and certification at Subscriber and Provider level. It will be used as single point for user registration for ELION and TEO
AXMEDIS Accounting and Reporting Tool	Enable efficient accounting and reporting and importing accounting information about content usage to content distributors and producer. VRS group could generate reports and analyze content usage
AXEPTool and AXMEDIA tool	Enable *Elion Content Administrator and Program Manager* to safely share, search and load content over a network using P2P protocols and access content coming from all the other connected business partners endowed by AXEPTools.
AXMEDIS Object Model	For organization, protection and delivery of cross media digital resources and their metadata.
AXMEDIS Content Production and processing tools	This AXMEDIS Factory automating tool will be needed for our partner VRS for: 1) the packaging of digital video files, 2) adapting and transcoding, 3) protecting content and producing corresponding Prot-Info, 4) publishing and distributing the produced package, 5) producing licenses for the users, etc.
AXMEDIS License Translation and DRM interoperability	The support of Right Expression Language (REL) gives the opportunity to link with other DRM systems and environments, which may use one or the other. The use of standardized mechanisms to provide DRM capabilities allows the connection with other proprietary solutions in an easiest way.
AXMEDIS Protection Tools	The protection model of AXMEDIS is based on the combination of protection techniques together with the use of DRM technology. Protection tools will be needed for enabling service providers to manage IPR and access rights.

AXMEDIS Component/Tool	Motivation
AXMEDIS Players, AXMEDIS Object Manager	The AXMEDIS Players will be used on an End-user PC to enable the end-users of to download, play and interact with the AXMEDIS objects.

5 Functional and business requirements

5.1 TEO

5.1.1 User Requirements

From the end-user perspective, the conceptual business model presumes that a current IPTV subscriber should be able to:

- By using an STB remote control through GUI on his TV screen enter the AXMEDIS portal;
- Through convenient user interface on his TV screen, browse through and request from a menu of AXMEDIS objects specifically formatted for TV viewing and appropriately identified,
- Select a desired object (video file) and, having requested and obtained a license – view the object,
- View it in accordance with the license permissions granted.

The end user, who is already an IPTV service subscriber, should be able to surf the VOD Portal without identifying his credentials and be able to access to all free content (i.e. trailers, promotional material, etc.). To purchase protected AXMEDIS content the IPTV user should be able to receive a notice about the fact of such protection of the desired content and an offer purchase it for viewing. The subscription and login data are stored in the IPTV DB as the user media content portfolio, the user credits and the AXMEDIS contents license status (enabled, expired, activation date, etc).

For paid content, payment methods encompassed in the TEO business model will be as follows:

- (Pay per view) Pay for single viewing of an AXMEDIS object (film)
- Pay less for a video, with embedded advertisement
- Select a video with heavier embedded advertising, and view it for free

As noted previously, all payment history will a) available for the subscriber to view on the TV screen on demand, and b) will be itemized and presented in the subscriber's monthly bill as additional payment to the fixed subscription fees.

5.1.2 Provider requirements

5.1.2.1 Accounting and billing

TEO should be able to account for the usage of viewed content, identify the user and instances of use, generate billing information and bill the client. In turn, TEO should have a system which informs content producer and or/another B2B content provider from which the content was purchased to automatically generate content usage and billing information using AXMEDIS.

IPTV Billing system server allows TV Portal users to pay for content acquisition. Once payment succeeded the IPTV Billing server request a license creation for that AXMEDIS content and for the specific end users.

5.1.2.2 Content management

All media contents are provided by the VOD portal server. Depending on the AXMEDIS content license configuration and the way how the TV Portal Manager has structured the Portal, the end user can play free content without having already bought the AXMEDIS content license.

The license to the end user must be generated automatically once the payment for the content is received. In demonstrator case the end-user will have to acknowledge the payment fact by entering PIN code. The other option is to issue the user license to view content for free, but the advertisements will be introduced in the video. In this case VRS has to provide two different versions of video object:

- Raw video clip
- Video clip with commercial advertisements included

AXMEDIS compliant VoD and IPTV services will be created using standard Windows Server 2003 platform technologies. Internet portals and middleware server will be developed using Microsoft .NET framework technologies ASP.NET, ADO.NET and MS-SQL. For integration with other CRM and billing systems, web-services and integration module based on Microsoft BizTalk and DIM module will be used.

5.1.3 AXMEDIS STB User Use Case

IPTV service subscriber knows about AXMEDIS portal and some interesting video on demand content placed on it for viewer's purchasing and viewing. The user desires to view a number of comedy video clips developed by a local content producer VRS. End User uses STB which connects him to TEO Middleware home page (see Figure 9)

Figure 9: TEO Middleware homepage.

When user wants to view AXMEDIS objects, he must choose "AXMEDIS" button (see Figure 9) and connect to TEO VOD Portal. Upon the user pressing this button by his remote, the user is connected to IPTV network to browse through local AXMEDIS DB and play selected objects.

A possibility to browse through global AXMEDIS network and search for objects placed remotely could also be developed, if AXMEDIS FRAMEWORK provides such interface using HTTP or web-services protocols. In this case STB Web browser could connect to Web page and using standard HTTP protocol make queries in global AXMEDIS network. End User can select objects and subscribe to them. Later this subscription will be send to TEO VOD Manager (see paragraph 5.1.4 for details), where content will be prepared for demonstration through STB.

When the user selects an AXMEDIS object, he can view in AXMEDIS STB Player Object description, any available free video or audio content, like a brief 10 second trailer of a video.

When user chooses to buy AXMEDIS content, by pressing a Play button, the VOD Portal service will display on the TV screen User billing information and simple license conditions for the object (i.e. paid or free, pricing). The user will be prompted and enter a PIN, which is known by him when he signs a contract for TEO IPTV services. Upon the entry of a PIN, the user must choose payment options – for example, pay more and view video without advertisement, or pay less or view for free video with advertisement. AXMEDIS STB Player starts to play the selected Video content. DRM license for this object will be issued automatically from AXMEDIS Certifier and Supervisor.

When content is playing on STB, user with remote control will be able to "Stop", "Play", "Pause" and "Seek" this content, as long as this is programmed in DRM License.

From the TEO VOD Portal it will be possible to user to access user information. In this information screen the user can find all information about viewed AXMEDIS objects from current STB and billing information.

After viewing the video clip, the viewer will go back to AXMEDIS browser or can go to TEO home page by pressing remote control button or by selecting “Home” button on TV screen.

There are some scenarios, how the user can search and review AXMEDIS content. Steps are marked in the diagram in Figure 10.

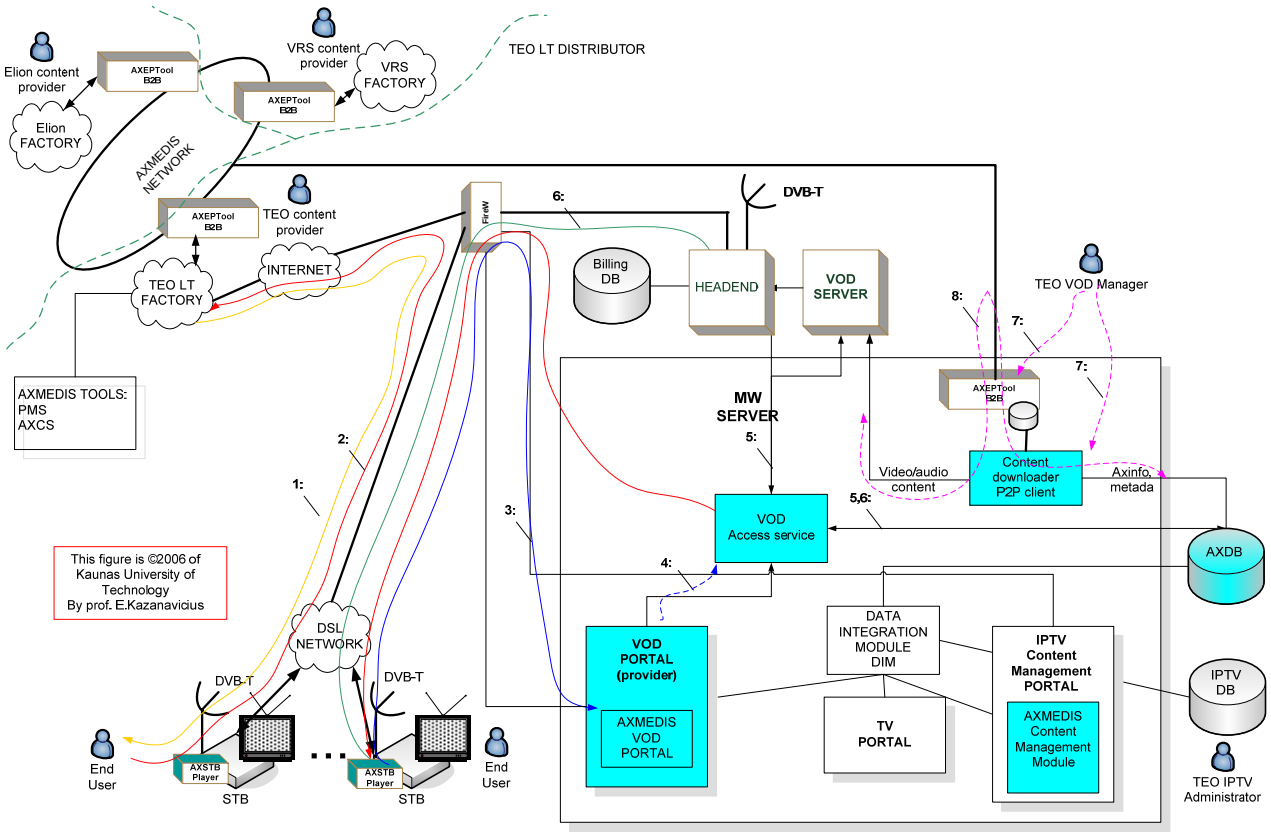


Figure 10: Detailed steps of the above scenarios

Scenario: End users via STB, with AXMEDIS STB Player and STB Browser installed

Actor: End User

Step 3, Figure 10: End user connects to VOD Portal at TEO IPTV Middleware Server via STB browser via DSL network and Internet, where he is searching for suitable audio or video content placed in VOD server from the AXMEDIS network.

Step 4, Figure 10: Having found the content, VOD Access service activates content viewing capability.

Step 5, Figure 10: VOD Access service module sends a request to download metadata (contracts, licenses, etc.). In parallel, request to start streaming to STB is sent.

Step 6, Figure 10: Metadata is sent from AXDB to AXMEDIS STB Player. At the same time, a DVB-CSA scrambled video/audio file is being sent to STB from VOD server through HEADEND. In accordance with DRM license rules the file is decrypted and, PMS having confirmed user actions, the file is played on AXMEDIS STB Player.

5.1.4 TEO VOD Manager Use Case

Another important actor in AXMEDIS IPTV network is TEO VOD Manager (employed by TEO), which is responsible for content and user management in AXMEDIS IPTV network. This actor downloads AXMEDIS objects from global AXMEDIS network via Content downloader P2P client (see Figure 1 for details) and prepares them for streaming in VOD server. TEO VOD manager downloads AXMEDIS objects at his own discretion, observing the DRM rules attached to the objects.

The key the role of TEO VOD Manager is Content Management.

In Content Management tab TEO VOD Manager will use AXEPTools, provided by AXMEDIS Framework and selects content from global AXMEDIS Databases. The main job of TEO VOD Manager will be to prepare AXMEDIS object for streaming from VoD Server. To do this TEO VOD Manager must save AXMEDIS Object in two locations, because it's impossible to stream AXOM object or store it in STB. STB is a thin mini PC, which has limited RAM and storage.

In User Management tab TEO IPTV Administrator can add, delete and modify properties of TEO IPTV AXMEDIS users. This interface connects TEO registered STBs with local AXMEDIS user database with Global Unique Identifier (GUID). There will be a possibility to make and view reports about user actions in TEO AXMEDIS DB and view billing information about any current user.

TEO VOD Manager using his content management tools can delete, add and change AXMEDIS Object in Local VoD Portal and AXDB. He can see a query of ordered AXMEDIS Object by users and then find and prepare them for viewing by STB, as described earlier in this chapter.

Another function, which will be implemented in management tools, is report where TEO VOD Manager can generate report about object usage and see billing information.

Description of detailed steps on how TEO video/audio content and program administrator manages AXMEDIS content in TEO IPTV system, are described below and depicted in Figure 10.

Scenario: Placement of AXMEDIS content into TEO IPTV system

Actor: TEO VOD Manager:

Step 7, Figure 10: works with AXEPTool integrated into MW server via GUI in accordance with B2B, searching for needed content;

Step 8, Figure 10: having found the content, places it into MW server. From here the content from AXMEDIS network is read as an AXOM object, which is placed into AXEPTool internal database. AXDB IN/OUT, from where Content downloader client module performs

placement of Video/Audio file into VOD server, while metadata is placed into AXDB database. Information from Axinfo is processed and placed into provider VOD portal or processed on demand, so that the end users can choose the content.

Detailed specifications will be provided in DE12.2.3

5.2 Elion

5.2.1 PC user requirements

Please refer to 4.2.2.4

5.3 Provider requirements

5.3.1 Accounting and billing

ELION should be able to account for the usage of viewed content, identify the user and instances of use, generate billing information and bill the client. In turn, ELION should have a system which informs content producer and or/another B2B content provider from which the content was purchased to automatically generate content usage and billing information using AXMEDIS.

E-PASS Billing system server allows PC users to pay for content acquisition. Once payment succeeded the Billing server request a license creation for that AXMEDIS content and for the specific end users.

EMT's Mobile payment system acquires media price information from CMS database and handles the payment directly (payment is attached to monthly service bill) and notifies systems about purchase, each month the detailed history is exchanged between ELION and EMT to verify all transactions.

5.3.1.1 PC Use case

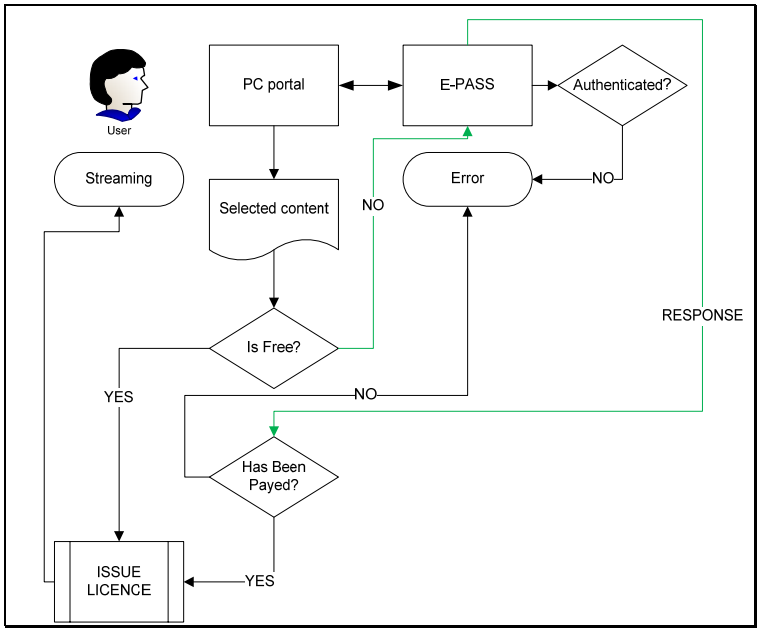


Figure 11: PC Use Case

1. User enters PC Portal and is redirected to E-Pass for login
2. E-pass redirects user after login back to PC portal and attaches account profile to request
3. User surfs the portal UI and finds interesting media and clicks on purchase
4. Depending on price user will be doing ;
    a. media is free;
        i. Playback license is issued, user is directed to playback page
    b. Media has cost;
        i. User is redirected to E-PASS with price information
        ii. E-PASS offers payment channels to user and performs the payment procedures according to chosen channel
        iii. E-PASS redirects user back with attached payment information
5. License is issued to user and logged in content base for B2B accounting, user begins playback

5.3.2 Administrator use case

Administrator can add, edit, delete content, generate usage reports and search for new content on AXMEDIS network

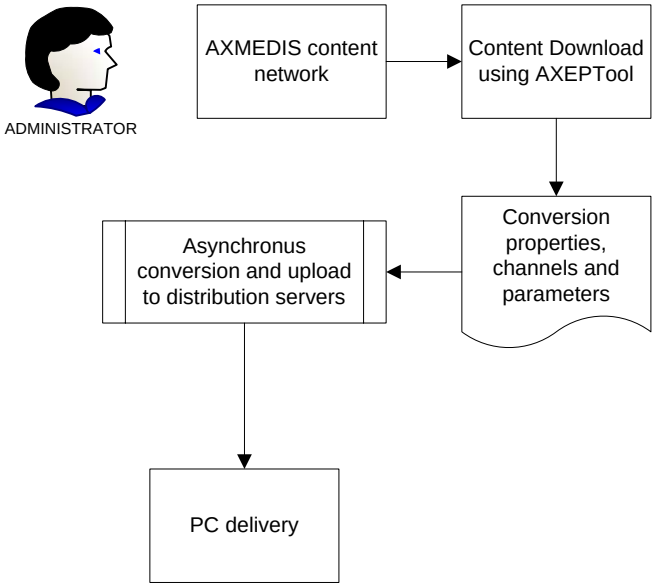


Figure 12: Administrator use case

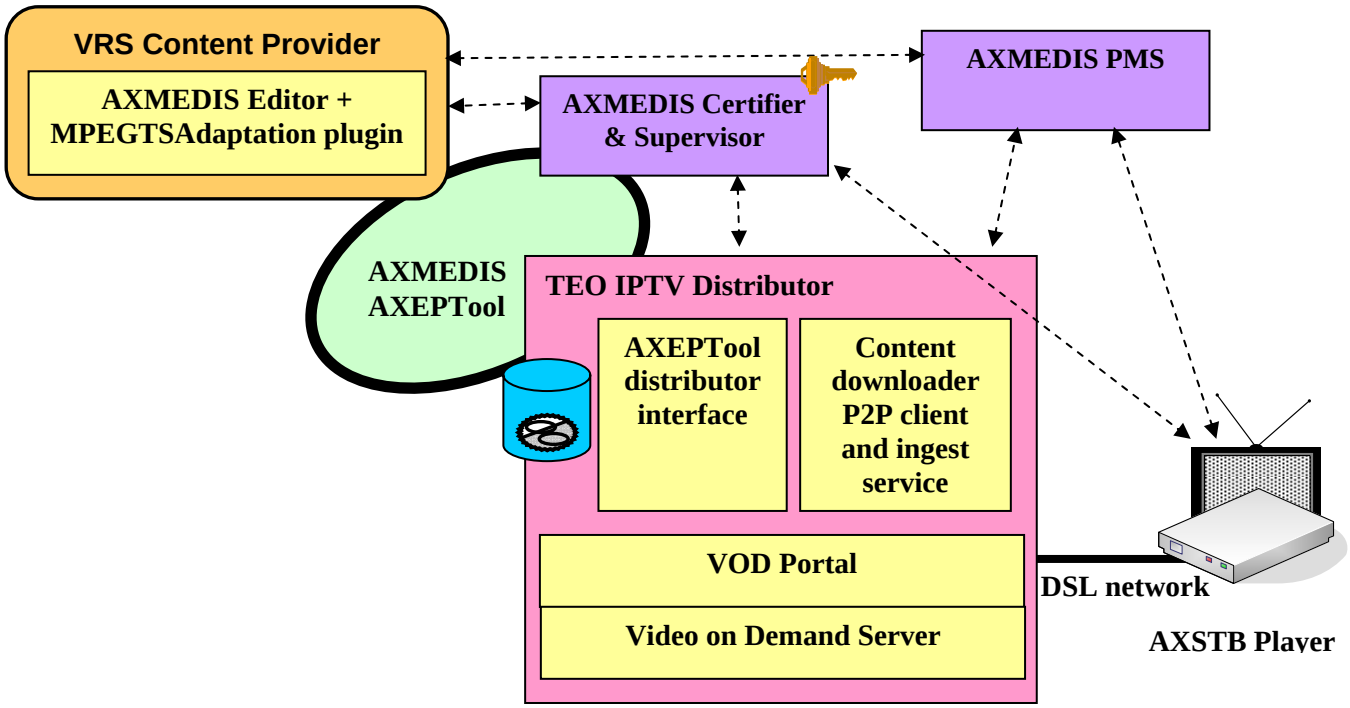
1. Administrator searches AXMEDIS network for content
2. The content is downloaded using AXMEDIS P2P into conversion server
3. Administrator defines a parameter set; including distribution channel, price, conversion parameters (if needed) and confirms the process
4. Conversion server processes the package doing all necessary steps and outputs the packages on defined delivery servers
5. Processing server enables the content and enables usability on destination portals

6 Demonstration: AXELTEO Demonstrators Fact Sheet

- **TEO – STB-IPTV,**
- **ELION – PC,**
- **VRS – Content Modelling**

6.1 Demonstrator AXELTEO – TEO – STB-IPTV

- **Main purpose:**
  - To stream protected AXMEDIS content to IPTV STB



AXELTEO TEO demonstrator via IPTV

- **Review of the architecture integration with AXMEDIS:**
  - **Acquisition / providing of content, where and how**
    - Content is provided by VRS (20 video clips, some of them with trailers)
  - **Production of content, where and how:**
    - Content is provided by VRS (MPEG-2)
    - number of content items produced: 20 Video Clips
  - **Processing content, where and how**
    - In the Distribution site, using the AXMEDIS Editor to adapt content ready for streaming. The MPEG2TSAdaptation plug-in will be developed. This plug-in will be used in editor to adapt existing MPEG-2 TS stream resource into AXMEDIS-ready streaming resources – scrambled video/audio MPEG-2TS and AxMPEGStreamInfo resource.
  - **Protecting content, where and how:**

- Signal protection level:
  - The transmitted video signal resource is encapsulated into MPEG-2 Transport Stream (TS) resource and scrambled using DVB-CSA algorithm. The signal can be unprotected if and only if AxStreamResource information is deprotected from AXMEDIS object.
  - Content license protection level:
    a. At production (VRS Factory) level, using AXMEDIS Editor or AXCP, with newly developed AXCP MPEGTSAdaptationPlugin for scrambling MPEG-2 Transport Stream (TS) resource using DVB-CSA algorithm.
    b. At Distributor (TEO) and end user level, upon AxSTBPlayer trying to access AxStreamResource in AXMEDIS object, AXOM protection processor is executed to deprotect the object according to the issued license. If the user has bought the object and has valid license, AxStreamResource is decoded from object and AxSTBPlayer.

- **mother licenses are produced, where and how**
  - content provider (VRS) provides mother licenses for distribution using its DRM editor or AXCP tools or directly the PMS Web Services. The PMS client will be employed to upload the license to PMS server which will be deployed at TEO site.
- **final licenses are produced, where and how**
  - produced by VOD access service using AXCP rule editor/scheduler+executor. When user chooses to view protected content, the payment has to be confirmed. Having received the payment, the VOD access service issues the license to end user using AXCP rule script. The issued license is sent to PMS server.
- **registration of user and devices, where and how**
  - The end user is registered to TEO database before providing the service. If TEO IPTV administrator checks AXMEDIS option in registration form, the standard registration process is extended and the user is registered to AXCS which is deployed at TEO site.
  - When user buys STB hardware it is registered automatically upon first usage. The standard STB registration process will be extended to register end-user STB to AXCS.
- **distributing content, where and how**
  - from TEO/KTU joint distribution site using streaming server
  - At first stage the custom VOD streaming server prototype will be build using open source components. The VOD streaming server will be adapted to stream protected AXMEDIS object resources.
  - migration to EXITECH streaming server when it is available.
- **accounting collection and action monitoring, where and how**
  - from TEO distribution site, using CAMART

- **Description of the effective installation**

- **Servers**
  - where are present: KTU/TEO joint site
  - who is responsible for server: TEO
  - which kind of server: Intel x64 CPU 4x server. RAM 4GB. 140GB SCSI RAID-10 disk array. Windows Server 2003 x64 OS. Initially up to 25% of server HW resources will be allocated to AXMEDIS services:
    - AXMEDIS Database
    - AXMEDIS AXEPTool
    - AXMEDIS Streaming server
    - Streaming server prototype
    - AXCS
    - PMS server

    Microsoft IIS HTTP server with ASP.NET 2.0 extensions Microsoft SQL server 2005 x64Microsoft .NET framework 2.0 x64
- **Portals**
  - AXMEDIS VOD Portal (http://mdwclust/Kreatel/AxVOD internal URL, available to STBs in IPTV VLAN)
  - VOD Portal (http://mdwclust/Kreatel/VOD internal URL, available to STBs in IPTV VLAN)
  - IPTV content management portal with newly developed AXMEDIS Management Module (http://mdwclust/iptv)
- **Distribution infrastructure needed if any**: The AXMEDIS content ready for distribution is stored in streaming server at TEO site. The content is downloaded from AXMEDIS network using P2P client. Then the content is prepared at Content downloader P2P client module and uploaded to streaming server using FTP service. After STB requests streaming of content, the streaming server starts UDP streaming of video content. The content is transmitted through headend switches to backbone network and finally it reaches the home gateway which is connected to STB.
- **Streaming/downloads**: streaming to end-user
- **Players needed**: PC/ PDA/ STB: PC for management, STB for end-user

- **AXMEDIS tools**
  - **List of major AXMEDIS tools:**
    - AXMEDIS Query User Interface and Query on-Demand
    - AXMEDIS Certifier and Supervisor (AXCS)
    - AXEPTool and AXMEDIA tool
    - AXMEDIS Object Model
    - AXMEDIS Content Production & Processing tools
    - Content Adaptation facilities
    - AXMEDIS Protection Tools
    - AXMEDIS Players, AXMEDIS Object Manager
    - AXMEDIS Accounting and Reporting Tool
  - **AXMEDIS P2P usage, yes or no, where and how:**
    - yes, on the TEO Distribution site
  - **AXCP usage, yes/no, where and how**
    - yes if needed for content adaptation

- **Workflow tools usage, yes/no, where and how:**
  - no
- **Programme and publication usage, yes/no, where and how:**
  - no
- **PMS/AXCS usage, yes or no, where and how**:
  - yes, for demonstrator an AXCS and PMS will be installed in TEO site. The AXCS services will be used by IPTV Content Management portal and AXMEDIS Content Management module in end-user and STB registration process. AXCS will be also used for content usage reporting. PMS will be used in license issue and validation processes.
- **AXMEDIS database usage, yes or no, where and how:**
  - yes, in TEO site

- **Target Market:**
  - The demonstrator will be a mock-up of value added video on demand (VoD) service to TEO IPTV service (Gala TV, www.galatv.lt) subscribers. At the end of 2006, there were over 5,000 IPTV subs subscribing to Gala TV.
- **Description of the business model**
  - **Conceptual revenue model:**
    - Revenue from content distribution to consumers could be earned based on three basic models:
      - Advertiser pays to the distributor for ads shown to consumers;
      - Consumer pays to the distributor for paid content; or
      - A combination of the two.
    - TEO demonstrator pricing model for consumer:
      - watch for free, but also view 5' non-skippable ads embedded into a piece
      - Pay EUR 1 but watch 2' non-skippable ads before the start of the programme
      - Pay EUR 2 and watch the movie with no ads.
      - Buy a "special" version of a programme (such as the director's cut of a movie) by agreeing to watch non skippable adverts.

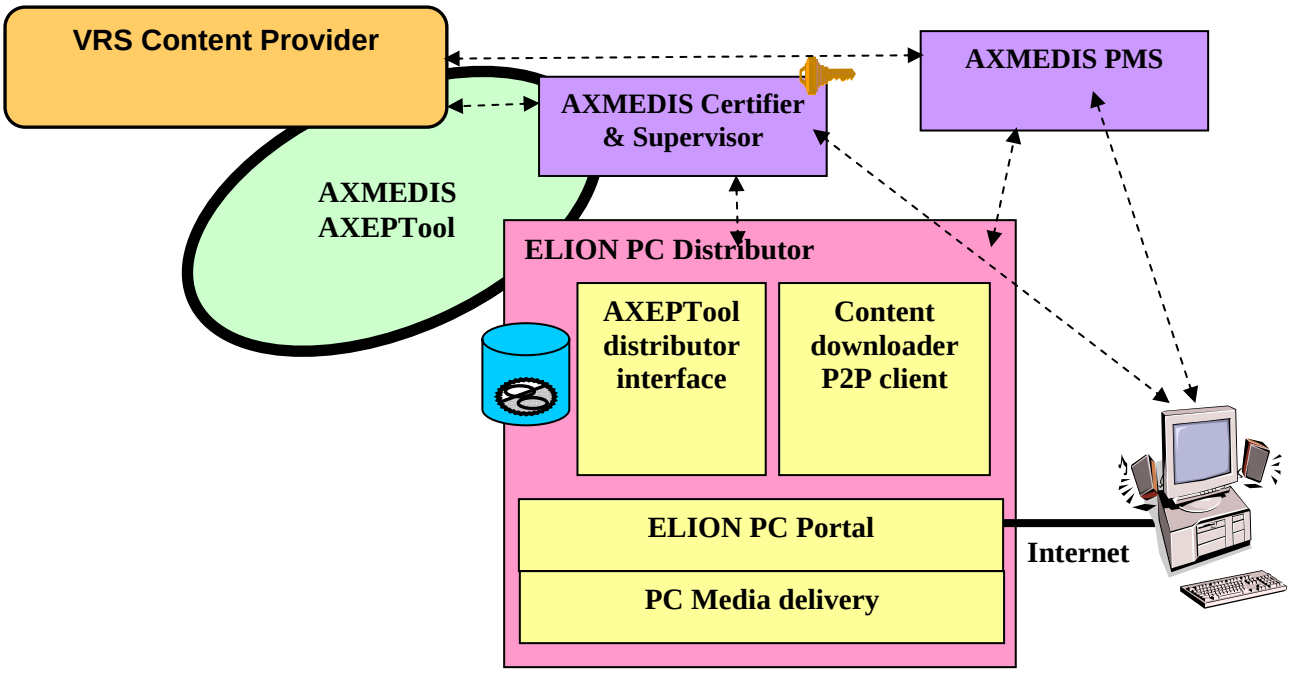
    Note: the above model is conceptual and developed for demonstration purposes only, and does not represent the real-life value for money pricing situations, which may or may not be used in real business environment.
  - **Licenses kind, please describe the model**
    - Free of charge licenses for trailers and pay per view licenses for AXMEDIS objects.
    - End user licenses allow to play, stop, pause and skip video stream from VOD server:
      - Ads inserted into clips cannot be skipped using seek operation;
      - End user can skip forward only.
    - temporal limitations for duration of the project
    - territory limitations: Lithuania
- **Description of content:**
  - **How many content AXMEDIS objects will be distributed**: 20 video clips:

- **Who is going to provide digital resources with the needed clearance of rights**: VRS
- **Content description**: funny videos from VRS Kamera
  - 5 unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 5 ad inserts
  - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 2 ad inserts
  - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with no ads
  - Above five unique Funny home video blocks of approx. 10 minutes each, with episodes arranged in a different manner
- **Kind of resources**: trial video clips of VRS authored funny home videos with embedded video ads
- **Typical Content size for each content type**: size of video clips approx. 600 MB

- **Final Users/Clients:**
  - **How many final users will be reached**: 4-8 trial users
  - **Their description**: TEO Gala TV trial Users
  - **Their registration is needed**: no, registered upon subscription to Gala TV service and full client setup
- **Partners involved and roles:**
  - TEO: to contribute to development, provide distribution site and trial end users
  - VRS: to provide content, model it as AXMEDIS objects and make available for demonstrators in required formats
  - KTU: to develop and integrate missing components

6.2 Demonstrator AXELTEO – ELION – PC

- **Main purpose:**
  - To stream/download protected AXMEDIS content to PC



AXELTEO Elion demonstrator via PC

- **Review of the architecture integration with AXMEDIS:**
  - **Acquisition / providing of content, where and how**
    - Content is provided by VRS (20 video clips, some of them with trailers)
  - **Production of content, where and how:**
    - Content is provided by VRS (MPEG-2 or MPEG-4)
    - number of content items produced: 20 Video Clips
    - number of content items produced at the same time
  - **processing content, where and how**
    - In the Distribution site, using the AXMEDIS editor to adapt content ready for downloading
  - **protecting content, where and how**
    - Original content is packaged into protected AXMEDIS object in VRS factory and distribution license is delivered with the object to Elion's distribution system. End user will receive only playback licenses after purchase of playback rights have been confirmed. License is delivered over secure website.
  - **mother licenses are produced, where and how**
    - content provider provides mother licenses for distribution using its DRM editor or AXCP tools or directly the PMS Web Services
  - **final licenses are produced, where and how**
    - produced by ELION AXMEDIS Manager using AXCP rule editor/scheduler+executor
  - **registration of user and devices, where and how**
    - performed before giving the Player to end user and allow also self-registration
  - **distributing content, where and how**
    - from ELION distribution site using streaming server or http server for download
  - **accounting collection and action monitoring, where and how**
    - from ELION distribution site, using CAMART
- **Description of the effective installation**
  - **Servers**
    - where are present: ELION site
    - who is responsible for server: Elion
    - which kind of server: Virtual Server with Windows 2003 R2
      - AXMEDIS Database
      - AXMEDIS AXEPTool
      - IIS http server (IIS 6, ASP.NET 2, SQL 2005)
  - **Portals**
    - AXMEDIS ELION Portal (http://pc.axmedis.neti.tv)
  - **Distribution infrastructure needed if any**: The AXMEDIS content ready for distribution is stored in streaming server at ELION site. The content is downloaded from AXMEDIS network using P2P client. Then the content is prepared at Content downloader P2P client module and uploaded to streaming server using FTP

service. After client requests streaming of content, the streaming server starts UDP streaming of video content. The content is transmitted through headend switches to backbone network and is transmitted over public IP networks to the client.

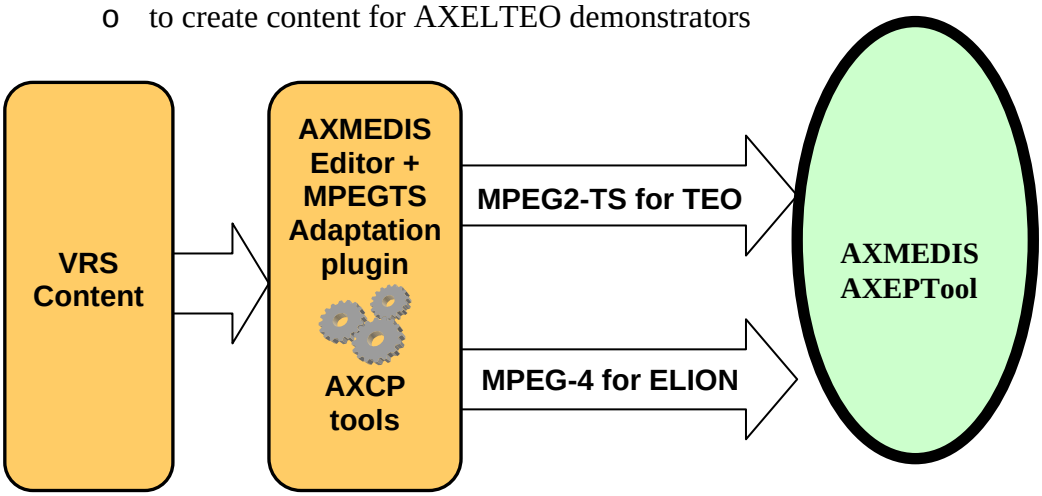
- **Streaming/downloads**: downloads to end-user, downloads from Content providers
- **Players needed**: PC/ PDA/ STB: PC for end-user and for management

- **AXMEDIS tools**
  - **List of major AXMEDIS tools**:
    - AXMEDIS Query User Interface and Query on-Demand
    - AXMEDIS Certifier and Supervisor (AXCS)
    - AXEPTool and AXMEDIA tool
    - AXMEDIS Object Model
    - AXMEDIS Content Production & Processing tools
    - Content Adaptation facilities
    - AXMEDIS Protection Tools
    - AXMEDIS Players, AXMEDIS Object Manager
    - AXMEDIS Accounting and Reporting Tool
  - **AXMEDIS P2P usage, yes or no, where and how**:
    - yes, on the ELION Distribution site
  - **AXCP usage, yes/no, where and how**
    - yes if needed for content adaptation
  - **Workflow tools usage, yes/no, where and how**:
    - no
  - **Programme and publication usage, yes/no, where and how**:
    - no
  - **PMS/AXCS usage, yes or no, where and how**:
    - yes, for demonstrator an AXCS and PMS will be installed in TEO site. The AXCS services will be used by Elion demonstrator in end-user registration and PC player certification process. AXCS will be also used for content usage reporting. PMS will be used in license issue and validation processes.
  - **AXMEDIS database usage, yes or no, where and how**:
    - yes, in ELION site
- **Target Market:**
  - The demonstrator will be a mock-up of value added video on demand (VoD)
  - service to Elion internet service subscribers using the media rental. At the end of 2006, there were over 150,000 internet subs subscribing to Elion internet service.
- **Description of the business model**
  - **Conceptual revenue model:**
    - Revenue from content distribution to consumers could be earned based on two basic models:
      - Consumer pays to the distributor for paid content; or
      - Free content.
    - Elion demonstrator pricing model for consumer:

        - Flat rate from 0 to x EEK, price is integral number, freely definable by administrator
        - 24 hours license on purchase, user can download media unlimited times during that period but is limited to use the PC, installation and account what was used for license purchasing
    - **Licenses kind, please describe the model**
        - Free of charge licenses for trailers and pay per view licenses for AXMEDIS objects.
        - End user licenses allow to play, stop, pause and skip downloaded video
            - Ads inserted into clips cannot be skipped using seek operation;
            - End user can skip forward only.
        - temporal limitations for duration of the project
        - territory limitations: Estonia
- **Description of content:**
    - **How many content AXMEDIS objects will be distributed**: 20 video clips
    - **Who is going to provide digital resources with the needed clearance of rights**: VRS
    - **Content description**: Funny videos from VRS Kamera:
        - 5 unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 5 ad inserts,
        - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 2 ad inserts
        - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with no ads
        - Above five unique Funny home video blocks of approx. 10 minutes each, with episodes arranged in a different manner;
    - **Kind of resources**: trial video clips of VRS authored funny home videos with embedded video ads
    - **Typical Content size for each content type**: video, 10 Mb
- **Final Users/Clients:**
    - **How many final users will be reached**: no less than 30
    - **Their description**: E-PASS users
        - E-PASS is Elion own version of Microsoft Passport, providing Elion with a single unified account system and generic payment channels. E-PASS currently has integrated payment channels using bank transfer and mobile phone. In case of bank payment user is directed to bank's internet site for payment, supported banks are HANSA, SEB and SAMPO. To pay with mobile a call number is show, user then dials the number making the payment.
    - **Their registration is needed**: no for private testing, (registered when giving them the Player), yes for public testing
- **Partners involved and roles:**
    - ELION: to contribute to development, provide distribution site
    - TEO: to provide PMS and AXCS
    - VRS: to provide content
    - KTU: to develop the missing components if needed

6.3 Demonstrator AXELTEO – VRS - content production

- **Main purpose:**
  - to create content for AXELTEO demonstrators



VRS content producing for AXELTEO

- **Review of the architecture integration with AXMEDIS:**
  - **Acquisition / providing of content, where and how**
    - internal VRS video clips from VRS Kamera
  - **Production of content, where and how**:
    - VRS site, using AXMEDIS editor and AXCP tools
    - SMIL, HTML, etc…
    - number of content items produced per day (20 Video clips)
    - number of content items produced at the same time
      - MPEG-2 TS – PAL resolution for streaming to STB
      - MPEG-4 – PC resolution (Elion demonstrator)
  - **processing content, where and how**
    - VRS site,
    - number of content items processed per day: 20
    - number of content items processed at the same time 20
  - **protecting content, where and how**
    - at VRS site using AXMEDIS protection plug-ins
  - **mother licenses are produced, where and how**
    - at VRS site, using DRM editor and AXCP
  - **final licenses are produced, where and how**
    - no final licenses are produced
  - **registration of user and devices, where and how**
    - no end-users
  - **distributing content, where and how**
    - at VRS site using AXMEDIS AXEPTool
  - **accounting collection and action monitoring, where and how**
    - at VRS site using CAMART

- **Description of the effective installation**
    - **Servers**:
        - one with AXMEDIS Database and for AXEPTool
    - **Portals**: no portal is needed
    - **Distribution infrastructure needed if any**: internet access
    - **Streaming/downloads**: downloads
    - **Players needed**: PC/ PDA/ STB: PC Player for testing content produced
- **AXMEDIS tools**
    - **List of major AXMEDIS tools**:
        - AXMEDIS Query User Interface and Query on-Demand
        - AXMEDIS Certifier and Supervisor (AXCS)
        - AXEPTool and AXMEDIA tool
        - AXMEDIS Object Model
        - AXMEDIS Content Production & Processing tools
        - Content Adaptation facilities
        - AXMEDIS Protection Tools
        - AXMEDIS Players, AXMEDIS Object Manager
        - AXMEDIS Accounting and Reporting Tool
    - **AXMEDIS P2P usage, yes or no, where and how**:
        - yes, at VRS site
    - **AXCP usage, yes/no, where and how**
        - yes, at VRS site
    - **Workflow tools usage, yes/no, where and how**:
        - no
    - **Programme and publication usage, yes/no, where and how**:
        - no
    - **PMS/AXCS usage, yes or no, where and how**:
        - yes, at TEO site
    - **AXMEDIS database usage, yes or no, where and how:**
        - yes, at VRS site
- **Target Market:**
    - Potential market for VRS are distribution businesses: Telcos, ISP's, etc. VRS may also have a direct access to PC end users through AXEPTOOL.
- **Description of the business model**
    - **Licenses kind, please describe the model**
        - VRS will issue distributor licenses to TEO and Elion, and will charge a revenue share for every video clip viewed by their end users:
            - Free of charge licenses for trailers and pay per view licenses for AXMEDIS objects.
            - End user licenses allow to play, stop, pause and skip video stream from VOD server:

        - Ads inserted into clips cannot be skipped using seek operation;
        - End user can skip forward only.
    - temporal limitations for duration of the project
    - territory limitations: Lithuania
- **Description of content:**
    - **How many content AXMEDIS objects will be distributed**: 20 video clips:
    - **Who is going to provide digital resources with the needed clearance of rights**: VRS
    - **Content description**: Funny videos from VRS Kamera:
        - 5 unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 5 ad inserts
        - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with 2 ad inserts
        - Above five unique Funny home video blocks of approx. 10 minutes each, containing between 2-3 episodes, with no ads
        - Above five unique Funny home video blocks of approx. 10 minutes each, with episodes arranged in a different manner
    - **Kind of resources**: trial video clips of VRS authored funny home videos with embedded video ads
    - **Typical Content size for each content type**: video up to 600 MB for TV and 10 MB for PC
- **Final Users/Clients:**
    - **How many final users will be reached**: no final users only distributors
    - **Their description**: ELION and TEO
    - **Their registration is needed**: yes, in AXCS
- **Partners involved and roles:**
    - VRS: to produce and adapt content

7 Bibliography

Web Site
http://www.axmedis.org

8 Glossary

A

API, **A**pplication **P**rogramming **I**nterface
A set of definitions of the ways one piece of computer software communicates with another.
ASP, **A**ctive **S**erver **P**ages
A web-scripting language by Microsoft.

B

B2B, **B**usiness to **B**usiness
Refers to one business communicating with or selling to another.
B2C, **B**usiness to **C**onsumer
Refers to a business communicating with or selling to an individual rather than a company.

C

CM, **C**ontent **M**anagement
Designs the set of processes and technologies supporting the evolutionary life cycle of digital information.
CMS, **C**ontent **M**anagement **S**ystem
A software tool designed to help content managers create, manage, and publish their content.
CRM, **C**ustomer **R**elationship **M**anagement
An information industry term for methodologies, software, and Internet capabilities that help an enterprise manage customer relationships in an organized way.
CSS, **C**ascading **S**tyle **S**heets
A style sheet format for HTML documents endorsed by the World Wide Web Consortium.

D

DAM, **D**igital **A**sset **M**anagement
DRM, **D**igital **R**ights **M**anagement
A system for protecting the copyrights of digital content.

E

ECM, **E**nterprise **C**ontent **M**anagement
The set of technologies, tools, and methods used to capture, manage, store, preserve, and deliver content across an enterprise.
ERP, **E**nterprise **R**esource **P**lanning
An integrated information system that serves all departments within an enterprise.

F

FTP, **F**ile **T**ransfer **P**rotocol
A protocol used to transfer files over a TCP/IP network.

G

GNU, **G**nu's **N**ot **U**NIX

A project sponsored by the Free Software Foundation that develops and maintains a complete software environment.
GPL, **G**NU General **P**ublic **L**icense
The license that accompanies the GNU software from the Free Software Foundation.

GUI, **G**raphical **U**ser **I**nterface
A computer terminal interface based on graphics instead of text.

H

HTTP, **H**yper**T**ext **T**ransport **P**rotocol
The communications protocol used to connect to servers on the World Wide Web.
HTTPS, **H**yper**T**ext **T**ransport **P**rotocol **S**ecure
Version of the HTTP protocol that enables secured transmission of Web pages.
HTML, **H**yper**T**ext **M**arkup **L**anguage
T*he document format language used on the World Wide Web.*

I

ICE, **I**nformation and **C**ontent **E**xchange
A data sharing specification that allows one Web site to obtain data from another Web site.
IP, **I**nternet **P**rotocol
The network layer protocol in the TCP/IP communications protocol suite.

J

J2EE, **J**ava **2** **E**nterprise **E**dition
A version of Java for developing and deploying enterprise applications.

L

LDAP, **L**ightweight **D**irectory **A**ccess **P**rotocol
A protocol used to access a directory listing.

N

.NET
Microsoft's framework for Web services and component software.

O

ODBC, Open **D**ata**B**ase **C**onnectivity
A database programming interface from Microsoft that provides a common language for applications to access databases on a network.

P

POTS, **P**lain **O**ld **T**elephone **S**ervice

Q

QoS, **Q**uality **o**f **S**ervice

R

RDF, **R**esource **D**escription **F**ramework
A standard for describing resources on the Web endorsed by the World Wide Web Consortium.
RSS, **R**eally **S**imple **S**yndication
A syndication format (developed by Netscape in 1999) for aggregating updates to blogs and the latest news from Web sites.

S

SSL, **S**ecure **S**ockets **L**ayer
A protocol developed by Netscape for transmitting private documents on the Internet.
SCORM, Shareable **C**ontent **O**bject **R**eference **M**odel
A standard for web-based E-learning.
SOAP, **S**imple **O**bject **A**ccess **P**rotocol
A message-based protocol based on XML for accessing services on the Web.
STB, **S**et-**T**op-**B**ox

U

UDDI, **U**niversal **D**escription **D**iscovery and **I**ntegration
An industry initiative for a universal business registry of Web services.
UML, **U**nified **M**odeling **L**anguage
An object-oriented analysis and design language.
URI, Uniform **R**esource **I**dentifier
The addressing technology for identifying resources on the Internet.
URL, **U**niform **R**esource **L**ocator
A type of uniform resource identifier (URI) that uses an HTTP connection.

V

VoD, **Video o**n **D**emand

W

WCM, **W**eb **C**ontent **M**anagement
WSDL, **W**eb **S**ervices **D**escription **L**anguage
An XML-based language (Developed by Microsoft and IBM) for defining Web services.
WYSIWYG, **W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou **G**et
A graphical interface to a process which shows how the end-result will look as it is being produced.

X

XHTML, e**X**tensible **H**yper**T**ext **M**arkup **L**anguage
A reformulation of HTML markup language with the same expressive possibilities but a stricter syntax.
XML, e**X**tensible **M**arkup **L**anguage
A metalanguage used to design markups languages.
XSL, e**X**tensible **S**tylesheet **L**anguage
A standard from the World Wide Web Consortium for describing a style sheet for XML documents.
XSLT, e**X**tensible **S**tylesheet **L**anguage **T**ransformation
Processing extensions to the XSL stylesheet language used to convert XML documents.