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3D VIAP Specification and API – Phase II

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SUMMARY

This document is a specification for the 3D Video Interactive Application Platform. It is split in two chapters: the first presents the overall reference architecture; the second lists requirements grouped by subsystem to form a complete specification. Each chapter is divided into equivalent sections and sub-sections, one for each platform subsystem.

DOCUMENT CHANGE LOG

Issue/ Revision	Date	Modification Nb	Modified pages	Observations
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1 REFERENCE ARCHITECTURE

This chapter describes of the overall reference architecture. It provides an overview of the platform scope and purpose and organizes functionality into subsystems.

1.1 INTRODUCTION

To understand how the Video Interactive Application (VIA) platform fits into the overall MUSCADE architecture, please refer to document D1.1.3 section 6.2. Here the VIA platform architecture is presented in more detail.

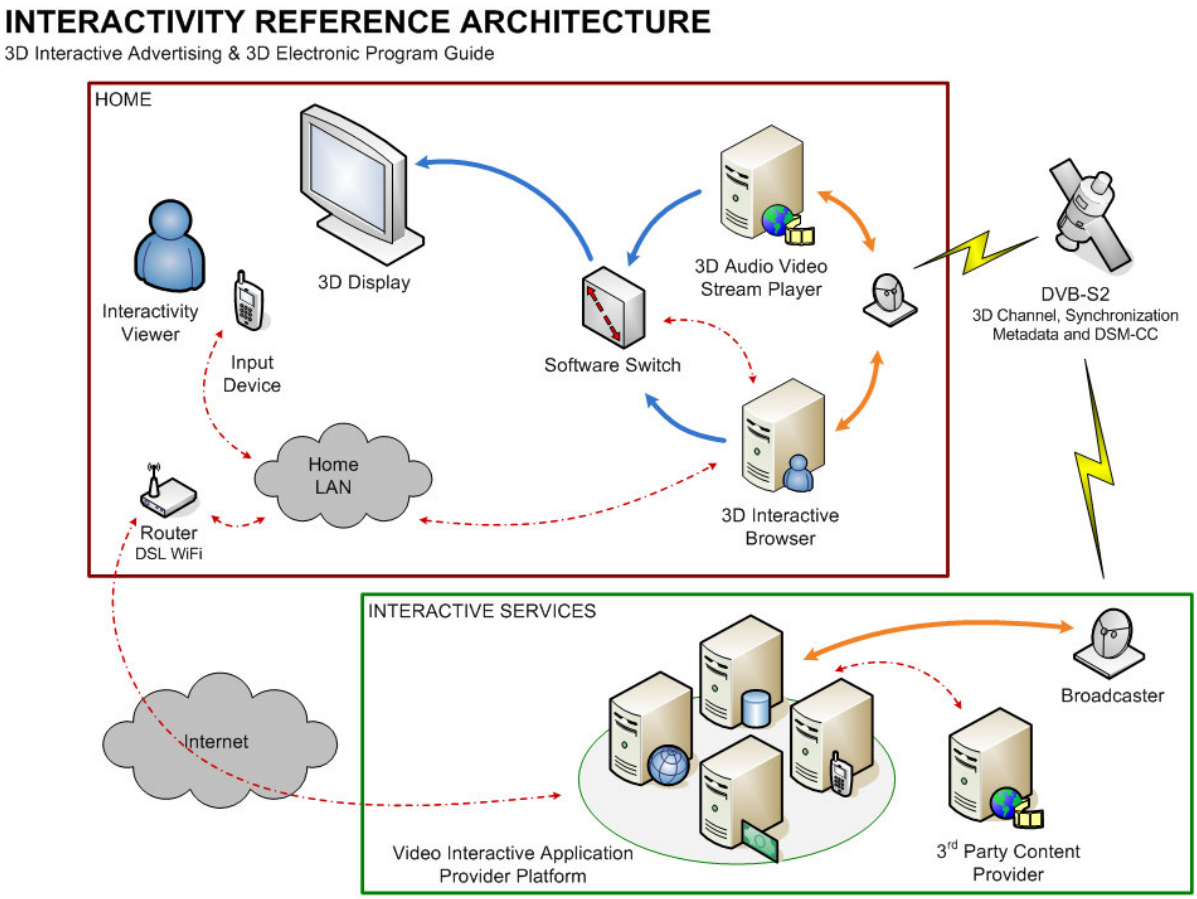

Figure 1 Interactivity Reference Architecture for MUSCADE

The Video Interactive Application (VIA) Platform provides a network agnostic framework for the development of multi-platform interactive TV applications. Figure 1 above provides an overview of the VIA platform architecture. A more schematic representation is depicted below (see Figure 2). Note that in Figure 2 the 3D Interactive browser of Figure 1 is split into two components, the Home Gateway and the presentation Client.

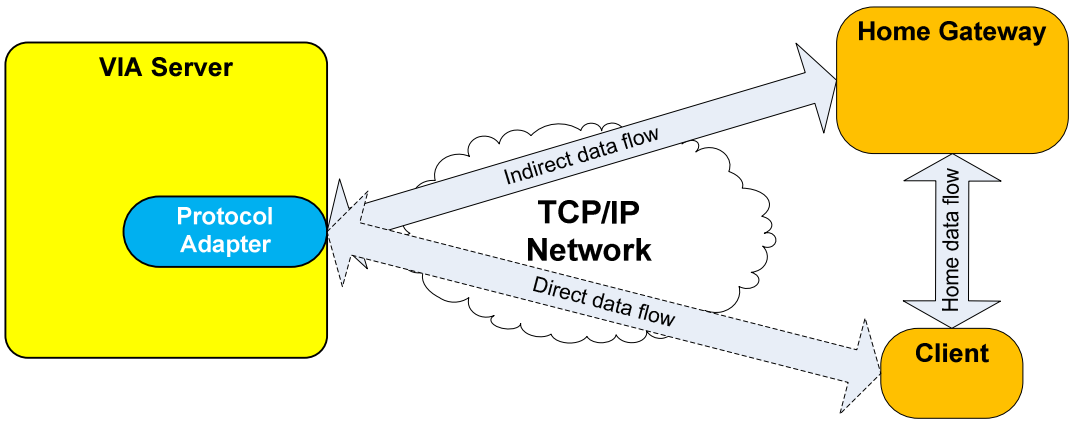

Figure 2 VIA Platform overview

Basic building blocks of the system are the VIA Server, Home Gateway (HGW) and Clients. Each of these components will be described in next sections.

- The VIA Server is the central and the most important component of the VIA platform. It provides an environment for the deployment of interactive applications and the hosting of support services.
- The Home Gateway, located at user's premises, provides additional services such as content pre-fetching and caching, event notification handling, congestion control, etc.
- The Client is a terminal for accessing platform services. The terminal functionality may be implemented either through a 3D browser or game engine.

1.2 SERVER

The VIA server is based on enterprise-grade middleware and consists of a set of components called Horizontal Services (HS). These components expose their functionality via public APIs implemented over a selection of protocols, so that a client has some choice in how to access and use the provided API. Horizontal Services aim to reduce cost and complexity of development and time to market by packaging functionality, commonly required by applications, into easy to use, modular components.

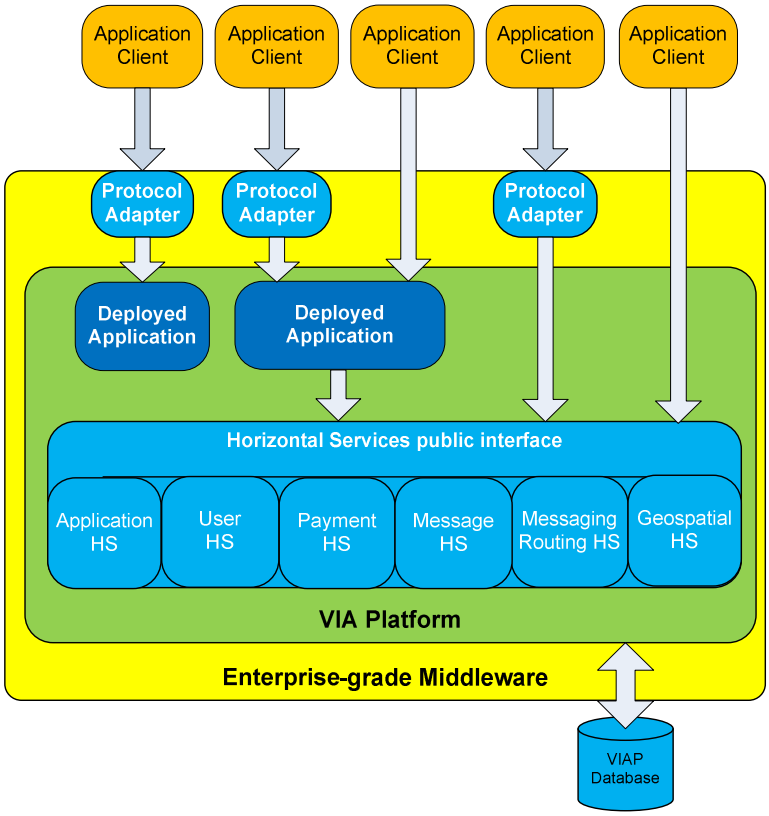

Figure 3 VIA Platform server side

Application clients, depicted in the Figure 3, can access specific application or horizontal services either natively or via protocol adapters.

A number of specific Horizontal Services have been identified and the VIA Platform will be bundled with these. However as new needs arise and commonalities abstracted more services can be created. The services are deployed as separate modules, however due to dependencies between modules, not all combinations are possible,. The following lists allowed combinations for the currently identified Horizontal Services (HS):

- User HS [+ Application HS] [+ Geospatial HS]
- User HS + Payment HS [+ Application HS] [+ Geospatial HS]
- User HS + Payment HS + Messaging HS [+ Application HS] [+ Geospatial HS]
- User HS + Payment HS + Messaging HS + Message Routing HS [+ Application HS] [+ Geospatial HS]

The horizontal services between square brackets are optional. The remainder of this section provides more details on each Horizontal Services and how such services will be employed in the Muscade Interactive Advertisement demonstrator

1.2.1 User

The User HS provides functionality to perform basic user manipulation. Users can be created, updated and removed from the platform.

A user has a set of roles which can be granted and revoked. Roles defined inside system are:

- User – ordinary users have this role, allowing them to login to applications.
- Application manager – application owners have this role, allowing them to manage their deployed applications
- Administrator – platform administrators have this role, allowing them to manage the platform. This includes operations such as creating users or deploying applications.

Roles are also used to enforce access control. Functionality can be marked as requiring one or more roles before it will be provided. In this context an additional "special" role called System is defined. This role cannot be assigned to a user, but is used to control intra-application access.

1.2.2 Application

The Application HS provides functionality necessary to deploy applications. This is usually done manually using the provided web user interface. In order to deploy applications the user needs to have an account on the platform with appropriate role. The Application HS allows querying of the status of an application, whether it is deployed or not, currently this only applies to the server side component of an application.

1.2.3 Payment

The Payment HS provides e-wallet and payment transaction functionality to the platform. Each user is given an e-wallet which he can use to pay for various services offered on the platform. The platform uses a pre-paid schema, so only after the e-wallet is charged with a credit card, can funds be used for platform payments. The payment service provides only one currency which is valid throughout the platform. The payment transaction API makes it as simple to integrate payments transactions into any VIA server-side application.

1.2.4 Messaging

The Messaging HS provides the possibility for any user or application to send and receive messages with other users on VIA platform or other third-party communication systems. A list of currently supported messaging systems is:

- e-mail
- SMS
- XMPP (Jabber)
- SIP (IMS)
- VIAP (Internal messages for users on platform)

The Messaging HS exposes a simple API that unifies semantics for message delivery. This means that the API is the same no matter what the user is sending, for example an e-mail or a Jabber message. Only recipient address and message type needs to be correctly set, before the message is sent, in order for the message to be delivered using the correct transport.

Some of the transports might charge for message delivery, and in such cases the message sending is charged from user's e-wallet. If the funds are insufficient, delivery will fail (Similar behavior for a prepaid user trying to send an SMS message from his cell phone if he does not enough funds in his account).

1.2.5 Message Routing

The Message Routing HS provides a user with the ability to configure the redirection of his messages when he is offline. For example a user might configure his Jabber messages to be redirected to SMS when he is not online (receiving messages). The service exposes an API and a GUI implementation for the user to configure service behavior.

1.2.6 Geospatial Tracking

The Geospatial HS provides a unified submission interface for geo-localized tracking information: tracked item identity, co-ordinates, timestamp, altitude, bearing. The HS also provides specialized storage, filtering and visualization support of this data. It is a generic interface thus the tracked items stored and manipulated in the same HS can actually be quite different, e.g. shops & product locations, user positions, geographic location of video content, etc. The HS only provides a means to submit the tracking information, how that information is collected is the responsibility of the client VIA.

1.2.7 Horizontal Service Demonstration

The Interactive Advertisement demonstrator will employ VIA Horizontal Services to:

1. Present the viewer with an offer to explore the interactive model of a product while she's watching the audiovisual stream related to the product in question. Note: the interactive model may be personalized depending on the viewer's profile
2. Allow the viewer to ignore or accept the offer by switching from passive viewing of the 3D audiovisual stream to active interaction with the 3D interactive environment by means of his mobile phone, used as a personal input device
3. From within the interactive environment, enable the viewer to explore the product and subscribe for a trial or enroll in a lottery. Ensure the viewer can always return to the audiovisual stream regardless of the content provider's interactive application

The above use case employs the VIA Horizontal Services to:

1. Deploy the 3D Interactive Advertisement application so that it becomes seamlessly accessible to the viewer (Application HS)
2. Authenticate the registered viewer by means of his mobile phone, used as a personal 3D input device (User HS)
3. Confirm the viewer subscription by means of an SMS message sent to the viewers mobile phone (Messaging HS)
4. Charge the sender application (or receiving viewer) for the SMS message price (Payment HS)

Please note the Interactive Advertisement demonstrator is only an example of use of VIA Horizontal Services. Other applications such as augmenting audiovisual content with interactive features (such as exercises in educational content or bonus features in movies) or integrating social communications by allowing viewers to exchange messages or interact through the 3D interactive environment are envisaged.

1.3 HOME GATEWAY

The Home Gateway (HGW) is a mediator component controlling data flows between the central VIA Server and at least one client in the home domain. A viewer will never directly access the HGW, which provides important transparent functionality such as caching of content, congestion control and service discovery functions.

1.3.1 Event Synchronization

In order to notify the viewer of interactive content related to the audiovisual sequence that is being rendered the HGW provides a service capable of receiving event notifications and propagating them to client applications executing on the HGW.

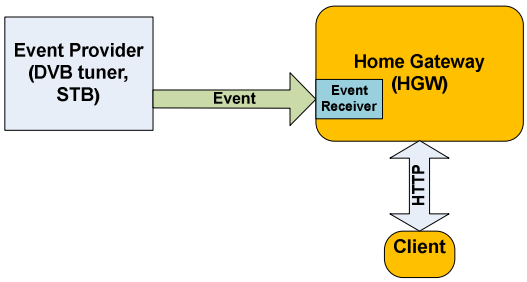

Figure 4 Event synchronization

As depicted on the Figure 4 the HGW receives event notification from an external component. This event is available for the applications running on the HGW. The applications are using available event information to render appropriate content (for example to display content related to the video feed that the viewer is currently watching).

Phase-2 provides volume selection within the 3D audiovisual stream. This is achieved by extending event synchronization to be able to describe multiple events with different on screen coordinates at the same time.

1.3.2 Content Pre-fetching and Caching

To improve the viewer's perceived performance and to avoid scalability issues the VIA platform provides caching functionality. A client always accesses interactive content via the HGW, allowing the latter to serve cached content, customize the viewer's experience and forward service requests to the VIA Server as required. Additionally the cache distribution mechanism can take advantage of the available network properties and react to different congestion conditions. For satellite and other asymmetric unidirectional broadcast networks, this implies the use of multicast and/or carousels for the distribution of interactive content that is either popular or requires pre-caching ahead of an audiovisual synchronization event (see section 1.3.1 above).

1.3.3 Content Packaging

Content is distributed to the HGWs in packages which include additional metadata (such as location, priority, expiry, etc) useful for content management. Packaging is also used to ensure a consistent and uninterrupted interactive experience for the viewer by bundling tightly coupled content in the same package. This avoids situations where the viewer is enticed into the interactive experience by the available content only to be left waiting for the remaining content to be downloaded. Packaging ensures that an interactive experience is either available in full or not visible at all to the viewer.

1.3.4 Hybrid and Mixed Network Support

The HGW provides support for the following network configurations:

- Terrestrial broadcast and broadband. This configuration relies on terrestrial broadband infrastructure for distribution of audiovisual and interactive content as well as for the viewer's network interactions with VIA Horizontal Services. The configuration offers the best viewer's experience when terrestrial capacity is sufficient to address bandwidth requirements both for audiovisual distribution and interactive 3D communication. This is not always the case for large population of viewers distributed over a wide geographical area.
- Satellite broadcast and terrestrial broadband. This configuration relies on satellite broadcast infrastructure for distribution of audiovisual content and popular or pre-cached interactive content. Conversely it relies on terrestrial broadband for the distribution of additional interactive content as well as for viewer's network interactions with VIA Horizontal Services. Such hybrid configuration takes advantage of the best of each network and offers the best viewer's experience
- Satellite broadcast and narrowband. In rural areas where high-end broadband services are not available, satellite can be used for the distribution of audiovisual content and popular or pre-cached interactive content as well as for viewer's network interactions with VIA Horizontal Services. The HGW ensures that additional interactive content, which is available via satellite multicast or carousel distribution is not made available to the viewer when the satellite link is congested.
- Satellite broadcast only. This configuration allows for a limited interactive experience that makes use of the available popular or pre-cached interactive content and that does not require VIA Horizontal Services for remote interactivity.

1.3.5 Congestion Management

In order to reduce congestion on the server side, links to content which is not locally cached can be automatically removed by the HGW as soon as it detects or is informed of a congestion situation.

1.4 CLIENT

The Client in the reference overview represents any component connecting to either the VIA Server or the Home Gateway using open standard protocols. In the MUSCADE project this is a 3D interactive browser used to render objects on a 3D display served from content cached by the HGW.

1.4.1 Application Container

A 3D video interactive application is expected to provide the viewer with rendered 3D content and to allow interactions with this content. The application container is the name given to the support framework that allows content and viewer to interact. The content will have a particular format which must be understood by the container so that it can be rendered to the 3D display appropriately (see 1.4.2). A desirable quality of the container is to provide a higher level of abstraction to ease the creation task of content providers. The container will collect and interpret interaction events triggered by the viewer using an input device (see 1.4.6) and manipulate the content as instructed.

Ideally the content format is standardized (see 1.4.2) and the application container will only need to host applications in this format. In practice such standardization of the content format is unrealistic. The adopted strategy to address this issue is to treat content as opaque and provide a framework (or meta-application container) that supports a number of popular application containers to interpret the corresponding content type. This strategy has the advantage of making platform adoption easier and more widespread, without committing to a particular content format. Existing content can be proposed with minimal changes. The definition of flexible container to system interfaces becomes more important.

1.4.2 Content Format

At both extremes a 3D interactive content pipeline must support the creative process of content production and ensure consistent deployment onto an interactive browser. The pipeline should support input and transfer between popular digital content creation (DCC) tools. It should also use an open transmission format as this will encourage compatibility between different interactive browser implementations. Thus the 3D content format and its ability to support all the pipeline requirements is central to the overall quality of the 3D interactivity provided.

Ideally the content pipeline should be standardized. Although there are industry standards (COLLADA, X3D, etc.) that attempt to cover all requirements, in practice there are too many exceptions and the functional scope is too wide ranging to be covered in a practical way by a single format. This leads to tools and practices that only partially and subjectively respect the standards. Professional content production houses have invested considerable efforts in their own dedicated content pipelines. The adopted solution is to select a subset of the most common content pipelines and address interfacing with these on a case by case basis.

1.4.3 Graphics Library

This is a low-level library that provides an interface between the application container 3D model representation and the graphics hardware that rasterizes pixels for presentation on screen. The library must be aware of what kind of 3D display technology is connected and include a means to provide as many renderings (camera views) of the model as required by the display technology, ideally automatically inferring this from the display type.

1.4.4 3D Display

Different 3D display technologies have different requirements on the number of fully rendered viewpoints used. Stereoscopic displays require 2 viewpoints, and rendering stereoscopic image pairs is often supported by 3D applications or the display driver itself.

Multi-view displays on the other hand require a minimum of 2 but typically use 5-8 (sometimes more) viewpoints and optionally depth maps. In case of 3D video, these can be transferred from a player to the display using one or more HDMI/DVI cables. The possibility of interfacing interactive applications to multiview displays is vendor dependent, some vendors do not support this, while others require the application developer to incorporate their code (eg. Alioscopy). The most convenient support for interfacing OpenGL applications for multi-view is provided by Dimenco (formerly Philips), with their OpenGL Visualizer (formerly OpenGL Control), which acts as a transparent layer between the application and OpenGL. It outputs an image+depth pair on the secondary monitor, which is then rendered into multiple views by the Philips display.

Light-field displays require so many viewpoints that it is currently not possible to transfer fully rendered viewpoints. Instead the model is transferred to the display that must render all the views it needs by itself. A single Gigabit Ethernet connection is used to transfer the model to the display. The HoloVizio light-field display uses the HoloVizio OpenGL wrapper software component to intercept the model, which allows integration of 3D visualization into existing applications without modification to the original application. Support for both jMonkey and WorldWind has been added to this software component recently, in order to support the next set of interactive applications developed in the project.

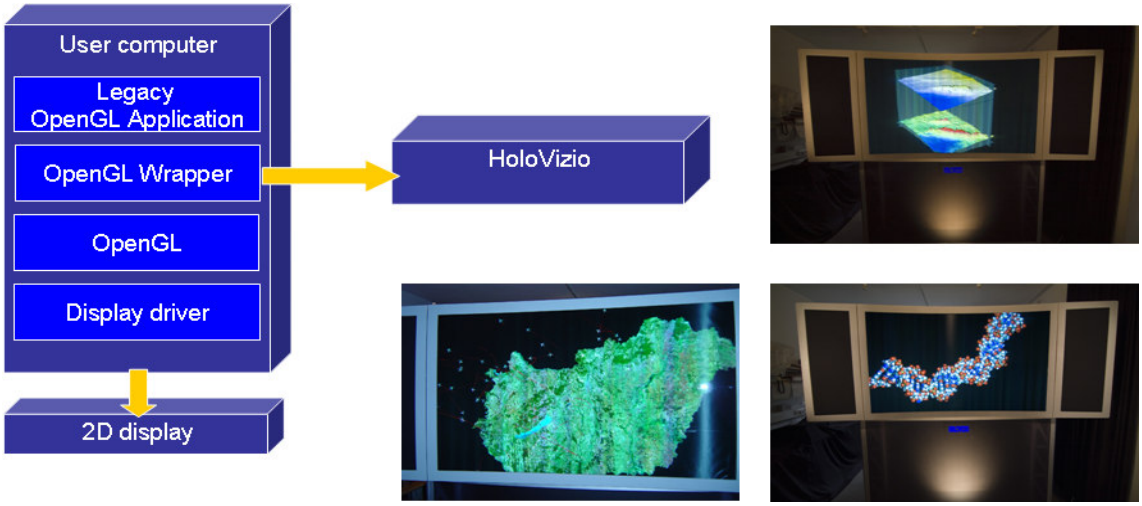

Figure 5 HoloVizio OpenGL wrapper operation

As mentioned earlier the graphics library provides access to the display and must cater for these requirements. However the details are not in the scope of this document and are not the focus of the MUSCADE interactivity workgroup.

1.4.5 Interactivity Switch

The MUSCADE reference architecture (see Figure 1) has one 3D display and two sources of 3D content (audiovisual stream player and interactive browser). There are two approaches to handling the mapping from two to one. The first is out of scope for Phase-1 and only described theoretically in Phase-2 of

MUSCADE, is the combination or overlaying of the two 3D content sources. The second approach is that the sources are mutually exclusive, requiring a switch to select the source that is actually displayed. The video stream player will be the default source but the interactive browser will be able to control the switching and when required switch over to become the source itself.

The conditions for switching from streamed to interactivity and back are completely up to the interactive browser. The following examples suggest how the MUSCADE demonstrators can be bootstrapped. Switching can be unconditionally triggered by the viewer, for example, the viewer presses the EPG button on his remote and any stream he is viewing is interrupted to present the EPG rendered by the interactive browser. It can be conditional on the viewer pressing the 'red' button during an 'interact now' period in the stream (see 1.3.1) to gain access to an Interactive Advertisement. Although not part of any demonstrator, another type of switching is caused by the interactive browser on its own. It could be allowed to interrupt streamed content on the reception of important notifications (emergency alert) or events (stock manager application has detected a drop in stock requiring immediate action).

1.4.6 User Input

Given a 3D environment that the viewer can interact with, what is the most natural or most intuitive way for the viewer to navigate? In order to freely navigate through a 3D scene, a navigation device has to support 6 degrees-of-freedom (dof). 3 dof are required to navigate a camera through 3D space and additional 3 dof are needed to rotate the camera in all directions. In a user interface, even a 3D one, that many dof might not be necessary, since the whole point of a UI is to channel the viewer's interaction. Limiting the dof will actually simplify a user's available choices. Certain applications might need to collect textual entries from the viewer. There are physical constraints from the environment, keyboards take up space, motion based devices require an un-encumbered 'air-space'. Another consideration is capability for collective viewing and simultaneous interaction. A table of devices is presented with some pros and cons.

Input Device	Degrees of Freedom	Advantages	Disadvantages
Remote Control	2 (arrow keys)	Familiar device. Color and special buttons. Non-bulky physical format	12 keys are required for 6 dof. Extremely unintuitive
Keyboard & mouse	2 (mouse)	Efficient textual entry	Bulky physical format, not enough dof for free navigation
Space Navigator	6	Well adapted to free 3D navigation	Un-familiar device. No textual entry
Smart phone	3 (gestures or accelerometer + gyroscope)	Secondary (2D) display. Multiple viewers can input concurrently. Personal device carries viewer identity	Not enough dof for free navigation
Kinect	6 (body & arm movement)	Accurate gesture capture of the body and in particular of hands, can be	Poor speed and accuracy. No textual entry. Requires un-

extremely intuitive	cumber 'air-space'

Table 1 Pros and Cons of input devices

The smart phone was selected during Phase-1 as input device. It provides a balance between intuitive on-screen gestures (swiping, pinching and tapping) and not too many dof, which is actually seen as a advantage in simplifying the viewer's choices. Additional advantages include:

- A secondary display, which can be used to alert the viewer of interaction opportunities without requiring overlaying on the main display (see 1.4.5).
- A personal device, which can be used to identify the viewer, to hold profile and personalization information, and to provide geo-localization information.
- A standard wireless link between device and client. Whether based on Wi-Fi, Bluetooth or Infrared, un-tethered links do not 'get in the way' in a lean back consumer environment.
- Well supported textual entry mechanisms, allowing easy login or form based information collection on the secondary display.

In Phase-2 a second user input paradigm based on the smartphone's internal gyroscope, compass, and accelerometer is explored to provide a physical proxy approach. When the viewer displaces, tilts or rotates the smartphone the same action will be performed on the 3D product represented on screen.

1.5 DEMONSTRATORS

1.5.1 3D Programme Guide

"Electronic Program Guides" (or EPGs) have evolved in last 20 years as a result of the increasing number of available channels. Starting with DVB and going further into IP based distribution, EPG providers are faced with new challenges and thus new concepts are introduced. EPGs are changing to accommodate new demands. The way that people are using EPGs is changing. A typical TV service provider today has hundreds of channels in his offering. EPGs provide users with the ability to navigate through huge channel offerings while they search for a channel that is of most interest to them. Typically we can describe 3 different usage scenarios that an EPG should support:

- What is available now or up next – the user just wants to watch TV, and needs to see what is currently being broadcasted on available channels.
- Finding particular shows – the user knows exact what show (or at least type of the show) he wants to watch, and he is trying to find it on the available channels.
- Casual browsing – the user does not know what he is looking for and relies on the EPG to provide suggestions. The EPG usually does this by matching a show's meta data (category, style, director, actors, geographic location, sound track, subtitle, keywords, etc.) with the user's preferences, which can be collected over time or specified directly by the user.

For each of listed scenarios, the EPG system should provide an appropriate response. In order to satisfy these use cases an EPG metadata format must provide sufficient amount of information so that user can be presented with useful information.

1.5.1.1 Delivery of EPG metadata

EPG metadata will be distributed via the cache distribution mechanism, with highest importance class. Since high importance classified items will be retrieved from server, non-cached metadata would this way be retrieved from the VIA server if they are requested.

If the cache supports invalidation mechanism, it would be used to update changed data.

1.5.1.2 3D rendering and navigation

Visual representations of the EPG data in 3D space can use 3 dimensions to ease navigation through data which is of the most interest for the users. For example in typical usage where two dimensions are used to represent timeline and various channels, a third dimension can be used to represent days. In such way user can move one day forward and back very easily. Additionally colors may be used to represent genre of the show being displayed.

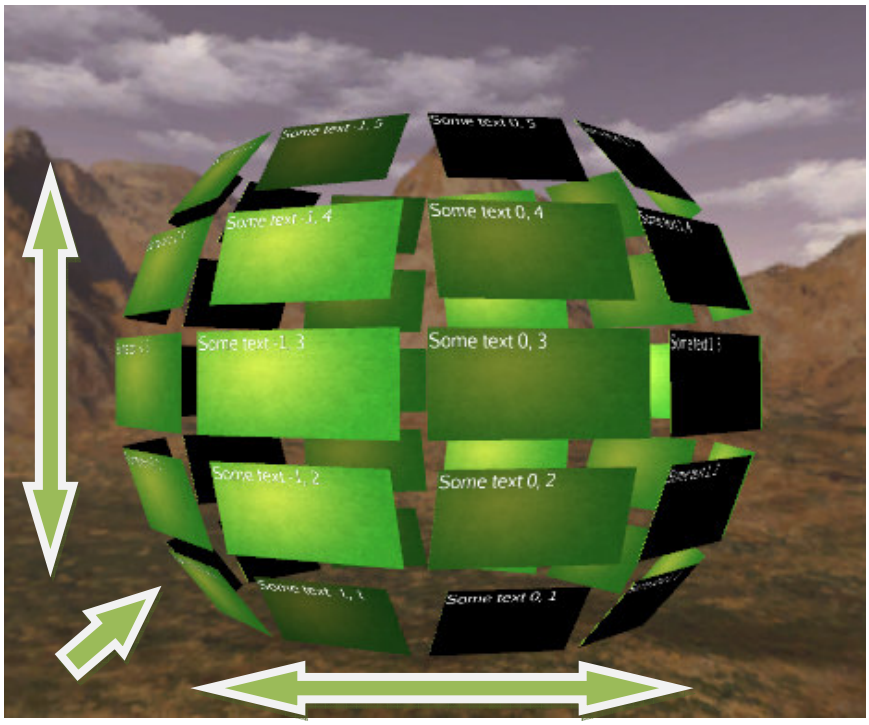

Figure 6 Prototype of a 3DPG concept

In this spherical prototype each panel on the surface of the sphere represents an EPG item. The central panel can be highlighted when it is selected. The viewer can trigger movement of the panels moving either up/down or left/right on the surface of the sphere. Movement on the sphere intuitively implies that it will eventually wrap around. However the distance travelled in panels steps in the same direction, before arriving back to the initial position is not limited by the number of panels visible. For example if the vertical direction represents TV channels, while only 5 panels are visible this does not mean the maximum number of TV channels available for selection is 5 or even 10, it can be whatever the real number of TV channels available is. Continuing with the example horizontal movements represent the time of day. A

third dimension, the day of the week can be represented by movements in and out of the screen, visually this will be seen as successive 'skins' of the sphere peeling in or out of the screen.

1.5.2 Interactive Advertisement

Over the last 50 years, two-dimensional television has developed to become a very powerful and attractive medium for advertisers. Traditional advertisements consist mainly of short video clips, which are shown between shows or during regularly planned show interruptions. Recently product advertisements are becoming placements within the actual show with help of *computer graphics*. Virtual product placement and virtual banner replacement are only two examples of this form of advertisement. Nevertheless consumers still remain *passive* observers.

Within the context of the 3D VIA Platform a demonstrator for *3D Interactive* Advertisements is developed. The content of Interactive Advertisements is represented by static or animated computer generated 3D objects or scenes. The interactive browser may also allow the viewer to interact with 3D content by navigating through the scene with a 3D input device (see Figure 7). An additional type of interaction is available in the form of viewer triggered animation chains, enabling producers of 3D Interactive Advertisements to explicitly draw a viewer's attention to interesting parts of the advertised product. In the interactive browser a viewer can also trigger a 'world hop', which is the equivalent of an Internet hyperlink. This hyperlinking mechanism allows the viewer to jump from one interactive 3D scene to another 3D scene, which is loaded from the Internet. Thus, the interactive 3D content is not limited to a closed environment. The hyperlinking mechanism allows also content producers to split 3D content into viewer meaningful chunks. Then, in parallel pre-caching and bandwidth management techniques work to provide a smooth viewer experience. Another feature supported in Phase-2 is the unification of the content's state across different viewers. Essentially one viewer's interaction can be reflected in another other viewer's content. It is believed that these enhancements will trigger the viewer's interest, leading him to subscribe to further product notifications. This is a pre-requisite for a targeted advertising and consumer statistics collection.

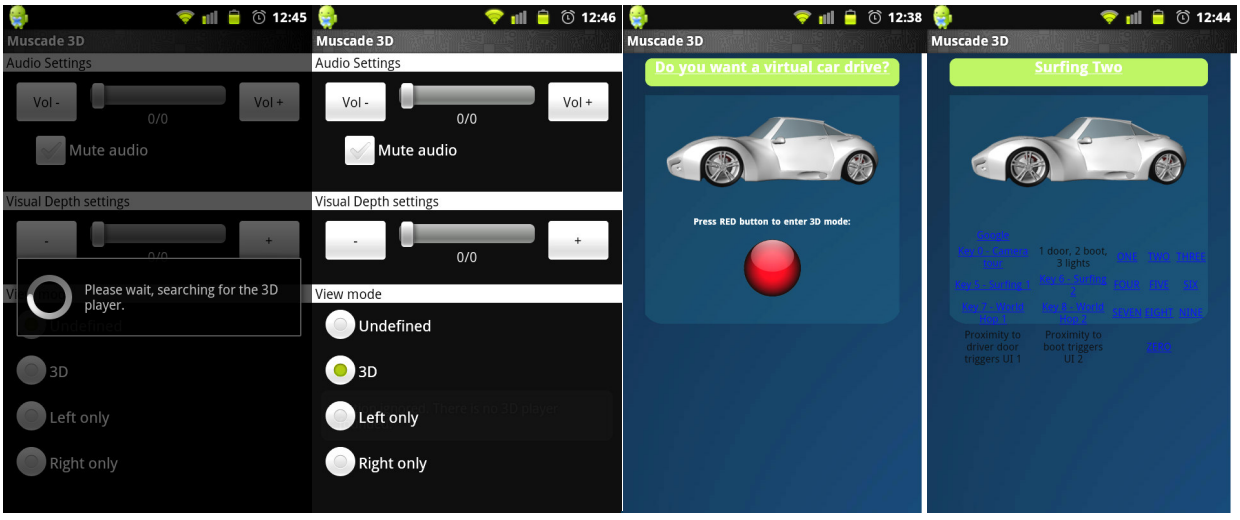

Figure 7 Smart phone used as 3D input device

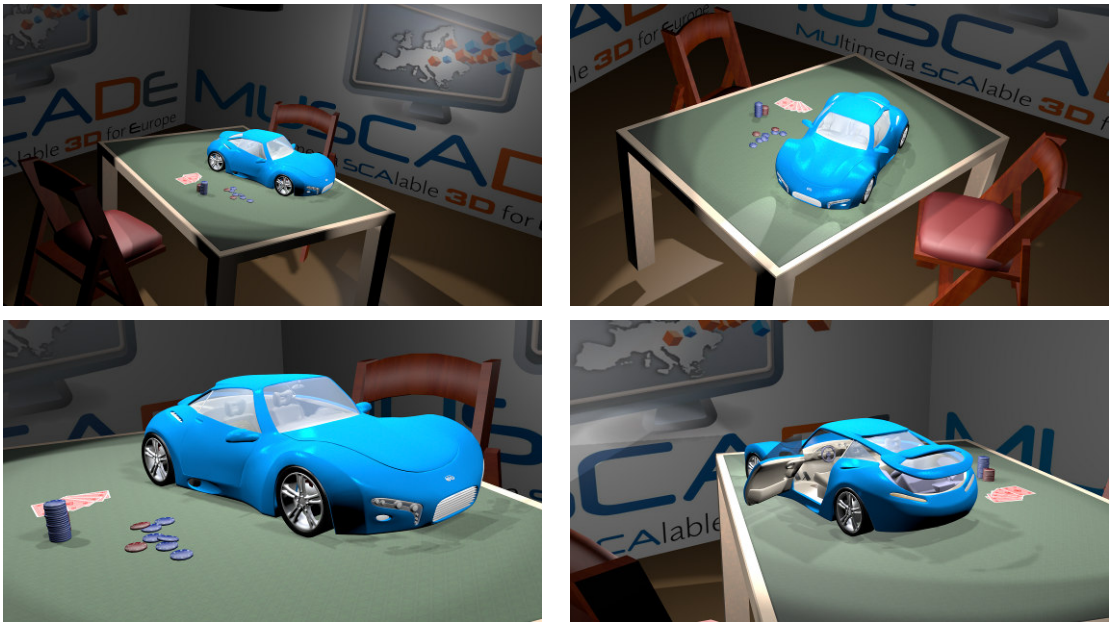

Figure 8 3D interactive content

For example, while displaying a car advertisement, the viewer is notified that by pressing the 'red' button he can see a 3D model of the car being advertised. On activation the 3D model (see Figure 8) is displayed to the viewer, who could watch it from different angles and perhaps even interact with the model (open doors, trunk, world hop to see the car interior, etc…). Then he could subscribe for more information, to be informed of special offers or chances to test drive the car in his nearest showroom.

Consequently, an Interactive Advertisement is specified by the following types of information:

- 3D models/scenes and animation data,
- triggers which start animation chains,
- triggers which initiate a world hop (hyperlinks).
- locations of triggers

Important aspects of the Interactive Advertisements are:

- Pre-caching of the contextual content to reduce network congestion – This content can be large so it needs to be cached locally in order to reduce latency. Caching of the content is provided by caching functionality of the platform, which utilizes available network characteristics (e.g. multicast on the satellite network).
- Streamed event notification mechanism used to notify the interactive browser of context related content availability – The mechanism is described in 1.3.1. Once an event notification is received, the interactive browser checks if the content is pre-cached locally, and if it is, will display it to the viewer.

1.5.3 **Gaming**

Gaming is clearly an area where viewer interaction is possible and expected by the viewer. An objective for the 3D interactive player is to provide some form of support for gaming. This however is such a widely scoped subject that some assumptions are made to reduce the scope while still providing a meaningful common denominator.

The type of gaming proposed and best supported should be in line with the lean-back viewing experience. The casual or family gaming type seems to best fit this expectation. These have simple rules and no requirement for long term commitment nor special skills. These kind of games do not usually require complex user input, sometimes just one action button suffices. Nonetheless they can still be media rich and present opportunities for multiple simultaneous players sharing the same screen.

By their nature, casual games are entertaining for a short period of time. Even the most popular games renew interest by providing new levels or stages released over time. To have a durable gaming offering there should be a wide range of choice for the viewer. Independent of how this is large choice is created, assuming this is the case highlights the issue of easily finding and selecting a game. Here the techniques applied in the EPG can be re-applied to provide a common intuitive user interface paradigm.

Phase-1 provided a baseline 3D interactive engine and a set of interfaces to provide integrated features such as world hopping, content caching, gesture based user input navigation and secondary display support. Phase-2 proposes a meta-container approach acknowledging the fact that not all content can be hosted on one engine. Games are also subject to this consideration. A game implemented on the baseline engine will be fully integrated and can take advantage of all the platform's features. Already existing games that use other engines might be playable but may not be fully integrated. This helps platform adoption by providing an offering with reduced refactoring effort, but requires sacrificing some quality of experience.

Another issue to be aware of when trying to add already existing games to the platform is that although they are in 3D, they might not be designed with stereoscopy and 3D viewing issues in mind. A fixed inter-axial distance between stereo cameras and game movements too close to an object can cause eye strain, headaches due to the effort required to fuse large screen disparities. Specific algorithms controlling the camera parameters need to be implemented to take this into account in the context of a game's particular needs.

2 SPECIFICATION

This chapter lists platform requirements, grouped by subsystem. Please refer to the previous chapter for an overview of the platform scope and purpose as well as its organization into subsystems.

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" below are to be interpreted as described in [RFC 2119, IETF].

2.1 GENERAL

[3DVIA-1000] The System MUST be based on open standards and technologies.

[3DVIA-1001] The System MUST be physical network agnostic (indifferent to DVB-S, DVB-T, ADSL, Cable, etc.).

[3DVIA-1002] The System SHOULD support multi-platform client terminals.

[3DVIA-1003] The System MUST support a 3D interactive browser client.

[3DVIA-1004] The 3D interactive browser client MAY be split logically into two components the HGW and Client.

[3DVIA-1005] The System SHALL support the development and deployment of video interactive applications.

2.2 SERVER

[3DVIA-2000] The Server SHALL be enterprise grade middleware.

[3DVIA-2001] The Server SHALL host Horizontal Services and VIA server components.

[3DVIA-2002] The Server MAY have additional components to complete the framework.

[3DVIA-2003] A Horizontal Service MUST provide an easy to use public API.

[3DVIA-2004] The public API MUST be accessible using the Server's native protocol.

[3DVIA-2005] The public API MAY be accessible using other protocols via a protocol adapter.

[3DVIA-2006] A Horizontal Service MAY provide a Web User Interface to manipulate the public API.

[3DVIA-2007] The Horizontal Services and VIA server components MAY have dependencies.

[3DVIA-2008] The Server SHOULD ensure existence and consistency of dependencies for hosted components.

2.2.1 User

Platform user is a person who has an account on the VIA Platform. Access to the platform is allowed for a platform user who has successfully identified himself with username and password.

[3DVIA-2100] The User HS MUST support the creation of new user accounts.

[3DVIA-2101] The User HS MUST support setting and resetting of a user account's password.

[3DVIA-2102] The User HS MAY support the removal of a user account.

[3DVIA-2103] The System MUST supports roles to distinguish different types of access: User, Administrator, System

[3DVIA-2104] The User HS MUST supports granting and revocation of roles for accounts.

[3DVIA-2105] The User HS SHOULD allow only administrators to change other user accounts' data.

[3DVIA-2106] The Platform user MUST be able to login with only the assigned password.

[3DVIA-2107] The Platform user's login MUST be unique.

[3DVIA-2108] The Platform user SHOULD be able to change his password.

[3DVIA-2109] The User HS functionality MUST also be accessible via a Web User Interface.

2.2.2 Application

[3DVIA-2200] The System MUST be able to deploy VIA server components using the Application HS.

[3DVIA-2201] The Application HS SHALL provide a Web User Interface for VIA server component deployment.

[3DVIA-2202] The Application HS SHOULD verify a VIA server component's dependencies before deployment.

[3DVIA-2203] The Application HS SHALL allow querying of the deployment status of a VIA server component.

[3DVIA-2204] The Application HS handling of HGW and Client components of a video interactive application is OPTIONAL.

2.2.3 Payment

[3DVIA-2300] The System MUST support electronic wallets for users.

[3DVIA-2301] A Platform user SHALL have only one wallet.

[3DVIA-2302] The Payment HS SHALL allow filling a wallet with funds by Internet-based payments.

[3DVIA-2303] The Payment HS MAY allow emptying a wallet of funds by Internet-based repayment.

[3DVIA-2304] Wallet charging and management functionality MUST also be accessible via a Web User Interfaces.

[3DVIA-2305] Funds for a Platform payment MUST come from a wallet.

[3DVIA-2306] A Platform payment MUST be balanced (funds are not lost, credit to seller equals debit to buyer).

[3DVIA-2307] A Platform payment MUST be transactional.

[3DVIA-2308] The Payment HS MAY support only one currency.

2.2.4 Messaging

[3DVIA-2400] Platform users SHALL have a unique address in each messaging protocol supported by the Messaging HS.

[3DVIA-2401] Platform users MUST be able to exchange instant messages with following IM protocols: SIP, XMPP and SMS.

[3DVIA-2402] Platform users SHOULD be able to send and receive e-mail messages.

[3DVIA-2403] The Messaging HS MUST provide store-and-forward functionality for all supported messaging protocols.

[3DVIA-2404] The Messaging HS MAY charge users when sending messages for some message types (e.g. SMS).

[3DVIA-2405] The Messaging HS functionality MUST also be accessible via a Web User Interface

2.2.5 Message Routing

[3DVIA-2500] A Platform user MUST be able to setup handling of incoming messages per messaging protocol to store-and-forward or to re-direct to a different delivery addresses.

[3DVIA-2501] The Message Routing HS SHALL support routing between different source and destination messaging protocols.

[3DVIA-2502] The Message Routing HS functionality MUST also be accessible via Web User Interface.

2.2.6 Geospatial Tracking

[3DVIA-2600] The Geospatial Tracking HS MUST support the submission of tracking information (identity, latitude, longitude, altitude, timestamp, speed, bearing and meta data).

[3DVIA-2601] The Geospatial Tracking HS SHALL support the separation of tracking information by type.

[3DVIA-2602] The Geospatial Tracking HS SHALL support the retrieval of geospatial tracking information in graphical and XML formats.

2.3 HOME GATEWAY

[3DVIA-3000] The HGW MUST be able to connect to remote services, the VIA Server in particular.

[3DVIA-3001] The HGW MAY be connected to a unidirectional broadcast network.

[3DVIA-3002] Clients in the Home network SHALL be able to connect to the HGW.

[3DVIA-3003] A discovery mechanism MAY be used to establish communication between Clients and the HGW.

[3DVIA-3004] The HGW MUST be able to store and process data received from remote services or Clients in the Home network.

[3DVIA-3005] The HGW MUST be able to transfer data to and from remote services or Clients in the Home network.

[3DVIA-3006] The HGW functionality MAY be decomposed into common and application specific modules.

[3DVIA-3007] The HGW MAY support automatic deployment of modules.

2.3.1 Event Synchronization

[3DVIA-3100] The System MUST support the diffusion of streamed event notifications.

[3DVIA-3101] A streamed event notification SHOULD be able to uniquely identify cached content.

[3DVIA-3102] The HGW MUST be able to receive either directly or indirectly the diffused event notifications.

[3DVIA-3103] The HGW SHALL make the event notification available to all Clients that have subscribed to receive them.

[3DVIA-3104] A streamed event notification SHOULD be able uniquely identify multiple cached content each related to a volume during the same time frame.

2.3.2 Content Pre-fetching and Caching

[3DVIA-3200] The System MUST support the diffusion of content to be cached over a unidirectional broadcast network.

[3DVIA-3201] The HGW MUST be able to receive and store unidirectionally diffused content marked for caching.

[3DVIA-3202] The HGW MUST be able to discard diffused content if it is the same version as that which it has stored already.

[3DVIA-3203] The HGW MAY support rule based management of the contents of the cache.

[3DVIA-3204] Content for caching MAY be assigned a priority to be used in cache management.

[3DVIA-3205] The HGW MAY pre-fetch non-cached content linked to from cached content.

2.3.3 Content Packaging

[3DVIA-3300] The System MUST support the packaging and transport of content to ensure all elements of a consistent/related content set are readily available for client consumption.

[3DVIA-3301] The System MAY use metadata to describe a consistent/related content set.

2.3.4 Hybrid and Mixed Network Support

[3DVIA-3400] The System MUST adapt its services under different broadcast and broadband network configurations.

[3DVIA-3401] The System MUST support different broadcast and broadband network configurations simultaneously.

[3DVIA-3402] The System MUST gracefully degrade service as the bandwidth of the return channel degrades.

[3DVIA-3403] The System SHOULD support a terrestrial broadcast and broadband network configuration.

[3DVIA-3404] The System MUST support a satellite broadcast and terrestrial broadband network configuration.

[3DVIA-3405] The System MUST support a satellite broadcast and narrowband network configuration.

[3DVIA-3406] The System MUST support a satellite broadcast only network configuration.

2.3.5 Congestion Management

[3DVIA-3500] The System MUST have a mechanism to signal congestion situations.

[3DVIA-3501] The HGW SHOULD support removal of links to content which is not already cached.

[3DVIA-3502] The HGW SHOULD support punctual retrieval of the high priority non-cached content on demand.

2.4 CLIENT

[3DVIA-4000] The Client MUST be a 3D interactive browser used to render and interact with 3D content.

[3DVIA-4001] The Client MUST be able to access 3D content from the HGW and the Server.

2.4.1 Application Container

[3DVIA-4100] The 3D interactive browser SHOULD provide a high-level environment for hosting application and content.

[3DVIA-4101] APIs provided by the application container MUST be open.

[3DVIA-4102] APIs provided by the application container MAY be standard.

[3DVIA-4103] The application container MAY support automatic deployment of applications.

[3DVIA-4104] The 3D interactive browser SHOULD support a number of application containers to be able to handle different content or application types.

[3DVIA-4105] The 3D interactive browser MAY support automatic deployment of application containers.

2.4.2 Content Format

[3DVIA-4200] The System MUST support a 3D interactive content production pipeline.

[3DVIA-4201] The pipeline SHOULD support transfer input and transfer between popular DCC tools.

[3DVIA-4202] The transmission format MUST represent all artifacts necessary for 3D interactive content.

[3DVIA-4203] The transmission format between Server and Client MUST be open.

[3DVIA-4204] The transmission format between Server and Client MAY be a standard.

[3DVIA-4205] There multiple transmission formats between Server and Client MAY supported.

2.4.3 Graphics Library

[3DVIA-4300] The Client SHALL use a graphics library to encapsulate the 3D rendering and display connection functions.

[3DVIA-4301] The graphics library SHOULD have an open and standard API.

2.4.4 3D Display

[3DVIA-4400] The Client SHALL be able to display 3D interactive content on a 3D light field display.

[3DVIA-4401] The Client SHALL be able to display 3D interactive content on a 3D stereoscopic display.

[3DVIA-4402] The Client SHALL be connected to only one display at a time.

[3DVIA-4403] The Client SHALL be able to display 3D interactive content on a 3D multi-view display.

2.4.5 Interactivity Switch

[3DVIA-4500] The Client MUST be able to control the interactivity switch.

[3DVIA-4501] The switch MUST also control any ancillary hardware required for 3D viewing (eg. shutter glasses).

[3DVIA-4502] By default the switch SHALL be set to pass the streamed video source.

[3DVIA-4503] The switch MAY be implemented in hardware.

2.4.6 User Input

[3DVIA-4600] A User MUST be able to navigate intuitively.

[3DVIA-4601] A User MAY be able to navigate freely (6 dof) through 3D space.

[3DVIA-4602] The Client MAY support navigation via a keyboard and mouse.

[3DVIA-4603] The Client MAY support navigation via a Space Navigator.

[3DVIA-4604] The Client MAY support navigation via a Smartphone with accelerometer.

[3DVIA-4605] The Client MAY support navigation via a Smartphone with screen gestures.

2.5 DEMONSTRATORS

2.5.1 3D Programme Guide

[3DVIA-5100] The System MUST provide a 3DPG.

[3DVIA-5101] A User MUST be able to navigate through the 3DPG.

[3DVIA-5102] The 3DPG MAY provide different views based on user preferences (example. browse listing or search for show by type).

[3DVIA-5103] For this purpose the Client MAY require the user to login.

[3DVIA-5104] 3DPG metadata SHOULD be cached on the Client or HGW.

[3DVIA-5105] If the data is not cached, the 3DPG SHOULD retrieve it on demand.

[3DVIA-5106] A discovery mechanism MAY be used to establish communication between the Client and the HGW.

[3DVIA-5107] The 3DPG navigation SHOULD be intuitive.

2.5.2 Interactive Advertisement

[3DVIA-5200] The System MUST provide a 3D Interactive Advertisement demonstrator.

[3DVIA-5201] The Client MAY require a user to login before using the application.

[3DVIA-5202] The System MUST provide a stream and content synchronization mechanism.

[3DVIA-5203] A Platform user MUST be notified about available content related to products presented in the video feed.

[3DVIA-5204] A User MUST be presented with 3D content related to the video feed when it is cached in the HGW and he signals interest.

[3DVIA-5205] A User SHOULD be able to interact with the 3D content.

[3DVIA-5206] A User MUST be able to subscribe for further information per product advertised.

[3DVIA-5207] Content related to video feed SHOULD be cached on the device in user's premises.

[3DVIA-5208] System MAY present a User with content personalized based on his profile.

[3DVIA-5209] The system SHOULD gather statistical information about a User's interactions locally.

[3DVIA-5210] This information MAY be sent to the Server regularly and only during low network congestion times.

[3DVIA-5211] A discovery mechanism MAY be used to establish communication between the Client and the HGW.

[3DVIA-5212] The Client SHOULD provide a mechanism to follow a content reference from within the currently displayed content.

[3DVIA-5213] The System SHOULD provide a mechanism to distribute content state between a group of Clients.

2.5.3 Gaming

[3DVIA-5300] The System MUST provide a Gaming demonstrator.

[3DVIA-5301] The type of gaming provided SHOULD be casual, with simple rules and requiring only basic skills.

[3DVIA-5302] The type of gaming provided SHOULD be media rich and appealing.

[3DVIA-5303] The type of gaming provide MAY be for multiple players interacting at the same time.

[3DVIA-5304] The System MAY provide an intuitive Gaming user interface to select by category or preference from a large collection of games.

[3DVIA-5305] The System MAY provide a generic hall of fame feature.

[3DVIA-5306] The Client MAY provide games that are not implemented with optimal 3D display requirements (screen disparity) in mind.

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