DEVELOPING MIDDLEWARE FOR THE OCAP MARKET

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Abstract

CableLabs, through the Open Cable process, has decided to adopt certain elements of the MHP standard. In this paper, we will provide perspectives on the nature of the differences between the MHP and its OCAP equivalent. Some of the implications of the changes as viewed from a middleware vendor and an application vendor will be discussed. OpenTV's road map for implementation of an OCAP/MHP solution that will also afford backwards compatibility with interactive solutions for existing thin set top boxes. The content migration path from thin middleware to OCAP and standards-compliant product architecture will be reviewed. We will also produce a forward-looking assessment of market trends in broadband/iTV content and resulting implications for set top box configurations and the software stack.

BACKGROUND

The DVB is a European industry group with over 250 member companies who have significant interests in the development and promulgation of standards for distribution of digital video services. The group has developed many standards since its inception in the early 1990's, including modulation formats for Cable, Satellite and Terrestrial delivery, System Information formats for use in EPG implementations, and electrical interfaces for equipment interconnection, just to name a few. More recently its members donated considerable of their resources in the specification of an API for set top boxes in order to foster interoperability of content.

The technical specifications developed to date by the DVB consist of two primary sub-components, an Execution Engine (EE) based on Java, and a Presentation Engine (PE) based on HTML/JavaScript. Cable Labs has also been developing similar specifications under the headings of OCAP 1.0 and OCAP 2.0. In a significant development, Cable Labs has aligned its standards with those developed by the DVB as much as possible. This decision is important because it offers the hope the vendors of Applications, Middleware, and Infrastructure will be able to leverage their technical developments across several markets.

The DVB released Version 1.0.2 of MHP in late February 2002, and the specification will be published as an ETSI standard. Version 1.1 of the MHP specification has also been approved. While version 1.0.2 only contains Java elements, version 1.1 includes HTML/JavaScript elements as well. It must be pointed out that these HTML/JS elements are optional, while all MHP receivers must be Java capable. It must also be noted that certain functions of the receiver, such as channel change, are only accessible through Java interfaces.

The next milestone to be reached to enable deployment of MHP products is the release of MHP Test Suites, which will be made available through ETSI to all implementers of MHP run-times and receivers. Implementers can then self certify their products by issuing an official statement that their product has successfully passed the Test Suites and claim MHP compliance. Only compliant products can be put on the market. Non-compliant products would be violating the legal rights

of the DVB concerning the MHP mark as well as the IP rights of third parties in the MHP specification, because licensing of these rights under the DVB MoU only covers compliant products. OpenTV's belief, a view shared by the DVB, is that MHP will be successful only if all MHP receivers are fully interoperable. As a consequence, OpenTV is in favor of a strong compliance regime supported by a very comprehensive Test Suite. Such regime will guarantee that any MHP compliant application will run on any MHP compliant receiver, just like any VHS tape is expected to play on any VHS VCR.

There is currently no schedule for the development of a Test Suite for MHP 1.1. As a consequence, it is impossible to predict when 1.1 compliant receivers will be introduced in the market

A second milestone relates to the arrangement of IPR pooling organizations patent rights that will enable equipment implementers so secure from a single entity a significant fraction of the required IPR for providing a licensed implementation.

OCAP 1.0 DEVIATIONS FROM MHP

There are several different types of changes that adopter of the MHP specification may need to make in order to adapt to a local market. These changes can be divided into the following classes:

- Underlying-media/legal – changes required by the underlying transport infrastructure or by the region's laws. These changes generally require significant modifications or additions of code to support and as such are justifiable regional modifications to MHP.

- Language/cultural – changes required by the cultural and language differences of a region. Though justifiable regional modifications to MHP, these changes generally require minimal code changes and are usually embodied by changes in the data the code uses.

- Extensions/enhancements – changes desired by the region to offer services beyond those provided by the originating specification. These changes are acceptable as long as these extensions enhancements do not impact upon the specification as they form superset of MHP. In order to maintain the integrity of the receiver population, it is recommended, however, to put in place a process that will review these extensions, reject unnecessary derivatives and include approved extensions into future versions of the MHP specification.

- Cost – changes desired by the region to minimize the cost of implementing the specification. The number of issues under this category is very large and can range from minor to very significant differences in cost. E.g. Using DVB-SI in the US is technically possible but not practical in terms of cost. As such, some cost issues are justifiable regional issues while others are near term expedients and should be avoided.

- Technical improvements – changes desired by the specification writers based upon their belief that they have a better technical solution. These types of changes are usually not wise and should be resisted, since they lead

to incompatibilities with MHP. It is better for all involved if truly superior technical solutions are submitted to the DVB for inclusion in future versions of the standard.

- Business Model – changes desired by the region to preserve or develop a given business model. Such issues often not advisable as they may lead to loss of application interoperability.

- Error – there is an error in the specification. As with improved technical design, corrections to error in the MHP specification are best fed back into the DVB for inclusion in future versions.

The changes made to OCAP 1.0 encompass most of these categories. Some of the key changes include (but are not limited to):

- Excising non-Cable protocols
- Substitution of AC3 Audio for MPEG-1 Layer 2 audio.
- Removal of DVB SI.
- Removal or Modification of subtitling and teletext.
- Replacement of AIT with XAIT.
- Modification to the application lifecycle.
- Prohibition of DVB HTML descriptors.
- Namespace changes for Xlet's, etc.

While many of these deviations are logical regional variations, we believe that some of them should be revisited during the Corrigenda process for the OCAP 1.0 specification. In particular, changes, which result in undesirable side effects for applications being ported from a pure MHP market to an OCAP market should be reconsidered and in many cases, revised.

Perhaps one of the changes with the most far-reaching effect is the prohibition in OCAP 1.0 for signaling DVB HTML content. HTML is the most pervasive and important of the Internet protocols after TCP-IP. Restricting its use in the standard removes a key tool in achieving content interoperability across heterogeneous STB platforms. The US cable market continues to convert from analog to digital at a robust rate, and for the foreseeable future this is being achieved with STB's purchased by the MSO and decidedly below the capabilities required to deploy the MHP specification. Content authoring and distribution in HTML/JavaScript affords many possibilities for achieving interoperability through transcoding to formats that can be rendered by the lightweight receivers that have already been deployed by US MSOs.

OPENTV's MHP/OCAP IMPLEMENTATION

OpenTV's Advanced STB implementation is shown in Figure 1. In addition to our MHP stack it includes a light-weight virtual machine and the Device Mosaic Browser. We distinguish four main layers in our MHP stack, where upper layers leverage resources shared by lower layers:

- The driver layer, which provides interfaces to the hardware through generic portability layers that guarantee interoperability between different hardware implementations. Because of OpenTV's leading market

share, our portability layer has become the de-facto standard in the industry, which is now emulated by our competitors. The design of our portability layer allows multiple clients to share the same resource through a single set of APIs. More specifically, C, Java and HTML components co-exist on the receiver and access the hardware through a common set of APIs that handle arbitration and serialization of requests where required.

- The kernal layer, which provides interfaces to the processing resources through generic portability layers that guarantee independence between different operating systems. C, Java and HTML components access the operating system through a common set of APIs.

- The Interactive TV libraries layer, which implements the core functionalities of our ITV run-time, such as communication, graphics, security, etc. C, Java and HTML components co-exist on the receiver and access these libraries through a common set of APIs. Arbitration and serialization of requests is implemented through policies such as application life cycle that are captured in our Control Task driver.

The Execution layer, which provides independence of the application binaries from the CPU of a particular receiver through an interpretive abstraction. We currently offer ANSI C, Java and HTML/JavaScript execution environments. It is likely that we will also introduce a Flash execution environment at a date to be determined. OpenTV is the only ITV middleware company offering an ANSI C execution environment, deployed on over 24 million receivers. Our Java environment is based on Sun Microsystems VM. Our HTML/JS environment is based on our Device Mosaic technology, which has already been licensed to PowerTV, Sony, Motorola, Tivo and WorldGate deployed on over 6 million cable receivers

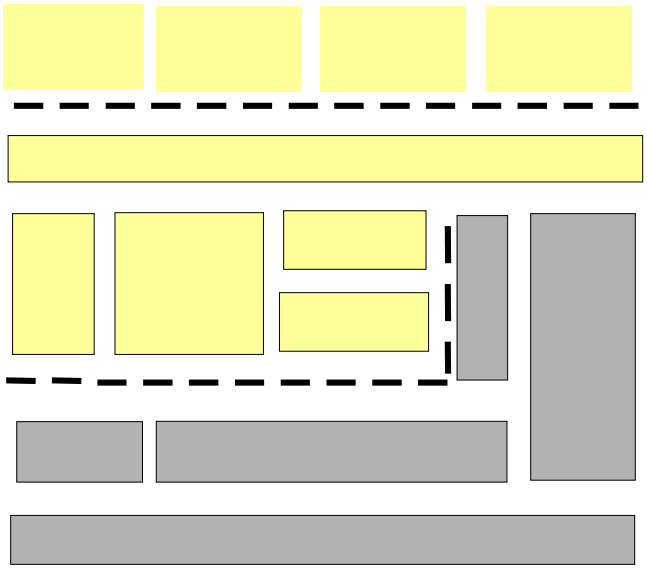

Figure 1: MHP/OCAP Software Stack

The main benefits of an integrated architecture include a smaller footprint, as well as flexibility in possible evolutions of the product, such as embedding Java scripts in an HTML page or carrying Flash content in DSM-CC carousels. It also allows us to quickly introduce new standards as they become available. One example is the implementation of an ARIB compliant BML module as an extension of our XHTML engine for the Japanese market. Finally, this architecture also allows us to make all features of our ITV libraries available to all execution environments. For example, our ITV libraries can support PVR functionalities (see for example the integrated PVR product

introduced by Via Digital later this year), which can be exposed to our Java module. The benefit is a Java execution environment that is fully MHP compliant but can also offer features that are not currently covered by the MHP standard, such as PVR. In other terms, our architecture can continue to progress at the forefront of the state of the art while incorporating standard components, as they emerge.

CONTENT INTEROPERABILITY

OpenTV sees the emergence of networks with multiple tiers of receivers, which will offer different levels of capabilities. Basic receivers with limited processing power and memory will remain dominant. Some of them will be able to render HTML content, but most of them, for the short to medium term, will not have the hardware capabilities required to render Java based content such as MHP. On the other hand, we expect the emergence of high to very high-end receivers with mass storage. These receivers will have enough hardware capabilities to execute MHP applications. OpenTV offers a number of solutions to enable delivery of content on such hybrid networks.

One option is to develop content around OpenTV's C based APIs. Since both low-end and high-end receivers include OpenTV's C player, C based content can be executed on the entire population of receivers.
A second option is to develop content around OpenTV's HTML/JavaScript based APIs. OpenTV's HTML engine can run on both mid-range and high-end receivers. In addition, OpenTV is currently developing an extension to its Publisher product that compiles HTML/JavaScript content into OpenTV's lightweight byte code (named o-code). Since low-end receivers include OpenTV's C player (which includes the o-code interpreter), it is possible to execute this content on these receivers. As a consequence, it is possible to create ITV content once, and deliver it to the entire range of receivers, either through Publisher for low-end receivers, or directly for mid to high-end receivers. As market demand arises, OpenTV will consider extending Publisher to support the HTML profile of the MHP 1.1 specification.

Another option for content migration is to create multiple executables for different classes of receivers, while sharing the data for all classes of receivers. In this scenario, a C based executable would be created for low-end receivers and an MHP version would be created for MHP capable high-end receivers. These receivers can already share data provided through the return path, since both classes of receivers support the same communication protocols (HTTP, TCP). The benefit there is to use a single Web server infrastructure for all receivers. It would also be possible to for the receivers to share broadcast data. While our C player and our MHP extension currently support different carousel formats, as market demand arises, OpenTV is ready to implement a common broadcast stack for its C and MHP players in order to share carousels. The benefit would be to reduce broadcast bandwidth consumption.

CONCLUSIONS

The OCAP 1.0 specification is well aligned with the MHP 1.0.2 specification. Software Vendors will be able to significantly leverage their MHP development when developing for the OCAP market, however maintenance of two test regimes for MHP and OCAP remains a costly

by product of the deviations which OCAP takes from the MHP specification. HTML/JavaScript is expected to form the largest body of interoperable content in interactive TV and fact that OCAP 1.0 does not provide for DVB HTML signaling.