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49TH ANNUAL CONVENTION AND INTERNATIONAL EXPOSITION OF THE NATIONAL CABLE TELEVISION ASSOCIATION

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Mark Eyer Sony Electronics

Cable Multiple-System Operators (MSOs) would like to supply not only digital audio, video, and data services, but also software applications that can run on customer-owned equipment. With this goal in mind, CableLabs® issued a Request for Proposal in 1999 to help identify and standardize a software Application Program Interface (API) for OpenCable compliant retail boxes. This paper explores the challenges involved in this effort, and identifies some of the pitfalls and obstacles that These include issues of must be overcome. platform independence, the cost and complexity of the platform, the challenge to support an evolving digital world, and the need on the part of consumer electronics manufacturers to differentiate their products in the marketplace. Suggestions for resolution of some of these dilemmas are presented for consideration.

THE MSO'S VISION

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The eventual availability in the retail market of digital cable-compatible consumer devices offers the cable MSO a number of significant benefits. Whenever a customer buys a retail cable-ready device, the operator's capital expense is reduced. Due to competitive market pressures, the retail devices will be able to offer the latest technologies, including faster CPU speeds, ever-speedier graphics, and interfaces to the newest audio/video peripherals. And happier customers can result: many are more content without the need for the bulk and clutter of the set-top box, as set-top box functions are integrated with the digital television.

This picture is quite clear for services including standard- and high-definition audio/video offered on subscription and impulse-pay-per-view (IPPV) basis. The standardization of the interface to the removable security module, the network (physical cable) interface, and system and service information (and agreements to deliver it) has enabled consumer electronics manufacturers to start designing digital cable-compatible devices for retail sale, starting with digital TVs (DTV).

But what about other services, such as Electronic Program Guides (EPGs), video on demand (VOD), voice over IP (VOIP), or streaming audio and video in formats other than MPEG-2 or Dolby Digital? And what about services not yet conceived? Set-top boxes supplied by the MSO can be built to offer advanced services. How can a device available for retail sale be enabled to do so?

A simplistic view of the world, from the point of view of the cable operator, is that the primary purpose of any cable-ready device to be available at retail should be to generate revenue for that operator. To that end, the retail device would be 100% controlled by the cable operator in terms of everything that is presented for viewing—its "look and feel."

An MSO's dream, therefore, might be that a DTV or other retail cable-ready device, after being brought home and installed by the consumer, would be downloaded with code supplied by the local cable operator. At that point, any access the consumer would attempt to make of any services offered on the cable would be managed through a navigation application supplied by the cable operator.

If a special offer or preview were available, the navigator could make sure to present that information to the user. If new services were offered, the navigator could be set up to notify the user of their existence, and to guide the user towards their access. As an additional source of revenue, advertising or links to commercial sites could be included in the navigator.

Services such as VOD could be offered, because the navigator could support whatever proprietary form of access and control was required by that operator's plant and equipment. New forms of services could be offered when they became available, even if the details of presentation and

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decoding are yet unknown. That's because an updated navigator could be provided when the details of the new service are worked out.

An example of such a new service is a data broadcasting service. Multicast data synchronized to video is offered today, but the standardized techniques for transport and the content coding formats are not yet totally settled. When industry acceptance is widespread and the particular cable operator implements the new standard, the navigator can be upgraded to allow all subscribers to have access to the new data enhancement.

The EPG can adapt the presentation based on what services are authorized for viewing in this particular device. For example, if the user has not subscribed to *MovieMax*, the navigator can direct that user to the *MovieMax* preview channel, can notify the user of special sign-up offers, or allow him or her to sign up online (self provisioning).

With a downloaded navigator, the cable operator has direct control over the look and feel of the EPG. They can organize the guide in such a way that the services with the highest profit margin (IPPV perhaps) are given prominence. They can put effort into human factors design to help ensure that the consumer's experience is productive and pleasurable.

FACING REALITY

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What's wrong with this dream? A troubling aspect of this code download scenario is the implied notion that every retail device, regardless of manufacturer, make, or model, would behave in exactly same way. In the following sections we first explore this product differentiation problem, and then discuss further difficulties, including:

- Problems with the overall philosophy of cable- operator-supplied downloaded code
- Technical challenges, such as reliability and the difficulty of porting the API
- Challenges related to the magnitude and complexity of the problem

The paper goes on to suggest some resolutions to these problems, and describe example products we would like to be able to manufacture once the software download system design and specifications are complete. We then suggest a way forward in the near-term, bridging between technologies available today and that which we will develop and refine in the next several years.

PRODUCT DIFFERENTIATION

From the point of view of the consumer electronics manufacturer, the idea that every model of every manufacturer's product ultimately runs the same cable operator-supplied code causes real marketing problems.

Competition in the marketplace

Consider a high-end product from manufacturer A compared with a high-end product from manufacturer B: when compared side-by-side on the sales floor, both products will appear to be *identical* once downloaded with the local cable operator's application suite.

Low, middle, and high-end

Commonly in consumer electronics marketing, a manufacturer offers low-end, middle, and high-end products. The middle of the road product offers some features not found on the low-end model, and the high-end product offers bells and whistles not found on the level below.

Perhaps the low-end product doesn't support software download at all. But let's say the middle and high-end products do support the OpenCable Middleware Solution. Once downloaded with the cable operator's application, when either of these boxes accesses a cable service, the user experience is the same (aside from factors like CRT display size).

In this world, a manufacturer can no longer differentiate one product from another based on a software-related feature.

PHILOSOPHICAL PROBLEMS

Native applications

A native application is one written in or compiled to the machine code of the retail device's

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CPU. A cable operator may want to maintain control over native applications, for example by downloading a "Master Application" capable of authenticating them, launching them, and determining their privileges and resource usage. Is this practical, possible, or even reasonable? We think not.

Given that each model of each manufacturer's product would typically have a different set of native code, it is entirely unclear how the cable operator's downloaded application could be afforded such control.

Consider that a cable-ready device offered for retail sale must have *some* level of functionality even before an operator-supplied code download occurs. For example, it will likely provide access to analog and free services on cable, assuming that the user has a basic cable service. It would provide some form of user setup and/or diagnostic functions even without a basic cable service.

This native application cannot and should not be under the control of the Middleware Solution or the cable operator's downloaded application.

In fact, the native application needs to take priority over anything that might be downloaded, for example to allow it flush memory and reinitialize the unit in case of trouble. Or, in case the user moves it to a new city and/or a new cable system.

It is not only impractical but also unwise to say that an application provided by the cable operator should control the native applications in a retail device.

The native application on the right in Figure 1 accesses OS functions in the device directly. As shown, a companion *resident* application is also present. The resident app is written in a platform independent way by the manufacturer, and takes advantage of the middleware layer implementation.

As shown, a cable-operator supplied Application Suite is present, including a "master application." We feel that this master application should be the "master" of the elements of the application suite (EPG, VOD, web browser, as

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shown), but it cannot and should not be involved with the control of the resident or native applications.

Extensibility

Let's say an API is eventually agreed upon, and some number of compliant platforms are fielded. In a year or two, as history tells us, typical CPU speeds will be doubled, memory prices will be halved, and graphics capabilities will increase by a large factor. In two years it may be cost effective to include video hard disks in most devices.

If the MSO or cable operator does not create a new application suite tailored to the 2nd generation platform, the power of any new available hardware cannot be fully exploited. The size and capabilities of the application are limited by the least common denominator platform.

If the solution is to provide a new application suite to be run on the next-generation boxes, where does this progression stop? The process of defining and standardizing new platforms and API extensions is never-ending as the operator's configuration control and management problem becomes exponentially more difficult.

How many new downloadable applications might any MSO develop over a five-year period? We think the answer is something like one or two at most, given the enormous complexity of the task. A software release for a large cable plant must be rigorously and thoroughly lab-tested before largescale deployment. Testing such an application would be an unprecedented challenge because of the large (and growing) number of target platforms upon which the application must be validated.

Control over all cable-delivered services

A cable operator may want to use the downloaded application to control the look and feel of *all* cable-delivered services, including the DOCSIS cable modem. Clearly, the operator grants or denies access via the cable modem to the Internet. Access to cable modem services is based on whether or not the consumer has paid for a subscription to the cable modem service.

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