THE EFFECT OF OCAP MIDDLEWARE ON ITV APPLICATION DEVELOPMENT

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Abstract

Cable networks have been active in laying the groundwork for the interoperability of applications for interactive television. By upgrading their physical plants, deploying more powerful set-tops, and pushing for both hardware and software standards through CableLabs, networks are poised to launch OpenCable/OCAP systems in the US.

OCAP and the OpenCable standards will have a powerful effect on the development of applications for these networks in addition to building a strong market for the creation of application development tools.

INTRODUCTION

For the past 15 years, we have seen the promise of Interactive Television looming on the horizon. Cable, Satellite, and Telecom companies have each, in turn, experimented with different transmission technologies, hardware platforms, and software environments. Each successive generation of trials has provided valuable insight and experience so that the next step down this road seems not quite so insurmountable.

Lest we, as technologists become enamored with technology advancements for their own sake, it is important to remember that consumers don't know or care anything about the technology that we are deploying. They care about the services that are offered to them and how using those services changes the way that they think of and interact with their television.

That said, we stand on the brink of a radical new transformation of television as a vehicle for the delivery of entertainment and information in our homes. Having a nationwide standardized platform for the development and deployment of new services promises to fundamentally alter the economics of deploying those services to the public, as much as the standardization of home personal computers created the basis for the internet to explode during the 1990s.

This paper will address the historic and emerging forces that have shaped this evolution, focusing on the OpenCable standards in general, and the OpenCable Application Platform (OCAP) specifically.

STANDARDS AND INTEROPERABILITY

Historically speaking, the development and adoption of technology standards are essential for the successful deployment of consumer electronics. Open standards create the conditions for many companies to develop products which are fundamentally interoperable with each other. This competition drives down the costs of manufacturing as well as the cost of publishing software and multimedia content for those products.

Although some aspects of cable television networks are currently standardized, US cable operators have, with only a few small exceptions, built their networks on proprietary (non-interoperable) systems designed and manufactured exclusively by two companies: Motorola and Scientific-Atlanta.

This is about to change due to the OpenCable standards being developed by CableLabs. These publicly available standards specify an end-to-end architecture which will

allow any number of companies to develop truly interoperable products for the US cable networks.

THE COMPONENTS OF INTEROPERABILITY

There are several key components to the interoperability of products and services in the US cable network: transmission systems, set-top hardware platforms, and set-top software environments (or middleware).

From an infrastructure point of view, these components are intertwined, yet each has a fundamental dependency on the others. Building a digital two-way network was necessary before advanced service set-tops could be deployed. Similarly, set-tops with a minimum, standardized feature set were required before a consistent software environment could be built which takes advantage of those features. And finally, a common software programming environment is required in order to support the wide scale deployment of applications throughout the country. To bring it full circle, the deployment of those applications is what will, in the end, pay for the network build-out which was necessary to support them.

Transmission Systems

When I first got CableTV in my house, in 1985, my cable company (TCI) broadcast analog video straight to my "cable-ready" TV. There was no set-top box involved and ordering a premium channel involved sending out a technician to remove a filter from the cable demarcation box set on the side of my house. Those days seem quite remote.

Now, we take for granted a digital, bi-directional network. Premium tiers of service are authorized remotely. Digital keys for decryption of those services are sent through the network, to target my specific set-top box(es). The increase in bandwidth has made it cheaper to broadcast what might be considered a plethora of niche programming, such as the History Channel or HGTV.

Although there are different encryption schemes available for use, most aspects of the video broadcast are very highly standardized. MPEG-2 transport streams using QAM modulation schemes combine several digital broadcast channels into the same 6 MHz band that previously carried only one analog channel.

Organizations such as the ATSC and SCTE have dozens of standards which govern everything from the wireline protocols for delivery of data over that network, to the size and shape of the F-connector on the back of the set-top box. While interactive services such as those being deployed today would have seemed unthinkable 20 years ago, the cable industry as a whole has done a good job of upgrading their physical plant to the point where bandwidth no longer seems to be a critical barrier for new service deployments.

These improvements required a very large capital investment over the last several years, but were fundamentally required in order to support the tier of services which are even now being deployed.

Hardware Platforms

The second critical element for interoperability is the set-top box. In the mid-1990s, Motorola and Scientific-Atlanta each selected a specific CPU for their respective set-top boxes and, in turn, designed several custom processors for control of the graphics and video displays. Applications, such as the EPG, were written in C and compiled specifically for those processors and their capabilities.

This choice of processors and the associated choice of operating systems and API libraries has locked application

developers (not to mention Motorola and S-A themselves) into a compatibility straight-jacket. The vast majority of set-tops currently deployed are based on 8-10 year old designs, with a feature set that is deficient considering the types of applications that we want to deploy today. And while each of those companies has begun to innovate based on those early designs, each incremental improvement implies the need to rewrite all of the applications which run on those platforms, while also maintaining all of the old versions that run on the installed base of legacy set-tops.

It is this installed base which represents the next large infrastructural investment required of the network operators, but which, thus far, has proven insurmountable. The cable operators currently own all of the cable set-tops deployed in America, leasing them to subscribers for a monthly fee, built into our cable bills. With tens of millions of set-tops deployed, it would cost billions of dollars to replace them all; an investment which has, so far, been deferred in preference for the upgrade in the physical plant.

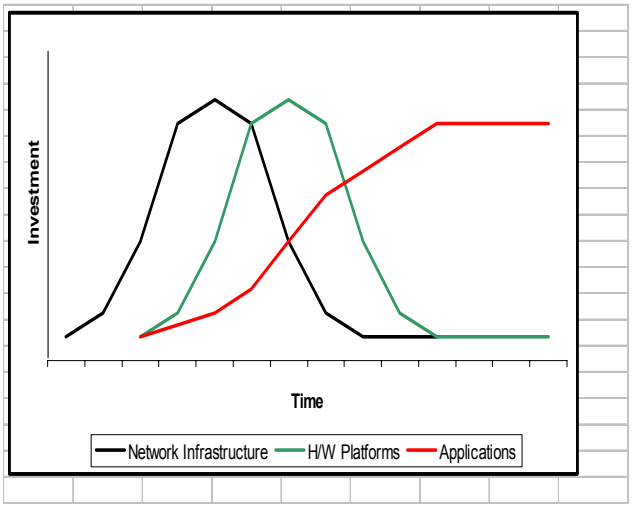
This has created somewhat of a stalemate. Hardware capabilities, in general, have evolved considerably over the last several years, reflecting continual incremental improvements in CPU speed and the cost of RAM, not to mention greater competition in the business of developing powerful integrated multimedia components. But much of this power remains out of reach.

Software Platforms

The last element of interoperability for interactive television is the software application development environment, or middleware. The ability of the set-top box to run sophisticated applications is the key to differentiation between broadcast television and the advanced services that we wish to deploy.

And even though the investment in network infrastructure and hardware platforms is significant, it is fundamentally time limited. Once the initial investment is made to build a digital network, the costs of maintaining that network are relatively minor. Similarly, the costs of buying a new set-top will pale in comparison to the cost of writing software for the box, especially when there are dozens, or even hundreds of applications which will run on that box.

This comparison is illustrated by the chart below.



While this chart is not meant to connote specific dollar values for these activities, the essential message is that investment in developing new applications for a given platform continues long after the investment for building and deploying that platform.

One may ask why we don't see this investment taking place today. Even without a completely standardized environment, there are surely sufficient numbers of set-tops in the market to justify the development of applications for those platforms.

One factor is the high cost of entry into the application business. Most network operators have a mix of different set-tops in their networks, sometimes upwards of a dozen

different models. And even though there are only two primary operating systems which run on those boxes, older set-tops have not always been updated at the same rate as the new ones are being deployed. This, combined with new features available on the newer boxes, makes for a non-trivial number of hardware/software combinations to target.

A second barrier is that an ITV application developer must install a very expensive headend in order to create and test their applications. This initial investment can often approach a million dollars, an insurmountable barrier to most companies.

To be fair, however, one could argue that we are, in fact, seeing an increase in the deployment of applications. As the network build-out in support of two-way data traffic has been completed and more headends are being upgraded with Video On Demand servers, a growing number of subscribers are being offered their first taste of interactive television. The limiting factor for wider deployment of advanced services is increasingly the base of set-tops on which those applications must run.

OpenCable

The OpenCable standards being developed by CableLabs promises to break the interoperability gridlock by lowering some of the key barriers to the development of a mature cable software environment. The most basic element of OpenCable is the standardization of the cable data transmission network. This includes both in-band (IB) and out-of-band (OOB) traffic, as well as references to industry standards (ISO, DVB, SCTE, and ATSC).

The second element of this strategy was the definition of standard hardware platforms. OpenCable defines 3 tiers of set-tops, or more specifically "host devices" (since some newer TVs have even more processing power than many older set-tops).

At the heart of each of these OpenCable hosts is the concept of removable/replaceable security. Any discussion of hardware platforms would not be complete without a reference to Conditional Access (CA) technology. CA is the basis for digital video encryption and creates the fundamental basis by which Motorola and S-A maintain control over the cable network architecture. The FCC has mandated that by July 2006 set-top manufacturers must move the video decryption circuitry off of the motherboard and onto a removable card. CableLabs calls this a Point-Of-Deployment module, or POD. The POD would contain all of the network-dependent circuitry and software, thus creating the possibility of competition in building set-tops or other host devices.

OCAP

The third component of the solution is, naturally, a definition for a common software environment that the mid- and high-tier devices are required to run. This environment is the OpenCable Application Platform (OCAP).

OCAP is based on the Java programming language. This basis has two very strong advantages. First -- there are thousands of Java programmers who will come "pre-trained", as it were, without having to learn a fundamentally new programming language and environment. Second -- Java is machine-independent. A Java application will run on any set-top box, regardless of the CPU or operating system; a key to interoperability.

Other advantages of Java include the more general efficiencies of Object Oriented Programming. OOP is proven to reduce software development and testing cycles, especially in the second or third generation of applications, as developers build up the

library of Objects that they can re-use and re-purpose. Similarly, Java applications are much less likely to "crash" a set-top. Null pointers or other software errors are caught by the interpreter, before they cause catastrophic failure. This is especially important for consumer electronics, such as a television, where users have a much higher expectation for reliability.

In short, OCAP combines the best features of having a powerful programming language, with the reliability demanded for use by unskilled users.

THE EFFECTS OF OPENCABLE

Hardware Design Innovation

Defining a standard set of OpenCable hosts has several immediate effects, some of which may, at first, seem contradictory.

First, and most radically, separating the Conditional Access circuitry from the core set-top box sets the groundwork for a highly competitive retail market in host devices. European, Japanese, and Korean consumer electronics companies will be able to aggressively enter the US set-top business. This will result in lower prices and more innovation in design.

Although standardization and design innovation may seem incompatible, they really are not. There are still many features which are only optional in either mid- or high-tier OpenCable hosts, such as:

- High Definition Support
- DVR
- External I/O and storage devices
- DVD players or writers
- Home Networking Interfaces

This is not meant to be an exhaustive list, but represents a number of extensions which are likely to be found in set-tops.

Beyond the simple equation of competition, is the notion that set-tops will no longer be bound to maintaining CPU compatibility with older hardware designs. They will be able to make processor decisions based on emerging technologies much more easily, instead of worrying about the cost of upgrading and maintaining different binary versions of every application. This has a ripple effect through to the cable operators as well, who will need to maintain and distribute only one version of each application.

Consumer-Driven Upgrades

One aspect of the retail market effect which is often overlooked, is the fact that people are used to buying new consumer electronics at a fairly high rate. The average computer owner, especially the coveted high end customers, will buy a new computer every few years. The same is true of DVD players and increasingly, even televisions. Ironically, they may have the same cable set-top box that came with their cable service when they moved in to their house. There has been no rationale to upgrade even if they had the opportunity to do so. The availability of advanced set tops at retail, and the attraction of new services which require those set-tops for operation, will act to purge the networks of the lowest end set-tops, without the network operators having to spend the money directly to do so.

Better Platforms for Applications

In terms of software development, the primary benefit of OpenCable and OCAP is that OpenCable hosts are, as a whole, far more capable than the vast majority of cable set-tops deployed today. Better hardware means that software can do more. There is so little RAM available in most set-tops that

most optional or creative application features are, by definition, impossible to implement.

Creative Innovation

When the resources of a platform are limited, much of a developer's time is spent trying to figure out how to fit in to the constraints of the environment, not creating innovative new designs. Not only does this result in less interesting or compelling applications, it also drives up the cost of deploying an application.

With a common, more powerful platform for the deployment of services, the application developer community can start to build on the successes of each other instead of continually solving the same problems over and over. This acts to drive down their costs, and thus increase the number of applications available.

Better Application Development Tools

Developer tools become much less expensive to build and maintain when they have only one target, instead of two or three. Knowing that the network operators are all committed to the same platform will increase the confidence of tool developers to invest in this development.

Having an open network architecture and a larger number of set top platforms will also drive the development of mini-headends for developers to use. Compared to the cost of a full Motorola or S-A headend today, a developer should be able to get by with spending a small fraction of that amount. Key to this is having open interfaces between the network and set-top, and increasing the potential customer base for those mini-headends.

Reducing the Testing Cycle

Java applications, as with all applications written in high level, interpreted languages, are inherently more secure and less prone to catastrophic failure. Most real problems are trapped by the underlying Virtual Machine, long before they spiral out of control by crashing the machine. As well, the use of higher level tools and data-driven application templates means that applications will be "pre-tested", again shortening the development cycle tremendously.

Niche Applications

Next, having a larger user base will allow more niche programming. When there is a larger pool of users, even a small percentage of those users can support the deployment of a profitable service. This again, should act to increase the number of applications being written, by broadening the scope of acceptably profitable services. This effect ultimately results in more subscribers electing to upgrade their set tops for access to services, since they are more likely to want the services that are available.

CONCLUSION

The groundwork has been laid for the deployment of ITV applications. The network infrastructure is in place and advanced set tops are being built for deployment.

OCAP and the underlying OpenCable standards, coupled with consumer demand for more powerful set-tops and services (e.g. VOD and PVR), are the crucial foundations for building a dynamic application developer community.

The development of these applications will start slowly, but gain a lot of momentum as more advanced set-tops are deployed. More applications means more tools. More tools, in turn, drive down the cost of producing applications, allowing for more companies to become involved.

The bottom line is that application development for ITV will rapidly become much less expensive, which will lead to many new applications and services.