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Pace: Transitioning To OCAP

By Chris Dinallo, VP-Technology, Pace Americas

Introduction

Today in North America, the cable set-top box software environment consists of proprietary software logic that is very specific to the cable plant (i.e., network infrastructure) on which the set-top is deployed. It has been this way for many years and, for the most part, has served its main purpose of video delivery in an acceptable manner. However, the modern set-top has become more powerful and capable of providing advanced services beyond video delivery and this adds complexity to the proprietary software executing within the set-top. In addition, applications developed to provide these advanced services also add complexity, and since they were created for proprietary software environments, they cannot be deployed across different cable plants. All of this leads to longer development, integration and qualification cycles for advanced services that are often unique to a particular network and therefore non-scalable. As a result, cable operators are faced with increased complexity in their networks and increased costs. Clearly, cable operators are not well positioned to drive new services quickly to the subscriber while keeping costs in check.

These issues begin to beg the question: is there a better way to have a software environment that scales across *all* cable plants, provides fast application development, and is not proprietary to any one supplier such that the operator can instill competition into the software market? Enter Cable Labs and its goal of creating an open-standard common application software environment for set-tops, known as OCAP (Open Cable Application Platform).

Enter OCAP

In short, OCAP is a software specification describing the software *environment* (stack and application execution environment) that addresses the goals of being an open-standard, non-proprietary environment with cross network scalability [and applications developed to such]. In addition, OCAP isn't limited to set-tops: it is suitable for televisions as well, thus diminishing the need for basic set-tops, in some cases. Essentially, OCAP is suited for new advanced set-tops, televisions and some legacy, basic set-tops. OCAP does make a recommendation for the minimum hardware requirement in order for the *environment* to execute properly and acceptably. That minimum is stated in terms of memory and computing processing power, 32MB SDRAM and 150MIPS, respectively. It's this hardware requirement that introduces a significant deployment issue for OCAP to be rolled out to existing set-tops.

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OCAP Transition

The challenge: there are millions of perfectly good working set-tops deployed that don't meet the minimum hardware requirements to run an OCAP stack. So, merely loading the software stack on all set-tops is not possible. These *legacy* set-tops are technologically out of date, so they don't have the necessary computing processing power and/or sufficient memory. Yet, there is one proposed solution underway that essentially allows an OCAP stack to be trimmed down and functionally scaled back so it can run on the legacy set-tops. It is known in the industry as "On-Ramp." On-Ramp's goal is to allow *legacy* set-tops to run a smaller, less robust OCAP yet retain a compatible application interface. Although this is a step in the right direction, it compromises the OCAP solution, which now becomes fragmented with some unique "one-off" implementations. These implementations may differ by set-top manufacturer or even within set-top models from the same manufacturer. Hence, this will lead to incompatibilities amongst set-tops and divergence from OCAP's goals. Of course, this is not what the industry envisioned for OCAP and causes problems for MSOs (multi-service operators) and vendors alike. Pace Micro Technology, on the other hand, falls into a unique competitive advantage because Pace set-tops do not have the limitations that all of the other *legacy* set-tops incur. Let's explore these advantages and Pace's transition to OCAP.

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Current Pace Set-tops OCAP Capable

Today, Pace also provides MSOs with set-tops running the *legacy* software environment (e.g., PowerTV™ and Motorola GITV), but because Pace set-tops have a different memory and more advanced code execution architecture, the Pace set-tops are capable of running a complete OCAP software *environment*. This means that one-off implementations of On-Ramp are not necessary, in fact, not even desired. For example, take the case where the network is of the type created by Scientific-Atlanta (S-A), the software executing is called PowerTV™ – a proprietary software stack. Pace's currently deployed DC-5xx family of set-tops run this PowerTV™ stack, however, Pace's set-tops (DC-511, DC-550, and DC-551) all have sufficient FLASH (persistent memory), SDRAM (volatile memory), and MIPS (computing processing power) to sufficiently support the complete OCAP *environment*. Referring to table 1, one can see the core statistics of these currently deployed platforms that are capable of both downloading (software download upgrade) and executing OCAP.

Set-top Model	FLASH (MB)	SDRAM (MB)	MIPS	CA
DC-511	8	32	175	PowerKey
DC-550 HD	8	64	250	PowerKey
DC-551 HD	16	64	250	PowerKey
DC-755 HD	16	64	300	DCII

Table 1 - Currently Deployed Pace Set-tops Capable of OCAP Environment

Also note that Pace set-tops have another advantage of "Run-from-RAM" code execution architecture, meaning that any software image running on the platform is executing from SDRAM (main volatile memory). The benefits of this are two-fold: 1) better performance because software executes much faster when running from SDRAM vs. FLASH; and 2) less FLASH memory is required because the software stack is stored in a compressed format in FLASH and then during set-top boot up uncompressed to SDRAM. Typical FLASH compression is a 4:1 ratio (32MB SDRAM compresses to 8MB FLASH), meaning this all adds up to Pace's existing set-tops meeting and exceeding the OCAP hardware requirements.

Pace has continued this memory architecture with its next generation set-tops, allowing the MSO to continue to have a choice of software stacks. Table 2 depicts the hardware specifics of Pace's new product lineup - all capable of running OCAP *environments*.

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In addition, Pace's architecture allows for choice of Conditional Access Systems (CAS). For example, the cable operator may choose existing embeddedCA systems such as PowerKey™ & DigicipherII (DCII), or may optionally fit the set-top with a Cable Labs CableCARD implementation, or even SmartCard CA systems[1] such as those offered by NDS and Nagravision.

Set-top Model	FLASH (MB)	SDRAM (MB)	MIPS	CA
DC-501 "Chicago"	8	32	300	PowerKey / CableCARD / SmartCard
TDC-775 HD-DVR "Tahoe"	16	128	450	DCII / CableCARD / SmartCard
TDC-770 HD-DVR "Tahoe"	16	128	450	PowerKey / CableCARD / SmartCard

Table 2 - New Pace Set-tops Capable of OCAP Environment

Pace Platform Software

As with any set-top, there exists underlying software: Operating System (OS) and platform specific code to control the hardware. The *legacy* set-tops use, and continue to use, proprietary OSs and platform code. The issue this creates is that these older OSs have numerous drawbacks inherent to their architecture. For example, such design fundamentals as multitasking, thread-safe multithreaded processes, and application isolation are not available in these *legacy* OSs. What this means for OCAP is that multiple applications can not execute concurrently and if one errant application crashes, the whole set-top crashes. Recall, that one of the OCAP's goals is for fast application development time in a Java environment (Java – open-standard application language and execution environment). These Java applications need to execute concurrently while the set-top is performing other tasks such as playing (descrambling/decoding/displaying) audio and video. Other tasks may also be executing, such as the set-top communicating with the network head-end. As such, any application failure must not crash the entire system. Pace's software architecture ensures against such system failure by basing the design on modern OS technology, while also maintaining the open standards approach to eliminate proprietary software – this is accomplished with Linux.

[1] The SmartCard CA systems are DVB-based and are gaining traction in North American markets when used in conjunction with DOCSIS DSG (set-top gateway signaling protocol as defined by Cable Labs).

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Linux is the optimal choice of Operating Systems, for it offers the modern features described, regardless of use, while being completely open in terms of being a non-proprietary, royalty-free, OS. Linux also has another unique advantage in that the source code is available worldwide to anyone by merely downloading it from the Internet. This is a true testament to its openness. From embedded devices such as handhelds (e.g., PDAs, cellphones, etc.) to mainframe computers, Linux has proved its versatility, robustness, and acceptance in the marketplace.

In addition to the OS, there is the platform specific code controlling the hardware and set-top functionality. This Pace software is typically comprised of device drivers, CA system specifics, and network specifics. Pace has created this platform software in a modular, component-design fashion to ensure OCAP stacks optimally reside on top. This allows for the OCAP stack to be isolated and agnostic from the underlying hardware and OS. The advantage this brings is that it allows for multi-supplier OCAP stacks, thus giving choice to the cable operator as to whose OCAP stack they wish to deploy. This, of course, is in contrast to other approaches that are attempting to custom fit OCAP on top of the existing *legacy* OS and platform code – a band-aid approach to meeting OCAP. Pace's approach does not incur legacy baggage and allows a clean architecture to meet OCAP. To better illustrate this point, please refer to the Pace software architecture known as EngineWare™ in diagram 1 below.

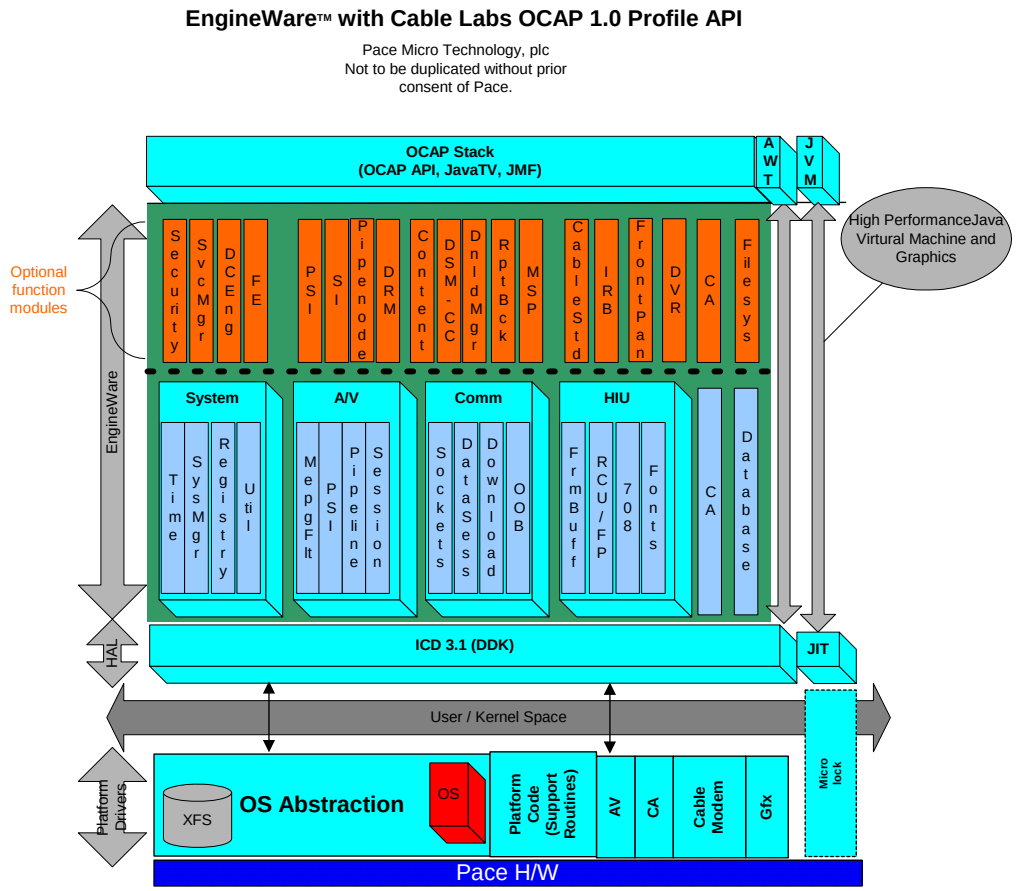

Diagram 1 Pace Software Architecture

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Another advantage Pace offers with this clean architecture is field upgradeable software downloads of the OCAP *environment*. Because Pace does not have legacy issues to deal with (hardware or software), it becomes a trivial task for Pace to take a 'live' in-the-field set-top and send it an OCAP software stack via the download mechanism (via the RF coax network). Thus, a Pace set-top can instantly transition to an OCAP set-top in mere minutes. Other set-top manufacturers are struggling with such an approach as their hardware and software architecture has limitations preventing a 'live' OCAP transition from happening.

Summary:

This paper addressed many of the challenges that set-top manufacturers are faced with in making the transition to OCAP. The challenges span the range from hardware to software of new set-tops, and also include transitioning of the *legacy* set-tops. Those manufacturers whom have come to terms with abandoning their proprietary ways are the ones best positioned to meet these challenges. Unfortunately for those who are hanging on to the past, time is running out, for an OCAP transition is loosely linked with other initiatives mandated by the FCC. One such law is the upcoming removal of embedded CA in leased set-tops by July 1st 2007. This is not to say that OCAP is a government mandate, however, it does clearly represent the trend for non-proprietary cable set-top environments. Pace has taken great strides in ensuring openness and willingness to adopt to these ever present initiatives, listed below are the advantages Pace offers as a MSO OCAP partner.

Pace Advantages in Transitioning to OCAP:

1. Existing deployed set-tops and all next generation units meet and exceed OCAP hardware requirements. These platforms are field upgradeable and optimized to run advanced software stacks like OCAP.
2. Interim one-off implementations are not needed. Initiatives like On-Ramp are not a necessity, because the cable operator can transition directly to a full OCAP solution.
3. Removal of the *legacy* software stack. Hence, a pure and optimized OCAP stack implementation can be realized without the bloatedness of *legacy* stacks with legacy operating systems.
4. Choice of Conditional Access (CA), whether it be the existing embedded CA (PowerKey & DigiCipher II), or CableCARD, or SmartCard CA (NDS, Nagravision, etc.) via DSG.
5. Choice of OCAP stack provider.

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Mr. Dinallo's responsibilities for Pace focus on U.S. Cable digital set-top box development, future technological directions, and participation in standard bodies. Chris brings 22 years experience developing innovative solutions in software and firmware, from operating system development to MPEG and DVD. He holds four U.S. patents, along with numerous white papers, and trade publications. Cable related papers may be found at http://www.pace.com/americas/content/webcontent.asp?nav=products&fullid=technology_whitepapers

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