

OPENTV CORE™ 1.1

▶ Meeting the **UNIQUE DEMANDS**
of the **ITV MARKET.**

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EXECUTIVE SUMMARY

OpenTV Core™ 1.1 is an embedded software solution designed to meeting the unique demand of the interactive digital television market. Target customers range from chipset vendor to set-top box manufacturer and from content developer to network operator. Building on OpenTV's earlier industry-leading middleware products OpenTV EN1™ and EN2™, OpenTV Core 1.1 provides a compact, modular software core bundled with a variety of extensions for fast customization and deployment of interactive services. Optional add-on packages are available to allow use of content authored using open industry standards and to support advanced features such as digital video recording and web browsing.

WHAT'S NEW IN VERSION 1.1?

Building on OpenTV Core 1.0, Version 1.1 adds new functionality in several areas. The most important new feature in Core 1.1 is a new pipeline architecture which supports delivery of video and audio content from multiple sources to multiple destinations concurrently. Depending on the capabilities of the target set-top box, this architecture forms the foundation of a multiple tuner single decoder personal video recorder (PVR) implementation. Additional improvements in Core 1.1 include enabling better broadband access, improved sound and image quality and more flexibility for display and user input of Asian character sets.

A new DOCSIS-SCM extension allows O-code and native OpenTV applications to use a DOCSIS Cable Modem for IP protocol transactions via standard OpenTV functions.

OpenTV Core 1.1 now supports true color in On Screen Displays (OSD) so that the interactive visual elements can be more easily displayed with a level of quality similar to that of MPEG stills and video. Dolby Digital (AC-3) support enables a richer, surround-sound audio experience to be provided by supporting set-top boxes.

The new EFE-Bitstream extension and Front End Processor (FEP) support provide more flexibility in

OpenTV Core 1.1 also supports two new optional OpenTV products - HTML Package 2.0 and PVR Package 1.0. HTML Package 2.0 enables HTML and JavaScript to be used to author and display television-centric interactive content. PVR Package 1.0 provides hardware porting kit and software developers kit APIs which provide the functionality needed for a full-featured PVR set-top box.

Upgrading from Core 1.0 to Core 1.1 does not require any changes to low-level drivers or compiled applications where functionality remains the same. Of course, implementing features new in Core 1.1, such as a second tuner, will require code changes.

WHAT IS MIDDLEWARE?

Interactivity generally refers to a cable or satellite television subscribers ability to respond to and control their TV viewing experience. Applications may include games, weather, news, interactive gambling and live chat. In the interactive television (iTV) market, middleware is a term for embedded software that enables interactive applications to run on set-top boxes from different manufacturers, regardless of the underlying hardware or operating system. As many network operators use set-top boxes from more than one manufacturer, middleware provides the essential common denominator necessary to deploy application software to every subscriber in a cost-effective manner, regardless of set-top box hardware.

Stated another way, middleware serves as an abstraction layer or binder that shields applications from the inherent differences between set-top boxes and operating systems.

Middleware is important because consumers have more choices than ever for how they receive their television services - cable, direct-to-home satellite, terrestrial and, in some areas, telco broadband solutions. Today's digital television service providers are looking for ways to differentiate their services, create new sources of revenue and reduce churn, or subscriber turnover. While expanded programming is certainly one way to lure subscribers, many operators are turning to interactive services and applications to give them an edge. The opportunities are unlimited, but implementing new technologies can

Set-top box manufacturers and chipset vendors are confronted with ever-shrinking margins on hardware and software, skyrocketing R & D costs required to add new features, and the need to comply with government regulations and industry standards. Network operators face a number of questions as well: Can we use existing set-top boxes in the field? Will deploying new services take a long time? Once we begin offering interactive applications, how will we upgrade the set-top boxes or add new services? As a key component of an interactive television deployment, middleware addresses these issues while minimizing development costs and speeding time to market.

THE ADVANTAGES OF OPENTV CORE™ 1.1 MIDDLEWARE

OpenTV Core is more than just middleware. While it does provide all of the benefits of middleware stated above, it also provides a foundation upon which network operators and hardware manufacturers can author and deploy interactive applications and services. As set-top boxes evolve, new models are equipped with more memory and more extensive features than earlier ones. OpenTV Core keeps pace with this evolution by offering multiple methods for authoring content and a variety of expansion options with its add-on packages and modularity through the included extensions.

OpenTV Core 1.1 supports satellite, cable and terrestrial broadcast networks with any level of connectivity - from one-way satellite services to complex bi-directional cable and broadband networks. The optional HTML Package allows operators to create iTV content easily using JavaScript and HTML authoring environments, which are widely used. The new, optional PVR Package provides a foundation for set-top box manufacturers to enable recording capabilities in their products and for operators to offer PVR-based services.

For set-top box manufacturers and network operators, OpenTV Core improves time-to-market and saves money by shortening the development cycle for iTV set-top box software and iTV applications. It also provides a rich environment for building revenue-generating services and gives operators the freedom and options required to compete in today's dynamic markets.

WHAT TO LOOK FOR IN MIDDLEWARE

Ideally, middleware should require minimal resources such as CPU power, RAM and Flash memory, while simultaneously providing maximum capabilities, flexibility and ease of integration. In other words, it should do a lot with just a little.

From its earliest release, OpenTV Core 1.1 was specifically designed to target the set-top box environment. It supports set-top boxes from over 40 manufacturers, including so-called "thin" set-top boxes. Its code base is compact, yet extendible, in order to use as few memory resources as possible. In addition, OpenTV Core adheres to numerous television industry standards, ensuring interoperability and longevity.

Hardware Independence

Many network operators have deployed more than one type of set-top box (and often from more than one manufacturer) to their subscribers, creating a complex environment for interactive application development and deployment.

OpenTV Core 1.1 was designed to enable OpenTV applications to run on all generations of set-top boxes from all manufacturers, including thin boxes with limited CPU power and limited memory. Open TV Core 1.1 requires as little as 50MIPS of processing power and only 2MB of free Flash memory and 2MB RAM. Operators can leverage earlier investments by using set-top boxes already in subscribers' homes. This capability translates into significant hardware cost savings.

The O-code Virtual Machine provides a layer of abstraction from the actual set-top box hardware and operating system beneath it, enabling compiled O-code applications to run on a common "virtual" set-top box that is implemented only in software. This is done in two ways: (1) at the application layer with the O-code Virtual Machine and standards-based optional add-on execution environments and (2) at the hardware layer by abstracting driver functionality with OpenTV Core TV libraries. Written in ANSI-C code, applications are compiled into a byte code and run on the O-code Virtual Machine.

Application developers can write code once for a given application to run on any OpenTV-enabled set-top box. This ability to run the same middleware and same applications on different set-top boxes in networks that may also be different saves time and money.

OpenTV Core supports many set-top box processors including ARM, MIPS, PowerPC, DCU, ST20 Motorola 68k and ARM. Due to its portability to any hardware platform and its stringent definition of driver behavior, OpenTV Core 1.1 provides guaranteed interoperability since the same code is running on a heterogeneous set of set-top boxes.

Modularity

To be efficient, middleware should be compact. Bloated code slows down applications, as most set-top boxes have very limited memory and processing power. OpenTV Core 1.1 comprises a set of TV libraries, extensions and a runtime interpreter. The software selectively encapsulates set-top box services and provides an application environment in under 1MB of Flash memory (depending on processor) and as little as 128kB of free RAM. These figures do not represent memory or hardware requirements for hardware drivers, conditional access, resident applications or add-ons such as the HTML and PVR Packages. With its small footprint, OpenTV Core 1.1 is ideal for deploying compelling interactive applications in a cost-effective manner.

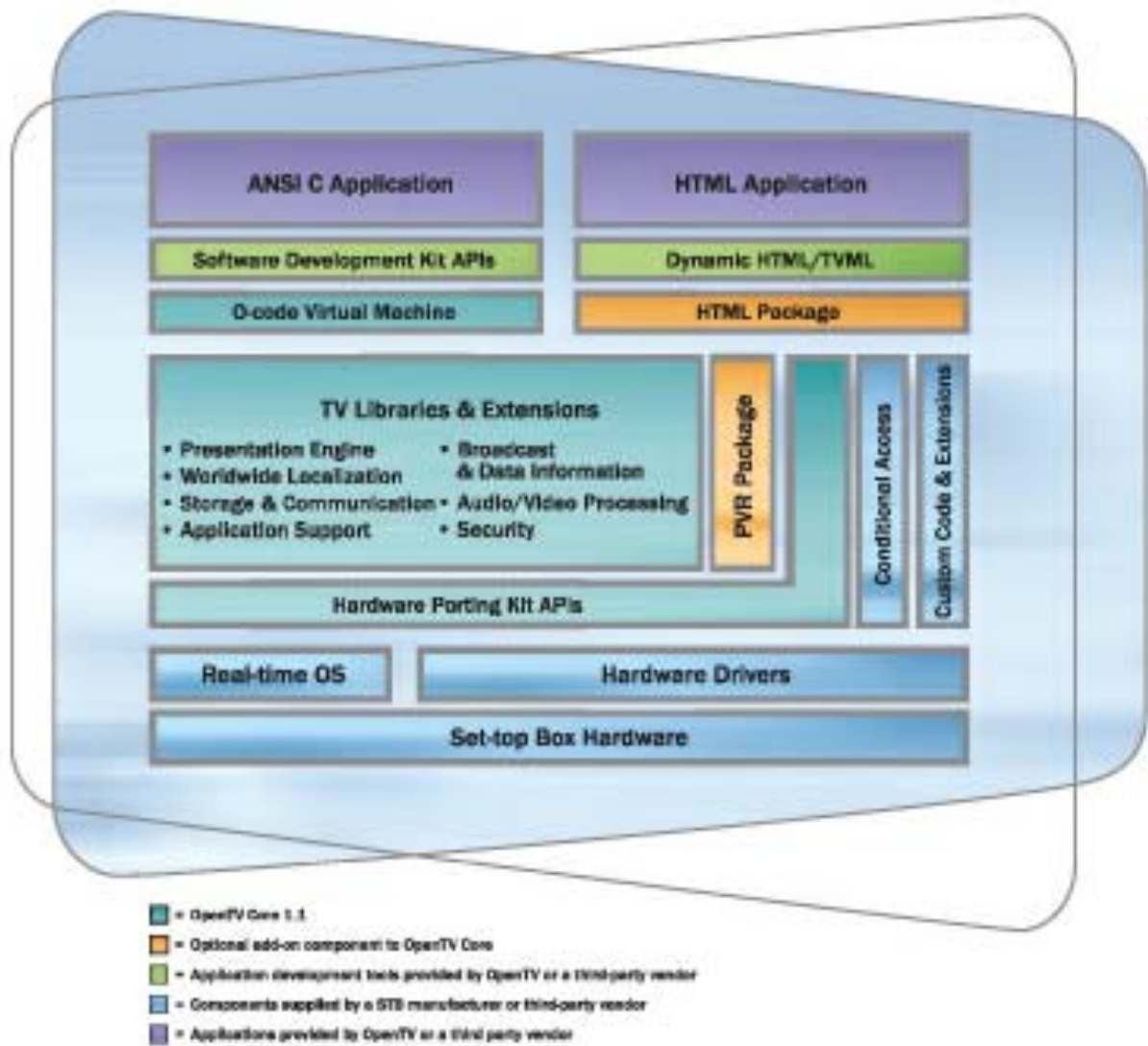
Minimizes Infrastructure Requirements

OpenTV Core 1.1 middleware provides a flexible framework for getting content, interactive applications and services into the set-top box. In turn, the infrastructure necessary to distribute them can be efficient and scalable. By enabling a mixture of broadcast (in-band) and return path (out-of-band) communication to download programs and services into the set-top box, load balancing of the supporting servers can be managed in a flexible manner.

Support for Industry Standards

Broadcasting, and digital broadcasting in particular, has evolved around certain technologies and sets of standards. By adopting common standards, the broadcast industry creates new economies of scale and facilitates deployment of new technologies. This ultimately benefits both broadcasters and consumers. OpenTV continues to track these standards and participate in their evolution.

To help meet its customers' needs, OpenTV Core 1.1 supports key industry standards such as DVB, MPEG-2, HTML, JavaScript and Java. OpenTV's support of standards extends into the communication layers of the middleware. Core 1.1's networking stack is compatible with Internet standards (HTTP, SSL, TCP/UDP, IP, PPP, 802.3/ethernet) for a seamless integration of set-top boxes in existing Internet infrastructures, including secure servers (for E-commerce).



OPENTV CORE 1.1 GENERAL ARCHITECTURE

The following underlying features provide a fertile environment for deploying interactive applications and minimizing resources:

- The OpenTV Core 1.1 architecture enables developers to add new functionality, enhance existing functionality and facilitate maintenance quickly. The compact "heart" of the software is the TV libraries themselves. Services may be added by utilizing various

Abstracted via a hardware-porting layer, the broad functionality of OpenTV Core 1.1 enables set-top box manufacturers to design new capabilities and adapt the middleware to new hardware in a cost-effective manner. OpenTV Core 1.1 scales directly with the underlying set-top box's processor, graphics, communication requirements and memory capacity.

- **Dynamic Downloading and Linking:** OpenTV Core supports dynamic downloading and upgrading of libraries, extensions and applications. The OpenTV dynamic link service makes it possible to split an application into multiple units and link the units into the whole application on demand. Combined with the module download service, the dynamic link service allows code modules to be dynamically downloaded and linked to an application. Thus, the application can avoid using excessive memory at start-up. It also lets the application load additional code modules dynamically as needed, thereby saving transmission bandwidth.
- **O-code Virtual Machine:** Middleware shields applications from varying hardware requirements and allows a single application binary to run on all set-top boxes, regardless of their particular configuration. The O-code Virtual Machine creates a common environment, or "virtual" set-top box, on which to run compiled applications. Application management is minimized since the single executable can be rendered on different target set-top boxes within diverse network delivery mechanisms. OpenTV applications can execute in a mixed set-top box environment, thereby eliminating the need for multiple application versions to support multiple set-top box types.

OPENTV CORE 1.0 TV LIBRARIES AND EXTENSIONS

The TV libraries in OpenTV Core provide the foundation for iTV applications and services, in a minimal RAM footprint. Extensions provide flexibility to add/enable features as needed without squandering precious RAM for features that are not required.

- File managers are included for both the EEPROM and FLASH. This support allows the file system to store application and system data more efficiently and in the most appropriate memory device, improving the overall efficiency and performance of the system.
- **Sleep / Wake-up Function:** OpenTV Core 1.1 supports low-power stand-by mode in line with

- **System Query and Control:** The System Query and Control library provides application access to set-top box specific hardware and features. OpenTV Core 1.1 defines a generic control task as a starting point.

Presentation Engine

The Presentation Engine enables application developers to deliver broadcast-quality visuals within the capabilities of a given set-top box.

- **EFE (Extension) NEW!:** EFE, or External Font Engine, is an extension that allows font vendors to plug their font rendering engines into OpenTV Core 1.1, thereby enabling the support of external fonts. This first release of EFE specifically supports the Bitstream font engine and fonts, and can be adapted for use with other font engines and fonts. EFE increases font formats supported as well as portability of the middleware. The supported Bitstream font engine can provide for rotation, scaling (size and ratio), skewing (horizontal and vertical) and anti-aliasing.
- **Front End Processor Manager NEW!:** The Front End Processor Manager supports Front End Processor (FEP) -- sometimes referred to as an input method editor -- extensions. FEPs allow text to be entered via a device that may not inherently support all of the characters in a specific language. For instance, via a Front End Processor, a consumer could use a remote control device to enter Western alphabet-based text into an iTV application running on the set-top box. Another FEP implementation might provide the mechanism to allow a QWERTY keyboard to be the input device for character-based languages such as Japanese, Chinese and Korean, whose characters may number in the thousands. Some languages may require dictionary files to be added, apart from the language-specific Front End Processor itself. FEPs can support predictive input as well as the selection of input from more than one character code such as Hiragana, Katakana and Kanji for Japanese.
- **Virtual Keyboard (Extension) NEW!:** The Virtual Keyboard extension is a specific Front End Processor that enables characters to be entered from remote controls that otherwise could not support a full character set with their limited keys for alpha/numeric entry.
- **2-D Primitives:** Lines, polygons, rectangles, round rectangles, and ellipses are supported. Supported shapes have many different attributes including, but not limited to, pen color, pen size, and fill pattern.

- **Anti-Aliased Fonts:** Support is provided for multicolor bitmapped anti-aliased fonts. This can improve the resolution, readability, and overall presentation of the fonts displayed on a television screen. The anti-alias techniques utilize computation of intermediate colors to outline the font based on the background and foreground colors selected.
- **Transparency:** Color palettes include an extra mapping parameter, giving the degree of transparency (alpha) for each color entry. Each color entry may have up to 256 different levels of transparency (dependent upon hardware.) Several transparency modes have been added for existing applications.
- **Variable Color Depths-Expanded to Support True Color!!! :** OpenTV Core 1.1 supports a variety of color depths including 2, 4, and 8-bit palettes and 16 and 32 bit colors, depending on the hardware capabilities of the target set-top box. This enables visual elements that are displayed in the on screen display to be rendered with visual quality similar to that for MPEG stills and video.
- **Multi-plane Graphics (Extension):** OpenTV Core supports multiple graphic planes for on screen displays (OSD) and video. By utilizing the varying levels of transparency between planes supported by OpenTV Core, still images and graphics can be combined with video in limitless ways to produce the most dynamic interactive television applications imaginable.
- **Video Scaling (Extension):** The video scaling extension places the video on the screen in the size and location desired.

Worldwide Localization

Worldwide localization consists of features and extensions that enable applications to be deployed in various regions, by country, language and/or time zone.

- **Time and Date Localization:** Operators can use OpenTV middleware to display times and dates according to rules specified in different countries and different languages. An application can select local information based on a given country code. Additionally, when receiving DVB-SI time information, the proper time zone can be automatically set for the currently selected country and the correct local time can be displayed.
- **16-bit Fonts (Extension):** 16-bit "Unicode" character format is a standard to support the

Storage and Communication

The storage and communication options supported by OpenTV Core 1.1 give developers and network operators the ability to get programs, interactive applications and data to and from the set-top box efficiently. This can be achieved through several delivery mechanisms - via the broadcast stream, the return path (dial-up or cable modem) or resident on the non-volatile Flash/RAM.

Cable Modem - DOCSIS-SCM (EXTENSION) NEW!!! DOCSIS (Data Over Cable Service Interface Specifications) is an internationally recognized standard for delivery of IP data across a Hybrid Fiber Coax network. Its goal is to provide cross-platform compatibility in the delivery of IP data across multiple cable operator networks. To deliver DOCSIS data services over a cable television network, one downstream 6 MHz radio frequency (RF) channel in the 50-1000 MHz spectrum range is typically allocated for data traffic to homes and another channel in the 5-42 MHz band is used to carry upstream data from cable modems.

For operators who choose to use DOCSIS as their return path technology, the DOCSIS-SCM extension works with a DOCSIS cable modem within or external to a set-top box. In this extension, OpenTV treats the cable modem subsystem as a software Ethernet interface. The DOCSIS-SCM extension allows O-code and native OpenTV applications to use a DOCSIS cable modem for IP protocol transactions via standard OpenTV functions.

The DOCSIS-SCM extension provides the following network components:

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The DOCSIS-SCM extension provides the following network components:

- Data Link Layer: MAC 802.3 and DIX; and LLC 802.2 and DIX
- Network Layer: IP/ICMP/ARP (provided by the Socket Service extension)
- Transport Layer: TCP/UDP (provided by the Socket Service extension)

Applications that use the DOCSIS channel include Web surfing, email/chat, software

Socket Service (Extension):

Socket service includes three components:

- **TCP/UDP over IP socket:** allows any OpenTV application to use TCP and UDP protocols to connect to remote servers and perform online transactions.
- **Link Manager:** enables multiple security modules to control access of online service providers, and make sure set-top boxes connect to Internet.
- **Session Manager:** allows multiple modules to be used by a set-top box to perform secure online transactions. The session manager not only provides both client and server authentication when performing an online transaction, but also can build a secure E-commerce client.

The Socket Service extension provides basic services that are required if the Cable Modem-DOCSIS-SCM, Cable Modem-DVB-RC or PPP Link extension is to be used.

Cable Modem - DVB-RC (Extension): DVB-RC is a high-speed data return channel standard established by the DVB organization for networks that deliver services via cable. The OpenTV DVB-RC extension is fully compliant with the DVB-RC specification ETS 300 800.

PPP Link (extension): The PPP Link extension ties in with the modem service enabling connectivity via dialup and establishing a PPP connection to a remote server.

Access to Application Data: APIs are provided to allow applications to load data modules off of multiple delivery mechanisms including the OpenTV broadcast carousel. There are also APIs to allow applications to access data modules stored in non-volatile memory.

Application Resource Support: Applications can load and manage multiple collections of resources such as graphics, text and fonts. This can be used to support localization of applications or simply to better manage bandwidth.

Data Compression: OpenTV modules can be compressed at delivery time using an OpenTV utility and automatically decompressed after they are downloaded. Compressed data makes more efficient use of transmission bandwidth for loading applications and, once downloaded, also makes more efficient use of the limited memory resources of the set-top box.

HTTP (Extension): The HTTP 1.1 extension provides the HTTP native interfaces and data structures for this industry standard data transport mechanism. This allows any OpenTV application to act as an HTTP 1.1-compliant client. The extension is compliant with the Internet Engineering Task Force RFC 2068, and also supports both http:// and https:// U

Modem Service (Dial-up support): Modem service allows raw modem-to-modem connection from a set-top box to a remote host without high-level protocols. In a resource-constrained environment, such as software modems common in many set-top boxes, the modem service can maximize bandwidth usage. High-level protocol support is available through the PPP Link extension.

Application Support

OpenTV Core provides several means of managing how applications are initiated and terminated.

Application Life-cycle and Rights Customization: The extensibility of OpenTV Core 1.1 core tasks enable network operators to customize various stages of running and terminating application, including system services applications.

Event Broker (Extension): The Event Broker extension enables an OpenTV application to specify an action that will be triggered when a specific event occurs. The action can take the form of an application launch, a pop-up or a message sent to the control task. This facility allows for advanced iTV applications, synchronous with an active media stream.

Pop-up Support: OpenTV Core supports notification pop-ups as independent applications. These applications utilize special operating functionality and can be used to alert the viewer to urgent messages that may be unrelated to the current application.

Broadcast and Service Information

OpenTV Core 1.1 supports industry standards for program and service information, including MPEG PSI and DVB-SI.

Multiple Tuner Support-NEW!!!: OpenTV Core 1.1 supports set-top box architectures with multiple tuners, which are typically used for applications such as personal video recording (PVR) to record one or multiple programs to a hard disk while one live television program is being watched using another tuner. Support for multiple tuners is dependent on the capabilities of the target set-top box.

DVB-SI (EXTENSION): The DVB-SI standard for Service Information is fully supported by OpenTV Core 1.1. This support includes the ability to retrieve data from standard DVB tables within the MPEG-2 transport streams as well as the efficient storage and caching of this information in a dedicated database. In addition to OpenTV applications such as EPG, native tasks and Broadcast Name Servers can also obtain access to this information as necessary.

The DVB-SI extension provides an abstraction to the DVB built-in service lists by implementing the Service List Library. This library provides an API to build multi-DVB table lists of services available on the network so that the EPG and the Broadcast Name Service can use this abstraction to surf available channels without directly having to interact with the SI-PSI database.

An MPEG-2 PSI (Program Service Information) module has been implemented as part of the DVB-SI extension. The function of this module is to access the MPEG-2 tables in the transport stream (PMT, PAT and CAT) and supply other modules (Conditional Access, Broadcast Name Server) with the appropriate information.

DVB-SI EIT Schedule (Extension): DVB specifies EIT Schedule tables that contain descriptions of events taking place sometime in the future (up to 64 days). Because the transmission of these schedule tables is optional, an operator may choose to enable or disable OpenTV's EIT-Schedule. This extension conforms to ETSI specification EN 300-468. However, for flexibility, a manufacturer or network can customize the DVB-SI EIT Schedule extension module.

SI Enhancements: A number of enhancements have been provided to the OpenTV SI engine. These include:

- Enhanced reliability on network stream errors and features for easy tune-up.
- NIT Actual and SDT Actual notifications: new functions have been introduced which enable or disable applications or native client notifications.

Language tags for European languages: Support of the DVB-SI language encoding for all major European languages.

Modular SI: SI support in OpenTV Core 1.1 is modular, meaning that the set-top box manufacturer and network operator can install an SI engine of their choice. OpenTV Core 1.1 now provides the DVB-SI engine as an extension, which can be removed if desired, conserving set-top resources.

Enhanced Program Connection Mechanism: OpenTV supports a broad model of program connection that satisfies most networks' and manufacturers' needs. This feature allows two ways of connecting to a program:

- Service list-based connections, where the parameters of the connection are looked up in the service and transport lists.
- PSI-based connections, where only PSI tables, such as PAT and PMT, are used. Connections are carried out in two steps; first a connection to a transponder is required and later, a connection to a program within that transponder.

Stream Processing

OpenTV Core 1.1 addresses audio and video control and synchronization with iTV application code.

- **Dolby Digital (AC-3) Audio Support NEW!!!:** OpenTV Core 1.1 now supports the Dolby Digital (AC-3) 5.1 channel audio specification so that enabled set-top boxes can provide multi-channel surround sound audio to an entertainment center's audio system.
- **Application/Video Synchronization:** OpenTV Core 1.1 provides a method for tightly synchronizing an OpenTV application with video by using the frame/time stamps in the MPI video stream.

- **Audio/Video Support:** OpenTV Core 1.1 supports streaming audio and video tracks as they arrive on the broadcast stream. The implementation takes advantage of hardware features available in the current generation of MPEG video decoders. This includes support for scaled and positioned MPEG video display, as well as a secondary image plane, and application-based audio volume control.
- **DVB-Subtitling :** OpenTV Core 1.1 supports streaming audio and video tracks as they arrive on the broadcast stream. The implementation takes advantage of hardware features available in the current generation of MPEG video decoders. This includes support for scaled and positioned MPEG video display, as well as a secondary image plane, and application-based audio volume control.
- **Subtitling / Teletext - STB & VBI (Extension):** The STB extension version allows an application to retrieve subtitling or teletext data from the digital stream to the data on the OSD. EBU teletext format up to level 2.5 is supported.

The VBI extension version employs a driver interface that retrieves teletext and subtitling data from the digital stream, and reinserts the data into the vertical blanking interval of the analog signal sent to the television set.

- **SCART Support (Extension):** OpenTV middleware supports SCART, a high quality A/V connection that enables RGB output. SCART is used widely throughout Europe.

Security

Security is important to ensure that the programs and services are received and viewed only by those who are authorized, as well as to protect content from unauthorized duplication and/or usage.

Security Manager: OpenTV Core 1.1 offers a number of defenses against security threats. All downloaded modules are validated for authenticity and integrity before being allowed to execute.

This feature provides a collection of services that are used to establish the security environment of the set-top box and the running application. This includes authentication of the set-top box and external data sources, encryption and decryption, and managing the rights of the current application.

Copy Protection API: OpenTV Core 1.1 provides a driver interface to control audio/video circuitry that is designed to prevent videotaping of broadcast programs. The interface enables the control task to either enable or disable copy protection.

Secure Socket Layer 3.0 (SSL 3.0) (Extension): Support for the public key encryption methods of the Secure Socket Layer ensures industry standard secure data transmission capabilities for commerce type applications.

Conditional Access: The conditional access (CA) API's in OpenTV Core 1.1 provide support for all major CA vendors, rather than limiting the set-top box vendor or network to a single vendor. Supported CA systems include CryptoWorks (Philips), DigiCipher 2 (Motorola), Irdeto Access (MIH), NagraVision, Telenor (Conax), Viaccess (France Telecom), and VideoGuard (NDS).

Multiple Smart Cards (Extension): In addition to the first smart card used for Pay-TV services, OpenTV Core 1.1 now supports multiple smart cards. Smart Cards can be used for applications such as electronic commerce, banking and shopping. An O-code interface enables private or standard smart cards to be used with interactive applications.

PACKAGES

The various extensions to OpenTV Core 1.1 allow developers to add functionality while minimizing the extra headroom required. The extensions described earlier in this paper are included as standard components with OpenTV Core 1.1. For even greater utility, OpenTV also offers packages of optional extensions that the set-top box manufacturer or network operator may purchase to enhance the capabilities of Open Core.

HTML Package 2.0 EXPANDED!!!!: The HTML Package 2.0 is an add-on package to OpenTV Core 1.1, which allows network operators to display HTML and JavaScript content authored for TV on their set-top boxes. Operators can migrate existing Web content to iTV and take advantage of HTML and JavaScript as iTV application authoring environments. In addition, operators can create a customized user interface to reinforce branding for web surfing or delivering a TV-centric web browsing experience to viewers. The package can be implemented with other OpenTV Core 1.1 add-on packages such as PVR Package 1.0 or MHP Package.

New features in HTML Package 2.0 include:

- Data delivery either as part of the broadcast signal or via the return path.
- A TV media handler that supports positioning of a scaled video window within the HTML

Using HTML Package 2.0, virtual channel applications can be created using common web tech that dynamically generate content in HTML and JavaScript.

The OpenTV HTML Package 2.0 conforms to the following Internet standards:

- HTML 4.0.1
- CSS 1.0 and absolute positioning from CSS 2.0
- ECMA-262
- JavaScript 1.5
- DOM Level 1
- SSL 2.0 and SSL 3.0
- GIF87a, GIF89a, JPEG, PNG and XBM image support

In order to deploy HTML Package 2.0, set-top boxes must have at least 2MB of free Flash memory in addition to that used for OpenTV Core 1.1. Both processing power and RAM required are dependent upon the complexity of content to be accessed. To display the breadth of content on the Web (general browsing), OpenTV recommends a 100MIPS processor and 8MB or greater RAM.

The HTML Package provides a control mechanism that allows it to be started, stopped, pause/resumed by a Core 1.1 control task. When started, or during operation, a URL may be sent to the Package by OpenTV Core to force a specific page to be displayed.

The HTML Package also features an embedded web browser that enables standard web browsing on television display. This technology, built on OpenTV Device Mosaic, is a proven HTML iTV product deployed on over eight million set-top boxes worldwide. The HTML Package provides a facility for column-centric formatting of Web content, reducing the need for horizontal scrolling of web pages by : both page layout and images, including image map coordinates. This formatting is managed client-side on the client side, eliminating the dependency on complex server side display formatting.

PVR Package 1.0 NEW!

The OpenTV PVR Package is a foundation to enable Personal Video Recording (PVR) functionality on set-top boxes running OpenTV Core 1.1 middleware. The technology behind PVR Package 1.0 is the most widely deployed PVR technology worldwide.

The PVR Package 1.0 is a dual tuner, single decoder PVR implementation that enables time shifting and supports VCR controls to pause, resume, fast-forward and rewind live television. Additional supported features include the ability to record live A/V programs to the set-top box hard drive and play them back.

concurrently, as well as the ability to record multiple programs concurrently. The PVR Package also includes libraries for hard disk drive control and provides a framework for adding other PVR capabilities.

PVR Package is not a standalone product and requires some level of integration. The OpenTV Professional Services group is available to implement playback, record, VCR trick modes and a streaming file system for interested operators.

CONCLUSION

OpenTV Core 1.1 satisfies the rigorous demands of network operators, application developers and set-top box manufacturers in the interactive television market. By supplying a small, modular and efficient set of TV libraries with a variety of extensions for fast customization, OpenTV Core 1.1 allows rapid deployment of set-top box services. Because software is downloaded into the set-top box, new features can be added in the field. The OpenTV Core application run-time enables content developers to create a single version of an interactive application and deploy that application across many different networks and set-top boxes, minimizing development costs and speeding time to market. OpenTV Core 1.1 is built with the highest degree of reliability expected in consumer electronics products, a crucial feature in today's home entertainment marketplace.

With its compact size, flexibility and portability, OpenTV Core 1.1 helps set-top box manufacturers, chipset vendors, network operators and applications developers save time and money as they deploy interactive television services anywhere in the world. It is more than just middleware—it is the foundation of your successful interactive television business.



It's the

EXPERIENCE.™

OPENTV CORE™ 1.1

Technical White Paper

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