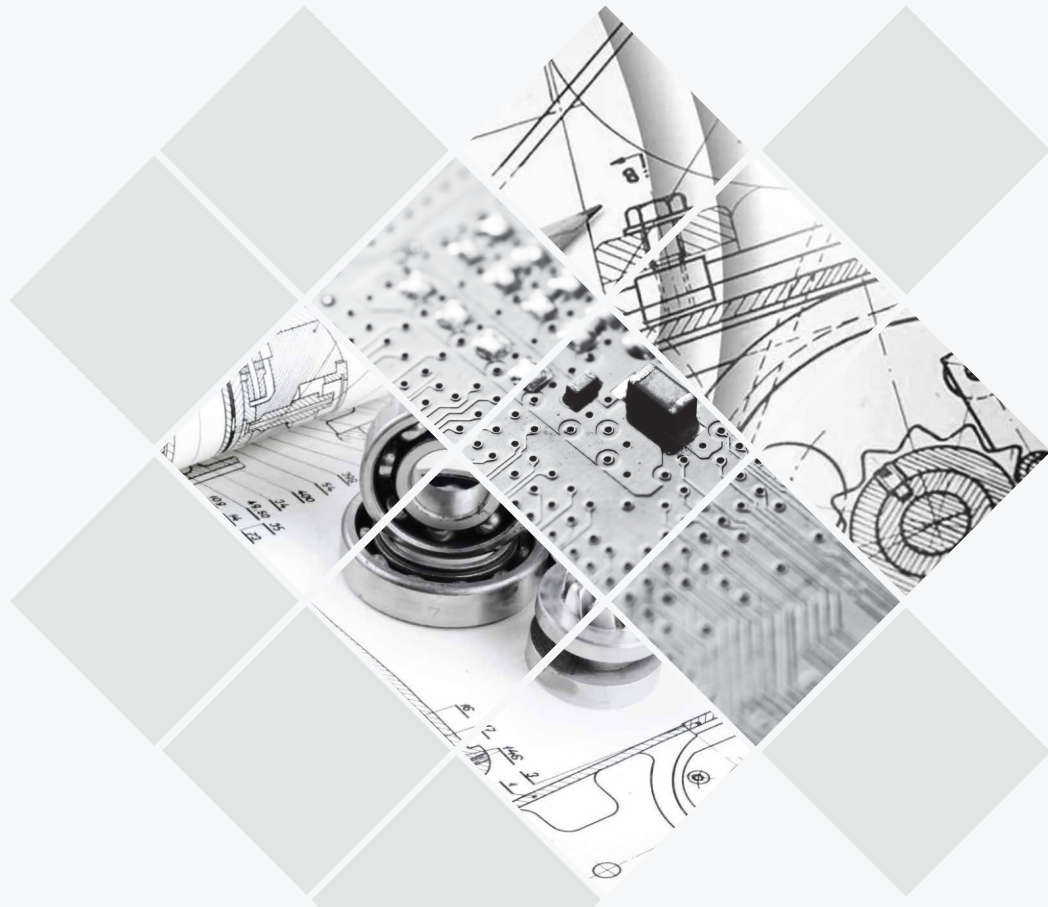


a whitepaper on hybrid set-top-box

A Set-top-Box (STB) is a very common name heard in the consumer electronics market. It is a device that is attached to a Television for enhancing its functions or the quality of its functions. On the other side, the STB is connected to an external source of signal, like satellite, cable, terrestrial or internet. The STB processes the signal it receives, turns it into content, which is then displayed on the television screen or other display device.



contents

0.1	Set-top-Box	01
0.2	Why Hybrid Set-top-Box?	01
0.3	Typical Application Scenario	02
0.4	Application Development Framework	03
0.5	A Typical Reference Design	04
0.6	Back End Simulation & Testing	06
0.7	Conclusion	06



A whitepaper on hybrid set-top-box

Set-top-Box

A Set-top-Box (STB) is a very common name heard in the consumer electronics market. It is a device that is attached to a Television for enhancing its functions or the quality of its functions. On the other side, the STB is connected to an external source of signal, like satellite, cable, terrestrial or internet. The STB processes the signal it receives, turns it into content, which is then displayed on the television screen or other display device.

There are different types of STBs based on what kind of signals it can receive and what kind of processing it can do. The most widely used STBs are DVB STBs, which receive DVB (Digital Video Broadcast) transmission. This digital TV broadcast can be any one of the three types – Satellite, Cable or Terrestrial (DVB-S, DVB-C or DVB-T). Another type of STBs are IPTV STBs, which are used to bring broadband content, the data shared on the internet including multimedia, to Television. There are many other types of STBs based on different standards and geographies.

Why Hybrid Set-top-Box?

In the fast lifestyle of the twenty first century, people are very busy and they are unable to set aside enough time for entertainment with family. It is difficult for them to find time with PC as well as TV, for data and media separately. So it is a promising idea to make everything available to the Living Room, where the family members gather and spend time together for entertainment at home. With the decreasing price of flat-panel TVs and increasing use of HD TVs at homes, In-Home Entertainment is a fast emerging area of today's consumer industry.

Convergence is the distinguishing service for operators in today's fast changing world, bringing media and data together to the consumer. In addition, to receive media from different sources, especially to utilize the big pool of internet, the receiver device should be

versatile enough to support that. So a new device was required to bring in the enormous possibilities of infotainment from the internet, along with DVB reception. Thus the idea of Hybrid STB came into picture, which is a Set-top-Box providing Broadcast and Broadband content to the consumer on the same device. The Hybrid STB enables the Television to be used both for TV reception of DVB programmes as well as for Internet access and other PC like functions.

Thus Hybrid STB is a device which provides the capabilities of both DVB STB and IPTV STB on the same platform, bringing access to DVB-S/C/T and Broadband internet together. This provides DVB-over-IP services.

Today, DVB STBs are widely available. IPTV STBs are also becoming common. But Hybrid STB is relatively a new and emerging area. So, more products are awaited in this product line. And new players are coming up in this arena.

Emerging technologies and standards like HbbTV (Hybrid Broadcast Broadband TV) and Canvas are giving wings to the fast widening market of Hybrid STB. According to IMS research, the Hybrid STB market is growing very fast based on statistics of year 2009. The operators' new initiatives are driving continued growth to increase ARPU (Average revenue per user, sometimes called average revenue per unit) by providing new on-demand services like Push-VoD, specialized internet access etc. Here in this paper we are introducing the concept of Hybrid STB and its significant features. The Hybrid STB addressed here is a Set-top-Box with DVB-S2 and IPTV connectivity. The services provided are Free-to-air as well as pay-TV on the DVB side and value-added applications on the IP side.

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Typical Application Scenario

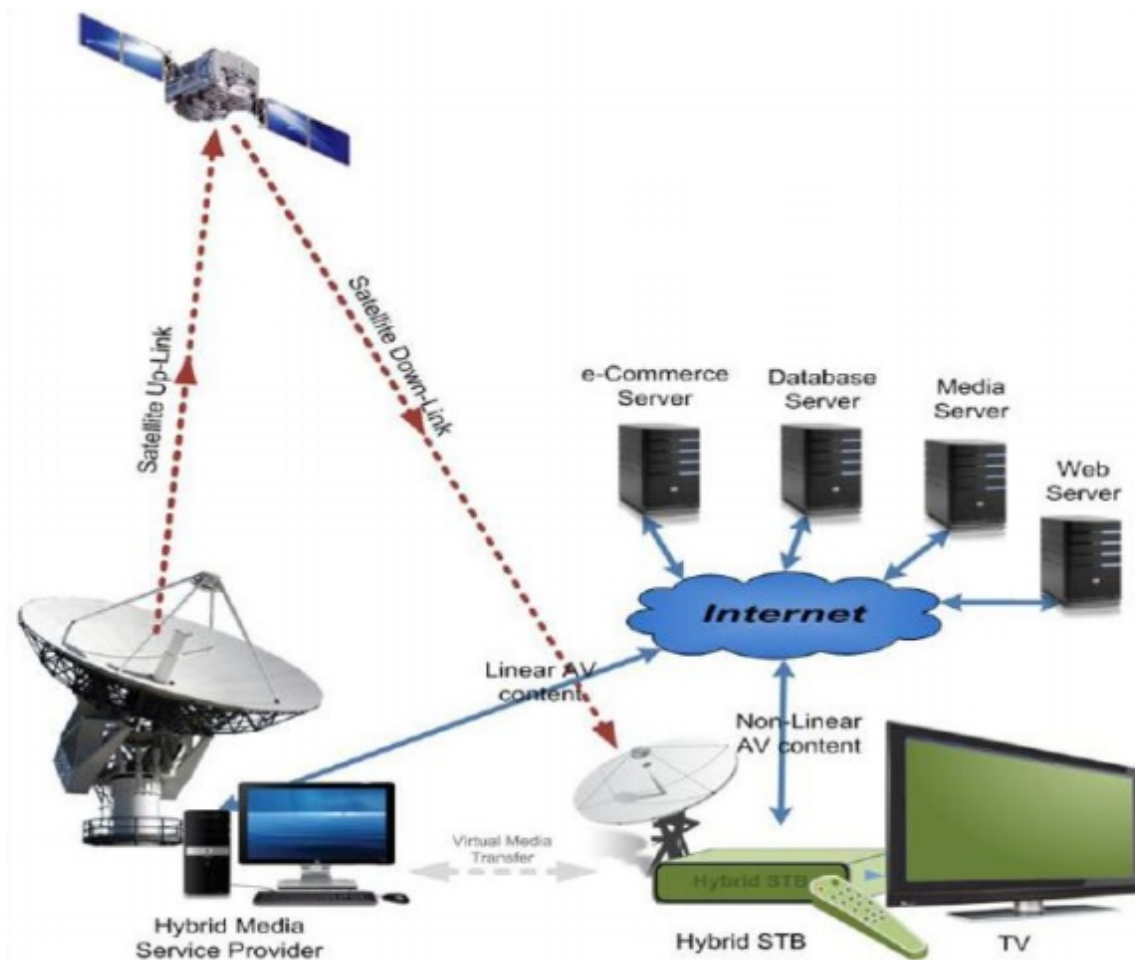


Figure 1: Typical Hybrid Set-top-Box Application Scenario

The typical application scenario of the Hybrid Set-top-Box is shown in Figure 1 above. The Hybrid media service providers uplink their Broadcast and Broadband content to the DVB Satellite and internet respectively. On the consumer side, the Hybrid Set-top-Box connected to a big screen TV with HD support, receives the DVB Satellite and internet contents and displays on the TV, using its specialized applications and GUI. The consumer can access the content according to his/her preferences.



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Hardware Platform Selection

The first step is to fix the hardware platform from the available solutions in the market. The hardware we select should have the capability to meet all the requirements which need complex processing. The most widely used chipsets in the STB market are Broadcom BCM7xxx, ST Microelectronics Sti71xx, Sigma Designs SMP865x, NXP PNX89xx etc. A comparative study is conducted based on the required features of Hybrid STB, processing power, performance levels, availability of hardware plug-ins, software tools like SDK, debugging tools, expandability of memory and storage, price of evaluation kit, approximate BoM price, volume price, SDK price and features, proven solutions available in the market, technical support modes, customer preference etc. Since there are lots of solutions in the market, this is a tough job to select the platform. The best suited hardware platform has to be selected before going for a solution.

Middleware Selection

Middleware is the most critical component in a Hybrid STB. This determines the amount of additional engineering effort required, feature additions, future expansion possibilities etc. The Operating System (OS) is fixed based on either customer preference or selection by the design house. Linux, WinCE, Windows Embedded etc. are the operating systems mainly used in STBs. Once this is selected, the next step is to select the suitable Middleware, which is very critical. For this, a comparative study is conducted based on Hardware platform support, OS support, availability of IPTV stack, DVB stack, support for High Definition/Standard Definition (HD/SD) video, support for H.264/MPEG2 compression, Java support, support for basic STB functionalities of Electronic Program Guide (EPG), Video-on-Demand (VoD), Personal Video Recorder (PVR), advanced features like interactive TV functionalities, Push-VoD, Catch-up TV (CuTV) etc., Multilanguage support, support for 3rd party applications and plug-ins,

expandability features, technical support, customer preference etc. There are many vendors in the Middleware market. ANT, NDS, Irdeto, OpenTV, OceanBlue, DCC Labs, Espial, Alticast are there to name a few. All of them are coming with a rich set of features. But a true hybrid middleware is not so widely available. So selecting the middleware best suited to our requirements is a difficult task. However, the Middleware best suited to our requirements, has to be selected before starting the development work. Suitable Conditional Access (CA) system and Digital Rights Management (DRM) also have to be selected.

Application Development Framework

Another issue is to bring framework independence to the GUI/Application development of our solution. The custom application requirements can be so versatile that none of the Application Framework available in the market can be fitted into. Some of the applications have to be Java based, some others have to be Flash based, yet another set has to be Browser based. Support needs to be provided for advanced features like developing and uploading custom applications for others to use on their STB. When such requirements are coming to Hybrid STBs, it is difficult to identify a suitable Application Framework or Application Development SDK, which supports more than one of these kinds of applications. In such a case, we have no option other than developing our own Application Framework. But this a high volume work, which is not possible in a short schedule.

Interoperability

The most important issue in the deployment of STBs is interoperability, whereas the issues in STB development are hardware, middleware and Application Framework selection. The international standard for digital TV broadcasting is in fact a family of standards: DVB-T, DVB-C and DVB-S, which are using different transmission media. So the STBs are different for different services. Even though the compression and transport schemes are the same, the

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transmission media are different. And also, different operators use different CA Systems (Conditional Access Systems) for their content delivery management. So the STBs are not interoperable between different networks and services provided by different operators. Providing WebTV or IPTV service along with the DVB service using a Hybrid STB makes interoperability more difficult. The solution for STB vendors is to use an open architecture catering to different networks and services. DVB-CI/DVB-CI+ (DVB-Common Interface) are the standards that help to provide a common interface for different networks/operators. Standards like HbbTV and Canvas are coming up to provide an open architecture to address the interoperability issues.

A Typical Reference Design

Design Considerations

We need to study the requirements, especially the custom requirements and implied needs. The requirements will be of different categories: common DVB functions, common IPTV functions, new and custom functions some of which may be of hybrid nature utilizing both IPTV and DVB infrastructure. So the solution should address all of these in an efficient and effective manner. The solution should provide seamless user experience. And it should be a viable solution, meeting the customer's time and cost requirements.

The Hardware and Software platforms are selected before starting the design. As discussed in the previous section, this is done by a thorough comparative study of the available options in the market against our requirement analysis. Once these are finalized, the next step is to choose the Middleware. Our product design is heavily based on the features and support readily available with the Middleware. Any feature of middleware that helps jumpstart the STB application/feature development will impact the time to market. So this is one of the main criteria for selecting the Middleware.

At the project startup, we have to make a critical decision whether to buy or develop our own Middleware. By analyzing the features of different Middleware available in the market against the product requirements, the allotted time and budget and the scope of the project – whether to make quick prototype or a full product development, we make the decision. If it is a quick prototype development with a very short schedule, it is better to go for buying a 3rd party Middleware having features matching with our requirements. If we go for the full product development cycle, with a high volume of the order of millions, it is better to invest several man years on developing our own Middleware considering easy customization, scalability and maintainability; and licensing terms.

Hardware Architecture



Figure 2: Hybrid Set-top-Box Hardware Block Diagram

Figure 2 shows the hardware block diagram of a typical Hybrid STB. The SoC with hardware accelerators for complex signal processing, and its peripherals form the hardware platform. In a typical Hybrid STB hardware platform, there are interfaces for DVB tuners, Ethernet, WiFi, IR remote control, HDMI, SmartCard, USB, Hard disk etc. This is a platform with high processing power to handle multiple streams of high quality video of upto 1080p HD along with user interactions with internet media.

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Software Architecture

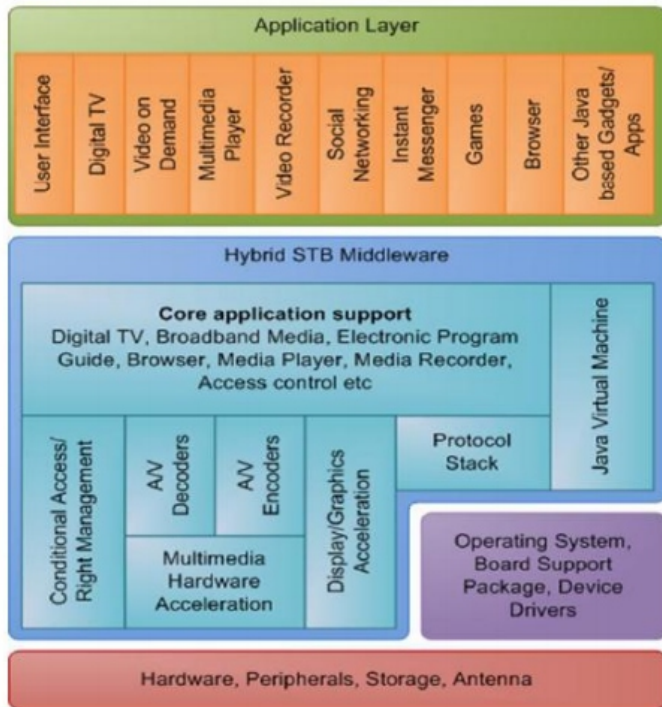


Figure 3: Hybrid Set-top-Box Software Architecture

The Software Architecture of a Hybrid Set-top-Box is given in Figure 3. A Hybrid Set-top-Box is a complex system which can be visualized in four layers: Hardware, Operating System (OS) and Board Support Package (BSP), Java-enabled Middleware stack and Applications. It has a complex hardware and software design.

Hybrid STB Applications

The most attractive part of the Hybrid STB is its intuitive GUI along with its rich set of value-added applications like content aggregation. The integrated browser and web-enabled applications help to access the media-rich internet resources. It is possible to push and pull data and media content with a selected Content Management System and Satellite, with the help of the Hybrid STB Applications. In addition to the main applications, there are Widgets or small applications/controls. There is flexibility regarding size, positioning, transparency etc. of the Widgets. Additional services and value-added applications are the key strength for operators. These customized services are the

distinguishing factors between operators. Due to technological advancements in this area, there are endless possibilities to satisfy the consumers' day-to-day needs.

The high performance Hybrid STBs can provide numerous services fulfilling consumer dreams rather than satisfying consumer demands. Digital TV services like Satellite/Cable/Terrestrial Broadcast reception with easy-to-use Electronic Program Guide (EPG), interactive TV functionalities, flexible ondemand services like Video-on-Demand (VoD), Catch-up TV (CuTV), Personal Video Recorder (PVR) are made available with seamless access to internet content. Its 10-foot intuitive GUI can enrich the user experience.

It is the set of Applications that distinguishes a Set-top-Box. The main attraction of Hybrid STB applications are custom applications facilitating services like Instant Messaging, integration with YouTube and Social Networking Sites, along with VoD, CuTV, PVR, EPG, Games and specialized access to DVB and internet content provided by the selected content provider.

On the DVB reception side, there are applications handling both pay-TV as well as free-to-air channels. For pay-TV, CA, DRM and Billing Support Systems (BSS) are required. In the Hybrid STB mentioned here, the customized applications and value added services along with bringing in the digital TV broadcast (DVB-S2) and IPTV services cater to various day-to-day needs of the consumer. The highlights are localized advertisements, instant messaging, e-mail, SMS, integration with social networking sites, remote games and eBooks download. Along with this, the consumer can enjoy Free-to-Air and pay-TV channels of different categories like News, Sports, Education etc. and other standard STB services.

In the fast changing user scenarios, the importance of social networking sites are getting increased, without which no internet service



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would be self-sufficient. So integration of such social networking sites on to the Hybrid STB is an added advantage which enables the user to access it in the comfort of a 10- foot GUI in the living room.

Back End Simulation & Testing

In order to do the product testing of the Hybrid set-top-box, the server side system (the content management system or back end and its infrastructure) is an essential part. If the back end is not available, it has to be simulated – the media server, database server, web server etc. along with the Satellite broadcast. The verification of security and functional requirements with a sample set of contents in the simulated content management system itself is a big task, considering the possible user scenarios.

Conclusion

With operators' value added services, the Hybrid STB market is increasing in size rapidly. It is on the fast rising trend since 2008. New services and strategies are being devised to beat the market and to have an increasing market share. At the same time, there are opportunities for new players also because of the custom requirements of geographical and cultural differences along with technology advancements resulting in new possibilities. The demand for specialized STBs will only increase in the coming years when digital life and convergence become a reality.



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