



February 22, 2007

Mr. Lakshman One  
School of Engineering Science  
Simon Fraser University  
8888 University Drive  
Burnaby, BC V5A 1S6

Re: ENSC 440 Project Functional Specifications for Internet Media Streaming on TV

Dear Mr. One:

Enight Solutions would like to present to you our functional specifications for the ENSC 440 capstone project, outlined in the attached document, *Functional Specifications for a Next Generation IPTV Set-Top Box*. The objective of our project is to realize an application running on an ARM/DSP development board in order to display internet media streams on a standard television without a personal computer. This project is done under the guidance and support of Dr. Farid Azhar of Varietize Technologies.

The functional specifications describe the business requirements of the end product as requested by the client. The document contains a high-level overview of the functionality of our system, which includes requirements for the hardware, network, audio and video components of our proof-of-concept model.

The company comprises of four undergraduate engineering students: Allen Lai, Hugo Kwok, David Shen, and Jimmy Jeong. If you require more infoRMation, please do not hesitate to contact me by phone at (778) 883-3376 or via e-mail at [ensc440-group10@sfu.ca](mailto:ensc440-group10@sfu.ca).

Sincerely,

A handwritten signature in cursive script that reads "Allen Lai".

Allen Lai  
President and CEO  
Enight Solutions

Enclosure: *Functional Specifications for a Next Generation IPTV Set-Top Box*

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Functional Specification for a

# NEXT GENERATION IPTV SET-TOP BOX

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**Submission Date:** Feb 22, 2007

## Executive Summary

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*"We call it IPTV. And no doubt this is where the world is going."*

*Bill Gates  
ChairMan, Microsoft*

IPTV is a system where users are able to view TV contents over the public internet. In essence, IPTV contains two segments: live broadcasts and stored broadcasts or Video on demand (VOD) in which users are able to stream contents after they are downloaded. Ever since the first successful live webcasts started by a radio station back in 1998, this technology had been steadily increasing in existence and making its way into households worldwide due to its simple compatibility with only an Internet connection and a network detecting device such as a personal computer (PC), or 3G mobile cell phone. Enight Solutions is bringing the next generation IPTV set-top box that will be compatible with any IPTV service provider.

Development of the next generation IPTV set-top box will be performed under the guidance of Farid Azhar of Varietize Technologies. Enight Solutions is currently performing the proof-of-concept (POC) phase of the set-top box, with goals to achieve completion by April of 2007. In the POC stage, the ARM system based set-top box will stream live Real Media by converting them into MPEG2 or MPEG4 format. The POC model can be divided into three layers:

- Network transport layer
- Audio layer
- Video layer

Completion of the POC prototype, will allow future developers to implement streaming of other media formats.

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## 1 Introduction

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The next generation IPTV set-top box will be capable of handling streaming signals from any IPTV service provider. For our application, the input is a Real Media, MPEG2 or MPEG4 file from any remote streaming server on the internet using the RTP/RTSP protocol. The ARM and C6000 based system will stream Real Media, MPEG2 or MPEG4 formats and display it on a connected TV in real time.

### 1.1 Scope

This document describes the functional specifications of the set-top box developed by Ensignt Solution's IPTV system. A set of requirements is listed for the proof of concept device and partially listed for the production device. This document will guide our design and implementation process. It will be traceable from the design specification document.

### 1.2 Acronyms

AAC	A lossy data compression scheme for streaming audio
ARM	Advanced RISC Machine
AV	Audio and Video
DEVM	Digital Video Evaluation Module
IP	Internet Protocol
IPTV	Internet Protocol Television
LAN	Local Area Network
LCD	Liquid crystal display
MPEG	Moving Picture Experts Group
MPEG2	A standard from the Motion Picture Expert Group which define for digital television
MPEG4	A standard from the Motion Picture Expert Group which define for multimedia applicaiton
POC	Proof-of-Concept
RM	Multimedia container foRMat created by RealNetworks
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
TV	Television
VOD	Video On Demand
WAN	Wide Area Network

### 1.3 Intended Audience

The engineers of Ensignt Solutions will use this document as a guideline during the development stages of the IPTV set-top box project; acting as a reference to evaluate progress along the way. The marketing team will use this document in planning attack strategies for sales. All specifications and descriptions contained in this document is the intellectual property of Ensignt Solutions.

## 1.4 Convention

From here henceforth, the following convention will be applied throughout this document to indicate functional requirements:

**R[A.B]** A functional requirement

To denote the priority of each functional requirement, a number (A) will be appended to the front of each functional requirement. The symbol (A) shall signify:

- (1) A functional requirement for both the proof of concept device and the production device.
- (2) A functional requirement for only the proof of concept device.
- (3) A functional requirement for only the production device.

The number B will be incremented for every subcategory of a functional requirement.

## 2 System Requirements

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The system requirements define the operating standards and various guidelines necessary which the user needs to configure. This will allow the equipment to function optimally and allow development and testing without any failures.

### 2.1 System Overview

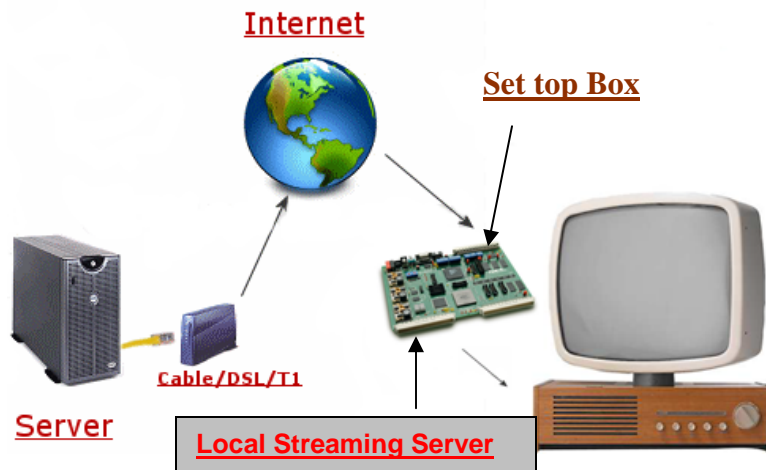


Figure 2-1: System diagram

As shown in Figure 2-1, the set-top box can take input media from both WAN and LAN. It decode the data will appropriate codec. After that it displays the decoded video signal to a normal TV. Besides, it can store media into the local storage which is inside the set-top box. As a result, it can perform VCR function. Moreover, the set-top box will send user request to the remote server. Therefore, user can control the flow of the media and experience VOD service.

## **2.2 Physical Requirements**

- R[2.1] The set-top box's size shall be standardized for home AV equipment. (3)
- R[2.2] The set-top shall maintain an operation temperature below 40°C. (3)
- R[2.3] The proof of concept model shall be powered up by an external power supply. (2)
- R[2.4] The set-top box shall include an internal power supply. (3)
- R[2.5] The set-top box shall access the internet through a onboard standard 10/100 Base-T female Ethernet port(1)
- R[2.6] The set-top box shall receive video input from a RCA video jack.(1)
- R[2.7] The set-top box shall output video signal through a S-Video jack and a RCA video jack.(1)
- R[2.8] The set-top box shall output audio signal through a pair of RCA audio jacks. (1)

## **2.3 Hardware Requirements**

- R[2.9] The set-top box Input/Output supply voltage must stay within the range between 1.8V to 3.3V, Core supply voltage must remain 1.2V (1)
- R[2.10] The set-top box shall display a welcome screen during the booting process. (3)
- R[2.11] The set-top box shall enter the GUI within 10 seconds from power up. (3)
- R[2.12] The set-top box shall connect to the PC through a Serial Port for applications code transfer.(2)
- R[2.13] The set-top box shall include a 2.5" Samsung hard disk drive with 40GB storage, drive speed at 5400 RPM and 8MB cache for saving video/audio media if requested from user(3)
- R[2.14] The set-top box shall connect to a 5.6" LCD screen with 320X240 pixels, NTSC standard to display streamed output for development purposes.(2)
- R[2.15] The set-top box shall have an IR remote control to provide a user interface to the application GUI(3)
- R[2.16] The set-top box shall respond to user commands within 250ms. (3)

## **3 Network Transport Requirements**

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The Media Transport Layer defines the connection requirements such as the setup and protocols used in order establish communication for streaming video contents from the Internet.



### **3.1 Connecting a remote server**

- R[3.1] The set-top box shall be controlled from the command line interface, using the Linux or Windows telnet session to the ARM based platform. (2)
- R[3.2] The set-top box shall play Real Media files from any remote streaming server on the internet using RTP and RTSP. (1)
- R[3.3] The set-top box should send user commands using RTP. (1)
- R[3.4] The set-top box shall maintain network traffic speeds faster than 300 Kbit/s to retain smooth media streaming. (3)
- R[3.5] In case of execution failures, the application should display appropriate error messages on the debug console. (1)
- R[3.6] Application shall be able to decode the video codec MPEG2 with data rates at 300-1000KBps. (3)

## **4 Video Requirements**

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This section shows the functional requirements of the video layer of the set-top box.

### **4.1 Media Streaming from LAN or WAN**

- R[4.1] The set-top box shall stream live media contents in Real Media, MPEG2 or MPEG4 format. (1)
- R[4.2] The set-top box shall convert Real Media to MPEG2 or MPEG4 format in order to decode in the ARM processor. (2)
- R[4.3] The set-top box shall provide Video on Demand service. The user can perform play, fast forward or reverse, pause and stop on the streaming media. (1)
- R[4.4] The set-top box shall reduce the fps value in order to avoid frozen frames when experiencing slow network traffic. (3)
- R[4.5] The set-top box shall allow the user to capture a frame from the streaming media and store it on the local hard drive. (3)
- R[4.6] The set-top box shall show an error message on the screen if there is network or hardware failure. (1)
- R[4.7] The set-top box shall start from the same playing position after reconnecting to the remote server. (3)
- R[4.8] The set-top box shall show captions if it is available. (3)

### **4.2 Media playing from local storage**

- R[4.9] The set-top box shall play Real Media, MPEG2 and MPEG4 files from local storage. (1)

- R[4.10] The set-top box shall allow the user to fine tune the contrast, brightness and color temperature currently showing the media. (3)
- R[4.11] The set-top box shall save the last playing position and picture preferences for at most 10 media files (3)
- R[4.12] The set-top box shall show at most 4 media contents on a single screen simultaneously.(3)

### 4.3 Video Recording

- R[4.13] The set-top box shall record live streaming media on its local storage in MPEG2 or MPEG4 foRMat(1)
- R[4.14] The set-top box shall record video signals connected to the set-top box into the local hard drive. (3)
- R[4.15] The set-top box shall let the user schedule the set-top to record a particular Internet channel. (3)
- R[4.16] The set-top box shall show streaming media from the Internet while video recording. (3)

## 5 Audio Requirements

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This section shows the functional requirements of the audio layer of the set top box

- R[5.1] The set top box shall convert RM Audio stream to "MPEG1 Layer 2" Audio Elementary Stream and play in real time without saving to system HDD. (1)
- R[5.2] The set top box shall convert RM Audio stream to "MPEG1 Layer 2" Audio Elementary Stream and save it on the system HDD, if requested.(1)
- R[5.3] The set-top box shall decode and play a two-channel audio stream.(1)
- R[5.4] The set-top box shall use the FAAD AAC MPEG-2/MPEG-4 Audio decoder as the audio codec for audio playback. (1)
- R[5.5] The set top box shall play any audio component through an audio output of the DaVinci TM320DM6446 dual core device.(1)

## 6 User Interface Requirements

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### 6.1 Main Menu

- R[6.1] The application will allow the user to pick the desired IPTV channel for viewing, with listings of the popular IPTV channels. (1)
- R[6.2] The application will have a setup menu to change system preferences and make other changes. (3)
- R[6.3] The application will enable timers to be set up save shows while away from the TV (3)

- R[6.4]** The application will have the option to enter in URL of a IPTV channel the view wishes to view(1)

## 6.2 While viewing a Media

- R[6.5]** The application will be capable of adding a channel into the Favourites folder(3)
- R[6.6]** The application will be able to change to a previous or adjacent channel based on the listing displayed in the main menu. (3)
- R[6.7]** The application will be able to record streaming media to HDD for VOD capabilities(1)
- R[6.8]** The application will be able to perform fast forward, pause, rewind, split screen display, and other VCR-like functions.(3)

## 6.3 System Setup

- R[6.9]** The application will have a menu to check for firmware upgrades, system updates, and other important news(3)
- R[6.10]** The application will be able to perform an internet connection test(1)
- R[6.11]** The application will have a menu to set the system clock(3)
- R[6.12]** The application will have a menu to personalize theme of main display (change background)(3)
- R[6.13]** The application will be a menu to indicate IP address(1)
- R[6.14]** The application will contain an option to edit the Favorites folder should user wish to delete a channel, or change the orientation of the order the channels are listed.

## 7 Documentation & User Training

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The initial target for the IPTV set-top box are for those who are looking to save money are their television costs. Service providers generally offer bundles as the number of services you receive from them increases. Also there are those who are passionate about technology and are eager to have the latest advancements in their living room. These varying groups of people will lead to different levels of technical knowledge and the following requirements will cover the documentation that will be required to suit the varying audience.

- R[7.1]** This application will include thirty-four page manual with instructions in English, Mandarin, Cantonese, Korean, Japanese, French and Spanish. German, Dutch, and Italian versions will be available on the Ensignt Solutions website.(3)
- R[7.2]** The user manual included in the set-top box will go over in detail how the cables are to be connected to the Ethernet port, and the television set.(3)

- R[7.3] The user manual will include diagrams to lead relay comfort to the less technically savvy, yet still include material for the more advanced users who will explore all the settings in the set-top box. (3)
- R[7.4] The user manual will include a troubleshooting section, and also a customer service number for those that require additional guidance. (3)
- R[7.5] The user manual will have the URL of Ensignt Solution's website where the user will be able to obtain additional information such as FAQ, and other updates. (3)
- R[7.6] Due to the nature of this application, the level of user training required to correctly utilize the set-top box is minimal. Any required knowledge will be sufficiently provided by the manual.(3)

## 8 Test Plan

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The proof of concept set-top box will be tested by following sections to verify their functionalities.

### 8.1 Video and Audio Streaming

#### LAN Streaming

A test streaming server will be constructed and connected to the set top box for testing the performance of the media with in a LAN environment.

#### WAN Streaming

The set-top box will connect to a live remote server through the internet to test the performance of the media.

### 8.2 Video and Audio Recording

Ensure video and audio stream store on the local hard drive with appropriate format and without frame dropping.

Ensure user can view the stored media from the local hard drive.

### 8.3 User Interface

Perform a user acceptance test to verify every function in the user interface

Ensure the set-top box displays an error message on the screen when a failure occurs.

## 9 Conclusion

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The requirements outlined in this document will serve as the goal Ensignt Solutions will achieve. At the end of the POC stage in April, each of the above mentioned requirements will be met. Ensignt Solutions is hopeful that the work accomplished in making this application will help push further development of the IPTV set-top box for Varietize Technologies, and the rest of the IPTV market.

## 10 References

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