StormTest HD Considerations

Product Note

S3 Group Document ID: ST-13032

Revision Date: December 2013

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Contents

1 Introduction

In version 3.0, StormTest introduced support for native HD capture. This has introduced a number of technical implications that users should be aware of. This document will attempt to explain what those implications are and how they impact on users.

2 HD Architecture

The HD video capture architecture is based on a 4 port HDMI video capture card which can capture, encode and stream video over a network interface.

The video[1] is encoded into a standard H.264 stream by a hardware chip on the capture card. The fact that the video is based on the standard is an important benefit of the HD solution. The benefit over the StormTest SD video capture is that the video can be played back using any video player that understands H.264 video in an AVI container. SD video logs always required that the StormTest video player be used to play the files back.

2.1 Video decode challenges

The decoding of the video in StormTest is built on the Microsoft DirectShow media framework. This allows StormTest to use any available H.264 codec on a Windows PC to decode the video and display it in the StormTest Developer Suite application. However this has a number of implications:

2.1.1 Windows XP not supported

There is no H.264 supplied with Windows XP. As a result, we cannot support Developer Suite or StormTest scripts running against an HD server on Windows XP.

We only support **Windows 7** and will support **Windows 8** in a future release.

2.1.2 Windows Server 2008 limitations

The server in an HV16HD system runs Windows Server 2008. This OS can optionally have an H.264 codec installed, but as the OS is not designed for media playback we **strongly** recommend that the remote control applet in the Developer Suite application is **NOT** run on the server.

If Developer Suite is run on the server, only one slot should be reserved at a time.

To view all 16 slots, please use the StormTest Server Monitor application

2.1.3 Resource Usage

HD video is much more resource intensive than SD video when it comes to CPU resources for decode and network bandwidth.

2.1.3.1 Network Bandwidth

To illustrate the data rates required, please see the table below. The 576i entry is for SD video captured over HDMI using an HD StormTest server. Note that the bandwidth figures are based on a sample of video and may not reflect the performance for your particular video:

[1] Audio is also captured and encoded using the card. In this document we refer exclusively to video, but in all cases, video/audio is implied.

	Resolution	Raw frame size	Average Network BW Static image	Average Network BW moving video
SD	704 x 576	1.54 MB	400 kbps	800 kbps
SD 576i	720 x 576	1.58 MB	150 kbps	500 kbps
HD 720p	1280 x 720	3.51 MB	270 kbps	1 Mbps
HD 1080i	1920 x 1080	8MB	800 kbps	4 Mbps

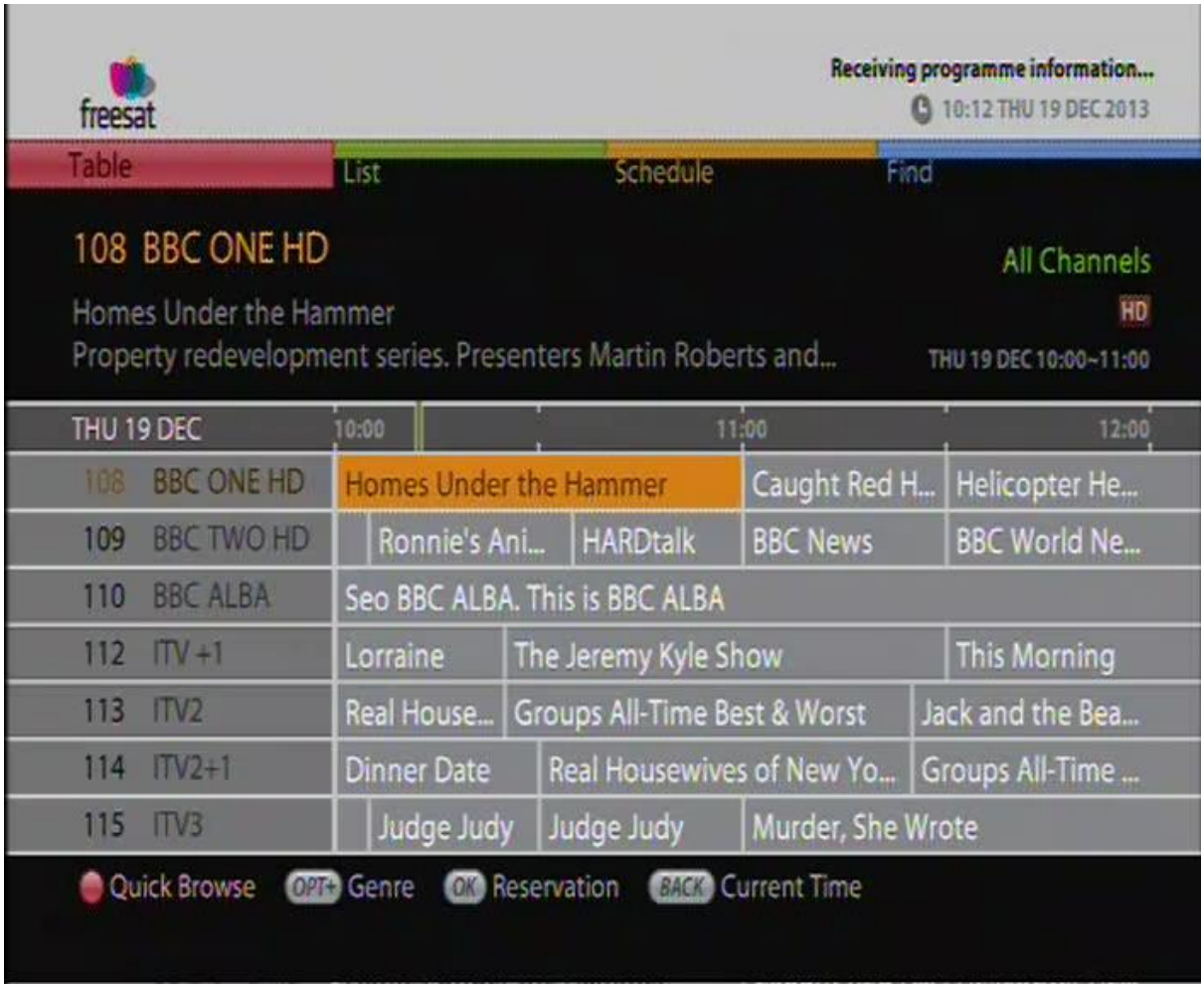
Note: Digital captures were carried out with SetMaxBitRate() set to 256000
For analogue capture, the bit rate was manually altered to give an 'acceptable' quality

It is difficult to do a direct comparison of network bandwidth usage as a StormTest SD system will generally use all the bandwidth you give it (via SetMaxBitRate()). If it needs to, it will degrade the video in order to get it to fit into the set limit.

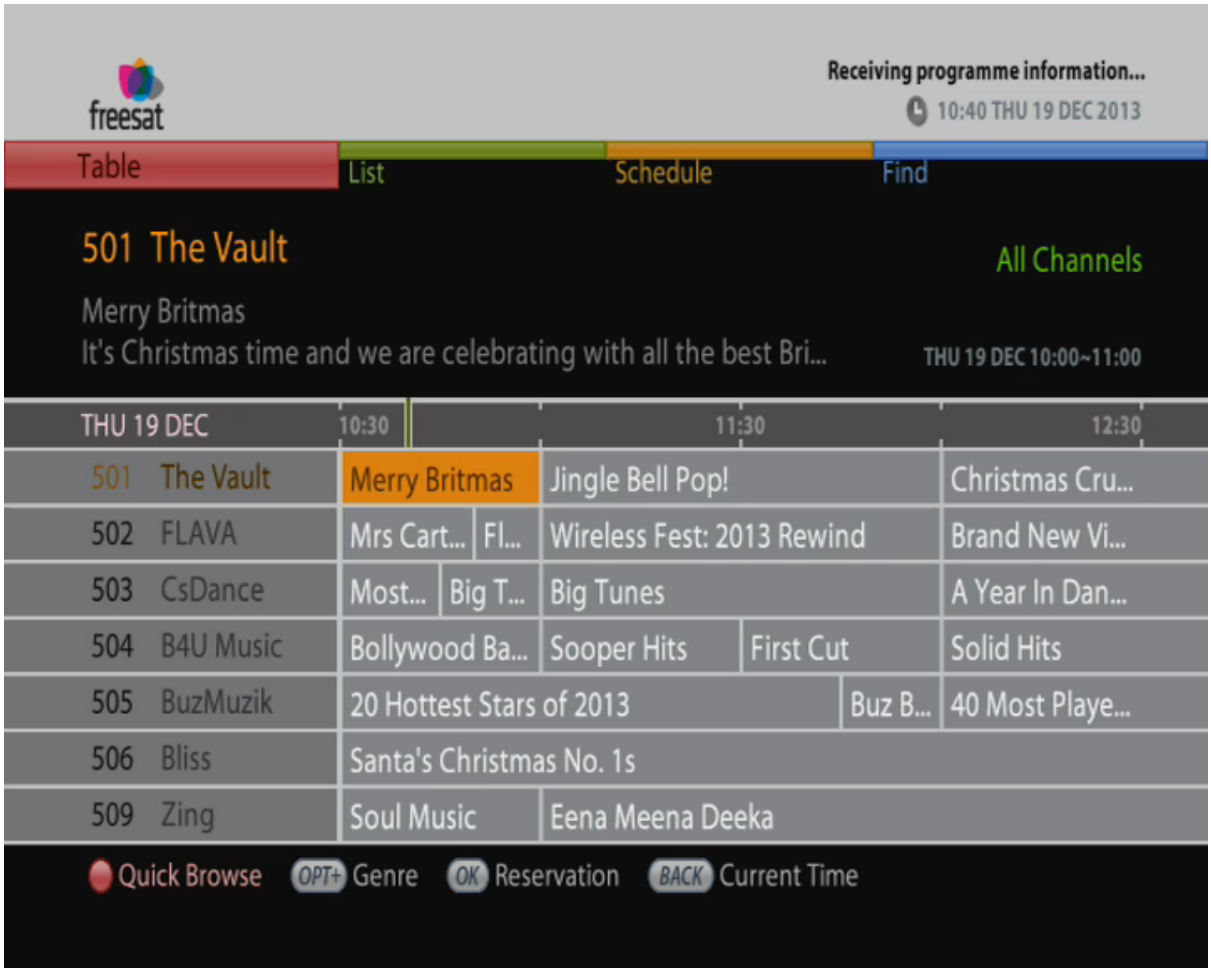
On HD systems, the value set with SetMaxBitRate() is more of a guide and the video bandwidth usage expands and contracts according to the requirements of the on screen video.

Recommendation: When testing with HD servers, always set the bit rate to a low value such as 256kbps

It is interesting to note that bandwidth usage for a StormTest HD system capturing at SD resolution is significantly lower than for the equivalent SD system. The quality is also far superior, as illustrated by the following two screen captures:



SD Analogue capture from StormTest



SD Digital capture from StormTest

Of course, the majority of testing with HD systems will use the full 1080 resolution which requires significant extra bandwidth on the network. If the network connection from the server to the client is not good enough, then frames will be dropped and the video will not appear smooth.

To address this, StormTest is moving to do all video analysis and capture on the server side. This will mean that network bandwidth limitations will not impact on test execution.

Video streamed to the client will only be necessary for the remote control applet and the test design trainers in the future.

2.1.3.2 CPU Usage

The video stream must be decoded by the client PC using the available CPU resources. The higher the resolution, the more CPU resources will be required. It must be born in mind that opening multiple slots in the remote control applet will lead to a corresponding increase in the CPU usage by the Developer Suite application.

As a result it is highly unlikely that a standard Windows 7 desktop/laptop PC would be able to decode and display all 16 slots in an HV16HD rack without causing problems such as corrupted video and significant resource usage.

The end user should establish what their PC is capable of and ensure they do not open more video windows than it can handle.

As a guide here are the CPU usage figures for a typical laptop:

- CPU: Intel Core i5-2520M CPU @ 2.5GHz (4 cores)
- OS: Windows 7 64 bit
- Memory: 8 GB
- DirectX version: 10
- Display Adapter: Intel HD Graphics
- Network: Gigabit network connection
- Windows Experience Score
    - Processor: 7.1
    - Graphics: 6.4

(for this test, the video bit rate was set to 6Mbps)

- Decoding 1 720p50[2] video stream: 18% CPU
- Decoding 1 720p60[3] video stream: 22% CPU
- Decoding 1 1080i50[4] video stream: 13% CPU
- Decoding 1 1080i60[5] video stream: 14% CPU

CPU usage scales linearly according to how many video windows are opened. For this PC, 4 720p slots would be the maximum and even that would not be recommended since there are other processes that will also require and use the CPU.

It is important to note that 1080i sources are captured at half the 'frame rate'. In actual fact, 1080i60 video does not have 60 frames per second – it has 60 fields per second with 2 fields in each frame.

So a 1080i50 source is captured at 25 frames per second. A 1080i60 source is captured at 30 frames per second. From a CPU processing point of view therefore, it means that 1080i decodes use less CPU than 720p decodes due to the reduced number of frames per second.

2.1.4 HDCP

Most video devices with HDMI outputs also implement the HDCP protocol to protect the content transmitted over the link. StormTest cannot remove the HDCP protection. If a protected source is connected to StormTest then only a black screen will be captured.

[2] Progressive scan video with spatial resolution of 1280 x 720 and temporal resolution of 50 frames per second
[3] Progressive scan video with spatial resolution of 1280 x 720 and temporal resolution of 60 frames per second
[4] Interlaced scan video with spatial resolution of 1920 x 1080 and temporal resolution of 50 interlaced fields per second
[5] Interlaced scan video with spatial resolution of 1920 x 1080 and temporal resolution of 60 interlaced fields per second