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Decoder Performance

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Summary

This document details the performance characteristics of the RealVideo 9, RealVideo 8, and Mp4 Decoder. Performance measurements for the Strong ARM and XScale are included.

Revision History:

Revision	Date	Comment
1.0	5/13/03	Initial ARM Performance
1.1	9/17/03	New RV9 Xscale/Armulator Timings.
1.2	03/25/04	New wMMX Optimizations

Table of Contents

1. Setup

The decode times for several pieces of content on different platforms is given in the few tables below. The sections have been separated by platform. The decoders were built for the platform using the best compiler settings and platform specific assembly. There was no blitting to the screen or file output. Since the data was captured at different times they reflect different state of the code base at each point. Bug fixes and further optimizations may change the observed timings. All information is available to compute MHz numbers for each codec on each machine type.

2. How to read the Tables.

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*

Machine = Information about the Processor, Clock speed, and test machine used. In case of a Simulator the processor, clock speed and the memory mapis mentioned.
Codec = RV9, RV8 or Mp4
Time(ms) = The avg time required to decode 1 frame.
fps = Avg number frames decoded per second.
File = File name followed by all the information about the file.

Size = Image Size
kbps = Bitrate if encoded at the given *fps.*
fps = The actual frame rate of the file.
Frames = Total numbers frames in the file.
Mode = The QP used (If the files are encoded in Constant Quantizer mode). If the files were encoded for average bitrate, then it specifies encoding mode CBR (constant bitrate) or VBR (variable bitrate).

MHz = Time(ms) * *fps* * clk_speed / 1000

The definitions of some abbreviations are:

RV9 Unopt = RealVideo 9 decoder compiled with portable C code only
RV9 Opt = RealVideo 9 decoder compiled with platform specific optimizations
RV8 Unopt = RealVideo 8 decoder compiled with portable C code only
RV8 Opt = RealVideo 8 decoder compiled with platform specific optimizations
MP4 Unopt = Mpeg4 Simple Profile Video decoder compiled with portable C code only
MP4 Opt = Mpeg4 Simple Profile Video decoder compiled with platform specific optimizations

QCIF = image size of 176 x 144
QVGA = image size of 320 x 240
SIF = image size of 352 x240
CIF = image size of 352 x 288

3.1 RV9 ARM StrongARM

TABLE 1: RV9 Timings on a StrongARM,

Machine = Strong ARM SA1110, 206 MHz, HP Jornada								
Codec	Time (ms)/ Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV9 Opt	10.69	93.5	Akiyo	QCIF	30	15	300	Q=12
RV9 Opt	16.5	60.5	Commercial	QCIF	48	15	626	Q=25
RV9 Opt	59.4	16.8	Bus	SIF	248	25	300	Q=24
RV9 Opt	59	16.9	Foreman	CIF	204	30	300	Q=24
RV9 Opt	77.1	12.9	Foreman	CIF	605	30	300	Q=16

3.2 RV9 ARM XScale

TABLE 2: RV9 Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200 MHz / 400 MHz Turbo WinCE2002								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV9 Opt	8.47	117.9	Akiyo	QCIF	30	15	300	Q=12
RV9 Opt	14.1	70.8	Commercial	QCIF	48	15	626	Q=25
RV9 Opt	51.5	19.4	Bus	SIF	248	25	300	Q=24
RV9 Opt	47.86	20.9	Foreman	CIF	204	30	300	Q=24
RV9 Opt	62.5	15.9	Foreman	CIF	605	30	300	Q=16

- PXA250 and WinCE2002 had Write Back Cache Disabled, and WinCE was not optimized for XScale, resulting in very poor Video performance.

TABLE 2.1: RV9 Timings on a New XScale

Machine = ARM XScale, PXA255, H5550 , 400 MHz, Windows Mobile HackMaster 498:100 Overclocked!								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV9 Opt	3.82	261	Akiyo	QCIF	30	15	300	Q=12
RV9 Opt	6.53	153	Commercial	QCIF	48	15	626	Q=25
RV9 Opt	23.13	43	Bus	SIF	248	25	300	Q=24
RV9 Opt	21.70	46	Foreman	CIF	204	30	300	Q=24
RV9 Opt	29.18	34	Foreman	CIF	605	30	300	Q=16

TABLE 2.1: RV9 Timings on a Bulverde Kit

Machine1 = ARM XScale, Bulverde Kit, wMMX optimizations **Machine2 = ARM Xscale, Bukverde Kit, Xscale optimizations** **Machine3 = ARM Xscale, Dell Axim X5, 400Mhz, Xscale optimizations**									
Codec	Time (ms) / Frame **M1**	Time (ms) / Frame **M2**	Time (ms) / Frame **M3**	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV9 Opt	4	4.2	4.61	Akiyo	QCIF	30	15	300	Q=12
RV9 Opt	6.4	7.19	8.11	Commercial	QCIF	48	15	626	Q=25
RV9 Opt	24	27.7	27.6	Bus	SIF	248	25	300	Q=24
RV9 Opt	28.94	32.47	34.69	Foreman	CIF	605	30	300	Q=16

TABLE 2.2: RV9 UnOpt Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo WinCE2002								
Codec	Time (ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV9UnOpt	10.2	98	Akiyo	QCIF	30	15	300	Q=12
RV9UnOpt	17.7	56.5	Commercial	QCIF	48	15	626	Q=25
RV9UnOpt	72.5	13.7	Bus	SIF	248	25	300	Q=24
RV9UnOpt	66	15.1	Foreman	CIF	204	30	300	Q=24
RV9UnOpt	86.3	11.5	Foreman	CIF	605	30	300	Q=16

3.3 RV8 ARM StrongARM

Measurements in Table 3 are without the RealVideo 8 postfilter.

TABLE 3: RV8 Timings on a StrongARM,

Machine = Strong ARM SA1110, 206 Mhz, HP Jornada								
Codec	Time (ms)/ Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8 Opt	9.92	100.8	Akiyo	QCIF	30	15	300	Q=12
RV8 Opt	13.3	75.2	Commercial	QCIF	48	15	626	Q=25
RV8 Opt	46.6	21.5	Bus	SIF	248	25	300	Q=24
RV8 Opt	43.9	22.7	Foreman	CIF	204	30	300	Q=24
RV8 Opt	57.2	17.5	Foreman	CIF	605	30	300	Q=16

Measurements in Table 4 include the RealVideo 8 postfilter.

TABLE 4: RV8 Timings on a StrongARM,

Machine = Strong ARM SA1110, 206 Mhz, HP Jornada								
Codec	Time (ms)/ Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8 Opt	15.62	64	Akiyo	QCIF	30	15	300	Q=12
RV8 Opt	19.9	50	Commercial	QCIF	48	15	626	Q=25
RV8 Opt	67.56	14.8	Bus	SIF	248	25	300	Q=24
RV8 Opt	69.47	14.4	Foreman	CIF	204	30	300	Q=24
RV8 Opt	79.36	12.6	Foreman	CIF	605	30	300	Q=16

3.4 RV8 ARM XScale

Measurements in Table 5 are without the RealVideo 8 postfilter.

TABLE 5: RV8 Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8 Opt	7.7	129.6	Akiyo	QCIF	30	15	300	Q=12
RV8 Opt	11.77	85	Commercial	QCIF	48	15	626	Q=25
RV8 Opt	40.54	24.66	Bus	SIF	248	25	300	Q=24
RV8 Opt	30.86	28.7	Foreman	CIF	204	30	300	Q=24
RV8 Opt	48.12	20.77	Foreman	CIF	605	30	300	Q=16

TABLE 5.1: RV8UnOpt Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time (ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8UnOpt	10.9	91	Akiyo	QCIF	30	15	300	Q=12
RV8UnOpt	16.8	59.5	Commercial	QCIF	48	15	626	Q=25
RV8UnOpt	68.54	14.6	Bus	SIF	248	25	300	Q=24
RV8UnOpt	53.92	18.54	Foreman	CIF	204	30	300	Q=24
RV8UnOpt	69.4	14.4	Foreman	CIF	605	30	300	Q=16

These measurements in table 6 include the RealVideo 8 postfilter.

TABLE 6: RV8 Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8 Opt	12.69	78.8	Akiyo	QCIF	30	15	300	Q=12
RV8 Opt	16.78	59.5	Commercial	QCIF	48	15	626	Q=25
RV8 Opt	56.34	17.74	Bus	SIF	248	25	300	Q=24
RV8 Opt	53.28	18.76	Foreman	CIF	204	30	300	Q=24
RV8 Opt	65.51	15.26	Foreman	CIF	605	30	300	Q=16

TABLE 6.1: RV8UnOpt Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time (ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
RV8UnOpt	19.9	50.2	Akiyo	QCIF	30	15	300	Q=12
RV8UnOpt	26	38.4	Commercial	QCIF	48	15	626	Q=25
RV8UnOpt	95	10.5	Bus	SIF	248	25	300	Q=24
RV8UnOpt	89.7	11.1	Foreman	CIF	204	30	300	Q=24
RV8UnOpt	106.5	9.4	Foreman	CIF	605	30	300	Q=16

3.5 Mpeg4 ARM StrongARM

TABLE 7: MP4 Timings on a StrongARM,

Machine = Strong ARM SA1110, 206 Mhz, HP Jornada								
Codec	Time (ms)/ Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
MP4 Opt	4.7	212	Akiyo	QCIF	30	15	300	CBR
MP4 Opt	10.67	93.7	Commercial	QCIF	48	15	626	CBR
MP4 Opt	34.9	28.65	Bus	SIF	248	25	300	CBR
MP4 Opt	39.9	25	Foreman	CIF	204	30	300	CBR
MP4 Opt	50.96	19.62	Foreman	CIF	605	30	300	CBR

3.6 Mpeg4 ARM XScale

TABLE 8: MP4 Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time(ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
MP4 Opt	4.54	220	Akiyo	QCIF	30	15	300	CBR
MP4 Opt	9.9	100.8	Commercial	QCIF	48	15	626	CBR
MP4 Opt	31.31	31.9	Bus	SIF	248	25	300	CBR
MP4 Opt	36.2	27.6	Foreman	CIF	204	30	300	CBR
MP4 Opt	46.1	21.7	Foreman	CIF	605	30	300	CBR

TABLE 8.1: MP4 UnOpt Timings on a XScale

Machine = ARM XScale, PXA250, iPAQ H3970, 200Mhz / 400Mhz Turbo								
Codec	Time (ms) / Frame	fps	File	*Size*	*kbps*	*fps*	*Frames*	*Mode*
Mp4UnOpt	5	200	Akiyo	QCIF	30	15	300	CBR
Mp4UnOpt	11.4	87.6	Commercial	QCIF	48	15	626	CBR
Mp4UnOpt	35.4	28.2	Bus	SIF	248	25	300	CBR
Mp4UnOpt	40.7	24.7	Foreman	CIF	204	30	300	CBR
Mp4UnOpt	57.3	17.4	Foreman	CIF	605	30	300	CBR

- Mpeg4 Codec is NOT available through Helix or Attachment G.

3.7 RV9 ARMulator ARM 925T

The following measurements in Table 9 were gathered using the ARMulator simulation tool. (Latest Helix Optimized build)

TABLE 9: RV9 Timings on a ARM 925T, 120 MHz

Machine = ARM 925T, 120 Mhz, zero wait states							
Codec	Time(ms)	File	Size	bps	FPS	Frames	Mode
RV9 Opt	6.01	Akiyo	QCIF	30K	15	300	Q=12
RV9 Opt	14.11	Commercial	QCIF	48K	15	626	Q=25
Machine = ARM 925T, 120 Mhz, OMAP 310 memory map							
Codec	Time(ms)	File	Size	bps	FPS	Frames	Mode
RV9 Opt	16.66	Akiyo	QCIF	30K	15	300	Q=12
RV9 Opt	30.19	Commercial	QCIF	48K	15	626	Q=25

3.8 RV8 ARMulator ARM 925T

The following measurements in Table 10 were gathered using the ARMulator simulation tool. These measurements do not include the RealVideo 8 postfilter. (Microcore build as release in June 2002)

TABLE 10: RV8 Timings on a ARM 925T, 120 MHz

Machine = ARM 925T, 120 Mhz, zero wait states							
Codec	Time(ms)	File	Size	bps	FPS	Frames	Mode
RV8 Opt	7.93	Akiyo	QCIF	30K	15	300	Q=12
RV8 Opt	14.97	Commercial	QCIF	30K	15	626	Q=26
Machine = ARM 925T, 120 Mhz, OMAP 310 memory map							
Codec	Time(ms)	File	Size	bps	FPS	Frames	Mode
RV8 Opt	20.34	Akiyo	QCIF	30K	15	300	Q=12
RV8 Opt	33.11	Commercial	QCIF	30K	15	626	Q=26

- RV9 Armulator Timings used the latest optimized build. RV8 Armulator timings are use the Old build as released on June 2002.

4 Observations:

- RV8 postfilter is very costly on ARM and Xscale.
- RV9 is 30% slower than RV8 on Strong Arm and XScale.
- XScale provides only up to 20% improvement w.r.t. StrongArm.
- wMMX provides upto 20% improvement w.r.t. Xscale
- PXA250 + WinCE2002 has severe performance issues.