



NSTL
A CMP Company

Final Report for Microsoft Corporation

Comparison Testing of

Codecs For Microsoft Windows Media Technologies 4.0,
RealNetworks RealSystem G2, and MP3.

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Executive Summary

Microsoft contracted NSTL to conduct a comparison test between the codecs for Microsoft Windows Media Technologies 4.0, RealNetworks Real System G2, and MP3. The test focused on the responses of listeners to clips of music encoded using the three codecs. In a blind comparison, listeners first listened to the original music clip and then to two additional clips encoded with two of the three codecs. Listeners were then asked which of the two sample clips sounded more like the original music. When compared to RealSystem G2 at modem data rates, listeners selected Microsoft's Windows Media as sounding more like the original music over 80% of the time. When compared to MP3 files of twice the size, listeners selected Microsoft's Windows Media as sounding more like the original more than 51% of the time and were unable to determine which sounded more like the original over 19% of the time.

About NSTL

NSTL is the leading independent information technology testing organization for the computer industry, dedicated to providing high quality services and test tools to hardware developers, software publishers, government agencies and corporations. NSTL has extensive experience developing and conducting objective tests to assess new and existing products for compatibility, performance, comparative performance, usability, and functionality. Our testing services are also used for capacity planning, acquisition support and impact analysis. NSTL's proficiency and thoroughness provide clients with a high quality, cost-effective means to assess, differentiate and evaluate IT products. Additional information about NSTL is available through the World Wide Web at <http://www.nstl.com>.

Testing Environment and Methodology

Testing Environment

Four multimedia systems were set up in individual office-type environments. Each system was equipped with a Sound Blaster! Live audio card and a Cambridge Soundworks, Inc. Microworks speaker system, including a sub-woofer. The two speakers were positioned approximately three feet from where the listener's head would be during the test. The subwoofer was placed on the floor with the bass tube facing forward, approximately five feet from where the listener would be sitting during the test. Volume was fixed at a reasonable level for the office environment. Three audio players were installed using the manufacturer's default configuration: Microsoft Windows Media Player v6.02.05.0331, Winamp v2.10, and RealSystem G2 v6.0.5.27. The original music clips, samples of classical and rock music, and the sample clips encoded using the test codecs were installed on the hard drive of each system. The original and sample music clips were approximately 10 seconds in length.

The original audio clips were PCM wave files at 44.1 khz, 16-bit stereo, resulting in a playback rate of approximately 1,379 kilo-bits per second. The MP3 audio clips were encoded using 128 kilobit per second CBR (constant bit rate) joint stereo encoder from MusicMatch Jukebox. The RealSystem G2 audio clips were encoded using RealNetworks 20 and 32 kilobit per second stereo music encoder. The Windows Media clips were encoded using Microsoft's Windows Media Encoder 4.0 at 20 and 32 kilobit per second stereo music settings for the RealSystem G2 comparisons and at 64 kilobit per second for the MP3 comparison.

Test Methodology

For comparisons between the Microsoft Windows Media codec and the RealSystem codec, 2 samples of music were compared at the 20 kilobit per second encoding rate: one sample of classical music and one sample of rock music. These same two samples were then encoded at the 32 kilobit per second encoding rate for comparison.

For comparisons between the Microsoft Windows Media codec and the MP3 codec, 2 samples of music were compared, rock music and classical music. Each sample was encoded at the 64 kilobit per second encoding rate using the Microsoft Windows Media codec and at the 128 kilobit per second encoding rate using the MP3 codec.

The net result, including the original music clip, was a master playlist providing six comparisons against the original music clip. From the master playlist an additional four playlists were created, guarding against any bias that may have been created by the order in which music clips were played during each comparison. From each playlist, a web page was created with the appropriate links to ensure that each music clip was associated with the proper audio player and that each music clip was played in the proper order with respect to the codecs being compared. A generic explanation of the test and explanation of the testing procedure, as well as questions to be asked of the listener by the test administrator, were scripted into each of the web pages at the proper place.

Seventy-seven men and women were recruited from the local community to participate in the comparison testing, which took place over a two day period. Each of the test subjects was escorted by the test administrator into the one of the office environments where the comparison testing was to take place. The test subject then filled out a short demographics questionnaire.

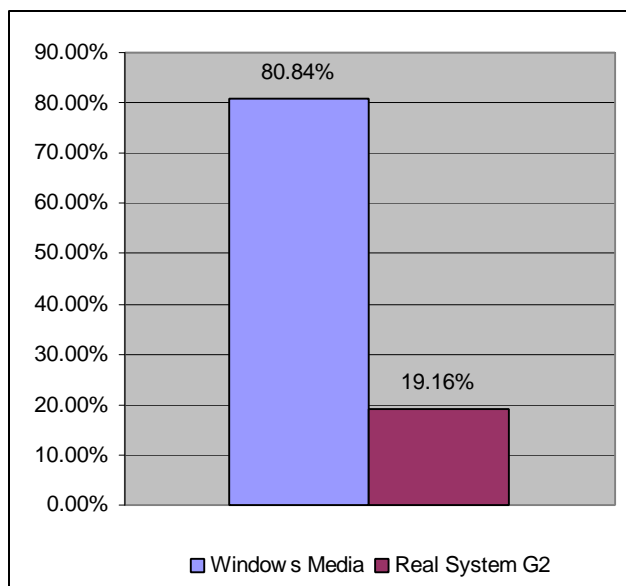
Testing began with the test administrator explaining to test subject the testing procedure: the original music clip was played first and then the two sample clips. The test subject was then asked to identify which of the two test clips sounded most like the original. If requested by the test subject, the original clip and the two comparison clips were played again. The test subject's answers to the comparison questions were recorded by the test administrator.

Test Results and Analysis

In comparisons of Microsoft's Windows Media Technology 4.0 and RealNetworks RealSystem G2 at a 20- and 32-kilobits per second encoding rate, test subjects selected Windows Media as sounding more like the original music clip.

Specifically, in 308 comparisons (2 genre of music x 2 comparisons x 77 test subjects), tests subjects regarded

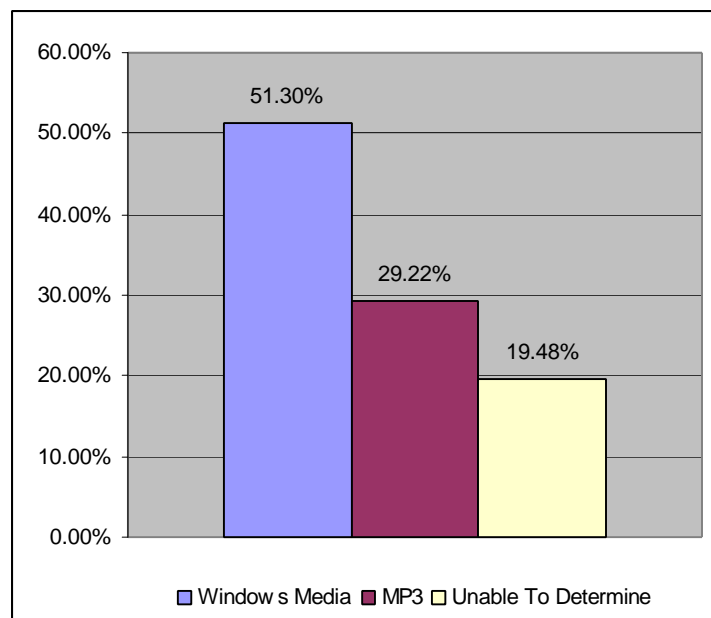
- Windows Media as sounding more like the original music in 249 comparisons, or 80.84% of the comparisons.
- RealSystem G2 as sounding more like the original music in 59 comparisons, or 19.16% of the comparisons.



In comparisons of Microsoft's Windows Media Technologies 4.0 and MP3, where the music clip was encoded using the Microsoft technology at a rate of 64 kilobits per second and the MP3 clip was encoded at 128 kilobits per second, test subjects selected Windows Media as sounding more like the original music clip in more than one-half of the comparisons. In almost 20% of the comparisons, test subjects were unable to discern which of the codecs sounded more like the original music clip.

Specifically, in 154 comparisons (2 genre of music x 77 test subjects), test subjects regarded

- Windows Media at 64 kilobits per second as sounding more like the original music in 79 comparisons, or 51.29% of the comparisons.
- MP3 at 128 kilobits per second as sounding more like the original music in 45 comparisons, or 29.22% of the comparisons.
- Were unable to discern which of the two sample clips, Windows Media or MP3, sounded more like the original music in 30 comparisons, or 19.48% of the comparisons.



Conclusion

Microsoft Corporation contracted NSTL to conduct a comparison of the Microsoft Windows Media Technologies 4.0 codec, the RealNetworks RealSystem G2 codec, and the MP3 codec. Seventy-seven people from the local population were recruited to participate in this study and, without knowledge of the codecs being compared, were asked to evaluate encoded music clips compared to the original un-encoded music.

In this subjective test, test subjects concluded that music clips encoded using Microsoft Windows Media Technologies 4.0 sounded more like the original, un-encoded music clip than if it were encoded using RealNetworks RealSystem G2.

Music clips encoded with the Microsoft Windows Media codec also compared favorably to music clips encoded using the MP3 codec at twice the encoding rate. In the comparison the majority of test subjects selected the music encoded with the Microsoft Windows Media codec as sounding more like the original, or were unable to determine which, the Microsoft Windows Media codec or the MP3 codec, sounded more like the original music clip.

Appendix A: Test Platform Configuration

Test Platform For Codec Comparison

Test Identification:	Dell Optiplex GX1
SysID Version:	97.04
System Vendor1:	Copyright 1985-1988 Phoenix Technologies Ltd. Copyright 1988-1998 Dell Computer Corporation. All rights reserved.
System Vendor2:	WARNING: Dell
System Vendor3:	Dell Computer Corporation
System Vendor4:	Dell System
System Vendor5:	Dell GX1
System Vendor6:	Dell GX1
System Vendor7:	Dell System Banff
System Vendor8:	Copyright 1990-1998 Dell Computer Corporation
BIOS Vendor1:	Copyright 1985-1988 Phoenix Technologies Ltd. Copyright 1988-1998 Dell Computer Corporation. All rights reserved.
BIOS Vendor2:	Copyright (C) 1985-1988 Phoenix Technologies Ltd.
BIOS Vendor3:	Copyright 1985-1988 Phoenix Technologies Ltd.
BIOS Date:	07/27/98
PnP BIOS:	Supported
APM BIOS:	Version=1.2; 16-Bit=yes; 32-Bit=yes
SVGA BIOS:	Vendor=ATI MACH64, Version=2.0
Adapter ROM1:	ATI MACH64(C) 1988-97, ATI Technologies Inc.BK3.9.2/3.086 gtgcmc.de6 6; Segment=C000h, Length=8000h
Adapter ROM2:	Copyright (C) 1997 Intel Corporation. All rights reserved., version 0.99c.03; Segment=C800h, Length=8000h
CPU Type:	Intel Pentium Pro
CPU Speed:	457MHz
CPUID:	Vendor="GenuineIntel", Model=5, Type=0, Step=0
Extended Memory:	64,512KB
ISA Bus:	YES
PCI Bus:	YES
LPT1:	EPP, 0378
COM1:	16550, 03F8
COM2:	16550, 02F8
Drive A:	Floppy drive (1.44 MB)
Drive C:	CD-ROM drive
Disk1 Type:	IDE Fixed storage
Disk1 Model:	WDC AC36400L
Disk1 Size:	2,153,652,224 bytes
Disk1 Rev.:	14.10R12
Disk1 s/n:	WD-WM4201451267
Disk1 Physical Cylinders:	13328
Disk1 Physical Heads:	15
Disk1 Physical Sectors per Track:	63
Disk1 Logical Cylinders:	13327
Disk1 Logical Heads:	15
Disk1 Logical Sectors per Track:	63
Disk2 Type:	IDE Removable CD-ROM storage
Disk2 Model:	TOSHIBA CD-ROM XM-6202B
Disk2 Rev.:	1108
DOS Version:	6.22