

MobileMark™2002

An Overview of MobileMark 2002

Business Applications Performance Corporation



June 4, 2002

Revision 1.0

1.0	Introduction	3
2.0	Development Methodology	3
2.1	Identifying Usage Categories	4
2.2	User Output	4
2.3	Characteristics of Output	4
2.4	Input Documents and User Interaction	5
2.5	Constructing the Workload	6
2.5.1	General Usage characteristics	6
2.5.2	MobileMark 2002 Workload Description	7
2.6	Automation and Workload Integration	8
2.6.1	Measurement Methodology	8
2.6.2	Performance rating methodology	9
2.6.3	Battery life rating methodology	10
3.0	Features & Characteristics	11
3.1	Usability Features & Execution Improvements	11
3.2	Workload Characterization of MobileMark 2002	12
3.2.1	Quantitative characterization of performance	13
3.2.2	Quantitative characterization of battery life effects	13
4.0	Conclusion	14
5.0	End Notes	16
APPENDIX A: Application Program versions		16

1.0 Introduction

BAPCo's MobileMark 2002 is a notebook computer benchmark program for mobile computers running Windows XP and Windows 2000. The primary purpose of this benchmark is to measure how long a mobile computer can run on a single battery charge. What makes MobileMark 2002 unique is that it measures system performance while the battery is discharging, and the benchmark reports both a performance score and a battery run time.

Today's notebook computers typically adjust performance to extend battery life. MobileMark 2002 shows you how well a notebook performs under battery power, to reveal a balanced performance and battery life picture. For MobileMark 2002, BAPCo, using its expertise in creating other industry standard benchmarks like SYSmark 2002, created workloads specifically suited for testing notebook computers. The user has the choice of running MobileMark under a *Productivity* workload or a *Reader* workload, which simulate two different usage models.

To make sure that the score is accurate and repeatable, the MobileMark 2002 has the capability to do a battery conditioning run. This is useful when the battery is new and has not been fully cycled, and to optimise the battery gauge and low battery alarm points on the notebook computer. MobileMark 2002 records system information, including power management settings, and reports this with the time and performance measurements. BAPCo suggests how to set up MobileMark (see product documentation on CD for details), and asks that any deviation from those suggestions be reported with the scores. It is possible to run the benchmark with different power management, processor speed, and LCD brightness settings.

MobileMark 2002 reports its results in a text file, which may be posted on the BAPCo web site, making it possible to compare results between different computers. The web site is an excellent place to see how your test systems stack up against comparable mobile computers.

This document explains, in detail, how BAPCo went about creating this benchmark and the methodology MobileMark 2002 uses to measure performance and battery life. It also explains the exact contents of the workloads and the features of the product, as well as some interesting quantitative characterizations of the workloads. BAPCo recommends that any tester who is seriously considering using MobileMark 2002 should read this White Paper.

2.0 Development Methodology

BAPCo follows a yearly development cycle in which it applies its standard development methodologies to a set of parameters driven by usage categories, usage models within the categories, software market segment indicators and technical feasibility. These parameters, along with the application of a judged model of logical and physical workload characteristics, determine the composition of workloads in BAPCo benchmarks.

For MobileMark 2002, BAPCo began by identifying business usage categories of mobile computers, followed by determining the types and characteristics of the output created by users in those categories. By determining the output characteristics, BAPCo reconstructed the user interactions required to create such outputs. These interactions were converted into instructions (or "scripts") and integrated into BAPCo's automated mobile benchmarking environment. The workloads were then judged based on their logical and physical workload characteristics and minor adjustments were made in order to arrive at a balanced workload.

A graphical representation of BAPCo's output-driven benchmark development methodology for creating workload candidates is shown in Figure 1.

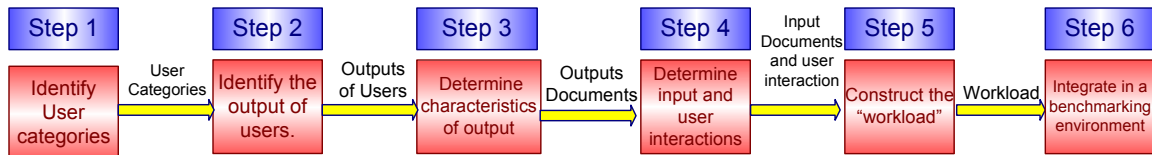


Figure 1: BAPCo's output-driven benchmark development methodology

The following sections will expand on these steps.

Step 1

2.1 Identifying Usage Categories

For MobileMark 2002, BAPCo began by looking at the usage categories it had already identified for desktop personal computers in SYSmark 2002. Those categories were Internet Content Creation and Office Productivity. Although the basic functionality in terms of software on mobile computers and desktop computers is essentially the same, BAPCo recognized that mobile computing usage models are in fact different. BAPCo identified two mobile usage types:

Productivity: A mobile professional uses both office productivity applications and content-creation applications.

Reader: A user utilizes his mobile computer to read documents such as cached web pages or a book.

BAPCo also recognizes that other mobile usage models, such as DVD playback, also exist. However, BAPCo chose to focus on the above two usage models for MobileMark 2002.

Step 2

2.2 User Output

The next step in BAPCo's benchmark development process identifies typical output generated in the usage category. For MobileMark 2002, the following types of output were identified:

Productivity: Formatted documents, spreadsheets, multimedia presentations, and electronic mail

Reader: Book content displayed on screen

Step 3

2.3 Characteristics of Output

In this step, BAPCo determined the format and characteristics of user output for the types identified in Step 2.2. BAPCo relied on the information gathered from studies for SYSmark 2002, and then modified the output characteristics to fit that of mobile-specific usage models.

For the *Productivity* usage model, the workloads are based loosely around SYSmark 2002, and use BAPCo's suite of documents that were created for a fictitious automobile company. The documents include an assembly manual, Excel charts (showing company forecasts) and presentations (on financials). MobileMark also includes various elements of content creation, to reflect a mobile professional creating elements for multimedia presentations.

The *Reader* workload displays a popular book ("War and Peace") in HTML format.

In selecting the applications that create the output in the benchmark, BAPCo uses a variety of sources to obtain market share data for applications used by business users in creating their output. Table 1 lists the output/documents identified by BAPCo, the application selected by BAPCo to be used to generate that output and the source of information that was used to select the given application.

<i>Productivity</i>		
Document	Application Program	Market Source
Digital images for multimedia presentations	Adobe Photoshop* 6.0.1	1. Forrester Report, "Creation Tool Strategies", June 1999 2. US Retail/Etail Sales Out 2001 - NPD INTELECT
Animation for multimedia presentations	Macromedia Flash* v5	1. December 2001 NPD Online Research Browser Survey 2. Media Metrix, Inc
Text Document	Microsoft Word* 2002	1. US Retail/Etail Sales Out Jan 2001-Dec 2001: NPD INTELECT. 2. Planning Assumption, "Microsoft Office - Update or Migrate?" Giga Information Group, November 2, 2001
Spreadsheet	Microsoft Excel* 2002	
Presentation	Microsoft PowerPoint* 2002	
Email	Microsoft Outlook* 2002	
Browsing Web pages	Netscape Communicator* 6.0	Jupiter Concept Report, "Beyond the Browser War", April 19, 2000
Virus free documents	McAfee VirusScan* 5.13	1. "Worldwide Antivirus Software: A Profile of the Leading Vendors in 2000", Document #25069, July 2001 2. US Retail/Etail Sales Out 2001 - NPD INTELECT
Compressed Documents	WinZip* 8.0	US Retail/Etail Sales Out 2001 - NPD INTELECT
<i>Reader</i>		
Document	Application Program	Market Source
Book displayed on screen	Netscape Communicator 6.0	1. "Barnesandnoble.com invests \$20 million in e-book site," CNET News.com June 6, 2000 2. "What Ebook Readers Want," Business 2.0, March 1, 2001

Table 1 - MobileMark 2002 Applications

Further details on the specific versions of the applications can be found in Appendix A.

Step 4 2.4 Input Documents and User Interaction

The remaining steps for the benchmark development are shown in Figure 2.

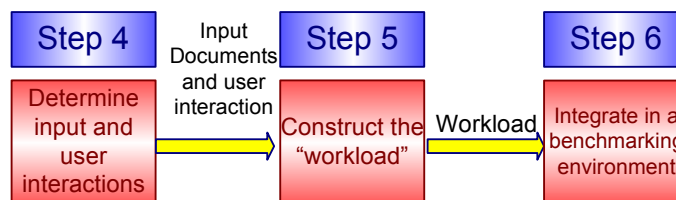


Figure 2 - Final steps of benchmark development

* Other product names used in this publication may be trademarks of their respective companies.

In step 4, BAPCo determines the interaction with the computer that a user needs to follow to produce the outputs that were identified in step 3. This set of interactions can be called a “storyboard” or “scenario”.

Step 5

2.5 Constructing the Workload

The output of Step 5 is the “workload”. The workload, in terms of BAPCo benchmarks, is defined as a series of input data and user interactions that occur to create the final output documents. The set of workloads corresponding to each user output in each category encapsulates the benchmark for that category.

2.5.1 General Usage characteristics

BAPCo identified a few general trends that govern how users interact with a notebook computer. When constructing the workloads, these characteristics were included to make the workloads more realistic:

Switching between applications: Notebook users frequently keep several applications open on their screen at the same time. For example, a mobile professional often has many components of Office XP (Word, Excel and PowerPoint) open at the same time and switches back and forth between these Office XP components. Thus, the workloads defined by BAPCo include opening and leaving applications open while work is being done in another application.

Concurrent Execution: In addition to switching between applications, it was observed that often a user would be actively working with one application while another application was performing work in the background. For example, a mobile professional user could have file compression and virus scanning applications executing in the background while Office XP documents are being created in the foreground.

User Think Times: It was observed that business users do not send their user inputs (to applications) in super-fast bursts. Input is provided at a finite typing rate with pauses between some of the operations (i.e. – the user would review the results of his request before proceeding with the next operation). This time where the user is assessing what to do next is called “think time”. In addition to normal delays to reflect think time and typing speed, mobile users will often leave their computer idle for several minutes at a time during a meeting or similar setting. To reflect these real world occurrences, BAPCo’s mobile workloads include think times and extra pause times between user interactions and applications.

2.5.2 MobileMark 2002 Workload Description

BAPCo developed the following workloads:

Productivity workloads:

The workloads in this category model a mobile professional at a fictitious automobile company. The worker creates documents using Microsoft Word, Excel and PowerPoint, accesses email, and creates graphics and animation with Photoshop and Flash to include in a multimedia presentation. An Internet browser is used to view presentations. The user also invokes file compression and virus detection in the background.

Microsoft Word 2002: The user starts Microsoft Word and opens an eight-page assembly manual document for a new transmission system. The user sets paragraph formatting, font configuration and adds text to the document. The user inserts an image, a table of contents and a table of figures. Twenty additional images, ranging in size from 3 Kb to 15 Kb are inserted throughout the document. The user then adds a watermark to the document and performs a global find and replace. The document is printed and the user inserts a hyperlink into the document and adds more text. The user inserts a training video, changes the theme and saves the document in web page format.

Later, the user returns to Word and opens a book to read. The user auto-summarizes the book to generate a shorter synopsis.

Microsoft Excel 2002: The user starts Microsoft Excel and opens a large spreadsheet (a 12 megabyte file with approximately 3000 rows and 248 columns of data). The user selects a group of formulae for data analysis. The user selects the data and performs a sort, using three key fields. This data is then used to create a chart, which is exported to a web page. The user then opens a different spreadsheet (an 8.5 megabyte file with approximately 2100 rows and 248 columns of data), and performs similar operations, resulting in another web page.

Microsoft PowerPoint 2002: The user starts Microsoft PowerPoint and opens a 24 slide presentation of the previous quarter's news and sales. The user moves through the presentation inserting and positioning several images (47 to 57 kilobytes in size). Upon completing this, the presentation is checked for spelling errors. The user then applies different themes/backgrounds to the presentation and selects one. Finally, the user reviews the material in slide show mode and exports the finished presentation to web page format.

Microsoft Outlook 2002: The user starts Microsoft Outlook and opens the inbox, changing the view mode to show the first lines of each message. The email editor, Word, is launched, and a document is opened, printed, and sent to an email recipient. The user then opens one of the documents in the inbox, adds a picture as an attachment, and emails it. Moving to the Draft folder, the user opens three email messages: the first has its spelling checked and is sent, the second is sent and the third is checked for spelling, summarized and sent. Three more messages are created and sent with attached images. Finally, the user compresses the Outlook offline folder.

Netscape Communicator 6.0: The user opens the Netscape browser and loads an HTML version of a Word document. The source HTML code is then viewed. The user also views two charts exported to HTML from an Excel file. Finally, the user browses through a 15-page PowerPoint slide show that was saved in HTML format.

WinZip Computing WinZip 8.0: The user creates a compressed data file from a set of bitmap files (7.6 megabytes total size) in a specific folder. The resulting

zip file is 54% of the size of the original group of files. Once started, the user moves this to the background and works with other applications.

McAfee VirusScan 5.13: The user scans program files (3,110 files and 438MB) for the presence of viruses. This is run in the background as the user works.

Adobe Photoshop 6.0.1: The user starts Adobe Photoshop and sets the workplace. A 7.12MB high-definition source file is opened and the image is sized to fit in the window. The user performs image manipulations, including Smart Blur, Distort Wave, and rotation. Finally, the user re-sizes the image and adjusts the image color levels before saving the image as a web-friendly 20-kilobyte JPEG file.

Macromedia Flash 5: The user creates a Flash animation using text, graphics and still images. The user works in an existing Flash animation, adding, then manipulating and positioning a new image to appear appropriately within the final animation. To do this, the user starts Macromedia Flash and opens a preconfigured project (FLA) file, containing 23 different layers. The user moves down to one of the layers in the project file, deletes the key frame and imports a new image of a person in a kayak (a 24-bit color, 72 dpi, 300 x 211 resolution PNG format image with transparency). This image is then manipulated (rotated, flipped) and positioned appropriately within the frame and is then grouped into an instance. Finally, the user exports the animation to a web ready SWF file using 100 percent jpeg compression.

Reader workload:

The workload in this category models a notebook user reading a book on his computer.

Netscape Communicator 6.0: The user opens the Netscape browser and loads an HTML version of "War and Peace." The book consists of 17 HTML files (one per chapter) which are 100KB-400KB each, totaling 3.3 MB. Starting from the beginning, the user reads the book on his screen, and then advances to the next page after two minutes. He continues reading and advancing one page per two minutes until the battery of the notebook computer discharges.

2.6 Automation and Workload Integration

Step 6

The final step in creating MobileMark 2002 is translating the workload into an automated benchmark. BAPCo uses Visual Test and Visual Basic to emulate a human using a keyboard to send commands to the computer. The keyboard commands are converted into scripts that are used by the benchmark to control each of the individual applications included in MobileMark 2002. In order to make sure the benchmark is deterministic, BAPCo uses something called a "harness" to install applications, run the scripts, record and display the performance results.

2.6.1 Measurement Methodology

MobileMark 2002 measures both the battery life and the performance of a mobile computer at the same time. Performance is measured in a method similar to that used by SYSmark 2002. Battery life (measured in **Minutes**) is computed by running the entire workload several times until the battery runs out.

To measure both performance and battery life accurately at the same time, MobileMark first gives the tester a chance to defragment the hard drive, condition the battery, and optimize the computer correctly with the Windows XP optimization routine. The program then reboots the machine, waits for the battery to charge fully, and then starts the workload scripts. After one iteration of the workload scripts, the program calculates and saves the performance score for the computer. It continues draining the battery, starting with a pause after the first iteration completes. The length of this pause depends on how fast the notebook completed the first iteration. It lasts 90 minutes minus the amount of time needed to finish the first iteration of the workload scripts. Therefore the second iteration of the workload scripts will always begin 90 minutes after starting the benchmark. This variable-length pause occurs only once, between the first iteration of the workload script and the second iteration, and will not appear anywhere else in the benchmark. After the second iteration, all subsequent iterations will begin without the pause. If the notebook takes more than 90 minutes to complete the first iteration, then the second iteration will begin immediately after the first, with no pause inserted.

This pause is one of several idle pauses in the benchmark. In addition to this pause, each iteration contains eight fixed-length pauses that last three minutes each and one 2.5 minute pause. These pauses occur between each workload script. There are also pauses within each workload script, each of which can last up to several seconds, between user interactions such as typing and clicking on menus. All these pauses simulate the user “think time” and “down time”.

MobileMark constantly monitors the state of the machine while the battery is draining, and checks for certain conditions that might invalidate the test (such as if the power cord is plugged back in during the test run, or the performance of the same workload script changes significantly during the course of the run).

2.6.2 Performance rating methodology

The fundamental performance unit in MobileMark 2002 is “Response Time”. Response time, in the context of MobileMark 2002, is defined as the time it takes the computer to complete a task that has been initiated by the automated script. The task can be initiated by a mouse click or a keystroke from the keyboard. For example, the response time for a *Replace All* command in Word 2002 is the time between clicking the *Replace All* button in the *Edit/Replace* window and the time that Word 2002 brings up the completion window. In MobileMark 2002, only the response time of individual operations is included in the performance metric. MobileMark 2002 ignores the time to send keystrokes and mouse clicks to the application. In the real world, these tasks are initiated and controlled by a human and therefore do not measure computer performance. Since these tasks don’t measure computer performance they are not timed.

Each time the *Productivity* category of MobileMark 2002 is run, it calculates a performance rating. MobileMark does not calculate a performance score for the “Reader” category (performance is not a relevant factor in this usage model scenario).

The performance rating is based on the average response time for the system being tested compared to that of a fixed *calibration platform*. A rating of 100 indicates the test system has a MobileMark 2002 performance equal to that of the calibration platform using MobileMark 2002. A rating of 200 indicates the test system has twice the MobileMark 2002 performance of the calibration

platform. The MobileMark 2002 calibration platform has the following configuration:

System name:	Compaq Armada M700 notebook
CPU:	Pentium* III processor
Core Frequency:	1.0 GHz with 100 MHz bus speed
Memory:	256 MB, Non-ECC, PC100, CL2 SDRAM
Video Adapter:	ATI Rage P/M Mobility AGP2X (8 MB)
Video Resolution:	1024x768 resolution (native) with 32 bpp color
Video Driver:	ATI Rage Mobility (Compaq) 5.01.2195.5012
File System:	FAT32
Disk:	30GB IBM DJSA-230 ATA/66
Disk Adapter:	Intel 82371AB/EB PIIx4/E IDE controller
Network Card:	Intel PRO/100+ MiniPCI for Compaq
Operating System:	Microsoft* Windows* XP Professional (Build 2600)
Power scheme:	Always On

2.6.3 Battery life rating methodology

The benchmark, in both *Productivity* and *Reader* modes, generates a battery life rating. To accomplish this, first the battery is conditioned. Conditioning is the process of discharging a fully-charged battery and recharging to full-charge status. Conditioning stabilizes the battery, ensures that the drain rate of the battery is consistent, and ensures that battery knows the exact point at which it is fully drained. In the case of either mode being selected, the benchmark exercises the workload continuously until the battery is drained. After the battery is drained, the system should be connected to a power supply and upon boot up the benchmark reports the battery life of the system for the specific workload that was chosen.

The battery life rating in MobileMark 2002 is measured in **minutes**. The metric reflects the number of minutes the machine can remain operational while executing the particular workload (either *Productivity* or *Reader*). These different types of workloads within this benchmark will produce two different battery life ratings. The battery life is established by recording the start time of the benchmark, recording a timestamp once per minute until the battery dies, and then calculating the absolute difference between the start time and the last recorded timestamp.

Other measurement considerations

MobileMark 2002 is designed to emulate human interaction with the computer by sending keystrokes at a rate that approximates how fast a human types. MobileMark 2002 departs from the common practice of using an automation tool (harness) that sends keystrokes as fast as the computer can generate them because today's computers are able to generate keystrokes much, much faster than a human can type. In MobileMark 2002, Think Time (up to several seconds) is added between operations to emulate human input to the computer. MobileMark 2002 also adds additional pauses to account for user delays. These pauses and think times are not included in the performance measurement.

Operating system and application behavior is more realistic in MobileMark 2002 because think time and user pauses enable the operating system and applications to perform normal housekeeping activities and conserve battery power in a realistic fashion. For example, applications can properly schedule spell checking and grammar checking, the operating system can execute idle

time optimizations, and the CPU and graphics adapter can enter low-power states. These delay times avoid unnatural compression of page use information which can make memory management algorithms in the operating system less effective. The addition of these pauses also enhances cross-platform stability.

3.0 Features & Characteristics

Like BAPCo's other benchmarks such as WebMark 2001 and SYSmark 2002, MobileMark uses real Windows applications and usage models.

MobileMark 2002 differs from BAPCo's older notebook benchmark, SYSmark 98/BL, in several ways:

- Instead of measuring performance indirectly through loop time, MobileMark measures real response-time based performance directly and accurately.
- New usability features have been added to streamline and improve the process of installation and execution. This enables higher test throughput.
- Error handling has improved resulting in quicker resolution of failures.
- Includes full support for Windows XP and Windows 2000.
- Supports several languages: Italian, Spanish, Dutch, French, German, Japanese and Chinese.
- Uses newer applications and workloads.
- Reports scores from two usage models.
- Includes automatic hard disk defragmenting.
- Removes the requirement for inserting the program CD during the test run.
- Includes an automated "Conditioning/Optimization Run" that conditions the system's battery and activates Windows XP's optimization routines.
- Uses a modern mobile usage model that includes task switching and multitasking.

Section 3.1 below briefly describes the new usability features, improved error handling and the support for Windows XP. For details on the operation of these new enhancements please refer to the documentation provided on the product CD-ROM.

Section 3.2 provides an in-depth treatment of the logical and physical implications of the applications and workloads.

3.1 Usability Features & Execution Improvements

Full Support for Windows XP: MobileMark 2002 has been tested on English versions of Windows XP (Home and Professional) and seven non-English operating systems (Italian, Spanish, Dutch, French, German, Japanese, Chinese).

New Applications: MobileMark uses Word 2002, Excel 2002, PowerPoint 2002, Outlook 2002, Photoshop 6.0.1, Flash v5, VirusScan 5.13, WinZip 8.0 and Netscape Communicator 6.0. These new applications reflect the current workflow in today's mobile scenarios.

Easier installation, setup and run: MobileMark can be installed directly from the CDs without copying the files to a hard drive first. MobileMark does not require any other external hardware such as a CD or a keyboard thumper.

Conditioning run with optimization: The conditioning run can be used to optimize the benchmark on a system before scores are generated. On Windows XP,

MobileMark 2002 calls the ProcessIdleTask API routine after the optimization run completes a full iteration in order to optimize Windows XP performance. BAPCo highly recommends running the optimization run before generating an official score on Windows XP.

Automated Error Reporting: It is now possible to report errors using a one-click error-reporting feature. All information pertaining to the error is captured to help BAPCo provide timely technical support.

3.2 Workload Characterization of MobileMark 2002

In completing the workload development process, as described in section 2.0, the candidate workloads are judged through a rigorous workload characterization exercise. This section provides some of the pertinent data used in this process for MobileMark 2002. The reader can use these data to understand and explain performance differences observed on test platforms.

3.2.1 Quantitative characterization of performance

The approximate quantitative contribution of the applications to the *Productivity* performance score in MobileMark 2002 is shown in **Table 2**.

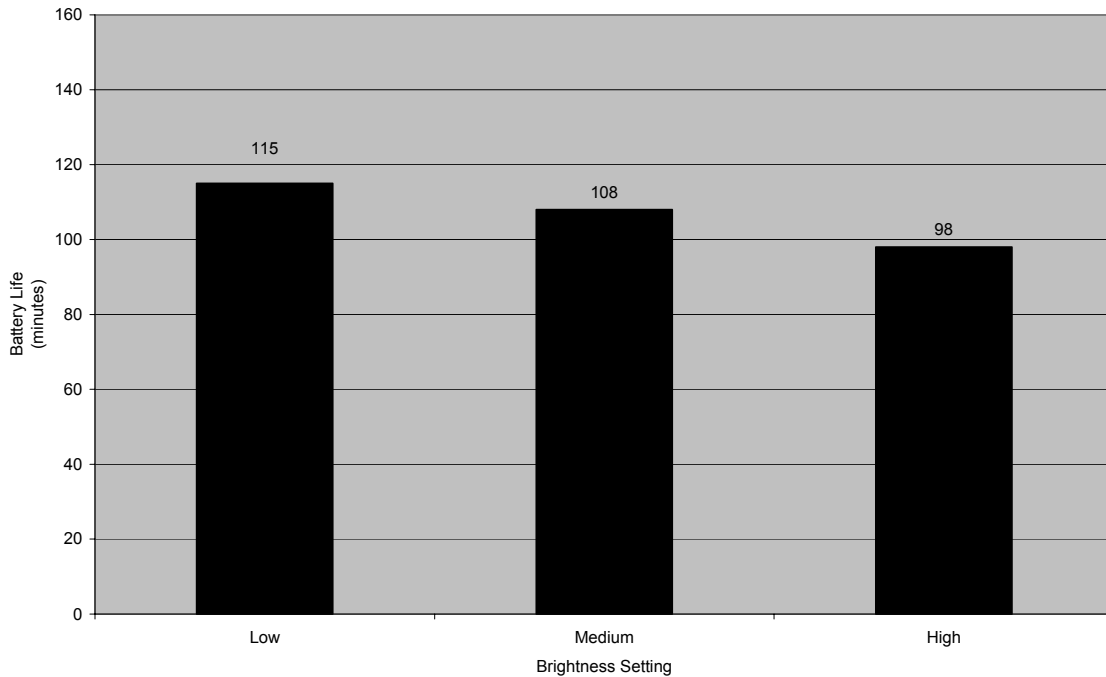
Application	Percent contribution on the MobileMark 2002 calibration machine
Microsoft Word	17%
Microsoft Excel	18%
Microsoft PowerPoint	3%
Microsoft Outlook	13%
Adobe Photoshop	17%
Macromedia Flash	17%
McAfee VirusScan	12%
Netscape Communicator	3%
WinZip Computing WinZip	1%

Table 2 - Application Contribution to *Productivity* performance rating

3.2.2 Quantitative characterization of battery life effects

In mobile systems, two main factors play a large role in determining the battery life: the battery size (capacity) and the system power consumption. Battery capacities are determined by the manufacturer of systems, and are usually similar in the same family of systems (e.g. thin & light notebooks). System power consumption though can vary drastically, and can be affected by workload and subsystem design. By using a standard benchmark such as MobileMark 2002 and comparing across systems, the workload characteristics are fixed and do not vary from system to system. Therefore, only the battery size and subsystem design will affect the battery life of the system. Subsystems include system devices, such as the display (e.g. LCD), graphics processor, CPU, chipset, hard drive, and memory. Settings for each of these have the potential to affect battery life as measured by MobileMark 2002. An example of this is the screen brightness setting of a system.

Screen Brightness Impact on Battery Life



The graph above shows the battery life scores from MobileMark 2002 in *Productivity* mode. All tests were run on a Toshiba Satellite Pro 6100 notebook¹ and all settings except for the LCD brightness were kept constant throughout all the tests. As you can see, the configuration with the lowest screen brightness setting resulted with a battery life of 115 minutes, while using the highest brightness setting lowered the battery life to 98 minutes.

Similarly, other subsystems have multi-state configuration options. The CPUs in the market today include power-saving features, as do some of the graphics processors. Hard-drives, chipsets and memory technologies also have different settings that potentially could affect battery life and therefore careful note should be made regarding the setup of this benchmark.

4.0 Conclusion

MobileMark 2002 is the first notebook benchmark suite that measures both battery life and performance simultaneously. This benchmark suite fully supports Windows XP, includes current applications, and gives testers a valuable tool in evaluating and analyzing notebook computers.

Some features have been carried forward from other standard methodologies. The workloads in MobileMark were generated through BAPCo's rigorous workload selection process. Usage characteristics like concurrent execution, switching between open applications and user think time and delay time are also included in this new benchmark suite. The benchmark measures battery life accurately in two different usage models, and Response Time continues to be the fundamental unit of performance.

MobileMark 2002 is easy to install, run and maintain. It carries forward the features that make BAPCo benchmarks the premier performance evaluation tools for business environments. And finally, it includes full support for the latest operating system, Windows XP, the latest office productivity suite, Office XP and has improved the workload characteristics to reflect how workers use notebook computers in their day-to-day activities.

* Other product names used in this publication may be trademarks of their respective companies.

5.0 End Notes

1. Toshiba Satellite Pro 6100 notebook configuration:

System name:	Toshiba Satellite Pro 6100 notebook
CPU:	Intel Pentium 4m processor
Core Frequency:	1.6 GHz with 400 MHz bus speed
Memory:	256 MB, Non-ECC, PC2100 DDR SDRAM
Video Adapter:	NVIDIA GeForce4 420 Go (Toshiba) (16 MB)
Video Resolution:	1400x1050 resolution (native) with 32 bpp color.
Video Driver:	NVIDIA, 1/31/2002, version 2.7.2.7
File System:	FAT32
Disk:	40BG, 4200RPM, ATA/100, TOSHIBA MK4019GAX
Disk Adapter:	Intel 82801 CAM Ultra ATA Controller
Network LAN Card:	Intel PRO /100 VE, driver version 5.42.22.0
802.11b network card:	Disabled (Toshiba Wireless LAN MiniPCI Card)
Operating System:	Microsoft Windows XP Professional (Build 2600)
OS Power scheme:	Overridden by Toshiba tray application (see below)
Battery:	3600 mAh, 10.8 V

Power Save Mode settings in Toshiba tray application:

Cooling Method:	Maximum Performance
Intel SpeedStep Technology:	Automatic
Processor speed:	Full (across all battery charge levels)
Turn off monitor:	Never (across all battery charge levels)
Turn off hard disks:	Never (across all battery charge levels)
System standby:	Never (across all battery charge levels)

APPENDIX A: Application Program versions

1. Microsoft Office XP:

- Word 2002 (v10.2627.2625)
- Excel 2002 (v10.2614.2625)
- PowerPoint 2002 (v10.2623.2625)
- Outlook 2002 (v10.2627.2625)

This version does not include the recently released Service Pack 1 as it was released after the code freeze date for MobileMark 2002.

2. Netscape Communicator: Mozilla 5.0 version.

4. McAfee VirusScan: Version 5.13

5. WinZip: Version 8.0 (v305).

7. Macromedia Flash: Version 5.

9. Adobe PhotoShop: The version is 6.0.1. MobileMark 2002 uses two updates from the Adobe web site. 1) Adobe Photoshop 6.01 update released on March 9, 2001. 2) Adobe PhotoShop 6.0.1 plug-ins update released on May 01, 2001.