

Palm, Inc.: Competitive Analysis

Test report prepared under contract from Palm, Inc.

Executive summary

Palm, Inc. commissioned VeriTest to compare battery life, time to data loss, storage efficiency, and wireless download speeds for the Palm Tungsten T, the Palm Tungsten C, the HP iPAQ 1910 and the HP iPAQ 5450.

The Palm devices equaled or outperformed the HP iPAQs in all of the battery life tests. The Palm Tungsten C posted the highest battery life scores, including slightly over 8 hours of run-time at full screen brightness. The Palm devices also maintained user data for significantly longer than the iPAQs once the devices entered stand-by mode.

Key findings

- ❑ The Palm Tungsten C lasted 1 hour and 35 minutes longer than the HP iPAQ 5450 in 802.11b wireless battery life tests.
- ❑ The Palm Tungsten C was more than 2 times as fast as the HP iPAQ 5450 in wireless download speed tests
- ❑ Palm, Inc. devices equaled or outperformed the HP devices in all tests
- ❑ The Palm Tungsten C outperformed all other devices in our battery life tests
- ❑ The Palm Tungsten T lasted 5 times longer than the HP iPAQ 5450 in our time to data loss test

The Palm Tungsten C was more than twice as fast as the HP iPAQ 5450 in our web page download test, loading our test page in just over 11.69 seconds as compared to 28.02 for the iPAQ.

Storage efficiency testing, consisting of storing a set of contacts, appointments and documents, revealed little difference in overall storage efficiency among the devices. However the Palm document sizes were significantly smaller than the equivalent document on the HP iPAQs with no difference in document formatting or content loss.

Testing methodology

Palm, Inc. supplied all of the handhelds in this test. With the exception of the Tungsten C, which was an unreleased unit, all the devices were received in their original retail packaging. A testing methodology was developed with Palm, Inc. to demonstrate battery drain and usage in real-world user scenarios and encompassed: MP3 playback, video playback, screen at full brightness, Bluetooth wireless, 802.11b wireless, storage efficiency, wireless download speed and time to total data loss.

The devices were unpacked and installed according to the manufacturer's instructions included with each device. Each device was charged for at least 12 hours before testing began in order to condition the batteries. During testing, we used the on-board battery indicator to determine when the device under test had returned to a 100% charge.

Each device was connected via USB cables to desktop PCs. We installed the accompanying synchronization software each PC and used it to transfer data to the device. We used Microsoft Outlook 2000, installed in Corporate/Workgroup mode and connected to an Exchange 2000 server, as the data source for address book and calendar data. Synchronization was provided by the software included with each device.

Battery Life

Figure 1 shows the tests that were conducted on each unit. The Palm Tungsten C and the HP iPAQ 1910 are not equipped with Bluetooth and the Palm Tungsten T and the HP iPAQ 1910 do not have wireless capability so these units were exempt from the respective tests. Although the Palm Tungsten C is capable of MP3 playback, the headphone jack on the device provides mono playback instead of stereo. Because of this, we removed it from the MP3 playback test at Palm, Inc.'s request as they felt that owners of the device would not use this feature.

	Palm Tungsten C	Palm Tungsten T	HP iPAQ 1910	HP iPAQ 5450
Screen on	✓	✓	✓	✓
MP3 playback	X	✓	✓	✓
Video playback	✓	✓	✓	✓
Bluetooth On	X	✓	X	✓
Wireless On	✓	X	X	✓
Total Data Loss	✓	✓	✓	✓

Figure 1. Battery tests performed on each device

We disabled auto-off on each device for the battery life tests. On the HP handhelds we unchecked the “turn off device if not used” box found in the power applet in the system settings. For the Palm devices we used a hidden feature for disabling auto-off. We created a new memo and entered into the memo the graffiti alphabet special character, a period and the number 3. This created a new memo called “[No Auto-Off]” and auto-off remained disabled until it was reset in the preferences applet.

Battery test detail

Screen On

For the screen on test, we set the screen brightness to 100%. We also disabled the backlight management features of the HP devices so they maintained constant screen brightness for the duration of the tests. We left each device on its default start-up screen. The screen going dark defined the end point of this test.

Device settings: Backlight enabled on the Tungsten T, all devices set to 100% screen brightness.

MP3 Playback

We loaded an MP3 file onto a Palm, Inc. supplied 32 MB SecureDigital card and inserted it into each device. The Windows CE devices played the file using the native Windows Media Player 8. We downloaded the Real One Player from the Palm website and installed it on the Palm Tungsten T and C for MP3 playback. Using the controls of the player used for the test, we played the MP3 file on a continual loop. The application used for MP3 playback remained active on the screen of the device for the duration of the test. The end of audio output defined the endpoint of this test.

Playback of the MP3 file would stop before complete battery drain on all of the devices. A message saying that playback could not continue displayed when this occurred.

Device settings: Backlight off on all devices, screen brightness at default levels. Volume set to 50%.

Video Playback

We converted the same MPEG-1 video for use on each device. For the Palm devices we used the vendor-supplied Kinoma Producer for Palm which converted the file to a proprietary format for the Kinoma Player. For the HP devices we used Windows Media Encoder 9 to convert the file to a Windows Media File (.wmv) using the included PocketPC output profile and setting the audio compression to voice quality audio. CD quality audio produced a file that would not play on the iPAQs. The video file contained both audio and video tracks and we confirmed that sound and video continued for the duration of the test. The end of video playback defined the endpoint of this test.

For the Palm devices, the battery warning messages required us to manually tap “OK” in order to continue video playback. We monitored the devices and tapped “OK” each time it appeared until the unit ceased playback. The HP iPAQs did not require manual intervention when the battery warning messages appeared.

Device settings: Backlight enabled on Tungsten T, auto-dim turned off on HP devices, screen brightness at 50% on all devices. Volume set to 50%.

Bluetooth Wireless

For the Palm Tungsten T and the HP iPAQ 5450, we enabled the Bluetooth wireless feature using the on-board controls. The HP iPAQ 5450 has an indicator light which shows that Bluetooth is enabled; the Palm Tungsten T does not. In order to verify that Bluetooth was still enabled and running on the device, once we received warnings of the battery needing to be recharged we had it scan for other Bluetooth devices. We left each device on its default start-up screen. The end of support for Bluetooth discovery defined the endpoint of this test.

Device settings: Backlight enabled on Tungsten T and set to 50% screen brightness, HP iPAQ 5450 set to 50% screen brightness and auto-dim was disabled

802.11b Wireless

We used the on-board controls to enable the 802.11b wireless NICs on the Palm Tungsten C and the HP iPAQ 5450. We placed the devices 3 feet away from a Linksys WAP11 access point (AP) and configured them to associate with the SSID of the AP. We did not enable WEP on the AP. DHCP assigned IP addresses to each device. When battery warnings displayed on the screen, we pinged the IP address of the handheld to verify wireless connectivity. We left the wireless status page on the device screen to allow for monitoring of the signal. Failure to respond to a ping request defined the endpoint of this test.

Device settings: Screen brightness set to 50% on all devices, auto-dim disabled on the HP iPAQ 5450

Total Data Loss

We determined the amount of time the device maintained user data after power failure (e.g. the unit shut itself off and would not power back on) by leaving the devices in their powered-off states in the same physical location. We left the HP iPAQ stand-by settings at the default value of 72 hours. According to the documentation for this device, the stand-by value is an approximation of when total data loss occurs on the device and it reverts to its default settings. The Palm device has no equivalent setting so we used the 7 day time frame found in the documentation.

We checked each device on the day before the manufacturer’s approximated time by briefly connecting them to their cradles or recharging cables and powering them on. We checked for the presence of our 500 test address book entries. If the device maintained this data, we unplugged the power and the device immediately returned to a powered-off state on its own. The devices were on power for less than 10 seconds during this check and received a negligible amount of charge to the battery. We then checked the device again the next day

and continued this cycle until data loss occurred and the device reverted to the default settings. The day that data was no longer present defined the endpoint for this test.

Storage Efficiency

We tested the efficiency of storing various information sources on each device. A set of calendar appointments, addresses and business documents were loaded on each device. We recorded the free memory from the on-board tools on each device before we loaded each item. The Palm devices report one decimal place of available memory, while the HP iPAQs report two decimal places. This resulted in the Palm devices showing no decrease in storage space after we loaded some data. We used the on-board tools to note the change in memory for each individual application (datebook, addressbook) in these cases.

For all synchronization tests we configured the HP iPAQ synchronization software for manual synch because the Palm synchronization software allowed only for manual synchronization.

Contacts

We extracted 500 contacts from the Veritest Corporate Directory using Outlook 2000 and saved these to a 1408 KB .pst file.

For each test run we imported the .pst file into Outlook 2000 on the test PC and configured the synchronization software to synchronize contacts only. We recorded the free memory available on the device, performed the synchronization, confirmed the successful transfer of all records, recorded free memory / memory utilized by addressbook (Palm devices), then deleted all the records from Outlook and the device. At the end of each test run, we rebooted the test PC and powered the device off and on. We repeated the test three times.

Appointments

We created 25 identical calendaring appointments in Outlook 2000 and exported them to a .pst file, 144KB in size. We then imported this file in Outlook 2000 on the test bed PCs.

For each test run we imported the .pst file into Outlook 2000 on the test PC and configured the synchronization software to synchronize appointments only. We recorded the free memory available on the device, performed the synchronization, confirmed the successful transfer of all records, recorded free memory / memory utilized by datebook (Palm devices), then deleted all the records from Outlook and the device. At the end of each test run, we rebooted the test PC and powered the device off and on. We repeated the test three times.

Business Documents

We loaded a Microsoft Word file, a Microsoft Excel file and an Adobe Acrobat PDF file (see appendix B for file sources) onto each device. For the Palm devices, we used Documents to Go (provided with the handheld) to convert the files and then load them onto the handheld. For the iPAQs, we dragged and dropped the file onto the device. The ActiveSync software performed document conversion to the handheld format. We transferred the Adobe Acrobat document to the Palm devices using the included Adobe Acrobat for Palm OS; and we dragged and dropped the file onto the HP iPAQs.

For each test run, we recorded free memory before and after the transfer of documents, and we confirmed the successful transfer of the documents. We then deleted the documents from the device, rebooted the PC powered the device on and off. We repeated the test three times.

All Data

We loaded all 500 contacts, 25 calendaring appointments, the MS Office and Adobe files on each device using the same techniques described in each individual test.

For each test run, we recorded free memory before and after we transferred the items, confirmed the successful transfer of the items, deleted the items from the device, rebooted the test PC and powered the device off and on. We repeated the test three times.

Wireless Download Speed

VeriTest tested the Palm Tungsten C and HP iPAQ 5450 for wireless download speed by timing the speed at which they loaded a page via HTTP from a web server on the same LAN. We associated the devices to a Cisco Aironet 350 access point (AP) with a 40 bit WEP key and placed the devices within 6 feet of the AP during the test. We configured an SSID on both the access point and the clients. The web server provided client IP addresses by DHCP. The web server and the AP were the only devices plugged into the same 3COM TP/12 10 Base T hub during the test.

We used a copy of the cnn.com home page (177 KB total size) for the test web page. Because we ran the tests on an internal LAN with no Internet connectivity, we removed all external sourced ads from the web page in order to ensure complete page loading without any client side errors or fetching delays. We tested the page by loading it in a web browser on one of the test bed PCs until no delays or errors were returned during loading.

RedHat Linux 8.0 running Apache 2.0 as shipped by RedHat and dhcpd version 3.01pl1-9 served as the web and DHCP server for client connections. We used TCPDUMP to capture all HTTP traffic between the server and the wireless clients, run on the web server. We recorded the results in a text file using the following command:

```
tcpdump -n src port 80 > logfile
```

Before the test began, we reset the history files on each device to 0. For each test run we recorded the time with a stopwatch for the page to be fully rendered on the device. We defined complete rendering of the web page by the disappearance of the spinning world icon in Internet Explorer on the HP iPAQ 5450 and the change in the top menu bar back to the icon set in the web browser on the Palm Tungsten C. At the end of each test run, we deleted the history and stored files, stopped Internet Explorer on the HP iPAQ 5450 via the running programs screen and the returned the Palm to its home screen. We powered each device between runs. We repeated the test three times.

Test results

Figure 2 shows the battery life for each device during in each test configuration. The Palm Tungsten C posted the longest battery life in all tests in which it participated. We expected the Palm Tungsten C to be the best performer in battery life testing, as it has the largest capacity battery of any of the units tested.

The Palm Tungsten T posted the next best scores and exceeded the battery life of the HP iPAQ 5450 by over one hour in the Bluetooth wireless test. The HP iPAQ 1910 matched the battery performance of the Palm Tungsten T in all but the video playback test. The HP iPAQ 5450 posted the lowest scores in all battery life tests.

	Screen On	MP3 Playback	Video Playback	Bluetooth On	802.11b On
Palm Tungsten C	8:09	NA	5:52	NA	3:45
Palm Tungsten T	4:15	4:30	3:30	5:12	NA
HP iPAQ 1910	4:15	4:32	3:16	NA	NA
HP iPAQ 5450	2:27	3:40	2:43	3:52	2:10

Figure 2: Tested battery life of each device in hours:minutes

Video playback was inconsistent across the devices, with the HP 1910 displaying poor refresh rates resulting in jerky, slide-show-like video instead of the smooth playback seen on the Palm devices and the iPAQ 5450. This is likely explained by processor speed differences in the hardware as video playback is a relatively CPU intensive task.

The time to total data loss is shown in figure 3. The Palm devices retained all the user data for more than twice as long as the iPAQs with the Palm Tungsten T lasting 5 times longer than the iPAQ 5450.

	Time to Total Data Loss
Palm Tungsten C	20 days
Palm Tungsten T	21 days
HP iPAQ 1910	10 days
HP iPAQ 5450	4 days

Figure 3. Days until all user data was lost from the device

Figure 4 shows the on-board storage utilized in each test scenario. We found overall storage efficiency consistent across all the devices under test. The Palm and HP devices report free and used memory differently, with the Palm devices reporting fewer decimal places via the on-board tools. Because of this, the overall memory usage reported for each Palm device does not equal the sum of the individual items. Where the Palm devices reported no change in overall free memory after content was transferred, we recorded the change in kilobytes of the reported memory usage of the specific application where the data was stored.

	Contacts	Appointments	Business Documents	All Items
Palm Tungsten C	0.049 MB	0.002 MB	1.4 MB	1.4 MB
Palm Tungsten T	0.046 MB	0.002 MB	1.4 MB	1.4 MB
HP iPAQ 1910	0.08 MB	0.01 MB	1.27 MB	1.36 MB
HP iPAQ 5450	0.08 MB	0.01 MB	1.27 MB	1.36 MB

Figure 4: MB of storage space consumed on each device as reported by the on-board utilities

All of the devices used converters to transform the business documents we loaded onto them. The necessary programs shipped on the software installation CDs that accompanied each device. In the case of the Palm devices this resulted in smaller file sizes on the device for all of the documents tested (figure 5). The content of each document remained unchanged despite the smaller file sizes. Although we expected identical results for the Palm OS devices as we saw for the HP iPAQs, the Tungsten C included a newer version of Documents-To-Go which produced smaller file sizes than the version shipped with the Tungsten T.

	Adobe PDF File	MS Word Document	MS Excel Document
<i>Native Format</i>	1300 KB	237 KB	258 KB
Palm Tungsten C	1138 KB	111 KB	163 KB
Palm Tungsten T	1138 KB	124 KB	163 KB
HP iPAQ 1910	1310 KB	193 KB	261 KB
HP iPAQ 5450	1310 KB	193 KB	261 KB

Figure 5. Size of each business document as reported by the on-board tools on each device and in their native formats

The difference in download speed for our test web page between the two 802.11b devices was significant (figures 6 and 7). In our tests, client-side rendering time (the time from the initial page request to complete page loading), server session length (the actual length of the conversation between the client and the web server) and download speed were more than twice as fast on the Palm Tungsten C over all 3 test runs.

	Client-side rendering time	Server session length	Client download speed
Palm Tungsten C	11.69 seconds	11.17 seconds	121 kbps
HP iPAQ 5450	28.02 seconds	27.04 seconds	51 kbps

Figure 6. Average time to download a single web page over the same 802.11b network

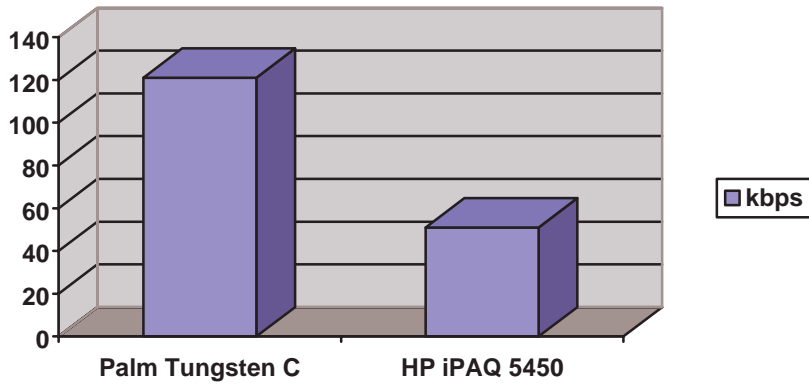


Figure 7. Wireless download speed in kbps for the test web page (higher number is better)

Appendix

A. Test Unit Configurations

Palm Tungsten C

Software:

- Palm OS v 5.2.1
- Chapura Pocket Mirror v 3.1.3 (Standard Edition)
- Palm Desktop v 4.1
- Docs to Go v 5.0003(566)
- Adobe Acrobat for Palm OS v 2.0 Build 062002
- Kinoma Player for Palm OS

Hardware:

- 400 MHz Intel Xscale Processor
- 64 MB RAM
- 1500 mAh Lithium-Polymer battery

Palm Tungsten T

Software:

- Palm OS v 5.0
- Chapura Pocket Mirror 3.1.2 (Standard Edition)
- Palm Desktop 4.1
- Documents to Go v 5.000 (481)
- Adobe Acrobat for Palm OS v 2.0 Build 062002
- Kinoma Player for Palm OS
- Real One Mobile Player for Palm

Hardware:

- Texas Instruments OMAP 1510 processor (144 MHz)
- 16 MB RAM 4 MB Flash ROM
- 900 mAh Lithium-Polymer battery

HP iPAQ Pocket PC 1910

Software:

- MS Pocket PC 2002 version 3.0.11171(Build 11178)
- MS Active Sync version 3.5 (Build 12007)
- Adobe Acrobat Reader for Pocket PC 2002

Hardware:

- 200 MHz Intel Xscale Processor
- 64 MB SDRAM 16 MB Flash ROM
- 900 mAh Lithium-Ion battery

Updates:

Installed update for MS media player from:
www.microsoft.com/windows/windowsmedia/software/pocket/plaerupdate.aspx

HP iPAQ Pocket PC 5450

Software:

- MS Pocket PC 2002 version 3.0.11171(Build 11178)
- MS Active Sync version 3.5 (Build 12007)
- Adobe Acrobat Reader for Pocket PC 2002

Hardware:

- 400 MHz Intel Xscale Processor
- 64 MB SDRAM 48 MB Flash ROM
- 1250 mAh Lithium-Polymer battery

Updates:

Installed SP23372 WLAN driver update
<ftp://ftp.hp.com/pub/softlib/software1/COL3280/hh-10840-1/SP23372.exe>

Test bed PCs and Web Server

Operating System	Windows XP Professional
Processor	Intel P4 1.3 GHz
System RAM	256 MB RDRAM
Motherboard Manufacturer	Intel Corporation
Motherboard Chipset / Model	Intel Corporation 82850 (850)/ D850GB
Main Bus Type	PCI
L2 Cache	256kB ECC synchronous ATC
BIOS / Version	Intel Corp. GB85010A.A017.P06.0102201104
HD Model # / Size	40 GB
HD Controller	Intel 82801BA Ultra ATA Storage Controller
HD Buffer Size	NA
Graphics Adapter	NVIDIA Vanta 16MB (Gateway)
Graphics Driver / Version	NVIDIA Vanta 16MB/ 6.3.2.0
Graphics Memory (MB type)	16 MB
Graphics Chip Type	Vanta
Video Resolution Assigned	1024 x 768
Color Depth Assigned	16 BPP
Refresh Rate Assigned	75 Hz
DAC Type	NA
Sound Board	Creative AudioPCI (ES1371, Es1373) (WDM)
NIC (Driver)	Linksys LNE100TX Fast Ethernet Adapter(LNE100TX v4)

B. Test Data Sources

MS Word Doc:

www.microsoft.com/office/techinfo/deployment/Xpdeploy.doc

Adobe PDF File:

www.planetpdf.com/mainpage.asp?webpageid=2373

[The_Adventures_of_Huckleberry_Finn_T.pdf](#)

MS Excel Spreadsheet:

www.microsoft.com/office/ork/2000/download/settings.xls

Video:

www.pocketmovies.net/detail_91.html

[jwsalmon_304X240.mpeg](#)

MP3:

Docs.real.com/docs/mobile/content/Orbiter_Sparks_on_a_string.mp3

Web Page:

www.cnn.com

VeriTest (www.veritest.com), the testing division of Lionbridge Technologies, Inc., provides outsourced testing solutions that maximize revenue and reduce costs for our clients. For companies who use high-tech products as well as those who produce them, smoothly functioning technology is essential to business success. VeriTest helps our clients identify and correct technology problems in their products and in their line of business applications by providing the widest range of testing services available.

VeriTest created the suite of industry-standard benchmark software that includes WebBench, NetBench, Winstone, and WinBench. We've distributed over 20 million copies of these tools, which are in use at every one of the 2001 Fortune 100 companies. Our Internet BenchMark service provides the definitive ratings for Internet Service Providers in the US, Canada, and the UK.

Under our former names of ZD Labs and eTesting Labs, and as part of VeriTest since July of 2002, we have delivered rigorous, objective, independent testing and analysis for over a decade. With the most knowledgeable staff in the business, testing facilities around the world, and almost 1,600 dedicated network PCs, VeriTest offers our clients the expertise and equipment necessary to meet all their testing needs.

For more information email us at info@veritest.com or call us at 919-380-2800.

Disclaimer of Warranties; Limitation of Liability:

VERITEST HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, VERITEST SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT VERITEST, ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL VERITEST BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL VERITEST'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH VERITEST'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.