Smartphone Efficiency Report

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http://www.rysavy.com

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Introduction

Over the last year, smartphone data usage on wireless networks has surged thanks to powerful, easy-to-use devices, fast networks, and useful, as well as entertaining, applications. Usage is expected to keep increasing as users find ever more ways of applying their devices.

Nielsen reports that average smartphone data consumption increased by 230 percent between the first quarter of 2009 and the first quarter of 2010, from 90 megabytes (MB) per month to 298 MB per month.[1] Validas indicates that Verizon Wireless smartphones currently consume 421 MB per month while iPhones consume 338 MB per month.[2]

There are a number of critical developments that have occurred over the last year. One is that the volume of traffic is beginning to strain wireless-network resources. Another is that operators are making a shift to usage-based data plans. AT&T's new tiered pricing is a prominent example. There is every indication that other operators will follow similar approaches. While flat-rate plans made sense initially to stimulate the market, today's smartphones can consume so much data that such plans will be decreasingly viable for operators.

Deploying more efficient wireless technologies and finding more spectrum will help alleviate congestion. But even as operators slowly expand network capacity, usage will keep pushing against network capacity. For details of this, refer to the Rysavy Research report of February 2010, "Mobile Broadband Capacity Constraints and the Need for Optimization."[3]

Applications that are designed specifically for bandwidth-constrained networks can consume significantly less data than those that are not. As shown in this report, efficient browsers communicate only half the data of other mainstream mobile browsers. Similarly, as previously reported by Rysavy Research in "Wireless E-Mail Efficiency Assessment," e-mail systems such as BlackBerry consume much less data for e-mail communications than alternatives.[4]

In this report, we advise on an efficiency comparison of the BlackBerry 6.0 platform versus Apple iPhone iOS3 and Android 2.1. According to IDC, BlackBerry OS, iPhone iOS, and Android accounted for over 87%

[1] http://blog.nielsen.com/nielsenwire/online_mobile/quantifying-the-mobile-data-tsunami-and-its-implications/

[2] http://www.fiercetelecom.com/press_releases/validas-reports-verizon-wireless-smartphones-consume-more-data-iphones-0

[3] http://www.rysavy.com/Articles/2010_02_Rysavy_Mobile_Broadband_Capacity_Constraints.pdf

[4] http://www.rysavy.com/Articles/2009_01_27_Rysavy_EMail_Efficiency.pdf

of the total US smartphone market by operating system in Q2 2010[5]. We tested across a number of applications including e-mail, Web browsing, instant messaging, and social networking. The report shows that BlackBerry consumes far less data. As a consequence, many BlackBerry users will be able to choose lower-cost data usage plans. This report is an update to a report by the same title that we published on August 2, 2010.

Wireless Application Architecture

Although the result provided to the end user is the same, the mechanism by which a BlackBerry device retrieves a Web page and other Internet content is very different from other types of smartphones.

Non-BlackBerry Internet Operation

Web browsers and clients utilizing HTTP (e.g., Facebook) on devices other than BlackBerry function much the same as those on a standard PC. When the browser makes a request for a webpage, it performs the same HTTP requests that a PC browser would. The main difference is not in the HTTP request-response cycle, but rather in the content that is typically returned from the Web server. Most of the popular sites on the Internet have Web pages that are programmed to return different content based on the value of the "User-agent" field in the HTTP GET request. Typically, the returned webpage will be tailored by the site operator to display nicely on the smaller screen of the mobile device and to minimize horizontal scrolling.

Once the browser retrieves the initial page, it will then parse the page and issue requests for the dependent objects just as a standard, non-mobile browser would do.

BlackBerry

When the BlackBerry browser accesses a Web site, it sends a request to a server at the RIM network operations center (NOC). The data server in the NOC retrieves the requested resource either via its own cache or directly from the Web server and returns the requested content to the device. The server also saves bandwidth by compressing the information being passed to the device.

One advantage with respect to efficiency that BlackBerry offers is that client applications do not communicate directly with end sites, but communicate with the RIM-hosted proxies that communicate with services on the mobile system's behalf. This allows for optimization of communication between the proxy and the mobile system. It also enables longer-term logins because the proxy has a stable connection with the service. In contrast, mobile connections directly to end services are vulnerable to connection losses and can result in session renegotiation.

[5] IDC Mobile Phone Tracker, August 2010

Overview of Testing

To quantify the amount of data used by typical consumer-oriented applications in representative usage scenarios, Rysavy Research, in a project sponsored by RIM, worked in conjunction with Quality in Motion to conduct a series of detailed and methodical tests. These tests included the latest BlackBerry 6.0 device–the BlackBerry 9800, the iPhone 3GS with iOS3, and Android 2.1 on a Motorola Milestone device. Although the iPhone 4 is now available, the amount of data consumed by the two phones is similar, because data usage is dependent upon application protocols, not the operating system. For instance, the WebKit based browser on the iPhone sends the same HTTP request and the server sends the same HTTP response for an iPhone with iOS3 as for an iPhone with iOS4. Similarly, with e-mail configured to use ActiveSync, it is the Microsoft Exchange ActiveSync protocol that determines the data usage, not the iPhone OS version.

We used an Agilent network emulator, which simulates connectivity to a real wireless network. In this approach, the device connects exactly as it would with a live network connection, but it enabled us to capture all the data traffic for analysis.

We performed tests on the following applications: e-mail, Web-browsing, instant messaging, and social networking.

E-mail Efficiency

This series of tests measured the amount of data consumed in sending data to mobile devices. We used both text messages and messages with attachments:

- 1K text body only
- 5K text body only
- 10K text body only
- 20K text body only
- 44K HTML body
- 5K text body + 150K JPG
- 5K text body + 355K PDF
- 5K text body + 500K DOC
- 5K text body + 1MB PPT
- 5K text body + 50K XLS

The following messaging systems were used.

- BlackBerry 6 accessing Gmail via BlackBerry Internet Service (BIS).

- iPhone iOS3 accessing Gmail using the ActiveSync protocol in conjunction with SSL. (We used this configuration, because it represents a push e-mail format that provides functionality similar to BlackBerry.)
- Android 2.1 accessing Gmail using the native Gmail client.

We captured data for the device to receive the message, to open and view the message, and to download attachments, when necessary.

Web Browsing

This series of tests measured efficiency accessing ten popular Web sites. We hosted these on our own servers to ensure consistent and repeatable content. We created the content by taking snapshots of popular Web sites as ranked by Alexa. These included Amazon, Bing, CNN, craigslist, ESPN, Facebook, Google, MSN, Yahoo, and Wikipedia.

Most Web sites will return different content based on the browser and device that is accessing the site, but to be consistent and ensure comparability across the range of devices used in our testing, we produced a single version of each site, which was used with all the devices. We updated the main page and many of the supporting cascading style sheets (CSS) and JavaScript files to point to our hosted version of the content instead of the version on the live site.

Instant Messaging

These tests measured the amount of data sent and received during the exchange of pre-defined messages and while performing account modifications from the mobile device.

The IM applications we tested were the Google Talk client on the BlackBerry 6.0, Google Talk on iPhone iOS3 (via Safari Web browser) and the Google Talk client on Android.

Social Networking

These tests measured the amount of data uploaded and downloaded while logging in, viewing information feeds, posting updates, exchanging messages, adding friends, and uploading photos, which in our view constitutes common social networking usage We used a Facebook client on all devices accessing the Facebook service.

Audio and Video Streaming

We did not perform video streaming tests since the amount of data consumed is consistent across all platforms. Furthermore, the amount of data consumed is almost directly correlated to the bit rate of the stream.

Summary of Test Results

We calculated the ratio of total bytes communicated in both directions relative to the initial message size and called this “percentage of data communicated.” For example, if a 10-Kbyte e-mail message involves 15 Kbytes of data received by the device plus 5 Kbytes of data sent to the device, then that means 20 Kbytes were communicated and the percentage of data communicated would be 20 Kbytes / 10 Kbytes, or 200%. If only 5 Kbytes were sent and received in total to transfer the message, then the percentage of data communicated would be 50%. Lower percentages are clearly desirable since they represent a more efficient system.

For some of the tests, it is impossible to do the percentage-of-data calculation since there is no source data size to use for the comparison. In these cases, efficiency is reported as the relative amounts of data that the different clients send and receive. For example, in the social-networking tests, there is no source media to use as the baseline for a “News Feed” or “Notifications” viewing. Thus, a direct comparison of the data transferred for the different test clients is the only available metric.

The tables show separately the bytes downloaded and bytes uploaded for each operation.

E-Mail Comparison

The following table summarizes the e-mail results between BlackBerry, iPhone iOS3, and Android.

Table 1: Comparison of Data Communicated for E-Mail

Device	Body Size	Attach Size	Attach Type	Total Upload	Total Download	Total Bytes	% Sent	BlackBerry Efficiency Advantage
BlackBerry 6	1024	0	N/A	313	938	1251	122.17%	
iPhone iOS3	1024	0	N/A	19942	19683	39625	3869.65%	**31.7**
Android 2.1	1024	0	N/A	1879	3300	5179	505.76%	**4.1**
BlackBerry 6	5120	0	N/A	444	3093	3537	69.08%	
iPhone iOS3	5120	0	N/A	17469	20122	37591	734.21%	**10.6**
Android 2.1	5120	0	N/A	2026	5088	7114	138.95%	**2.0**
BlackBerry 6	10240	0	N/A	948	6225	7173	70.05%	
iPhone iOS3	10240	0	N/A	18033	30881	48913	477.67%	**6.8**
Android 2.1	10240	0	N/A	2150	7589	9739	95.11%	**1.4**
BlackBerry 6	20480	0	N/A	2163	12494	14657	71.57%	
iPhone iOS3	20480	0	N/A	20255	46977	67232	328.28%	**4.6**
Android 2.1	20480	0	N/A	2546	13219	15765	76.98%	**1.1**
BlackBerry 6	44744	0	HTML	892	11965	12857	28.74%	
iPhone iOS3	44744	0	HTML	41746	184428	226174	505.48%	**17.6**
Android 2.1	44744	0	HTML	4111	18501	22612	50.54%	**1.8**
BlackBerry 6	5120	511488	DOCX	3776	45432	49208	9.53%	
iPhone iOS3	5120	511488	DOCX	48228	577593	625820	121.14%	**12.7**
Android 2.1	5120	511488	DOCX	20200	555135	575335	111.37%	**11.7**
BlackBerry 6	5120	51200	XLSX	989	5416	6405	11.37%	
iPhone iOS3	5120	51200	XLSX	23974	100530	124504	221.07%	**19.4**
Android 2.1	5120	51200	XLSX	10277	68657	78934	140.15%	**12.3**
BlackBerry 6	5120	152148	JPG	1674	27678	29352	18.66%	
iPhone iOS3	5120	152148	JPG	31433	191425	222858	141.71%	**7.6**
Android 2.1	5120	152148	JPG	16135	223286	239421	152.24%	**8.2**
BlackBerry 6	5120	363139	PDF	10310	345219	355528	96.54%	
iPhone iOS3	5120	363139	PDF	41637	417808	459446	124.76%	**1.3**
Android 2.1	5120	363139	PDF	17568	399332	416899	113.21%	**1.2**
BlackBerry 6	5120	966144	PPTX	23962	684175	708137	72.91%	
iPhone iOS3	5120	966144	PPTX	73040	1069669	1142709	117.65%	**1.6**
Android 2.1	5120	966144	PPTX	32840	1040422	1073261	110.50%	**1.5**
Average BlackBerry Advantage over iPhone								**11.4**
Average BlackBerry Advantage over Android								**4.5**

For each message type, the last column shows the efficiency advantage of BlackBerry over iPhone iOS and over Android. For example, in the first test message of a 1024 byte message with no attachment, BlackBerry communicated a total of 1251 bytes whereas iPhone iOS communicated 39625. This represents a 39625 divided by 1251, or 31.7 times efficiency advantage of BlackBerry over iPhone. Not only does BlackBerry implement efficient communications protocols, but its file viewers minimize the amount of information that needs to be downloaded for attachments. By averaging the efficiency of BlackBerry over all the message types, BlackBerry has an 11.4 times advantage over iPhone iOS and 4.5 times advantage over Android.

Web Browsing Comparison

The following table summarizes the Web-browsing results between BlackBerry, iPhone iOS and Android.

Table 2: Comparison of Data Communicated for Web Browsing

Device	Website	Website Bytes	Download Bytes	Upload Bytes	Total Bytes	% Sent	BB Efficiency Advantage
BlackBerry 6	Amazon	209869	10871	129144	140015	67%	
iPhone iOS3	Amazon	209869	31658	178716	210375	100%	**1.5**
Android 2.1	Amazon	209869	37840	200066	237906	113%	**1.7**
BlackBerry 6	Bing	78226	5546	53103	58649	75%	
iPhone iOS3	Bing	78226	17183	92663	109846	140%	**1.9**
Android 2.1	Bing	78226	19108	93109	112217	143%	**1.9**
BlackBerry 6	CNN	145406	5295	85384	90679	62%	
iPhone iOS3	CNN	145406	16448	156512	172960	119%	**1.9**
Android 2.1	CNN	145406	17783	168496	186279	128%	**2.1**
BlackBerry 6	Craigslist	122795	2543	43138	45681	37%	
iPhone iOS3	Craigslist	122795	6483	129313	135796	111%	**3.0**
Android 2.1	Craigslist	122795	6773	130000	136772	111%	**3.0**
BlackBerry 6	ESPN	92706	6014	61145	67159	72%	
iPhone iOS3	ESPN	92706	18284	105258	123542	133%	**1.8**
Android 2.1	ESPN	92706	20728	109249	129977	140%	**1.9**
BlackBerry 6	Facebook	181196	10051	137995	148046	82%	
iPhone iOS3	Facebook	181196	26787	203468	230254	127%	**1.6**
Android 2.1	Facebook	181196	28571	202990	231561	128%	**1.6**
BlackBerry 6	Google	88375	2877	41930	44807	51%	
iPhone iOS3	Google	88375	4704	85552	90256	102%	**2.0**
Android 2.1	Google	88375	5788	87027	92816	105%	**2.1**
BlackBerry 6	MSN	41268	4925	33606	38531	93%	
iPhone iOS3	MSN	41268	14424	51829	66253	161%	**1.7**
Android 2.1	MSN	41268	16946	53035	69981	170%	**1.8**
BlackBerry 6	Wikipedia	141536	3578	54940	58519	41%	
iPhone iOS3	Wikipedia	141536	9128	151684	160812	114%	**2.7**
Android 2.1	Wikipedia	141536	11571	153594	165165	117%	**2.8**
BlackBerry 6	Yahoo	90455	3618	41968	45586	50%	
iPhone iOS3	Yahoo	90455	12708	103776	116484	129%	**2.6**
Android 2.1	Yahoo	90455	13686	103745	117431	130%	**2.6**
Average BlackBerry Advantage over iPhone							**2.1**
Average BlackBerry Advantage over Android							**2.1**

As explained for the e-mail tests, the last column shows the BlackBerry efficiency advantage over iPhone iOS and Android. In averaging these results, BlackBerry had an average efficiency of 2.1 times over iPhone and Android.

Google Talk IM Comparison

For Google Talk instant-messaging, testing measured bytes communicated for sign-in, sending a text message, including an emoticon, and changing status.

Table 3: Comparison of Data Communicated for Sign-In

Device	Sign-in Upload	Sign-in Download	Total Bytes Sign-in
BlackBerry 6	2149	11412	13561
iPhone iOS3	69897	304502	374399
Android 2.1	738	1464	2203

Table 4: Comparison of Data Communicated for Sending Text-Only Messages

Device	Text Size	Upload Text Exchange	Download Text Exchange	Total Bytes Text Exchange
BlackBerry 6	362	6687	9176	15864
iPhone iOS3	362	45450	47461	92911
Android 2.1	362	2857	2771	5628

Table 5: Comparison of Data Communicated for Exchanging Emoticons

Device	Upload Emoticon Exchange	Download Emoticon Exchange	Total Bytes Emoticon Exchange
BlackBerry 6	495	1165	1660
iPhone iOS3	8786	14888	23674
Android 2.1	397	347	744

Table 6: Comparison of Data Communicated for Changing Status

Device	Upload Change Status	Download Change Status	Total Bytes Change Status
BlackBerry 6	359	597	956
iPhone iOS3	3514	4365	7879
Android 2.1	299	448	747

In this test, for all operations, Android was most efficient, followed by BlackBerry and then iPhone iOS. Not only does BlackBerry communicate significantly fewer bytes for each operation than iPhone iOS, but since its connection is via a proxy, the connection to the server is generally more stable and thus requires fewer sign-ins than with a direct connection.

For message transfer in IM, BlackBerry had an efficiency advantage of 5.9 times over iPhone iOS and was .4 times as efficient as Android.

Facebook Social Networking Comparison

For Facebook social-networking, testing measured bytes for a typical activity (including sign-in, obtaining a refresh of feeds and updates, posting a status update, commenting on a post, writing a message, and adding a friend); viewing a friend's photos; and uploading a photo.

Table 7: Comparison of Data Communicated for Typical Activity

Device	Typical Activity Upload	Typical Activity Download	Total Bytes Typical Activity
BlackBerry 6	34485	55944	90428
iPhone iOS3	73906	128986	202892
Android 2.1	62578	174782	237360

Table 8: Comparison of Data Communicated for Viewing Photos

Device	View Photos Upload	View Photos Download	Total Bytes View Photos
BlackBerry 6	4051	26917	30968
iPhone iOS3	13882	182690	196572
Android 2.1	9852	181088	190940

Table 9: Comparison of Data Communicated for Uploading a Photo

Device	Photo 1 Size	Upload Photo 1 Upload	Upload Photo 1 Download	Total Bytes Upload Photo 1
BlackBerry 6	255139	149567	4862	154429
iPhone iOS3	255139	133796	12205	146001
Android 2.1	255139	560783	29654	590437

Table 10: Comparison of Data Communicated for Uploading a Second Photo

Device	Photo 2 Size	Upload Photo 2 Upload	Upload Photo 2 Download	Total Bytes Upload Photo 2
BlackBerry 6	514038	149157	5367	154524
iPhone iOS3	514038	133561	11012	144573
Android 2.1	514038	353589	20010	373599

For most operations, BlackBerry communicated far fewer bytes.

For typical activity, BlackBerry had an average efficiency advantage of 2.2 times over the iPhone iOS and 2.6 times over Android.

Conclusion

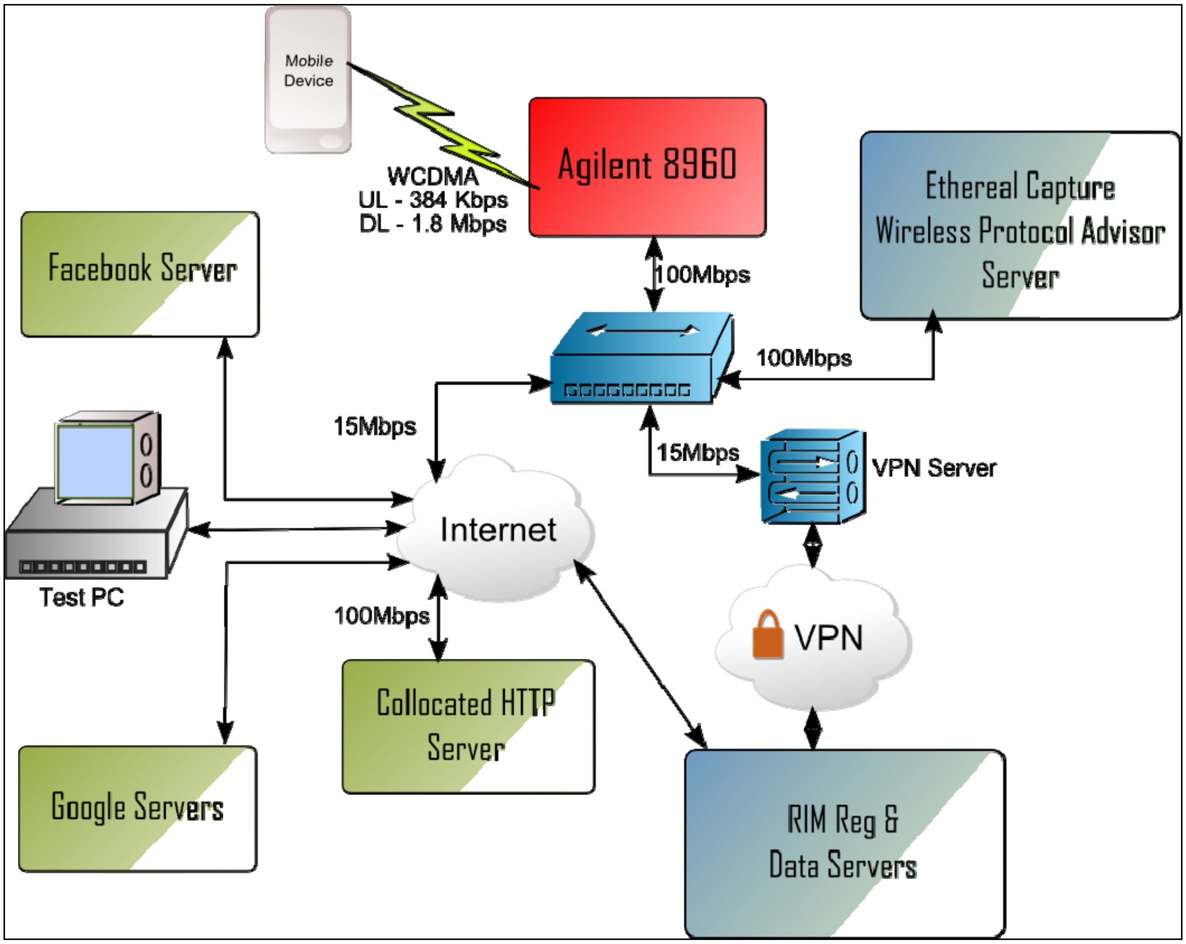
Across multiple applications, BlackBerry averages significantly less data consumption than leading alternative platforms such as iPhone iOS and Android, particularly for e-mail and Web browsing. For Web browsing, BlackBerry was on average 2.1 times more efficient than iPhone iOS and Android across the test sites measured. For the e-mail configurations tested, BlackBerry on average across all the message types, was 4.5 times more efficient than Android and 11.4 times more efficient than iPhone iOS.

Reduced data consumption provides users many benefits, including the possibility of lower monthly service plans, faster application operation, and increased battery life.

Appendix: Test Configuration

This section provides details on the test configuration, as shown in Figure 1.

Figure 1: Test Configuration



The test environment consisted of five main components: the test devices, the Agilent 8960, the Ethereal analyzer capture server, the collocated HTTP Server, and a PC connected to the internet. For the BlackBerry testing, we also had to establish a VPN connection to the RIM NOC. For all devices except the BlackBerry, the Web browser on the device would establish a TCP connection to the HTTP Web server, via the Agilent 8960 and the Internet, and retrieve the Web site content directly from the site. In this environment, no links in the system were slower than the radio link, ensuring that any bandwidth limitations were caused by the radio link. For the BlackBerry, the request would actually be issued over the VPN tunnel that was established between the test network and the RIM NOC. The RIM NOC then retrieved the Web site elements from the collocated Web server and returned the elements to the BlackBerry device via the VPN tunnel.

The network emulation test equipment was an Agilent 8960, a highly sophisticated wireless test system. This equipment combines a UMTS (Universal Mobile Telecommunications System) radio interface with a Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). In other words, it emulates an entire cellular operator network. Communications with the handheld device occur over a wireless connection provided by the network emulator, with all protocols identical to those used by a commercial network. The wireless device under test cannot differentiate between this and a commercial operator network. The Agilent equipment is able to capture the data traffic and make the traffic available for analysis.

The next element of the test architecture was an Ethereal capture server. The Ethereal, as described further in the next section, actively captured—via the Agilent equipment—all the data traffic being sent to and from the handheld device. In this test environment, we analyzed the data traffic captures to ensure that the devices were not utilizing cached data, were properly returning all HTTP requests and were not receiving any data from sources external to the test sites.

For the instant messaging and social network tests, we utilized a PC that was connected to the controlled test environment via the Internet and served as the source for exchanges between contacts.

The final element was the test Web server used to serve the static test Web sites. This Web server was hosted on Windows 2003 Server version using IIS 6.0. The server was located in a collocation facility with a 100Mbps, full-duplex connection and configured to serve no other traffic than the test Web sites.

We repeated each test configuration five times for each device. Given the high degree of consistency in the measurements, we achieved a high level of confidence in the test results.