



Wireless Data Efficiency

Get the Most Megabytes for Your Buck

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Agenda



- Importance of efficiency
- Characteristics of optimized wireless e-mail systems
- Wireless efficiency test methodology
- Test results, observations and recommendations
- Battery test methodology
- Battery test results, observations and recommendations
- Conclusion

Why Efficiency Matters

- User benefits
 - Transactions occur faster
 - Transactions complete when time matters
 - Batteries last longer
- Organization benefits
 - Usage charges can be lower
 - May enable lower-cost monthly data plan
 - Users more satisfied and productive
- Operator benefits
 - Experience lower loads on their networks
 - Can support more users



Optimized Wireless E-Mail



- **Push:** Rather than e-mail clients polling for data, the system “pushes” messages to the device
- **Efficient:** Users can read just the first part of the message rather than download the whole message and obtain additional portions of the message as desired
- **Fast:** The system compresses the data to minimize communication time
- **Efficient Attachment Handling:** Users can easily view attachments portion by portion and in a format optimized for the display on the device
- **Mailbox Synchronization:** Users can work with just one “mailbox” with the handheld inbox synchronized to the desktop inbox
- **Security:** The system encrypts communication on an end-to-end basis and does not depend on any security provisions in the wireless network
- **Sophisticated Management Tools:** The wireless e-mail system provides tools for easily managing, updating and adding user accounts

Efficiency Test Methodology



- Objective
 - Determine whether different wireless e-mail systems consume different amounts of data
- RIM:
 - BlackBerry Enterprise Server 4.1
 - BlackBerry 7290
- Microsoft:
 - Microsoft Exchange Server 2003 with Service Pack 2
 - Windows Mobile 5 Messaging and Security Feature Pack (Direct Push) on T-Mobile MDA
- Measure e-mail systems in completely controlled environments
- Use e-mail test messages that are representative of typical usage
- Measure actual amount of data sent and received
- Repeat each test 5 times to ensure repeatability
- Use test automation for message sending and data analysis
- Use test equipment to simulate cellular network connections

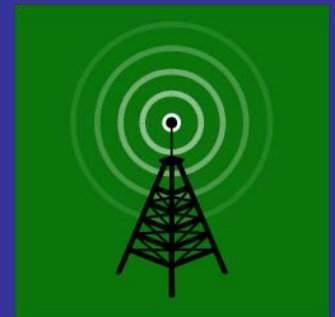
Note: Engineering analysis, including battery tests, performed in conjunction with Quality in Motion, Inc

Network Simulation

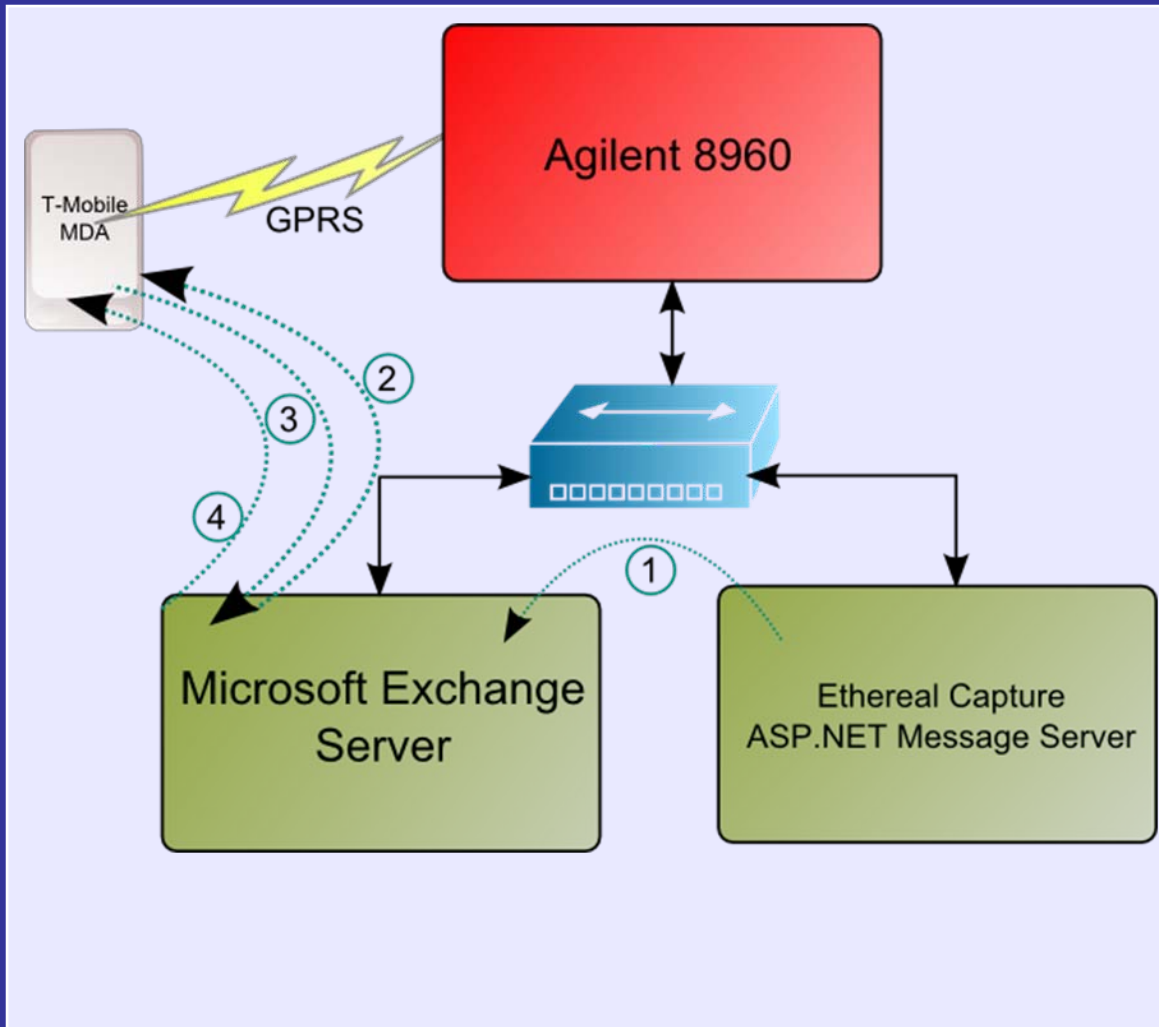
Why use a network simulator?

- Network simulator makes test network look like real cellular network – device sees no difference
- Provides completely controlled environment
- Has ability to capture exact “over-the-air” traffic
- Traffic can be analyzed for exact message sizes
- Extract IP-level payload (ignore radio protocols)
- High repeatability achievable

- Connection types
 - Direct antenna connection
 - Shielded antenna cage

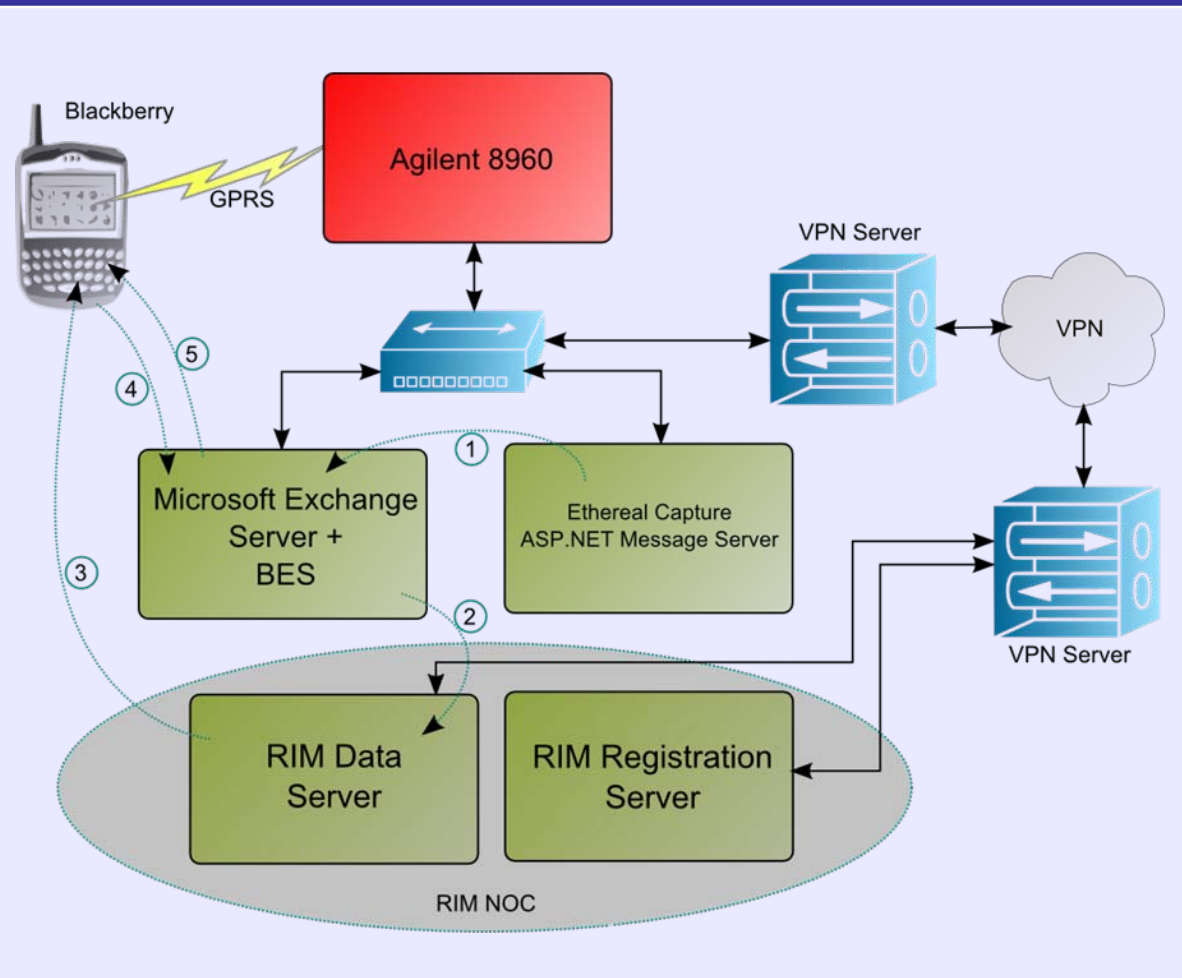


Microsoft Direct Push Test Configuration



1. E-mail sent from test script to Exchange Server
2. Exchange Server notifies handheld of new message
3. Handheld requests new message from Exchange Server
4. Exchange Server sends new message to handheld

RIM BlackBerry Test Configuration



1. E-mail sent from test script to Exchange Server
2. The BlackBerry Enterprise Server is notified of the new message and notifies the data server at the RIM NOC
3. The data server at the RIM NOC then notifies the handheld that a new message has arrived
4. The handheld and the RIM NOC communicate to confirm availability
5. The BES sends the new message to the handheld

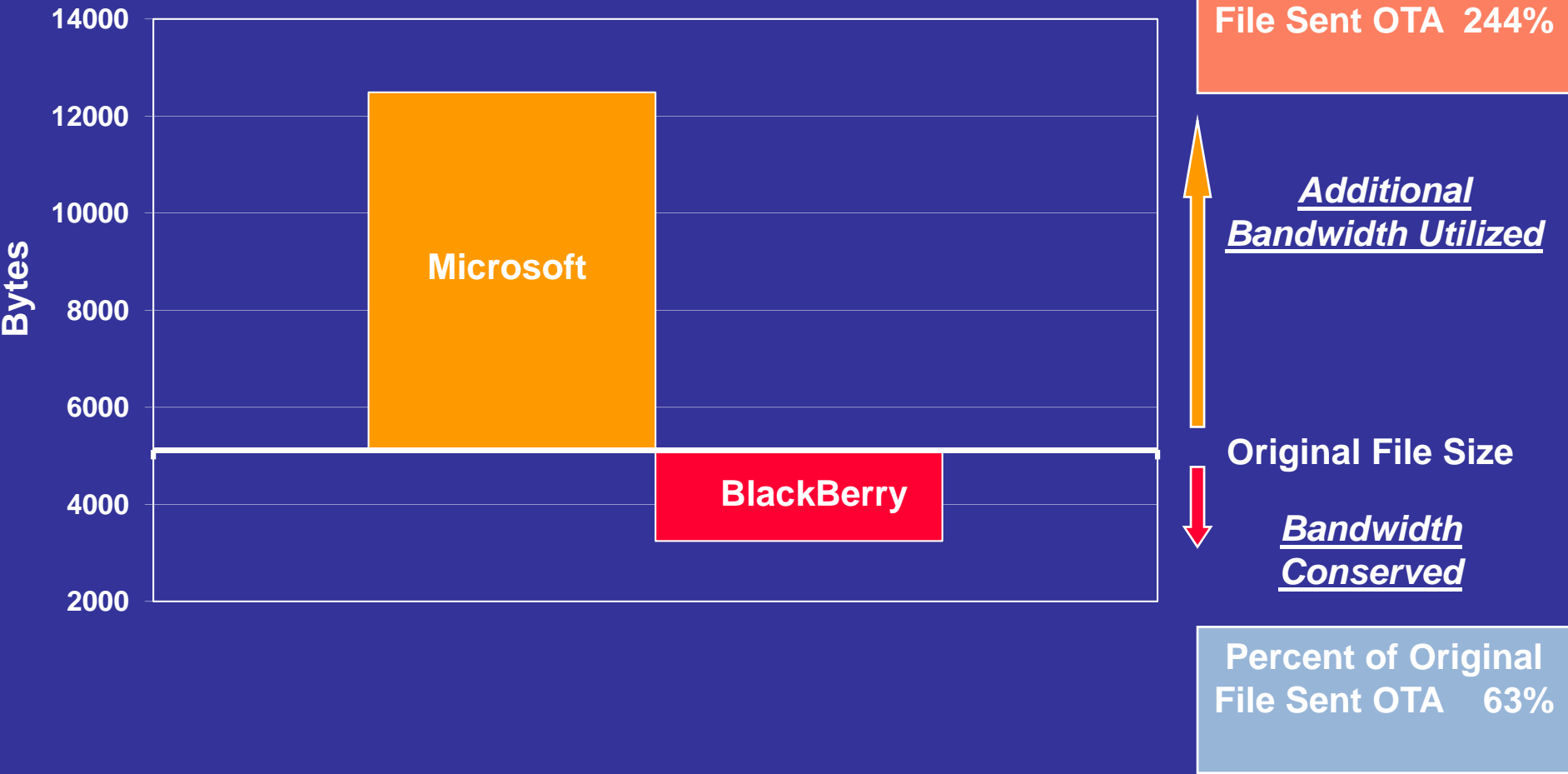
Test Message Types

Message Body Size	Attachment Size	Attachment Type
5 KB	0 KB	N/A
10 KB	0 KB	N/A
20 KB	0 KB	N/A
5 KB	149 KB	JPEG
5 KB	162 KB	PDF Text only
5 KB	106 KB	PDF Text + Images
5 KB	500 KB	Word doc
5 KB	944 KB	PowerPoint
5 KB	75 KB	Excel Spreadsheet

Bandwidth Comparison - Email only



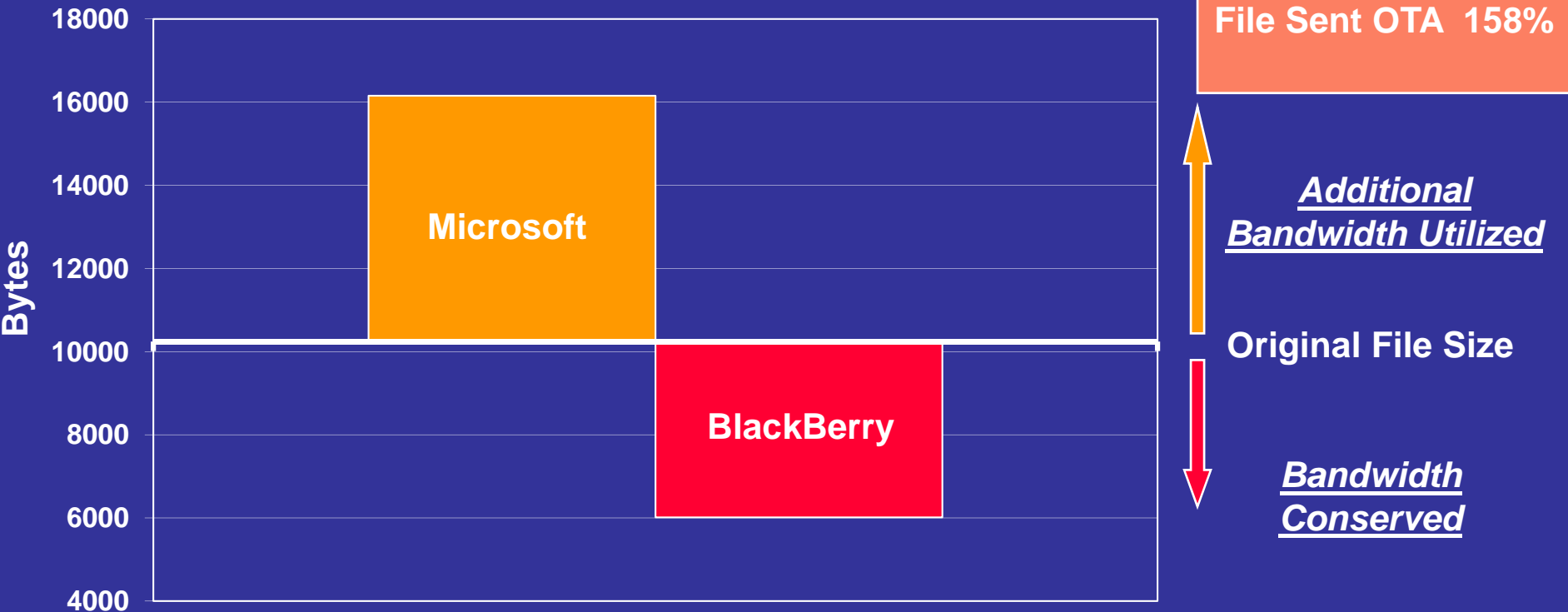
E-mail - 5120 Bytes : No Attachment



Bandwidth Comparison - Email only

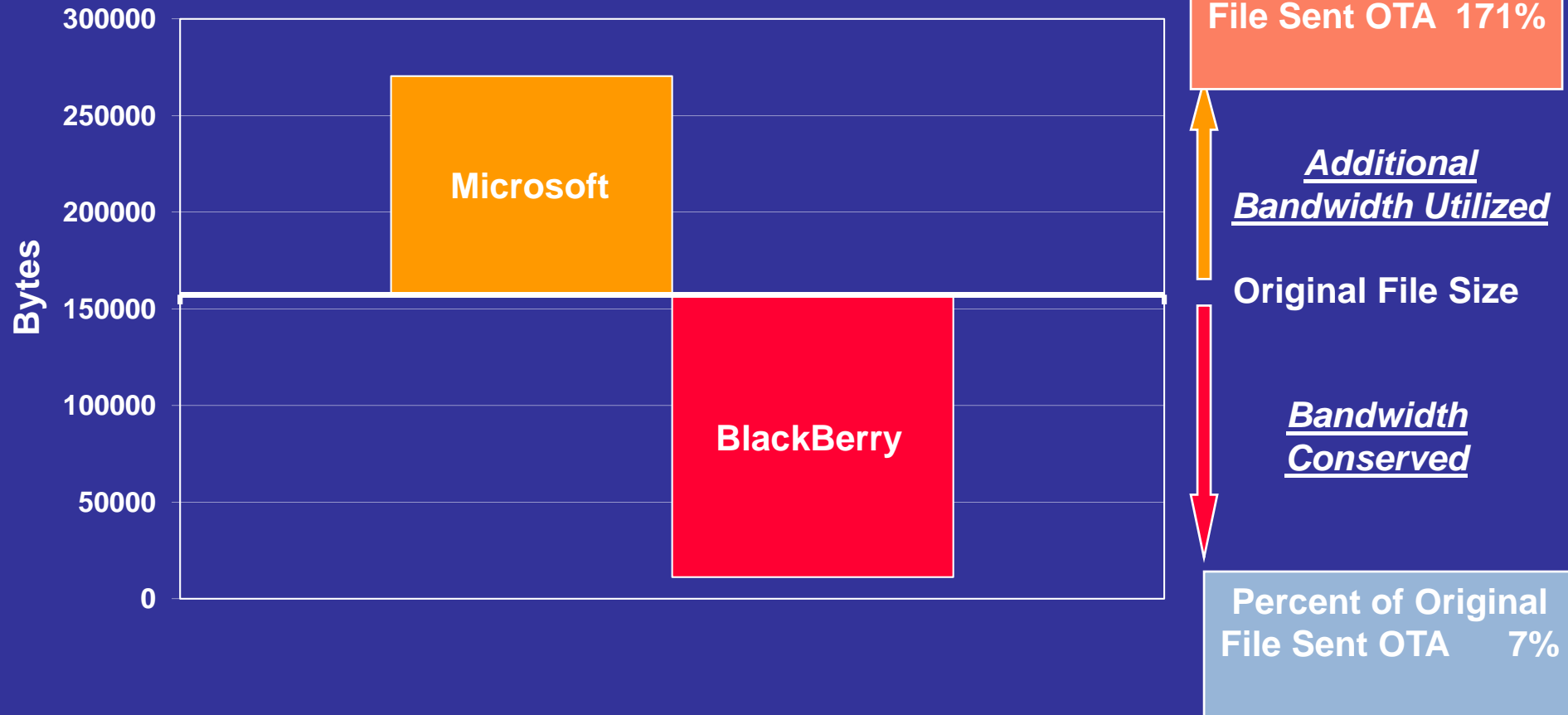


E-mail - 10240 Bytes : No Attachment



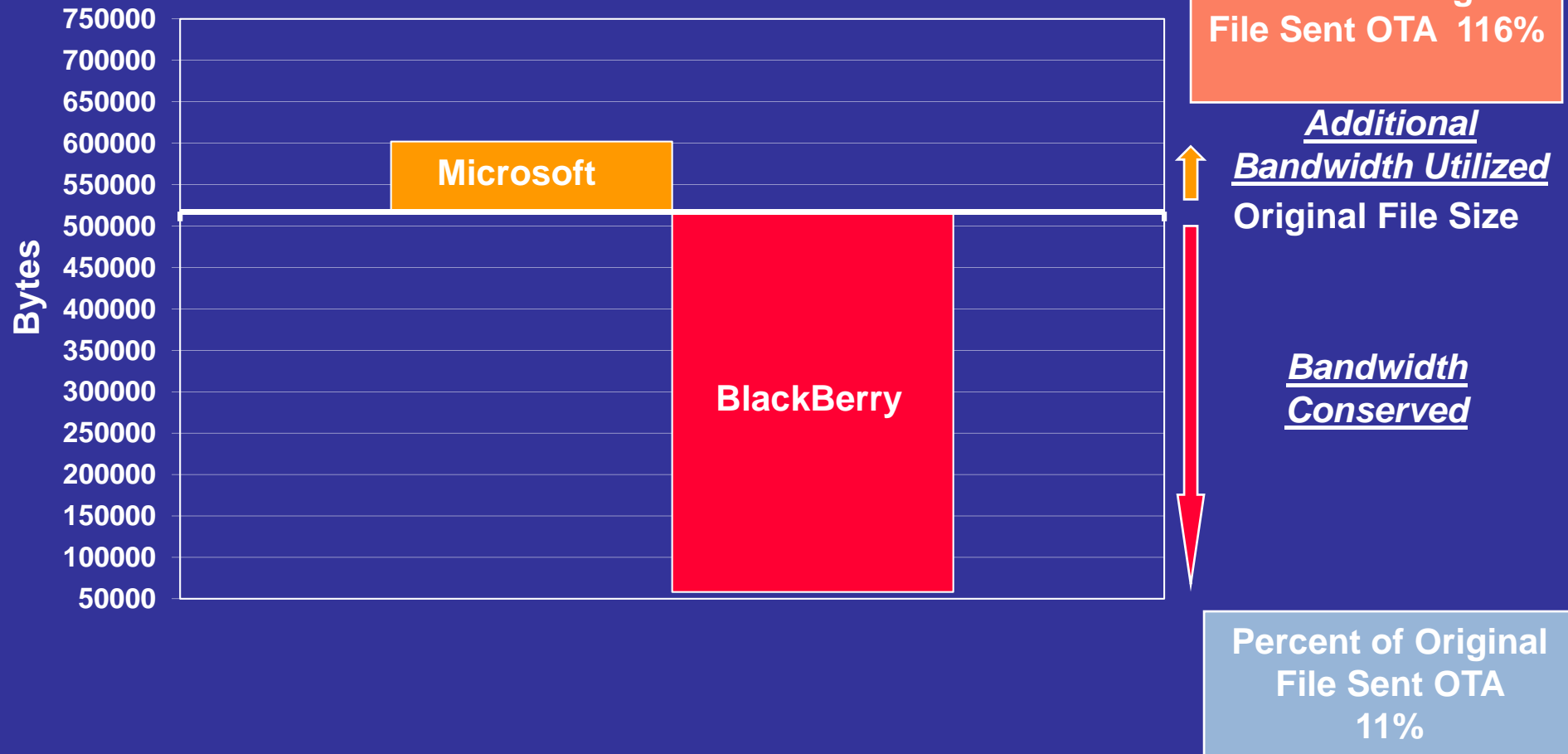
Bandwidth Comparison - Email With Image Attachment

E-mail - 5120 Bytes + JPG - 152576 Bytes



Bandwidth Comparison - Email With Word Attachment

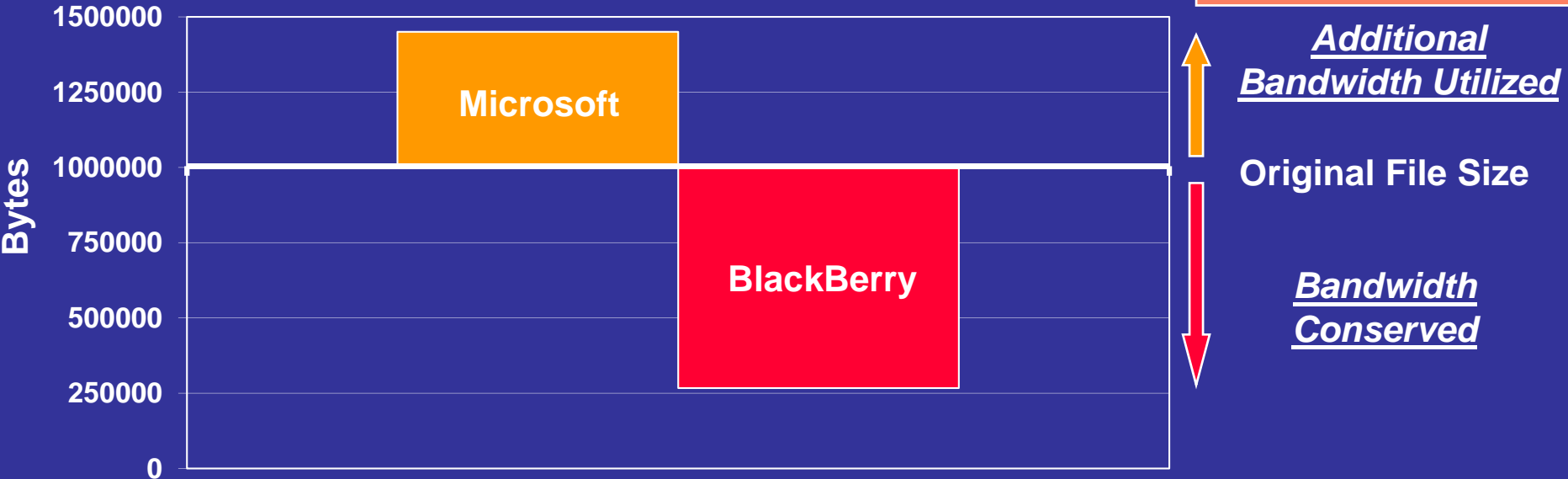
E-mail - 5120 Bytes + Word Doc - 512000 Bytes



Bandwidth Comparison - Email With PowerPoint Attachment

E-mail - 5120 Bytes + PPT - 966656 Bytes

Percent of Original File Sent OTA 149%

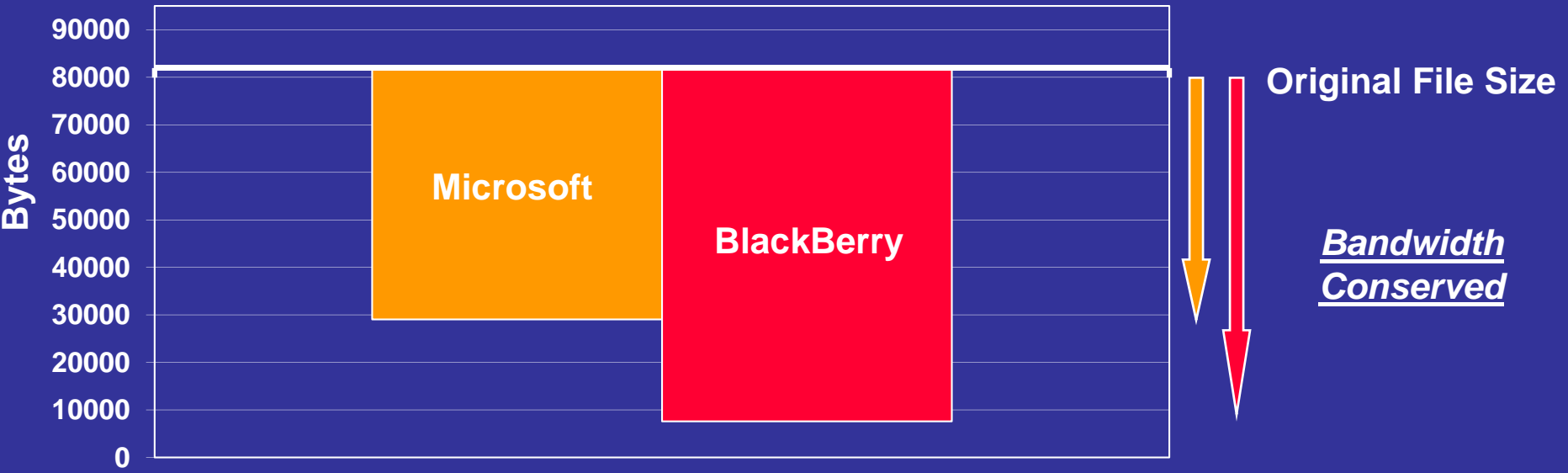


Percent of Original File Sent OTA 27%

Bandwidth Comparison - Email With Excel Attachment

E-mail - 5120 Bytes + Excel - 76800 Bytes

Percent of Original File Sent OTA 35%



Percent of Original File Sent OTA 9%

Efficiency Summary



				Direct Push		BlackBerry	
Message Size	Attachment Type	Attachment Size	Message Plus Attachment	Sent Over The Air	% Sent	Sent Over The Air	% Sent
5120	None	0	5120	12489	244%	3244	63%
10240	None	0	10240	16154	158%	6012	59%
20480	None	0	20480	20994	103%	11518	56%
5120	JPEG	152576	157696	270385	171%	11170	7%
5120	PDF text	165888	171008	251416	147%	187641	110%
5120	PDF image	108052	113172	183658	162%	26896	24%
5120	Word Doc	512000	517120	602027	116%	58209	11%
5120	PPT file	966656	971776	1450367	149%	266949	27%
5120	Excel	76800	81920	29055	35%	7581	9%

Efficiency Observations

- In all cases, BlackBerry was significantly more efficient than Direct Push
 - BlackBerry uses highly efficient UDP-based communications protocol
 - Direct Push uses HTTP over TCP, with higher overhead
- In nearly all cases, BlackBerry sent less data over the air than the original file size
- In nearly all instances, Direct Push sent more data over the air than the original file size
- Attachment viewers are a far more efficient approach than downloading entire file
- Efficiency benefits: faster e-mail, e-mail received in time, better battery life

Efficiency Recommendations



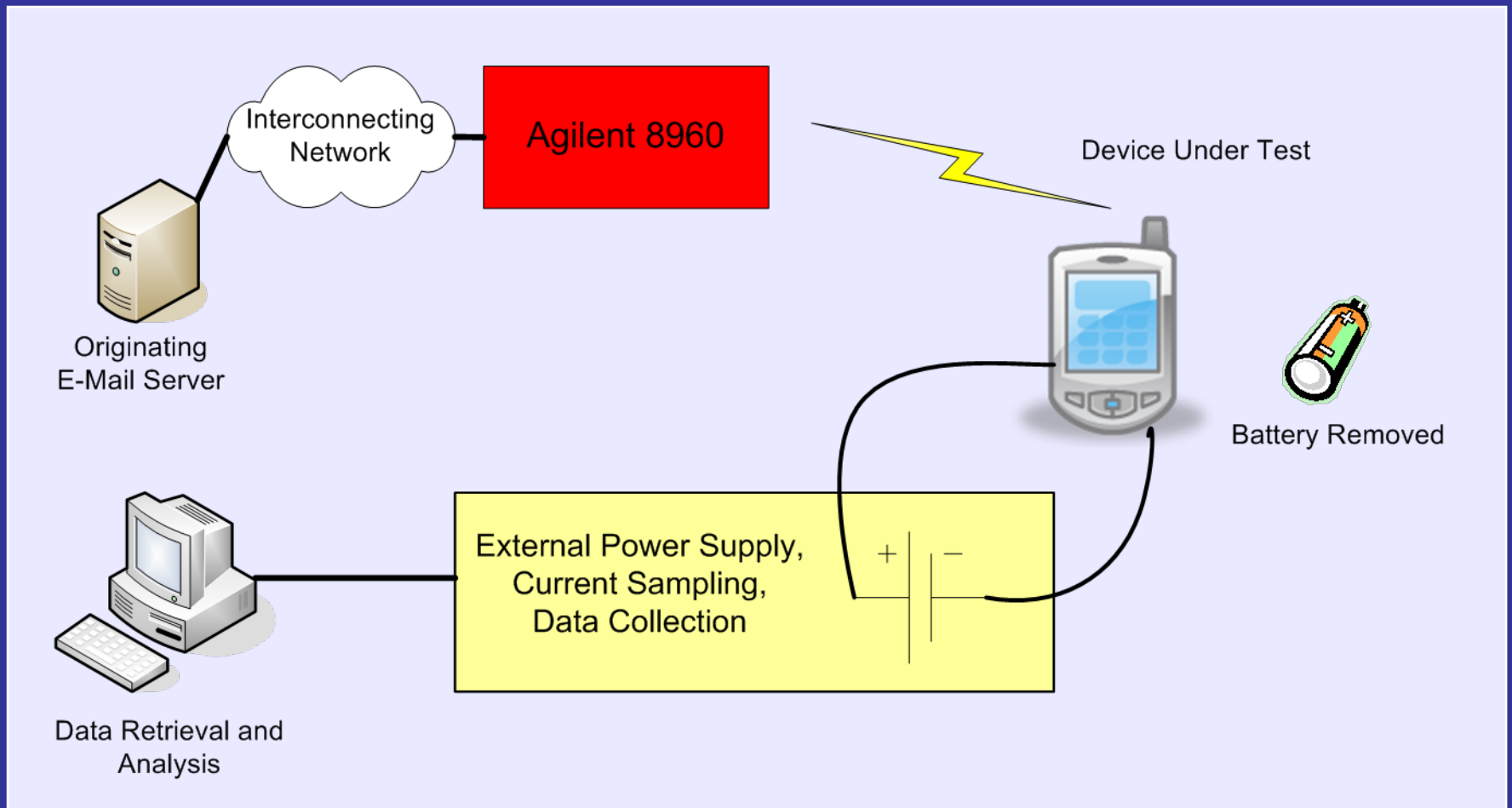
- Understand efficiency of different e-mail systems and purchase accordingly
- Conduct your own efficiency tests
 - Send test messages as per your own profiles
 - Use carrier-provided Web-based data usage metrics or install data consumption utilities
- Most e-mail systems are configurable for how much of a message the client loads at a time
 - Use smallest amount that provides good usage experience
- Understand how much data other applications consume
 - Web browsing may consume 100s of kilobytes per session
 - Video downloads may consume many megabytes (e.g., 3 Mbytes/minute watched at 320x240 pixels, MPEG4 format)
 - Some mobile VPNs (e.g., NetMotion Wireless) have policies to enforce allowed applications for different types of connections

Battery Tests

- Objectives:
 - Measure battery life of devices under specific operating conditions
 - Determine effect of wireless protocols on battery consumption
 - Measure consumption in voice standby, mail standby, active usage
 - Test Palm OS, RIM BlackBerry, Symbian, Windows Mobile devices
 - This report: BB 8310, BB8800, Treo 750, Motorola Q9h, Nokia E61i
- How not to test:
 - Monitor battery level indicators
 - Problems include: non-linearity, aging batteries
- How best to test:
 - Use network simulator to avoid varying RF environmental effects
 - Remove batteries, and supply power using an external supply
 - Sample current to determine instantaneous power consumption
 - We used 64,000 samples per second over 30-minute periods
 - Divide average current into battery capacity to project life



Battery Test Configuration



Battery Test Types



Test	Current Measurement
Radio off	Standby current with no radio activity
Voice service	Current in voice standby, but no data usage
Mail client connected	Current with mail client connected to mail server, but no e-mails being sent or received
Active usage	Current under load with short message automatically sent to device every 60 seconds

Test Results



Projected Hours Device Will Operate in that Mode Based on Average Current (mA) Measured and Rated Battery Life (mAh)

Device	Voice Standby	Mail Client Connected	Active Usage
BlackBerry 8800	330	272	237
BlackBerry 8310	301	269	179
Treo 750			
Direct Push	203	95	17
BlackBerry Connect	203	98	27
Motorola Q9h			
Direct Push	329	177	37
BlackBerry Connect	329	152	94

mA: Milliamps
 mAh: Milliamp hours

Test Results Continued

Projected Hours Device Will Operate in that Mode Based on Average Current (mA) Measured and Rated Battery Life (mAh)

Device	Voice Standby	Mail Client Connected	Active Usage
BlackBerry 8800*	330	272	237
BlackBerry 8310*	301	269	179
Nokia E61i			
Direct Push	130	130	55
BlackBerry Connect	130	118	94

* Repeated from previous page for reference

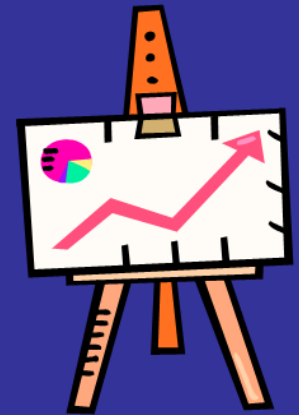
Battery Test Observations

- Life projections are based on new batteries and stated specifications. Batteries degrade in real world and so actual experience will be lower.
- BlackBerry devices have significantly better battery life than most other devices under active usage
- Wireless efficiency does translate to better battery performance
- On same device, BlackBerry Connect results in better battery life than Direct Push



Battery Life Recommendations

- Primary sources of power consumption:
 - Backlight
 - Voice activity
 - Data transmission
 - Data reception
 - Intensive computational activity
- Manage user activities/applications to obtain desired life
- Some devices have much better battery life than others
- Modern batteries: best life from regular complete discharges
- Consider new batteries after 1 or 2 years of life



Conclusion

- Wireless and battery resources are limited
- More efficient systems benefit users, enterprises and operators
- For users, better efficiency translates to:
 - Received instead of delayed messages
 - Better battery life
- For enterprises, better efficiency translates to:
 - Improved worker productivity
 - Reduced costs on usage-based data plans
 - Possibility of using lower-cost monthly data plans

