Nortel Networks Mobile Voice Client 2050

Engineering Notes and Guidelines

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2 Introduction

2.1 Background

Our customers are looking to add voice service to the generally available and popular WLAN 802.11b. Voice-over-WLAN using hand held PDA devices provides additional opportunity for our customers to meet their mobility requirements and enhance productivity. The Nortel Networks Mobile Voice Client 2050 is a UniStim based soft client that will compliment the Nortel Networks IP Softphone 2050 and Nortel Networks IP Phone 2001, 2002 and 2004.

This document is intended to raise awareness and emphasize subject areas that need to be considered in order to deliver effective audio quality while running the Mobile Voice Client (MVC) 2050.

2.2 Network Overview

Figure 1: Network Overview depicts the typical components needed to deploy an effective network to support the MVC 2050. A typical network will consist of the following main components:

PDA running MVC 2050 – Pocket PC PDA supporting WLAN 802.11b.

WLAN Access Points – Nortel Networks WLAN Access Point 2220 is a standalone multi-mode access point supporting 802.11a/b. The WLAN Access Points provides the PDA with access to the LAN.

Communication Server 1000 or Meridian 1 PBX – Release 3.0 or later is required as the call server interface.

Other beneficial network components:

WLAN Security Switches 2250 – An additional layer for a centralized architecture that offers seamless roaming over multi-subnets and a highly secure WLAN. WSS 2250 allows mobile adaptive tunneling, centralized robust security, traffic filtering, bandwidth management, rogue access point detection, and multiple authentication options to an enterprise's existing WLAN.

Contivity Secure IP Services Gateway - Provides IP routing, VPN, stateful firewall, policy management and QoS.

BayStack 460 – All Nortel Networks WLAN access points can be powered via their Ethernet ports. The BayStack 460-24T-PWR Power over Ethernet Switch is designed to provide Power over Ethernet capability while maintaining connectivity to standard 10/100 Mbps devices.

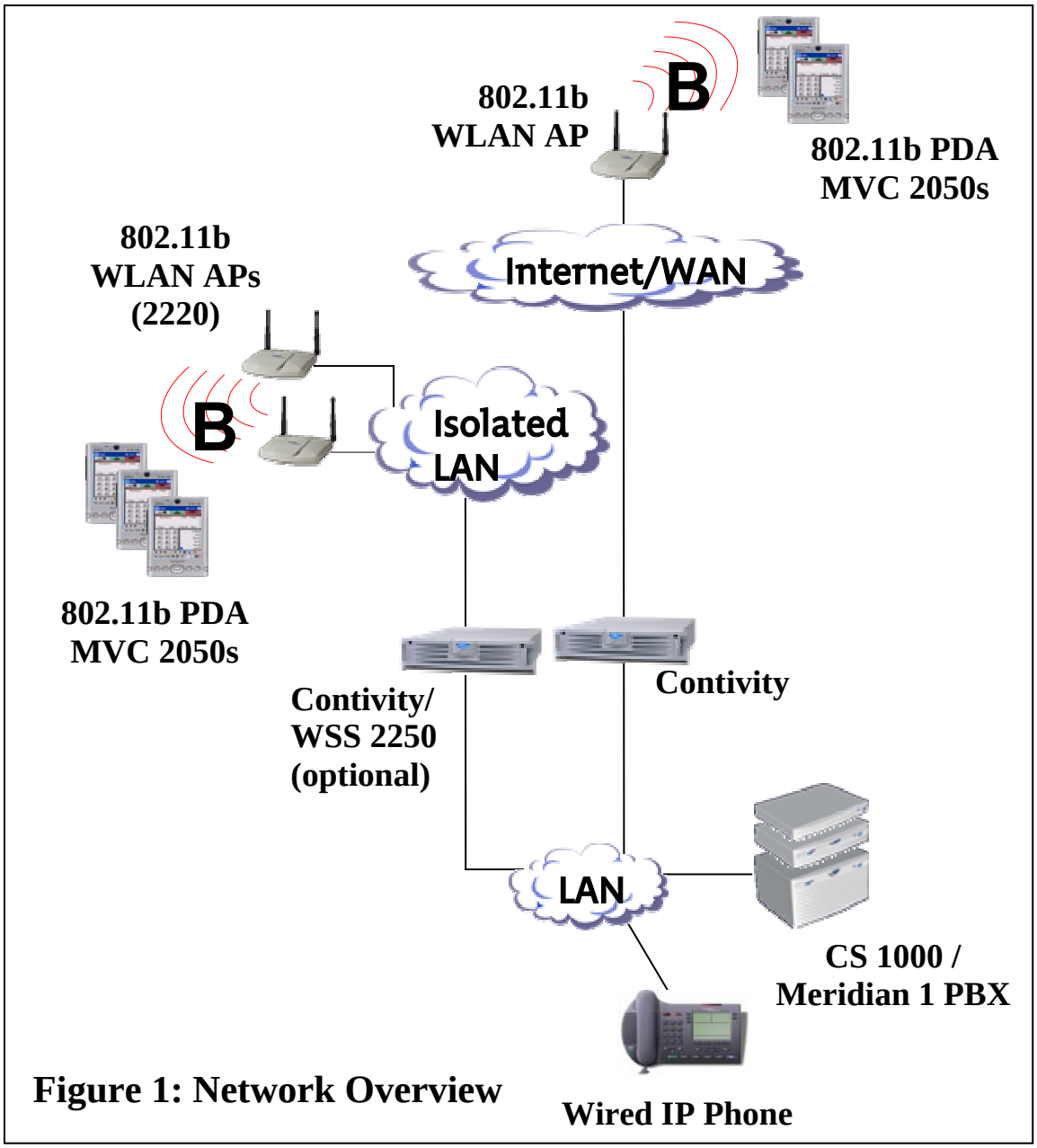

Figure 1: Network Overview

2.3 Document Overview

Client - PDA

- Operation Parameters
  - Processor, Memory, Battery Life, WLAN 802.11b Interface and Headset
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3 Client Parameters

3.1 PDA General Description

A PDA device is a computer that fits in the palm of the user's hand. Its primary purpose is to carry the user's personal information like their address book, calendar, and notes. To keep the PDA small and light weight, constraints were made to the processor, amount of memory, and battery capacity. The PDA limitations need to be understood and managed to provide a positive MVC 2050 experience.

3.2 PDA Operation Parameters

At introduction, the MVC 2050 is supported by Nortel Networks when used on the following Pocket PC PDA devices:

- HP iPAQ® h5550/h5555 Series
- Dell® Axim® X5 Advance
- Dell Axim X3/X3i 400MHz
- Toshiba e750/e755
- Toshiba e800/e805

The following Pocket PC PDA device is not supported:

- HP iPAQ h5450/h5455 Series

The PDA industry evolves at a rapid pace. In general, a new PDA model is released to the market every six months to a year. Contact Nortel Networks for the latest PDA models that Nortel Networks support, PDA models that have been tested and known issues. It is important that the user keeps their PDA up to date with the vendor's latest drivers.

When this document refers to a PDA, it will be referring to the approved Pocket PC PDA devices. The MVC 2050 is currently not supported on other PDA devices, such as Palm PDA devices.

Recommendation: Keep PDA up to date with the latest drivers.

3.2.1 Processor and Memory

The HP iPAQ h555x, Dell Axim X5 and Toshiba e75x Pocket PC PDA devices use Intel XScale PXA255 400MHz processor and have both SDRAM (RAM) and Flash memory (ROM). The newer PDA devices are using Intel XScale PXA263 400MHz processor. Refer to Table 1: PDA Processor and Memory, for the processor and memory specifications of the PDA devices that were evaluated.

The PDA requires at least an Intel XScale PXA250 400MHz and 32MB of RAM, though an Intel XScale PXA255 processor and 64MB of RAM is recommended. While the MVC 2050 could be installed on Pocket PC PDA devices that do not meet the above specifications, the MVC 2050 will not perform to the user's expectations.

Table 1: PDA Processor and Memory

PDA Device	CPU		Memory		Notes
	Type	Speed	ROM	RAM	
Dell Axim X5 Advance	PXA255	400MHz	48MB	64MB	1
Dell Axim X5 Basic	PXA255	300MHz	32MB	32MB	1
Dell Axim X3i 400MHz	PXA263	400MHz	64MB	64MB	2
Toshiba e755 / e750	PXA255	400MHz	64MB	64MB	3
Toshiba e800 / e805	PXA263	400MHz	64MB	128MB	4
HP iPAQ 5550/5555	PXA255	400MHz	48MB	128MB	5, 6
HP iPAQ 5450/5455	PXA250	400MHz	40MB	64MB	1, 5, 6

Note 1: Initially released using use Intel XScale PXA250, which is slower and uses more power than PXA255.
Note 2: Initially released using Intel XScale PXA255
Note 3: Difference between the e750 and e755 - ArcSoft Photobase is on the e755
Note 4: Difference between the e800 and e805 - ArcSoft Photobase is on the e805
Note 5: iPAQ 545x was replaced by iPAQ 555x.
Note 6: iPAQ 5x55 is consumer version and 5x50 is business version.

One significant limitation of the PDA is the size of the CPU. It is not as powerful compared to a desktop computer and can be easily overburdened with tasks. It is important not to overload the PDA processor with constant, intensive tasks. For example, having multiple applications open when using MVC 2050 can impede the PDA from processing the MVC 2050 voice packets to and from the access point, hence reducing the audio quality. Here is a list of known results at CPU consumption levels.

70% or less – The PDA, connection to communication server and voice call are stable.

80% - The PDA is starting to be unstable, connection to the communication server could be dropped and the voice call will be dropped.

90% - The PDA is unstable and could freeze; the connection to the communication server and voice call will be dropped.

100% - The PDA will freeze; the connection to communication server and voice call will be dropped. The MVC 2050 will freeze and possibly need to be stopped and re-started.

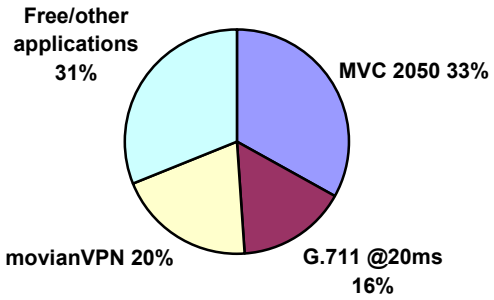
Therefore, for a stable call, the total CPU consumption should not exceed 70%. This is generally not an issue when MVC 2050 is idle since CPU consumption is less than 2%. But when on a call, the MVC 2050 can consume over 33% of the CPU. This does leave some room for other applications to run in the background. However other factors, like running a VPN client or using 20ms payload will also use CPU resources, leaving little room for other applications to run in the background. Table 2: CPU Consumption and Chart 1: CPU Consumption While on a Call provides the typical CPU consumption while on a call, running other applications, and providing input by tapping on the PDA screen.

Table 2: CPU Consumptions

Application	Details	CPU Consumption [7] (%)
MVC 2050 - Build 120	Launch / Background / On a Call	100 / 2 / 33
MVC 2050 - Build 120 with movianVPN®	Launch / Background / On a Call	100 / 2 / 53
movianVPN	Launch / Connection / Background	76 / 100 / 0
WLAN Connection	Launch / Connection / Background	95 / 88 / 0
SuperTask	Launch / Background / Page Change	100 / 4 / 24
Internet Explorer	Launch / Background / Surfing	94 / 0 / 100
Outlook	Launch / Background / Open / Save	100 / 0 / 100 / 45
Windows Media®	Launch / Background / Music / Video	59 / 0 / 20 / 33
Excel	Launch / Background / Open / Save	78 / 0 / 38 / 42
Word	Launch / Background / Open / Save	43 / 0 / 51 / 26
PDA Volume	Launch / Change Setting/ Closed	20 / 100 / 100
Adjusting Setting	Change Slowly / Change Quickly	45 / 100
HP Expansion Pack	Installing / Removing / Background	96 / 96 / 0

Note 7: This table is the average CPU consumption of the Dell Axim X5 Advance, Dell Axim X3i 400MHz, HP iPAQ h5550 and Toshiba e750. The results shown may not be what a user will experience. Many factors will vary these results. The shown results are provided to set user's expectations.

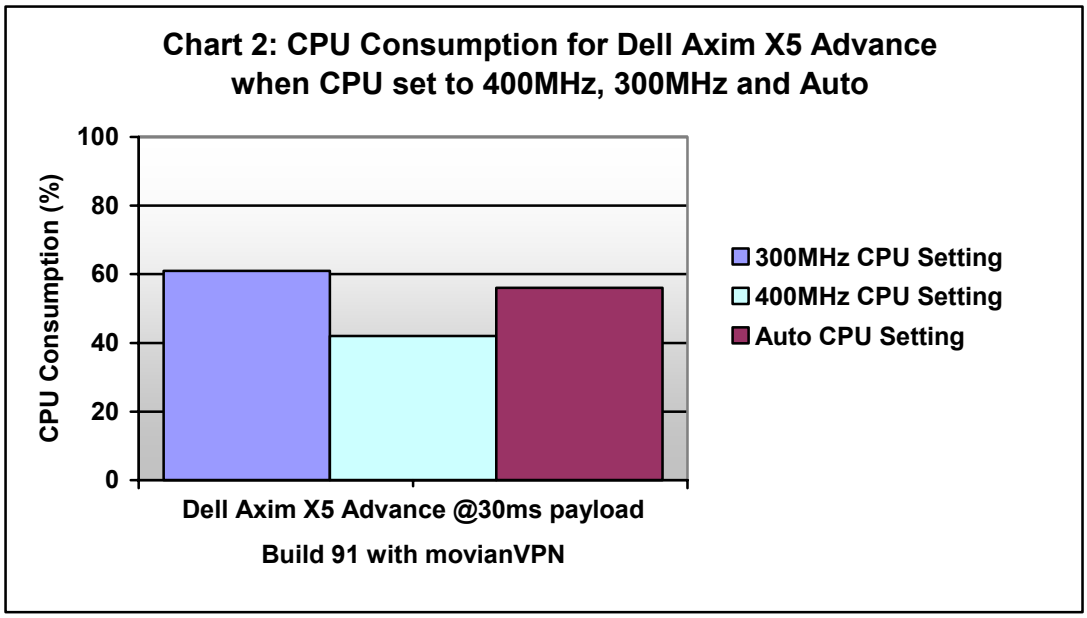
Chart 1: CPU Consumption While on a Call



It is recommended to set the processor speed to the maximum setting which is 400MHz. It is not recommended to reduce the processor speed to conserve battery power because this will decrease performance. For the Dell Axim X5 and X3i, it is not recommended to set the processor to the Auto setting, which changes the speed according to system status, since test results have shown that the MVC 2050 application consumes 10% more CPU at this setting. This is shown in Chart 2: CPU Consumption for Dell Axim X5 when CPU set to 400MHz, 300MHz and Auto.

Testing was done with a Dell Axim X5 Advance with the processor reduced to 300MHz to emulate a Dell Axim X5 Basic. CPU Consumption was 20-25% more than the 400MHz consumption and is therefore not supported. This is also shown in Chart 2: CPU Consumption for Dell Axim X5 when CPU set to 400MHz, 300MHz and Auto.

VOBenchmark was used to compare the PDA devices performance. Overall, the newest PDA devices had the highest scores. For the CPU section, the scores were almost identical for PDA devices using the same processor. There was a slight improvement for PDA devices using PXA263 compared to PXA255. The significant difference between the PXA263 and PXA255 is that the PXA263 is a multi-chip module that has the flash memory die stacked with the processor die. Both versions have the same processor die. For the VOBenchmark scores, the differences in PDA performance were the display to the PDA screen scores. The display drive is directly dependant on the PDA drivers. For this section, Toshiba had the highest scores compared to the other PDA devices.



The HP iPAQ h5450 was also tested and its scores were lower compared to the other PDA devices. The HP iPAQ h5450 uses the older PXA250 processor that has a slower 100MHz internal bus speed compared to the PXA255 processor's 200MHz bus. The CPU consumption while on a call is also significantly higher compared to HP iPAQ h5550 and the other PDA devices. The HP iPAQ h5450 is not supported. While the MVC 2050 will work is some cases, the user will need to take extra care in order for the call not to be dropped.

Recommendation: Set the processor speed to the maximum - 400MHz.

Recommendation: Try to avoid exceeding an overall CPU consumption of 70%.

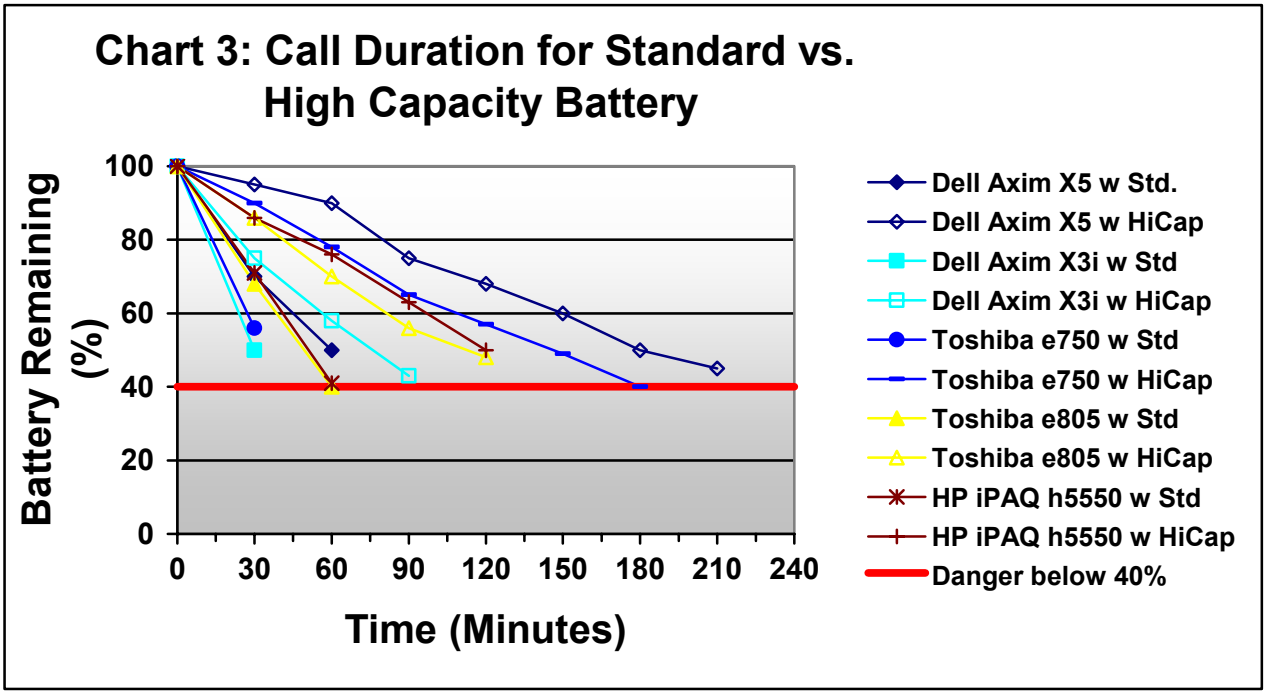
3.2.2 Battery Life

Battery life will vary depending on the type of battery, usage patterns and the configuration of the PDA. Each PDA vendor offers two types of rechargeable, replaceable battery: standard and high capacity. Refer to the PDA documentation for more details including how to recharge the battery. Table 2: PDA Rechargeable, Replaceable Batteries shows that for all the PDA devices, the high capacity battery will provide two to three times more milli Amps per hour and hence increasing the number of calls and longer call duration compared to the standard battery. Chart 3: Call Duration for Standard vs. High Capacity Battery shows the time duration while on a call for both standard and higher capacity battery for the various PDA devices.

Table 2: PDA Rechargeable, Replaceable Batteries

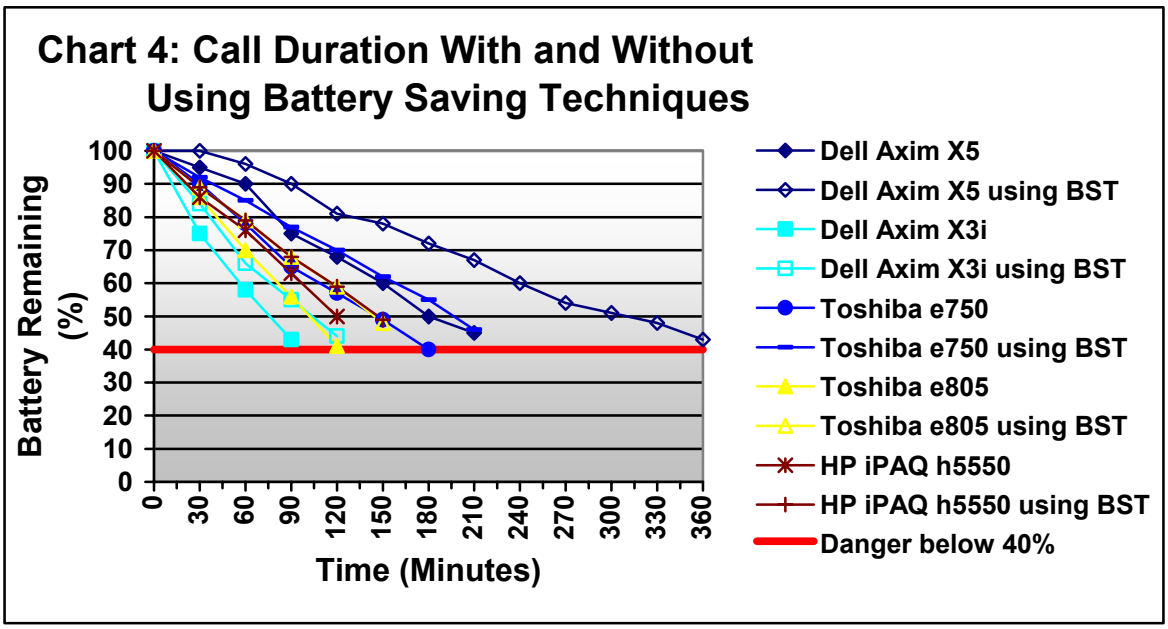
PDA Device	Standard Battery		High Capacity Battery	
	Capacity (mAh)	Call Duration (Minutes)[8]	Capacity (mAh)	Call Duration (Minutes)[8]
HP iPAQ 55/5400 Series	1250	62 - 74	2500	132 – 174
Dell Axim X5	1440	70 - 123	3400	230 – 382
Dell Axim X3i	950	40 - 72	1800	93 - 125
Toshiba e750/5	1000	51 - 78	3000	173 – 238
Toshiba e800/5	1320	60 - 95	2640	123 - 173

Note 8: The results shown may not be what a user will experience. Many factors will vary these results. The shown results are provided to set user's expectations.



The use of some applications or attachments significantly decreases battery life of the PDA. Refer to the PDA user guide for recommended battery saving techniques. Lowering the setting of the screen brightness and reducing the time that elapses until the screen light automatically shuts off after the last operation will increase battery life. Chart 4: Call Duration With and Without Using Battery Saving Techniques shows the time duration difference while on a call when using battery saving techniques for the various PDA devices. In general,

Dell Axim X5 Advance had the longest call duration result since it had the largest battery capacity. Its High Capacity battery can provide 4.3 hours or 210% more than its standard battery. Using battery saving techniques can provide 150 minutes or 75% longer call duration.
Dell Axim X3i had the shortest call duration result since it had the smallest battery capacity. Its High Capacity battery can provide 50 minutes or 130% more than its standard battery. Using battery saving techniques can provide 32 minutes or 80% longer call duration
Toshiba e750 High Capacity battery can provide 2.5 hours or 240% more than its standard battery. Using battery saving techniques can provide 65 minutes or 50% longer call duration.
Toshiba e800/5 High Capacity battery can provide 1.3 hours or 105% more than its standard battery. Using battery saving techniques can provide 42 minutes or 59% longer call duration.
Hp iPAQ h5550/5 High Capacity battery can provide 1.6 hours or 135% more than its standard battery. Using battery saving techniques can provide 42 minutes or 59% longer call duration.



The use of 802.11b wireless connection consumes battery life however it can not be avoided. Refer to Table 3: PDA WLAN 802.11b Power Consumption to view the power consumption of various PDA WLAN 802.11b interfaces. For a Standard battery, it is possible for the battery life to last up to 12 hours (Idle mode, no user input or output). The battery life sharply decreases to almost 3 hours when transmitting and receiving WLAN 802.11b (Idle mode, power management on). Further, during a call, someone is usually talking and therefore the PDA is constantly transmitting or receiving and battery life falls to around an hour.

In general, the PDA WLAN Power Management (i.e., turning off the WLAN when inactive for a certain amount of time) has little bearing on performance. The Signaling Server uses Keep Alive messages to poll each set. The time interval is dependent on the number of sets registered to the server, but it is generally within seconds (not minutes). Since there are known PDA WLAN Power Management issues, it is suggested to turn off the PDA's WLAN Power Management. WLAN Power Management is advantageous to use when using Pocket Internet Explorer to save battery life.

Table 3: PDA WLAN 802.11b Power Consumption

PDA / 802.11b Card	Transfer (mA)	Receive (mA)	Stand-by (mA)
HP iPAQ 5500 Series	<500	<260	<20
Dell TrueMobile 1180 CF Card	280	180	10
SanDisk Industrial 802.11b CF Card	<330	<260	<80

Recommendation: Use the high capacity battery to provide longer use.

Recommendation: Reduce the screen brightness and reduce the time elapses before the screen light after the last use to prolong the battery life.

3.2.3 WLAN Interface

The MVC 2050 is supported on an 802.11b WLAN. The Dell Axim X3i, HP iPAQ h5500 Series and Toshiba e75x/80x PDA devices have built-in 802.11b wireless Ethernet networking. For the Dell Axim X5, a CompactFlash 802.11b card is needed for wireless Ethernet networking. The 802.11b CompactFlash card can be purchased from Dell or from a third party, like SanDisk or Socket Communication. Table 4: PDA WiFi Interface shows the possible WiFi interfaces for each PDA device.

Table 4: PDA WiFi Interface

PDA Device	Built-in 802.11b	CompactFlash 802.11b	Secure Digital 802.11b	Bluetooth
HP iPAQ 54/5500		(9)		
Dell Axim X5				(10)
Dell Axim X3i				
Toshiba e75x				(11)
Toshiba e80x				

Note 9: Requires an expansion pack.
Note 10: Not build-in, require CompactFlash Bluetooth card.
Note 11: Not build-in, require CompactFlash Bluetooth card or SD Bluetooth card.

The stability of the connection and the data rate, which determines the throughput rate, will depend on the PDA WLAN hardware and its configuration. For example, if the power is reduced to the WLAN interface on the PDA to save

battery life, the performance of the WLAN chipset and therefore the throughput could also be reduced which could reduce audio quality. Testing has shown that while roaming, the handover from one access point to another was faster when using an external CompactFlash WLAN card compared to the PDA built-in WLAN.

Table 5: PDA WLAN Data Rate vs. Distance reveals that the further the PDA device is from the access point, the lower the data rate is. The actual throughput rate will be lower than the data rate. The table also illustrates that closed in areas (indoors) will reduce the throughput compared to open space since indoor spaces have more obstacles that absorbs and/or reflect the signal, such as walls and elevators, as well as sources of interference, like cordless phones and microwave ovens. Bear in mind that this reduction in range and/or throughput can be easily addressed by placing more access points in areas where the coverage is lacking. Information on throughput is relative – it depends on the application. Also, coverage information for closed spaces may vary from that listed in the table based on actual building composition, location of walls, obstacles, and interference sources.

Table 5: PDA WLAN Data Rate vs. Distance

PDA or 802.11b WLAN Card	Data Rate (Mbps)	Distance	
		Open Sight (ft)	Closed Space (ft)
HP iPAQ 5500 Series	11 5.5 1	1000 1100 1200	100 200 300
Dell TrueMobile 1180 WLAN CF Card	11 5.5 1	525 885 1750	115 115 165
SanDisk Industrial 0MB WLAN CF Card	11 5.5 1	1150 1475 2300	N/A

The HP iPAQ h5500 Series had a connection issue with their built-in 802.11b WLAN interface. It has been resolved by installing HP WLAN driver 3.2.4.133 and iPAQ h5000 IP Reset for Roaming utility. Contact HP Support for the utility. The Nortel Networks Access Point 2220 will also need to be running software release 1.3.

PDA devices can also have Bluetooth capabilities, either integrated or with an external card. Using a Bluetooth accessory while on a voice call is not recommended due to interference and contention. Bluetooth and 802.11b operate in the same frequency band. Essentially, 802.11 signals will cease when they are within the area of a Bluetooth device. Using Bluetooth will also increase CPU consumption with too many high capacity traffic links. Interference and CPU saturation will lead to a decrease in audio quality. PDA vendors are working to minimize this issue.

Customers could deploy an 802.11g WLAN CompactFlash card to take advantage of higher data rates; however 802.11g has not been tested. At this time, 802.11a is not an option since 802.11a is not available as a WLAN CompactFlash card. Refer to Section 5 WLAN Network for more information on the different 802.11 characteristics.

Recommendation: Use PDA devices on an 802.11b WLAN.

Recommendation: Move closer to access point to increase throughput / data rate.

Recommendation: Avoid as much as possible areas with WiFi interferences, like microwave ovens and cordless phones.

Recommendation: Operating a Bluetooth accessory while on a voice call is not recommended and is not supported.

3.2.4 Headsets

PDA headsets/headphones are not supplied with MVC 2050. They are purchased separately and are the customer's responsibility. Nortel Networks suggests customers contact their PDA vendor for more information. The HP website has a list of recommended headsets for their PDA devices. Headsets are an important part of audio quality. In general, MVC 2050 works best with a headset since it reduces background noise and acoustic echo. However, using an inadequate headset can reduce audio quality by injecting noise, delay, and acoustic echo.

The headset and headphone tested by Nortel Networks are:

Plantronics M130i Headset: has noise-canceling microphone feature that reduces background noise.

Jensen JM-11 Behind-the-Neck Headphone: used with Dell Axim PDA devices.

Table 5: PDA Headset – Audio Port Specifications shows the audio port supported for each PDA. Dell Axim X5 Advance and Dell Axim X3i 400MHz only has a headphone jack and not a headset (headphone/microphone) jack. The user will need to hold the PDA up to their mouth and use the built-in microphone on the PDA.

Table 5: PDA Headset – Audio Port Specifications

PDA Device	Headset		Size of Jack (mm)
	Headphone	Microphone	
HP iPAQ 54/55xx Series			3.5
Dell Axim X5/X3i			3.5
Toshiba e75x/e80x			3.5

When the PDA built-in speaker and microphone are used, the microphone will pickup sounds from the speaker creating a feedback loop. Automatic Gain Control is used to reduce the echo. However for the Dell Axim X5, the echo is severe and a headset is required.

As mentioned in Section 3.2.3 WLAN Interface, Bluetooth accessories are not recommended and this includes Bluetooth headsets.

Recommendation: Using a headset will improve audio quality compared to using the built-in speaker and microphone of the PDA.

Requirement: Customers are required to use a headphone when using the Dell Axim X5.

Recommendation: When using the PDA built-in speaker and microphone, use AGC to reduce feedback.

Recommendation: Review the PDA vendor's website for approved headsets.

Recommendation: At this time, operating a Bluetooth headset while on a voice call is not recommended or supported.

3.2.5 Microphone and Audio Settings

All supported PDA devices provide individual settings for the microphone, speaker and/or headset gain and volume control that work in conjunction with the PDA device or headset type. The microphone and audio settings should be adjusted depending on the user's environment (i.e. ranging from quiet to a noisy environment). It is recommended that options are exercised to adjust for peak performance. Refer to the PDA Help menu to adjust the specific PDA device's settings. See Section 7.1.2 Settings for suggested settings.

3.3 Applications

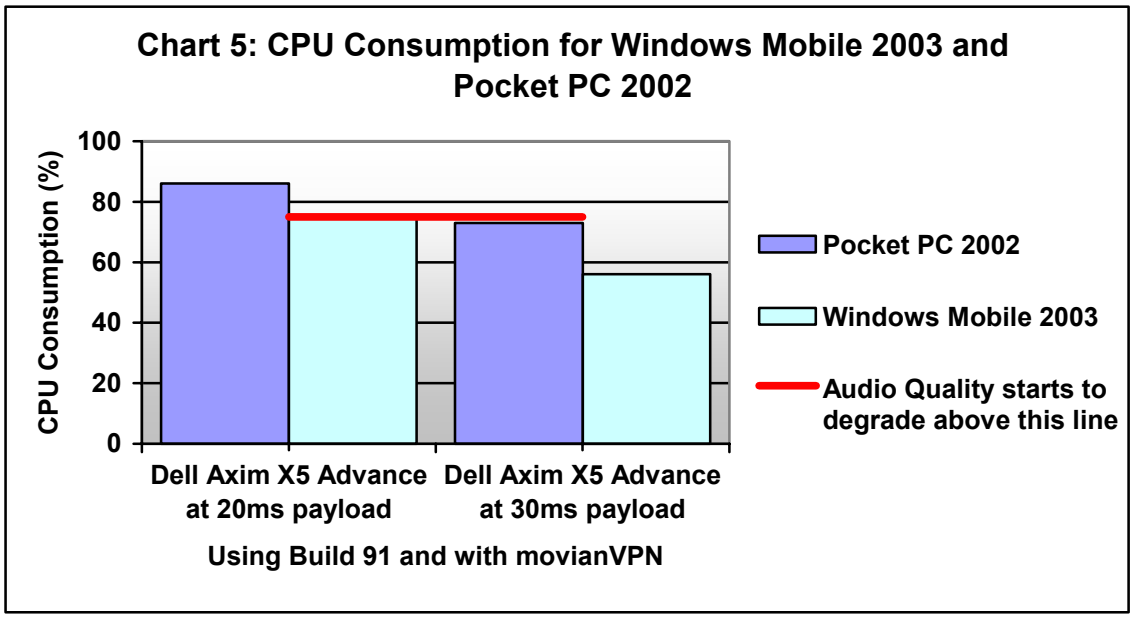
The configuration of the PDA device will have an affect on audio quality. Audio quality could be affected by the type of operating system or applications running in the background.

3.3.1 Operating System

A Pocket PC PDA is a PDA device that runs on Microsoft® Windows® CE operating system. The operating system has an affect on how flexible the support of the MVC 2050 is. If the operating system prioritizes the CPU ineffectively with other tasks, audio quality can be negatively affected.

The MVC 2050 runs on Windows Mobile™ 2003 operating systems. Using Pocket PC 2002 increases the CPU consumption by 10% to 19% compared to Windows Mobile 2003. Therefore, Pocket PC 2002 is not supported. Pocket PC 2002 was developed for the Intel® StrongARM processor while the selected PDA devices use Intel XScale processor. Refer to Chart 5: CPU Consumption for

Windows Mobile 2003 and Pocket PC 2002 for a comparison between Pocket PC 2002 and Windows Mobile 2003.



Requirement: Use Windows Mobile 2003 and not Pocket PC 2002.

3.3.2 Client VPN

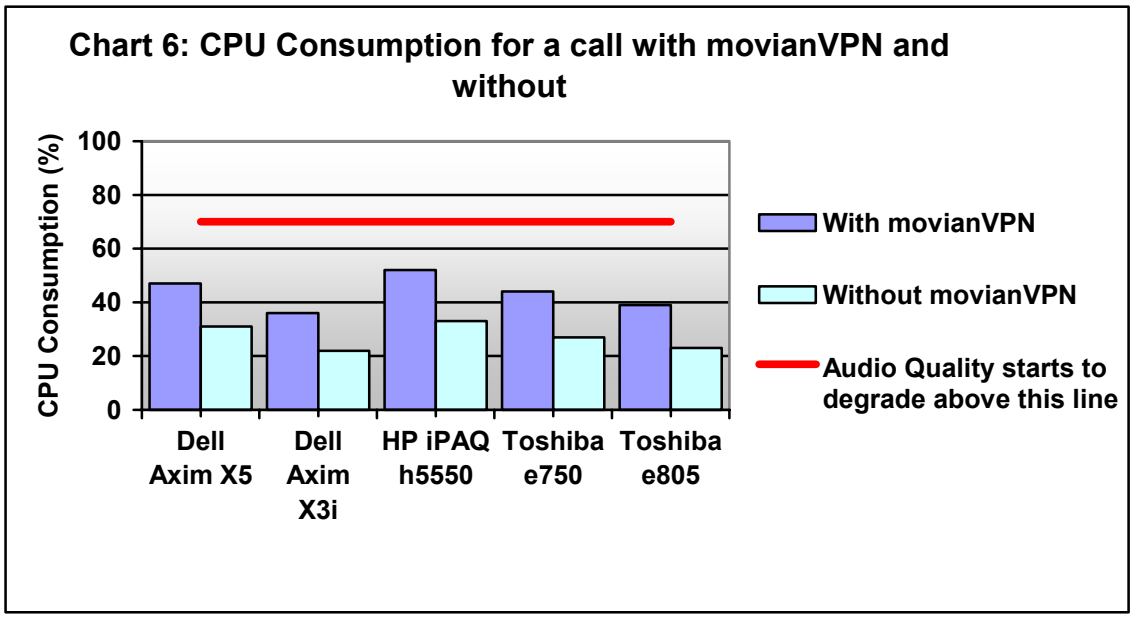
Security is an important aspect of the WLAN. A client VPN establishes the necessary IPSec tunnel to a Contivity or WLAN Security Switch. The MVC 2050 can coexist with Certicom® movianVPN® client. Improperly implementing security can potentially allow unauthorized parties with 802.11b interfaces to obtain access to the rest of the Intranet. However, like any other program running on a PDA, it does consume CPU resources. While on a call, the movianVPN consumes on average 20% of the CPU resources. Refer to Chart 6: CPU Consumption for a call with movianVPN and without for a comparison between a call requiring movianVPN and one that does not.

movianVPN version 3.10 was developed to fix a known issue when used on the Toshiba e750/5 PDA devices. While the IPSec now works on the Toshiba e750/5 devices, the dynamic binding is now disable, causing the user to be unable to view the WiFi signal strength.

Another third-party VPN client that was evaluated was Netlock® by Apani® Networks. Netlock and movianVPN do not come bundled with MVC 2050.

Recommendation: Use a client VPN only if enhanced security is required.

Requirement: Toshiba e750/5 requires movianVPN version 3.10, build 108.39c or later.



3.3.3 Other Applications

Degradation in audio quality could occur when simultaneously executing other applications while on a call. The PDA processor will be running other tasks instead of processing the voice packets. Table 2: CPU Consumption provides results of testing for various applications. While running some of these applications, audio quality could be temporarily affected when a spike in CPU consumption occurs. For example, launching an application or closing the PDA volume window. While in most cases, a spike will be a temporary affect, if there has been a number of consecutive spikes (for example opening the Inbox and then launching Excel), then the sharply increased CPU consumption could cause the call to drop or freeze the PDA device. The other issue a user must minimize is running too many small CPU consumption tasks – adding up to a large amount of CPU consumption. It is important to keep the overall CPU consumption from exceeding 70% for a stable call.

It is recommended to minimize the use of Pocket Internet Explorer while on a call. Both applications consume a significant amount of CPU and will be vying access to the 802.11b WLAN.

If the user is experiencing poor audio quality, check to see if other applications are running in the background. Tapping on the ‘X’ at the top right corner of the application window does not stop an application; it only sets it to run in the

background. Applications running in the background will also use program memory.

Besides consuming CPU resources and program memory, running applications while on a call will also consume battery life.

Recommendation: Users should strive to minimize using other applications while using the MVC 2050 for optimal audio quality.

Requirement: Minimize using Pocket Internet Explorer, or applications that access the WLAN, while on a call.

3.3.4 System Inputs and Outputs

User interactions with the PDA, such as tapping the PDA screen or pressing a button, will use scarce CPU resources. The CPU consumption can be characterized as a spike. It commonly occurs when tapping the screen to turn up the volume, scrolling down a page, or when a sound notification occurs. Since the CPU is now tasked with an operation, the voice call could be interrupted. If the interruption is continuous, the voice call could drop. Using expansion packs will also consume CPU and battery resources.

To reduce the impact, it is recommended if the user has many actions to execute, proceed in gradual stages. For example, if a user requires viewing an Excel file, it is recommended to tap on 'Start', pause and then tap on the Excel icon. That way, instead of a 100% spike, the user would have two smaller CPU consumption spikes. This gradual process becomes more significant if the user's overall CPU consumption is already above 60%.

For notifications, the CPU consumption will spike since the message is displayed on the screen and a sound is produced. Turning off the sound notification is not encouraged to reduce CPU consumption since the call will be interrupted anyway.

Recommendation: For tasks that require executing many actions, proceed in gradual stages.

3.3.5 SuperTask

A major factor for poor audio quality is for the overall CPU consumption to exceed 70%. SuperTask is a tool that monitors CPU consumption. SuperTask, or any other CPU monitoring tool, is recommended to be installed on the PDA. Additional information regarding SuperTask can be found at their website which is provided in Section 9.1 Websites.

Recommendation: Install a CPU monitoring tool like SuperTask.

3.4 MVC 2050 Parameters

The MVC 2050 has two audio tabs to control the audio quality. The QoS tab, meaning support of 802.1p/Q, is currently not supported. The MVC 2050 also does not have an echo canceller. The dominant issues causing poor audio quality is CPU consumption greater than 70% or a poor WLAN connection. Before adjusting the audio tabs,

Check to see if CPU consumption is below 80%.
Check if WLAN connection
- is stable
- is at a high data rate (11Mbps vs. 1Mbps)

Check if VPN client is connected (if used)

Recommendation: Review CPU consumption and WLAN connection before adjusting the audio tabs.

3.4.1 Audio Tab

There is an audio quality slider to adjust the number of buffers between the MVC 2050 application and the PDA audio hardware. Decreasing the number of buffers will reduce overall speech path delay however it does increase the chances of reduce audio clarity, and receiving broken or absent audio since late arriving packets could be discarded unnecessarily. Increasing the number of buffers will improve clarity but will increase the overall speech path delay.

Recommendation: Adjust audio quality slider to trouble shoot audio quality when there is too much delay or broken / absent audio.

3.4.2 Advanced Audio Tab

The Advanced Audio tab provides the option of using Global IP Sound® GIPS NetEQ, using the communication server settings or overriding the communication server values. At introduction, GIPS NetEQ is the only option available and is enabled by default. GIPS NetEQ software has been bundled with MVC 2050 to provide loss concealment and compensation for up to 30% loss packet.

3.4.3 Volume Control

The volume up and volume down icons on the MVC 2050 Operation Toolbar are controlled by tapping the screen. As mentioned in Section 3.3.4 System Inputs and Outputs, CPU consumption will increase by 10 to 20% when tapping on the screen. Therefore, tapping the volume icons could cause broken speech and if the volume icons are tapped too many times, the call could be dropped.

For MVC 2050 volume controls, to optimally voice quality, the microphone and audio settings of the PDA device must be first configured under the device setting.

Recommendation: Try to avoid rapidly tapping volume controls.

4 Communication Server

At introduction, only the following communication servers with Release 3.0 are supported.

Table 6: Applicable Systems

System	Applicability
CS 1000M Chassis	Y
CS 1000M Cabinet	Y
CS 1000M SG	Y
CS 1000M MG	Y
CS 1000M HG	Y
CS 1000S	Y
Branch Media Gateway	Y
Meridian 1 PBX 11C - Chassis	Y – Internet Enabled
Meridian 1 PBX 11C – Cabinet	Y – Internet Enabled
Meridian 1 PBX 51C	Y – Internet Enabled
Meridian 1 PBX 61	Y – Internet Enabled
Meridian 1 PBX 61C	Y – Internet Enabled
Meridian 1 PBX 81	Y – Internet Enabled
Meridian 1 PBX 81C	Y – Internet Enabled

Requirement: The communication server must be on Succession Release 3.0 Software for Enterprise (or later).

4.1 Configuration

The MVC 2050 is configured the same as the IP Softphone 2050. It does not require the ITG 802.11 Wireless Gateway. Refer NTP 553-3001-368, Internet Terminals: Descriptions for configuration details.

Recommendation: Configure the MVC 2050 the same way as an IP Softphone 2050.

4.2 Audio Quality

The perceived quality of a voice transmission is dependent on many factors, such as codec characteristics, echo canceller, jitter buffer size and the perception of the individual listener.

Refer to NTP 553-3001-365, IP Line: Description, Installation, and Operation, to configure the CS 1000 or Meridian 1 PBX.

4.2.1 Codec

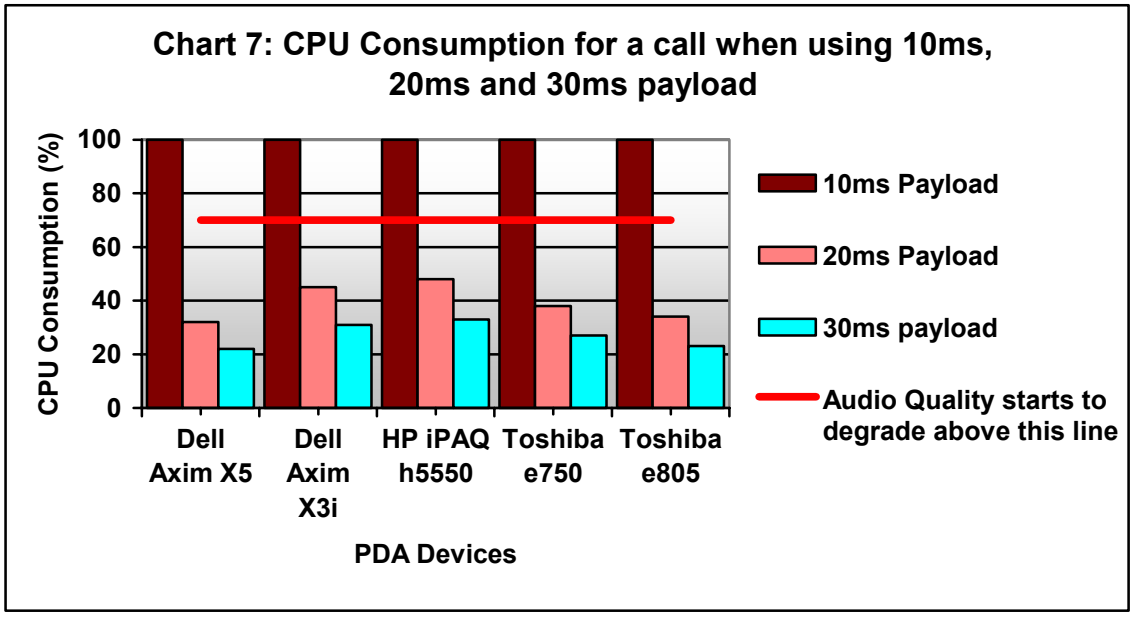
The MVC 2050 supports G.711 A-law and µ-law. G.711 provides higher audio quality compared to other codec's since there is no compression. The disadvantage is G.711 does require more bandwidth so the network must be able to provide the higher throughput or else audio quality will suffer.

G.729 and G.723 are codec's that use compression and would use less bandwidth, however the PDA will have higher CPU consumption since it will be required to compress and decompress the voice payload. Therefore, G.729 and G.723 are not supported at introduction.

Requirement: The CS 1000 or Meridian 1 PBX G.711 codec must be enabled.

4.2.2 Payload

Installed on the CS 1000 or Meridian 1 PBX, the MVC 2050 supports G.711 with 10ms, 20ms and 30ms payloads. The MVC 2050 at 10ms payload has 100% CPU consumption and thus, setting the payload to 10ms is not recommended. In general, a user using 802.11b WLAN would experience the best quality of experience at 20ms. However for the MVC 2050, the PDA CPU consumption at 30ms payload is on average 16% less than the CPU consumption at 20ms payload. If the user has other applications running, like movianVPN or using an expansion pack, it is recommended to use 30ms payload. Refer to Chart 7 for CPU consumption at 10ms, 20ms and 30ms payload sizes for various PDA devices.



Recommendation: Set payload of G.711 to 30ms.

4.2.3 Echo Cancellation

All telephony voice services reflect some level of echo back to the user. Echo refers to the return of a signal's reflection to the originator. Packet voice networks introduce sufficient latency to cause what a caller would consider an audible echo. The echo path is the round-trip. Any speech coding, packetization, and buffering delays accumulate in both directions of transmission, increasing the likelihood of audibility.

The echo canceller is enabled by default. For the echo canceller tail delay, select the maximum value available. The default value is 128ms. Do not reduce the echo canceller value unless directed by Nortel Networks Field Support.

Recommendation: Set echo canceller tail delay to maximum value, 128ms.

4.2.4 Voice Activity Detection

Voice Activity Detection or VAD, the threshold parameter controlling the sensitivity of the voice activation detection module, is not supported for G.711 on Release 3.0 for either the CS 1000 or Meridian 1 PBX.

4.3 Node and Zone Configuration

There is a known Release 3.0 issue with internode calls when the packet size is configured differently in the two nodes. This will occur even if they are the same codec. The issue can be as severe as the call fails. The cause is that the call server does not perform any codec negotiation for internode calls. This is a known issue within Nortel Networks and a fix is planned to address codec negotiation for internode calls within Succession Release 4.0. The interim solution until CS 1000 Release 4.0 is for all nodes require having their codec's set to the same payload size. Therefore, for all nodes, G.711 codec should be set to 20ms unless the customers require enhanced PDA CPU performance, than the payload should be set to 30ms. Setting the node's G.711 codes payload to 30ms will also change the payload of the other IP clients. However, there should not be any noticeable degradation of voice quality.

The MVC 2050 must be configured in a Zone that is BQ – Best Quality, since the MVC 2050 only supports G.711. For a Zone that is set to BQ, the codec used is G.711. If the MVC 2050 is configured in a Zone that is set to BB – Best Bandwidth, in other words G.729 or G.723, then the user may experience no voice path.

Refer to NTP 553-3001-160, Data Networking for Voice over IP for more configurations details.

Requirement: G.711 codec must have the same payload size for all nodes within a system.

Recommendation: Set all nodes to G.711, 30ms payload for enhanced PDA CPU performance.

Recommendation: MVC 2050 must be configured in a Zone that uses BQ – Best Quality.

5 Wireless LAN

In general, the MVC 2050 is supported on an 802.11b WLAN. This is due to the PDA built-in WLAN interface is 802.11b. Testing was therefore done on this standard. This is not to say that 802.11g, or 802.11a, could not be used however, 802.11b is currently the more popular standard. Future PDA devices and access points will undoubtedly be supporting new standards, and when they do, testing will occur on those standards.

The WLAN was built for data access and could provide inconsistent audio quality, which could lead to poor performance and dissatisfied MVC 2050 user experience. A successful deployment of the MVC 2050 in a WLAN begins with an understanding of the underlying network and the traffic that it transmits.

5.1 WLAN Introduction

The wireless medium is not a wire. It is a highly changing environment in which transmission errors are unavoidable and quite common. Some factors can be controlled while others are fundamental limitations of the wireless medium that must be recognized and taken into account when using the MVC 2050.

The three IEEE 802.11 standards, 802.11a, 802.11b and 802.11g, were the first radio layers to be ratified. The focus was on enhancing security and network-based management. The 802.11 basic MAC mechanism, CSMA/CA, is similar to Ethernet CSMA/CD protocol except that CSMA/CA uses Collision Avoidance instead of Collision Detection. Table 6: 802.11 Physical Layers summarizes the essential characteristics of the 802.11 physical layers. It is important to note that 802.11b standard operates within three non-overlapping channels in the 2.4MHz band and can support up to 11Mbps data rate. Devices using 802.11g are backward compatible with 802.11b but 802.11g devices will have the same data rate as 802.11b devices when deployed with 802.11b network – losing their advantage. In addition, 802.11b devices communicating on an 802.11g network will force all 802.11g devices into ‘compatibility mode’ whereby they have to transmit additional overhead in order to warn 802.11b devices they are transmitting. This extra overhead incurs a performance penalty on the 802.11 network for 802.11g devices.

Table 7: 802.11 Physical Layers

	802.11b	**802.11g**	**802.11a**
Adopted by IEEE	1999	2003	1999
Technology	DSSS	OFDM & DSSS	OFDM
Frequency band	2.4 GHz ISM	2.4 GHz ISM	5 GHz ISM
Channels (US)	3 non-overlapping	3 non-overlapping	13 (increasing to 24 in US)

Physical rates	11, 5.5, 2, and 1 Mbps	All 11a and 11b rates	54, 48, 36, 24, 18, 12, 9, and 6 Mbps

5.1.1 Coverage and Capacity

The audio quality for the MVC 2050 user is highly dependent on the coverage and capacity of their WLAN. The wireless medium is a dynamic, shared medium affected by several interacting factors. The following are known WLAN factors that degrade the coverage and capacity.

One fundamental factor of the wireless medium is that the data rate will decrease in direct relation to the distance from the access point. As in, the farther a MVC 2050 user is from its access point, the weaker the signal it receives and the lower the physical rates that it can reliably achieve. Of course other physical characteristics, such as obstacles (walls, cubicles, water, etc.) and sources of interference (microwave ovens, cordless phones) will cause the signal to be absorbed or reflected, changing the coverage and capacity as well.

In addition to the 802.11 MAC, IP/UDP and TCP/RTP headers, there is a radio preamble signal and PLCP used to enable the dynamic coding inherent in 802.11 systems. This fixed overhead will consume bandwidth and has to be factored into the WLAN capacity. Section 5.2 Voice over WLAN looks at bandwidth calculations for voice.

For multiple MVC 2050 users that are simultaneously active on the same access point, there are further reductions in the overall media coverage and capacity. The rate a MVC 2050 user connects to the access point not only affects them but also the MVC 2050 users around them. A MVC 2050 user connected at a lower data rate will use proportionally more transmit time and will have a disproportionately large impact on total system throughput. Since each device will still get access to the same percentage of capacity, but total capacity is now smaller, the result is that each user will have less throughput available to them. This effect is sometimes called the ‘edge user’ effect since the outer edge of the access point’s coverage area is where the lowest data rate occurs. A ‘sticky client’ can cause this effect since the mobile user will ‘stick’ with their access point at a lower data rate instead of roaming to the closer access point where a higher data rate would be possible.

The layout of access points will have an affect on coverage and capacity. If the access points are placed closer together, say connecting at the lower 1Mbps data rate was not permitted, the PDA distance to the access point would be shorter, and the user would then use less transmit time on the medium, resulting in a higher system throughput. Unfortunately, simply adding more access points to increase capacity may in fact have the opposite effect, as seen in the next section.

While a little contention improves the utilization of the medium efficiency, too much contention reduces the efficiency and wastes scarce bandwidth. When there

are one too many users on an access point, the performance is dramatically degraded; to the point that all users have poor audio quality and their call is dropped.

5.1.2 Large WLAN

Wireless capacity is a finite, scarce resource and can not be engineered by over-provisioning that is customary for wired LANs. Due to the shared nature of the wireless medium, deploying more access points might contribute to polluting the air waves without increasing the capacity. Interference resulting from two or more simultaneous transmissions on the same channel is called co-channel interference. For 802.11b, there are only three non-overlapping frequencies so reusing frequencies will occur. The more densely the access points are placed, the worse the interference from users on the same frequency potentially reducing coverage and capacity. The noise level is also dependant on WLAN traffic. As the traffic load changes, so will the capacity of the WLAN. The noise level will increase as the traffic increases, reducing capacity and coverage. Frequency planning, assigning frequency to access points in a way that maximizes the distance between access points using the same frequency, can lower the interference, increasing both coverage and capacity. In multi-story building, these effects make the deployment of WLANs more complex since it now needs to be examined in three-dimensions. A large WLAN is more complex than a single access point.

A well characterized WLAN plan is essential to deploying an effective WLAN. A site survey will take into account the physical environment (coverage area shape and obstructions) and radio conditions (signal strengths and interferences). While a simple site survey may guarantee coverage, it will not guarantee capacity or performance targets. WLAN traffic and co-channel interference are other factors that must be characterized for large WLANs. Further analysis, using automatic planning tools, is then required. The WLAN user population, usage pattern and WLAN applications will also change over time, so constant monitoring is required by intelligent management systems.

5.1.3 QoS – 802.11e Standard

QoS does not create bandwidth, it restricts traffic. In general, QoS will restrict data traffic to a lower priority. The current ratified 802.11 standards' basic MAC mechanisms do not support QoS which is needed for voice applications. The QoS mechanism PCF was included in the original 802.11 standard however several problems have been identified and it was not widely adopted. Proprietary QoS extensions, like SVP protocol, exist in the market particularly on systems targeted towards delivering Voice over WLAN. The need for these proprietary solutions will diminish as deployment and support of 802.11e becomes more wide spread.

IEEE 802.11e standard is pivotal to converged WLANs. The WiFi Alliance has divided the 802.11e draft proposals into two subsets called WME and WMS. As with their previous WPA pseudo standard (based on 802.11i), WiFi Alliance is

trying to promote pre-standards acceptance and get QoS into the market place sooner through WME and WMS. WME prioritized channel access for telephony while WMS provides deterministic access through polling. Included under WME is the enhanced DCF contention mode with different treatment for each of the eight traffic classes. Enhanced DCF is an extension of the original basic channel access mechanism that provides differentiated access to the wireless medium by varying the amount of time a station senses the channel to be idle, the length of the contention window during a back off, or the duration a station may transmit after it gets access to the medium. Included under WMS is HCCA which fixes the shortcoming of the original PCF polling mechanism and provides deterministic access for predictable, time-sensitive traffic. The access point gains control of the wireless medium as needed to send QoS traffic and to issue QoS polls to stations by waiting a shorter time between transmissions than the stations using the EDCA access procedure.

5.2 Wired LAN

While the focus is usually placed on the wireless part of the network, the wired network must not be ignored. To obtain the best possible audio quality, QoS needs to be implemented and enforced from end-to-end; both the wired and wireless LAN and they need to properly align with each other. While over-provisioning is a typical approach, the network will fail to deliver QoS just when it is needed the most. Refer to NTP 553-3001-160, Data Networking for Voice over IP for recommended optimal wired LAN configurations.

5.3 Voice over WLAN

To meet the user's expectations of a satisfying quality of experience, the user will need to be able to initiate a call at will, obtain the audio quality the user is expecting during a call, and maintain the call as the user roams.

5.3.1 Bandwidth

While data traffic tends to generate bursts of rather large packets, voice traffic is made up of short packets fairly evenly distributed in time. Data and voice can coexist on the same WLAN however; if no precautions are taken, even a single bursty data stream can temporary saturate the medium and negatively impact audio quality. A mix of voice and data deployed on the 802.11b standard could result in an unsatisfactory experience. QoS mechanisms are the most effective way to insure voice traffic gets higher priority access to the wireless medium. The draw back is if the QoS is too stringent, the data applications will suffer. Separating voice and data traffic users by frequency would be another way to ensure priority is given to voice packets. This could be done by placing data users on the 802.11a radio while MVC 2050 users would use 802.11b. 802.11b has scarce resources with only 3 non-overlapping channels while 802.11a is not as scarce since it has more non-overlapping channels. By moving the hungry data

applications from a scarce resource to a more plentiful resource, it will leave the MVC 2050 users alone on the scarce resource which is a more efficient use of the resources that are available.

Table 8: Overhead for G.711 Codec at 20ms Payload reveals the makeup of a WLAN MSDU carrying a G.711 20ms payload. This table shows that for 20ms of voice, which a 160-byte voice payload is, about 252 bytes are actually sent. In other words, over 33% of the bytes sent are overhead and not the voice payload. Table 9 shows the calculated time it would take to transmit a G.711 20ms payload at various data rates and preambles. Table 9 also provides an estimate to the maximum number of MVC 2050 users that can be on one access point. A number of observations can be made from these tables.

Connecting at higher data rate will use less time in the medium; less time on the medium will mean other users will have an opportunity to use the medium – increasing the number of users on an access point.

Shorter preamble reduces the amount of overhead transmitted before each frame and eliminates lowest 1Mbps data rate thus increasing the voice capacity.

A lower connected data rate user will consume more of the medium's available time, leaving little time for the higher data rate connected users - dragging all users, or capacity, down to the data rate of the 'edge' user.

Table 8: Overhead for G.711 Codec at 20ms Payload

Description	Size
MAC Header	24 bytes
CCMP Header	8 bytes
LLC/SNAP Header	8 bytes
IPv4	20 bytes
UDP	8 bytes
RTP	12 bytes
Voice Payload	160 bytes
CCMP MIC Trailer	8 bytes
MAC Trailer (CRC)	4 bytes
Complete MAC Frame [12]	252 bytes

Note 12: For every voice packet sent, a 14-byte acknowledgement is also transmitted at the highest mandatory rate not greater than client data rate.

Table 9: Calculated Packet Time and Estimate Maximum Capacity

802.11b Preamble	Date Rate (Mbps)	Packet Time (µs)	Number of Users [13]
Long	1	2572	~ 3
	2	1564	~ 5
	5.5	923	~ 8
	11	740	~ 10
Short	2	1316	~ 6
	5.5	675	~ 11
	11	492	~ 14

Note 13: The results shown may not be what a user will experience. Many factors will vary these results. The shown results are provided to set user's expectations.

Table 10: Calculated Throughput for 802.11b WLAN provides a reference for throughput of an 802.11b WLAN for the packet sizes of G.711 20ms and 30ms payloads. Table 10 shows that the throughput rate a user will get is not equal to the data rate, but significantly lower - especially for smaller packet sizes inherent to VoIP. A call using G.711 at 20ms and 30ms payloads require 160kbps and 149kbps, respectfully. For 10 calls on an access point, the 20ms payload calls would consume 75% of the throughput. For 10 calls using 30ms payload, the calls would consume 54% of the throughput. This does not leave much room for error and it implies all MVC 2050 users are operating at 11 Mbps, short preamble, and perfect radio conditions. Actual deployments need to allow for fewer MVC 2050 users due to real world radio conditions and for rate scaling as MVC 2050 users move away from the access point. If data users were mixed in with MVC 2050 users over the same radio channel (even with proper QoS mechanisms), even fewer MVC 2050 users could be supported.

Table 10: Calculated Throughput for 802.11b WLAN

802.11b Preamble	Date Rate (Mbps)	Throughput [14] (kbit/s) for Packet Sizes (IP header + data)	
		200 (G.711 20ms payload)	280 (G.711 30ms payload)
Long	1	581	660
	2	912	1080
	5.5	1432	1815
	11	1710	2254
Short	2	1024	1190
	5.5	1729	2150
	11	2151	2772

Note 14: The results shown may not be what a user will experience. Many factors will vary these results. The shown results are provided to set user's expectations.

Therefore, the maximum number of simultaneous calls per access point depends upon the user's particular network. For example, an 802.11b WLAN capacity could range from 10 users to 2 when non-overlapping channels are used. Realistically, the number of users on an access point is more likely closer to 5 to 3 users than the theoretical 10 users.

5.3.2 Delay

Delay is the time it takes from when the MVC 2050 voice packet is sent to when it is received at the far-end. While a user experiencing excessive delay will cause a data application to simply time-out, delay for MVC 2050 users will cause some degradation in audio quality or even a dropped call.

Delay can be fixed or variable. Examples of fixed delay include PDA processing IP packets, queuing delay (data transmission wait-time) at each network hop of the physical network, and propagation delay – the delay caused by the finite speed at which electronic signals can travel through a transmission medium. Examples of variable delay include queuing delay for traffic entering a network node, contention (vying for access) with other traffic at each network node, and queuing

delay for traffic exiting a network node. Variable delays are affected by the amount of network traffic.

Refer to Table 11 for measured one-way delay for the various PDA devices.

Table 11: Measured One-Way Delay

PDA	Payload	Measured Delay
HP iPAQ h5550	20ms	152ms
Dell Axim X3i	20ms	112ms
Dell Axim X3i	30ms	138ms
Toshiba e750	20ms	138ms
Toshiba e805	20ms	160ms

It is important to reduce the amount of delay throughout the wireless and wired network. Reducing delay can be achieved by implementing a simplify end-to-end QoS, adding capacity to the wired LAN, minimize the number of hop counts, segregate constant bit-rate voice traffic from sporadic data traffic, and lower jitter buffer size (without increasing packet loss to the point where broken speech becomes noticeable).

There is also a delay when a MVC 2050 user roams from one access point to another. This handover delay was measured and is shown in Table 12: Handover Delay for the various PDA devices. It was observed that

Handover delay varied with changes to the medium, traffic, etc.
The user would experience about a half a second with no voice, or
The user would experience between 2 to 10 seconds of 10ms to 100ms no voice periods.

It was also observed that the PDA device may not handover to the next access point even if it was directly under the other access point. PDA vendors are aware of these WLAN issues and are constantly updating their drivers to improve their characteristics. It is important to keep the WLAN drives of the PDA up to date.

Table 12: Measured Handover Delay

PDA or CF WLAN Card	Time with No Voice (s)	Voice Degraded Time (s)
	Worst Case / Best Case	Worst Case / Best Case
Dell Axim X5 and TrueMobile CF WLAN Card	0.710 / 0.268	0.710 / 0.263
Dell Axim X3i	No Handover / 0.172	No Handover / 0.432
Toshiba e750	No Handover / 0.434	No Handover / 1.712
Toshiba e805	0.563 / 0.154	10.311 / 2.087

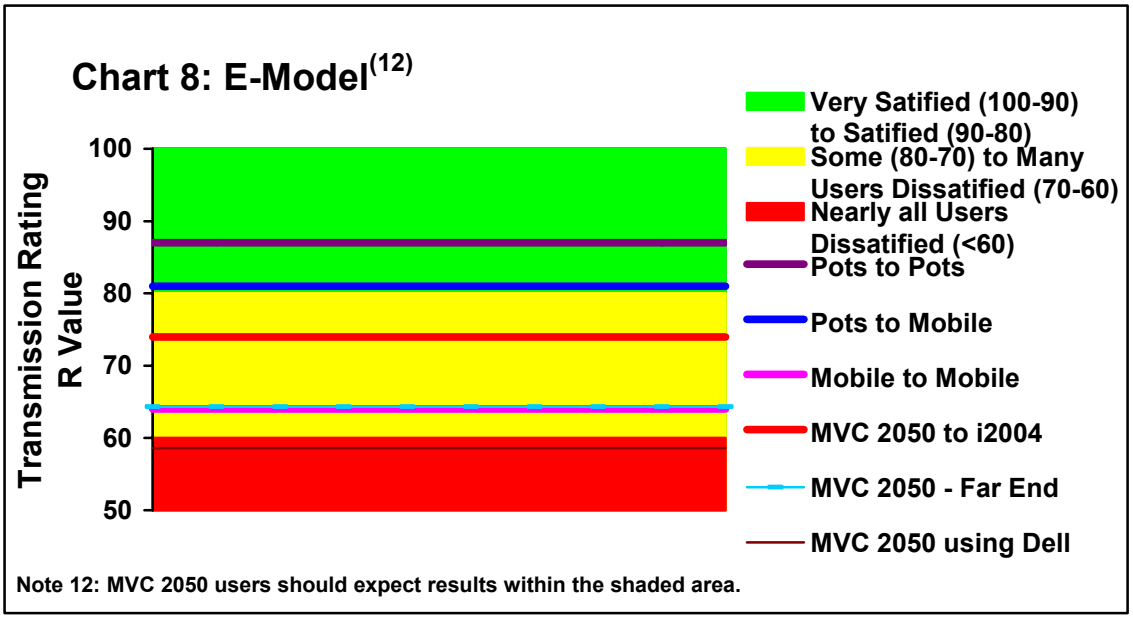
5.3.3 Audio Quality

Audio quality testing was performed employing one MVC 2050 user, on a WLAN with one access point, and without any data users. The calls were made from the MVC 2050 to an IP Phone 2004. The results are plotted in Chart 8: E-

Model. The chart has three colored sections representing the different definitions. For instance, green is used for an R transmission rating above 80 which the user will have a satisfying to a very satisfying experience. Three benchmarks were also plotted. Comparing the benchmarks to the definitions, a typical national call from an IP phone to another IP phone (Pots to Pots) or mobile cell phone (Pots to Mobile) will have a satisfying experience while national call from a mobile cell phone to another mobile cell phone (Mobile to Mobile) typically falls to where many users will be dissatisfied.

The results show by definition that at best, which is the top of the shaded area, the MVC 2050 user using the HP iPAQ h5550 and Toshiba e750 or e805 will be satisfied with their experience. On average (MVC 2050 to i2004), some of these users will be dissatisfied. However at the far end (MVC 2050 – Far End), many of the users will be dissatisfied. For users using the Dell Axim X3i or X5 (MVC 2050 using Dell), many to nearly all users at the far end of the call will be dissatisfied. The main factor for the Dell Axim lower result is the fact that the user must use the microphone on the PDA.

The shaded area represents the quality of experience the user will typically have. Of course, factors like the number of users on an access point or if the call is international will vary the results.



Note 12: MVC 2050 users should expect results within the shaded area.

5.4 Optimal Access Point Configuration

The following are recommended access point configuration to enhance the MVC 2050 experience.

For WLANs with only access points:

Create unique SSID for 802.11b-radio

Enable MAC security using RADIUS or local database on Access Point 2220

- Optional but recommended for enhance security

Enable Static WEP with longest key available that PDA device will support

- Optional but recommended for enhance security
- If WLAN Handsets 2210 and 2211 are in use on this WLAN, this may be too cumbersome to be worthwhile. It is easier to type WEP keys on a PDA device.

If the only voice devices are MVC 2050 users then use 802.1x in place of the two steps above

- Optional

Enable p-bit device prioritization for QoS. Map the p-bit assigned to voice to the highest queue on the Access Points 2220.

- Tagging on the switch port is required.
- MAC based QoS up to 8 PDA devices is an option as well however it does not scale.

Use RADIUS to designate, by MAC address or 802.1x, a unique tagged VLAN for each MVC 2050 user.

- Specify a default VLAN for all other devices or
- Map all devices to various appropriate VLANs
- This has not been validated

Do not use Close System

6 Summary of Limitations and Recommendations

The MVC 2050 is the latest in technology – converging IP Telephony, 802.11 WLAN and a PDA device which offers a great deal of efficiency and productivity benefits. It is very important, however, that customer expectations be well understood and managed, such that the MVC 2050 results in a positive customer experience and customer satisfaction. PDA performance is constantly improving with Moore's Law and this will directly benefit MVC 2050 performance specifications going forward. The WLAN performance will also change as the PDA moves from 802.11b to an 802.11 standard that includes QoS. Here is a summary of the known limitations and recommendations.

6.1 CPU Consumption

One significant limitation is the CPU inside the PDA. The processor is not as powerful compared to one in a desktop computer and can be easily swamped with tasks. In total, CPU consumption should not exceed 70% while on a call. Once the CPU consumption is over 70%, audio quality of the call will suffer.

Testing has shown that decreasing the payload size of the G.711 codec will cause an increase in CPU consumption. Increasing the payload from 20ms to 30ms will on average decrease CPU consumption by 16% and the MVC 2050 will be more stable. At 10ms payload, the CPU consumption is 100% - dropping the call.

Here is a list of requirements and recommendations to reduce CPU consumption in order to improve audio quality:

Set CPU to 400MHz (Maximum).
Use Windows Mobile 2003.
Set the Payload of the G.711 codec to 30ms.
When possible, avoid using a VPN Client, like movianVPN.
Minimize repeatedly tapping screen or repeatedly pushing input buttons on PDA.
Minimize running applications that consume significant amount of the CPU.
Minimize running multiple small applications that add up to a significant amount of the CPU.
Minimize operating extension packs that consume significant amount of the CPU.

6.2 Battery Consumption

To be mobile, the PDA runs on a battery that is small and light-weight. The battery has limited storage capacity. The number of calls and the duration of the calls have a direct relationship to the capacity of the battery.

The WLAN interface and MVC 2050 application will consume battery life. For the standard battery, call duration can be about an hour to two hours, depending on the PDA. For the high capacity battery, a call can be sustained for about two hours to over six hours, depending on PDA.

Here is a list of recommendations to reduce battery consumption:

- Use high capacity battery
- Use battery saving techniques described in PDA user manual, such as
  - Reduce the screen's brightness.
  - Shut off screen light when idle.
- Avoid saving battery technique that reduces CPU speed from 400MHz.

6.3 PDA Speaker and Headset

The PDA device does not have the same acoustic properties compared to the headset of a desktop phone. There will be acoustic echo at the other end of the phone call. Dell Axim X5 Advance and Dell Axim X3i 400MHz only has a headphone jacket and not a headset (headphone and microphone) jack. The user will need to hold the PDA up to their mouth and use the built-in microphone on the PDA.

Dell is aware and acknowledges that the PDA should support a wired headset.

Recommendations:

- Use a headset when on a call.
- Adjust the PDA microphone and speaker settings to peak performance according to if the user is using the built-in microphone and speaker or a headset and if the user is in a noisy environment or quiet environment.
- Set AGC when using built-in PDA speaker and microphone.
- Do not use a Bluetooth headset.

6.4 Roaming

There are two known roaming issues. The first is related to the HP iPAQ h5550 PDA. The second is with Nortel Networks Access Point 2220 using pre-1.3 software. For the HP iPAQ h5550, the roaming issue is very severe. If the Access Point 2220 is pre-1.3 software, the network connection will drop and therefore dropping the movianVPN connection, the connection to the CS 1000 or Meridian 1 PBX and dropping the voice call. The HP iPAQ h5550 attempts to bounce from one access point to another even if the HP iPAQ h5550 is motionless directly under one access point. The Dell Axim X5 and the Toshiba e750 are not as susceptible to the issue compared to the HP iPAQ h5550.

Recommendations:

Install HP WLAN driver 3.2.4.133 and iPAQ h5000 IP Reset For Roaming utility.

Use software release 1.3, or later, for Nortel Networks Access Points 2220.

6.5 Communication Server

The MVC 2050 supports G.711 codec. The CS 1000 or Meridian 1 PBX supports 10ms, 20ms and 30ms payload for G.711 codec. As the payload decreases from 30ms to 10ms, the CPU consumption of the PDA increases to the point where the PDA freezes at 10ms. For internode calls, the call may not be completed if the payload of the codec does not match. For Zone setting, a call may not be completed if the zones are configured to BB – Best Bandwidth.

Recommendations:

Configure the MVC 2050 the same as a IP Softphone 2050

Set the payload in all nodes to 30ms to improve CPU consumption on the PDA.

Set Zone to BQ – Best Quality

6.6 WLAN

Fundamental factors of the WLAN are:

Farther away from the access point, the weaker the signals received and lower the data rate.

Obstacles will cause the signal to be reflected or absorbed potentially affecting data rate and user throughput.

There is a fixed overhead.

Lower data rate users will drag other users closer to their throughput.

Contention, frequency interference from re-use and increase traffic will reduce throughput rate.

The following access point configurations that can improve throughput:

Separate data and voice SSID.

Configure MAC address per access point

P-bit priority - QoS

Short-preamble

- Eliminate 1Mbps connection.

For MVC 2050 users,

Try to avoid areas that have interferences, such as

Microwave ovens

Cordless phones

Minimize using other applications that use WLAN interface

Try to avoid Bluetooth devices

7 Tips and Tricks

Here are some of the tips and tricks discovered while this product was developed.

7.1 PDA

7.1.1 Known Issues

It is important not to drain the battery beyond the low battery warning. If the battery is too low, the PDA devices will hard reset and possibly removing important applications. It will also damage the battery if it occurs too many times – the battery won't hold the charge. In general, do not drain the battery below 40%.

For the Dell Axim PDA devices, if the user enables the option to 'turn off device if not used for (menu: 15 seconds to 15 minutes)', the PDA will shut off even if the user is on a call. The problem is, 'not used' refers to an input like a tap on the screen. The work around is to not enable this feature.

The Dell TrueMobile 1180 Wireless CF card, v.7.82 build 799, A01 (date: 6/25/2003) has a WiFi Power Management issue, it turns on even if the user selected it off and the WLAN connection can unexpectedly drop. The Dell TrueMobile 1180 Wireless CF card uses an Agere chipset and Agere has a newer driver that resolves this issue. It is recommended to use the Agere driver.

The Dell Axim X5 and Toshiba e750 can not recognize SanDisk WiFi cards that also has flash memory within the CompactFlash card and only SanDisk 0MB WiFi CompactFlash card work with those PDA devices.

7.1.2 Settings

To set the processor speed:

Dell Axim X5, X3i: Start -> Setting -> System-> Power-> Processor
Toshiba e750, e800: Start -> Setting -> System-> Power-> CPU Speed
HP iPAQ 5550: Not Applicable since it constantly operates at 400MHz

To determine the PDA's Pocket PC version:

Start-> Setting-> About

- Window Mobile 2003 will start with Version 4.x.x.
- PPC2002 will start with Version 3.x.x.

To determine which applications are running or to stop an application:

Start-> Setting-> Memory-> Running Programs

The controls for the volume of the PDA built-in speaker and headset are slightly different for each PDA.

Dell Axim X5 / X3i: Volume control icon at top of screen.

HP iPAQ h5550: Volume control icon at top of screen and volume buttons on the side of PDA.

Toshiba e750 / e805: Start-> Setting-> Systems-> Advance Audio

The AGC control can be found:

Dell Axim X5 / X3i: Start -> Setting -> System-> Microphone

Toshiba e750 / e805: Start -> Setting -> System-> Microphone

HP iPAQ h5550: Start -> Setting -> System-> iPAQ Audio

While testing the MVC 2050, the following microphone settings were used:

Toshiba e750 with Plantronics M130i headset:

- Use default setting

Toshiba e805, either using built-in microphone and speaker or with Plantronics M130i headset:

- Change setting from Interview to Custom,
- Enable AGC, and
- Disable boost

HP iPAQ h5550 with Plantronics M130i headset:

- In quiet environment - Use default setting (i.e. disable AGC)
- In noisy environment - Enable AGC and customize to acceptable level

Dell Axim X5 / X3i:

- Follow PDA Help instructions

7.2 Applications

7.2.1 Different Operating Systems

Most programs have a different version of their program to work on the different operating systems, movianVPN to mention one. While some versions may work on the other operating systems, the program's performance may be poor or even freezes the PDA. Be careful when installing programs and make sure the right version is used.

It is recommended to periodically backup the data on the PDA device and backup data before installing a new program. That way, if the PDA gets into a state where only a hard-reset will resolve the issue, the user can then easily restore their data to the state before the problem occurred.

7.2.2 WLAN Interface

In general, when the PDA device is placed in its cradle, the wireless network connection will be turned off, dropping the connection to the CS 1000 or Meridian 1 PBX and any active calls. The reason for this is that ActiveSync,

which uses PPP to connect to the host PC, causes the device's wireless connection to be dropped. By turning off ActiveSync, it is possible to use the MVC 2050 while the PDA device is in its cradle.

When upgrading HP iPAQ driver and utility, if the error message 'cannot copy xxxxxx.dll' occurs while attempting to overwrite the original 'vnetusba.dll' or 'leap.dll' files, rename the existing files in the '\Windows' folder and try again. What is happening is that files copied into RAM (as opposed to ROM) are locked while in use and cannot be deleted or overwritten. The driver revision listed in Asset Viewer will not change immediately after the drivers are copied. To update the WLAN driver revision in Asset Viewer, disable and re-enable the WLAN radio, then perform the soft-reset. If the WLAN driver revision is still not updated, remove the battery for a few seconds and replace it back again.

7.3 MVC 2050

Here are a few tips that can help make the MVC 2050 experience be more pleasant. Refer to the MVC 2050 User Guide for all the features of the MVC 2050.

7.3.1 ClearType

The MVC 2050 uses a special font that requires ClearType to be enabled on the PDA device. ClearType smoothes the edges of screen fonts for many programs. To enable ClearType, go to Start-> Setting-> Screen and check the Enable ClearType box.

7.3.2 Sound Tab

This feature provides an audible indication when the MVC 2050 has connected to the server, the server is unreachable or when the server is unresponsive. This is helpful to the user when they are roaming with the MVC 2050 running in the background since they will know if the MVC 2050 is not connected without having to look at the PDA screen. Users must provide their own .wav files.

7.3.3 Program Buttons

The PDA has four program buttons located on the front of the device. By default, the buttons launch the programs that are identified by the icons on the buttons. It is possible to reprogram a button to speed up the launch of the MVC 2050 application. This can be done by going to Start-> Setting-> Buttons, highlight the button from the list to assign the MVC 2050 to that hardware button, then choose MVC 2050 from the list of button assignment, tap 'ok' at top right of screen to enable the change.

8 WLAN Handsets 2210 and 2211

MVC 2050 users may also be on a WLAN that deployed Nortel Networks WLAN Handsets 2210 and 2211. This section will briefly look at this network.

8.1.1 Network Overview

Figure 2: Standalone and Hybrid represents two networks. Standalone Network is the simplest wireless configuration and is very similar to Figure 1: Network Overview. It is generally for a small WLAN with a few users. The Standalone Network consists of the following main components.

WLAN Telephony Manager 2245 – An Ethernet LAN application that works with the access point to provide QoS (SVP protocol) for WLAN Handsets 2210 and 2211 on the wireless LAN. This component is only required when WLAN Handsets 2210 and 2211 are deployed. It is not required for the MVC 2050.

WLAN Application Gateway 2246 – An OAI that enables third party software applications to communicate with the WLAN Handsets 2210 and 2211. The WAG 2246 is optional.

WLAN Access Points supporting 802.11b – WLAN Access Point 2225 is a standalone multi-mode access point supporting 802.11a/b/g.

The Hybrid Network uses the same components as the Standalone Network however it is for larger installations that require centralize security and therefore has a WSS 2250.

Figure 3: Adaptive Network is for customers in a greenfield environment. Like the Standalone or Hybrid Networks, an Adaptive Network uses the WTM 2245 and WAG 2246 to support the WLAN Handsets 2210 and 2211 (but not the MVC 2050). However, the WSS 2250 and access points are replaced by:

WLAN Security Switches 2270 – Security Switch 2270 provides centralized security and management plus total control of their RF domain and have yet to deploy WLAN.

WLAN Access Ports 2230 and 2231 – Multi-mode access ports with air monitoring capability and complemented by the WLAN Security Switch 2270.

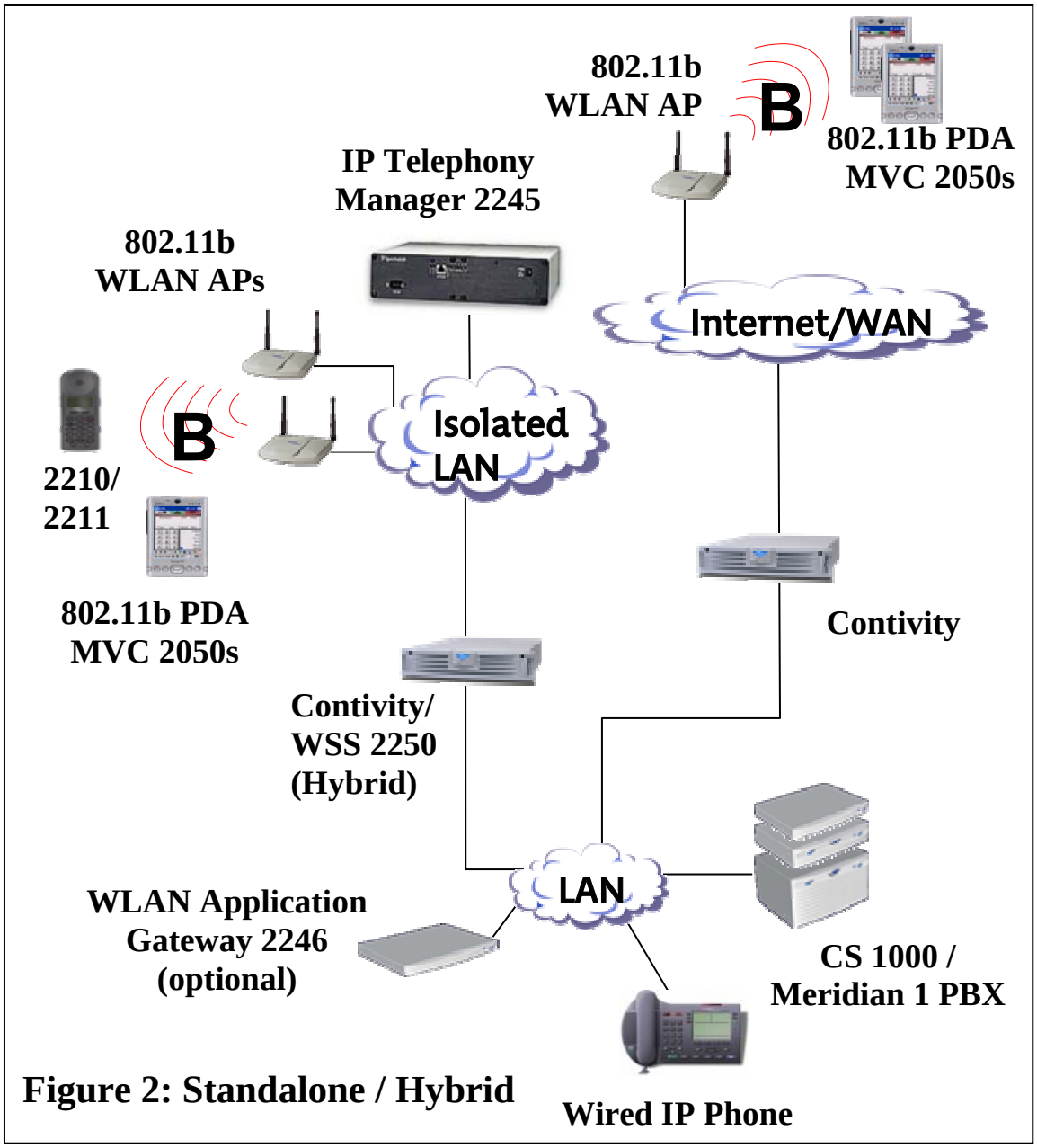


Figure 2: Standalone / Hybrid

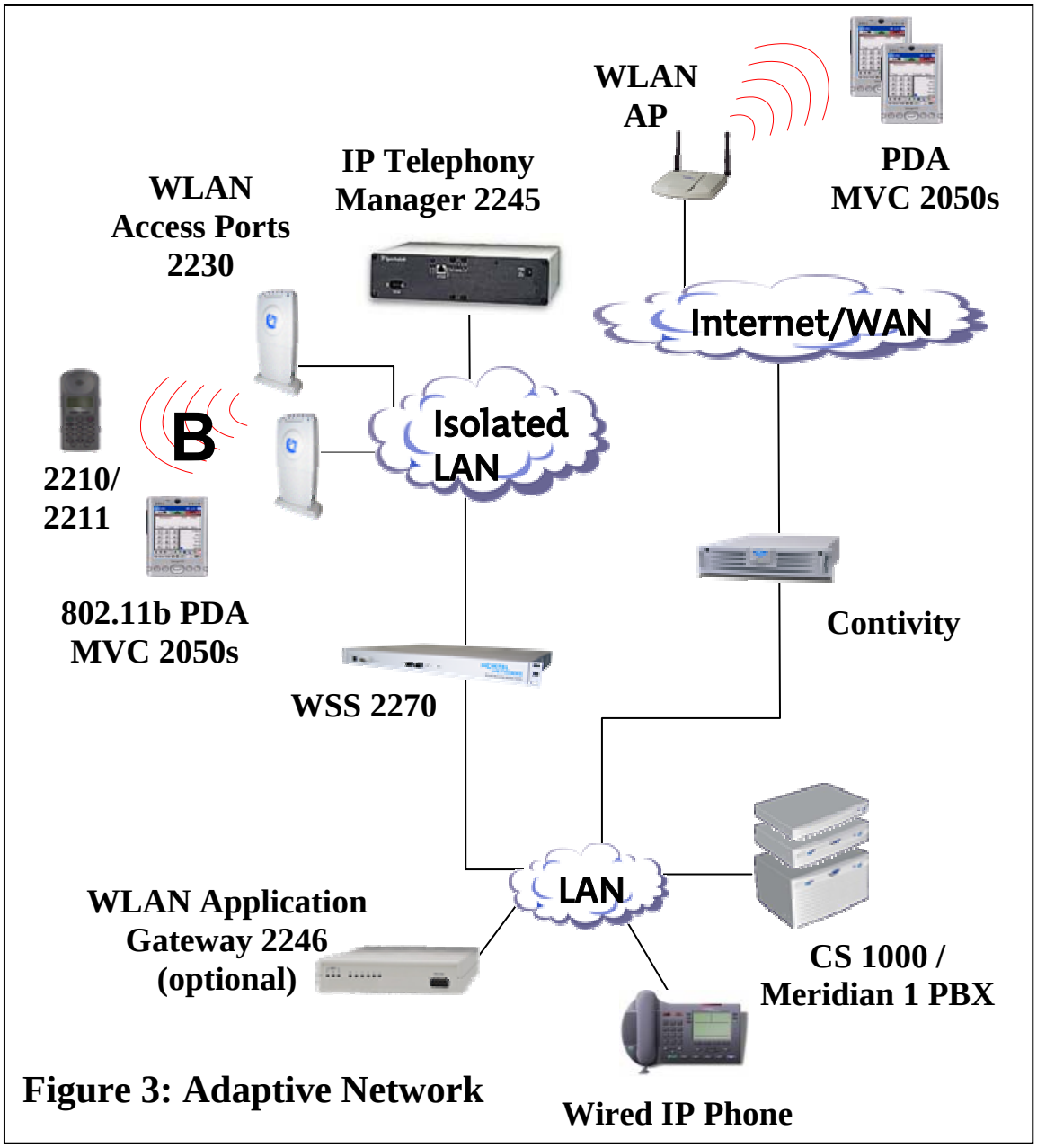


Figure 3: Adaptive Network

8.1.2 MVC 2050

SVP protocol is a proprietary QoS extension that provides the WLAN handset's traffic with priority over data traffic. While providing QoS to targeted WLAN handsets, voice traffic from MVC 2050 users will be invisible to the WTM 2245, potentially resulting in decreased audio quality for MVC 2050 users if the MVC 2050 users are on the same access points as a WLAN handset. If the access point is prioritizing PDA devices at the same level as the WLAN Handsets 2210 and 2211, then both devices will receive the same level of QoS. If the MVC 2050

users are treated at a lower priority, then quality may be less on the MVC 2050 than the WLAN Handsets 2210 and 2211.

The medium to long-term solution is the 802.11e standard which will replace proprietary QoS. The short term solution is:

Under SVP, the WTM 2245 can be configured to specify how many simultaneous conversations can be supported on each access point, typically 8 on 802.11b WLAN. The number could be decreased to 5 or 6, if there is a mix of WLAN Handsets 2210 and 2211 and MVC 2050 users.

Provide a mix of QoS mechanisms that support SVP and MAC based filtering and/or 802.11p/Q on a single access point.

Support Multiple SSID. For example, all of the voice, i.e. SVP devices and MVC 2050 users could be on the 802.11b and the data devices could be on the 802.11a.

8.1.3 Optimal Configuration

The following are recommended configuration to enhance the MVC 2050 experience.

Global settings:

Disable Aggressive Load Balancing

Enable Ethernet Broadcast support

- Only required if using PTT for WLAN Handset 2211

Enable Layer 3 LWAPP mode

- Optional, but required if using PTT for WLAN Handset 2211

Disable 802.11g support

Set Gold queue length to 20

- This can only be done by CLI

Create a unique interface,VLAN, on the WSS 2270 and map voice clients to the WSS 2270

Do not use Closed System

Per SSID settings:

Create dedicated WLAN/SSID for voice devices only

Map SSID/VLAN to the dedicated voice VLAN/interface.

Enable MAC security using RADIUS or local database on 2270

- Optional but recommended for enhance security

Enable Static WEP with longest key available that PDA devices will support

- Optional but recommended for enhance security
- If WLAN Handsets 2210 and 2211 are in use on this WLAN, this may be too cumbersome to be worthwhile

If the only voice devices are PDAs then possibly use 802.1x in place of the two steps above. 802.1x is not supported by the WLAN Handsets 2210 and 2211.

- Optional

Set Gold QoS for WLAN/SSID

Per radio settings:

Use WLAN override to disable all other WLANs and SSIDs than the voice SSID on 802.11b.

Use WLAN override on the 802.11a radios to disable the voice WLAN/SSID.

9 Resources

Here is a list of useful websites and documents.

9.1 Websites

PDA Sites:

- HP – Download latest drivers and discussion group
  http://h10010.www1.hp.com/wwpc/us/en/sm/WF02d/215348-64929-215381.html
- Dell – Login required to download drivers (under Service & Support)
  http://www1.us.dell.com/content/products/category.aspx/pda?c=us&cs=19&l=en&s=dhs
- Toshiba – Download latest drivers and specifications
  http://www.toshiba.com/tai-new/
- Axim user groups - Helpful for solving Axim issues
  http://www.aximsite.com/boards/ and
  http://www.aximusers.com/
- Dave's iPAQ – An iPAQ discussion group
  http://www.davesipaq.com/index.shtml
- Pocket PC PDA Buyer's Guide – Reviews of various PDA devices
  http://www.pdabuyersguide.com/ppc.htm

PDA Programs:

- Microsoft – Windows Mobile / Pocket PC
  http://www.microsoft.com/windowsmobile/default.mspx
- SuperTask – CPU consumption monitoring tool
  http://www.softwareandson.com/SuperTasks/
- Certicom's Movian VPN Client
  http://www.certicom.com/index.php?action=product,mvpn
- Apani Networks Netlock VPN Client
  http://www.apani.com/datasheets/netlock_vpn_nortel.html
- XCPUScale – Clocks CPU to different speeds
  http://immiersoft.com/
- Handango – Various Pocket PC Software
  http://www.handango.com/PlatformSoftware.jsp?siteId=1&jid=E7881E57CEAC488A51537D6AF1BEFC79&platformId=2

WiFi Sites:

- WiFi Planet – Tutorials, discussion groups, etc.
  http://www.wi-fiplanet.com/
- MobileInfo.com - Mobile computing and wireless information
  http://www.mobileinfo.com/Default.asp
- SanDisk – CompactFlash WLAN cards
  http://www.sandisk.com/
- Socket – CompactFlash and SD WLAN cards
  http://www.socketcom.com
- pocketWiNc – WLAN sniffer for PDA
  http://www.cirond.com/site/products/wifispotter.htm

Headsets

- Plantronics – Approved headsets for HP iPAQ PDA devices
  http://www.plantronics.com/ipaq/en_US/catalog/display_category_type.jhtml;jsessionid=D1M15GRQABIU0CQBGNTCFEYKAEZWKIV0?id=cat4820075&rootId=cat4820068&productTypeId=cat4820075&_requestid=195673

Other

- Goggle – For finding PDA programs and resolving issues
  http://www.google.com/

9.2 Documents

MVC 2050 documents:

MVC User Guide
NTP: Internet Terminals: Descriptions
NTP: IP Line: Description, Installation, and Operation

WLAN documents:

Moving Towards Converged Mobility: Straight Talk on Voice over Wireless LANs

10 References

[1] WLAN Security Switch white paper

[2] Nortel Networks Mobile Unit 2201 Install guide

[3] Nortel Networks WLAN Access Point 2220 User Guide

[4] Application Guide of the WLAN Security Switch 2200

[5] Using the Nortel Networks Wireless LAN Access Point 2220

[6] Dell Axim X5 User Guide

[7] Dell Axim X3 User Guide

[8] Toshiba Pocket PC e750/e755 User's Manual

[9] Toshiba Pocket PC e750/e755 Detailed Specifications

[10] Toshiba Pocket PC e800/e805 User's Manual

[11] Toshiba Pocket PC e800/e805 Detailed Specifications

[12] HP iPAQ Pocket PC h5100 and h5500 series User's Guide

[13] HP iPAQ Pocket PC h5400 series User's Guide

[14] Switches Improve WLAN Range and Performance
By Jim Geier July 2nd 2003 From WiFi Planet

[15] Moving Towards Converged Mobility: Straight Talk on Voice over Wireless LANs

11 Definitions & Abbreviations

Table 1: Definitions & Abbreviations

AGC	Automatic Gain Control
AP	Access Point
Bluetooth	A wireless technology standard for short-range (30 ft) networking devices that allows for enabled devices to automatically recognize each other.
BST	Battery Saving Techniques
CF card	CompactFlash card – A removable card that is used to expand the capabilities of the PDA. Common types of CF cards include wireless and memory cards.
CLI	Command Line Interface
Codec	COder / DECoder
CPU	Central Processing Unit
CR	Change Request
DCF	Distributed Coordination Function
DSSS	Direct Sequence Spreading Spectrum
EDCA	Enhanced Distributed Channel Access
G.711	64k bps voice digitization
G.729	8kbps compressed voice digitization
HCCA	HCF Controlled Channel Access
HCF	Hybrid Coordination Function
IP/UDP	Internet Protocol / User Datagram Protocol
ISM	Industrial, Scientific and Medical. This refers to the unlicensed radio bands which are typically unused due to interference from medical, industrial and scientific equipment. WLANs use these bands since no governmental approval is needed for transmission, making it a great deal cheaper.
ITG	Internet Telephony Gateway
Kbps	Kilobits per Second
LWAPP	Light-Weight Access Point Protocol
MAC	Medium Access Control
MB	Mega Bytes
MSDU	MAC Service Data Unit
OAI	Open Applications Interface

OFDM	Orthogonal Frequency Division Multiplexing
PCF	Point Coordination Function
PDA	Personal Digital Assistant
PLCP	Physical Layer Convergence Procedure
PPC or Pocket PC	A device which runs Microsoft Windows CE operating system
PPP	Point to Point Protocol
PTT	Push-To-Talk
QoE	Quality of Experience
RAM	Read Access Memory – The primary temporary storage area for instructions and data. Any information stored in RAM is lost when PDA is reset.
ROM	Read Only Memory – Memory that stores data and programs that can not be deleted or written to by the PDA. All information is retained after the PDA is rested.
SD card	Secure Digital card – Functions the same as CF but is a smaller form factor.
SDRAM	Synchronous dynamic RAM.
SSID	Service Ser IDentifier
SVP	SpectraLink Voice Priority
TCP/RTP	Transmission Control Protocol / Real Time Protocol
VLAN	Virtual LAN
VoWLAN	Voice over WLAN
VPN	Virtual Private Network
WEP	Wired Equivalent Privacy
WiFi	WIreless FIdelity – generally referring to any type of 802.11 network
WLAN	Wireless LAN
WME	Wireless Multimedia Enhancement™
WMS	Wireless Multimedia Scheduling
WPA	WiFi Protected Access™