Computer Science Honours Literature Survey

Evaluation of Windows 7 Build 7100 Release Candidate (RC)

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ABSTRACT

The release of **Windows 7 build 7100 RC** in May 2009 grants an opportunity to evaluate a Windows derivative and provide a detailed account of what features it possesses, its performance and the software it can support. This would allow consumers and businesses to make informed decisions when choosing an Operating System (OS) to use. This project will also seek to evaluate some of the new features in windows 7 as well as those common to the new OS and its predecessors to find out if there have been any changes and what impact they have.

1. INTRODUCTION

Windows Vista did not spread as rapidly as Microsoft expected for many reasons. The corporate sector believed it was a bad idea to spend substantial financial resources on software upgrades during an economic crisis while IT-professionals played their usual game of waiting for the release of the first service pack [24]. As for the home users who have been using ***Windows XP*** for a long time a hostile reception was inevitable. Considering that ***Windows XP*** has been in the market for such a long time and that the transition from ***Windows 98*** to ***Windows XP*** was not a smooth one critics have been questioning the timing of the release of the ***Windows 7*** OS. ***Vista*** has been around for less than 3 years and claims have been made that Microsoft is making a rushed decision by releasing a whole new OS instead of taking their time to fix the bugs in ***Vista***.

Some skeptics claim that ***Windows 7*** is *Vista* with bugs taken out of it with some critics going as far as claiming that ***Windows 7*** is just a Vista patch. John Curran, head of the Windows client group in the United Kingdom, during a ***Windows 7*** briefing was asked by Anderson that, "Since under the covers ***Windows 7*** is so similar to *Windows Vista*, how does Microsoft justify calling it a full new version? [1]" Curran is said to have responded by mentioning new features in ***Windows 7*** such as: *Digital Living Room Network Alliance (DLNA)* compliance in Windows Media Player (WMP) for easier media sharing, *BitLocker to Go* for encrypting USB storage devices, Direct Access for network access without VPN, and new support for sensors and devices that will enable *location-aware* laptops. Anderson then goes on to give a rather half hearted comment that, "…distinguishing between applications and the core operating system is a matter of debate... [1]" Despite this antagonism, ***Windows 7*** has been widely anticipated since developers got the first glimpse of it at Microsoft's Consumer Electronics Show (CES) booth tour held in Las Vegas on the 9th of January 2009 [2]. At the Show, Steve Ballmer, Microsoft's CEO is quoted to have said that they are working hard at putting all the right ingredients such as simplicity, reliability and speed into ***Windows 7*** [2]. He is also reported to have described ***Windows 7*** as a slick, fast, user-friendly successor to *Vista* and that ***Windows 7*** will be "the best version of Windows ever [2]." Microsoft has also promised that the new OS will have faster start up and shutdown times, fewer security alerts, and will provide better power management leading to improved battery life on laptops [22]. They also say that ***Windows 7*** will support *multi-touch interfaces*, simplified home networking, and easier management of peripheral devices such as cell phones and digital

cameras. In addition, Microsoft has also promised that the OS will have an updated Taskbar, new animated desktop effects, *context-sensitive menus* and a smarter desktop search tool [13].

Microsoft has been aiming for an early commercial release of the completed product, a shift from their initial proposed release in 2010. Gregg Keizer said that Microsoft confirmed on the 2nd of June 2009 that it will put ***Windows 7*** on store shelves and computer makers will have systems ready to sell with Vista's successor on the 22nd of October 2009 [8]. A Release Candidate (RC) of the OS has however already been released which has been made available to the public. A critical evaluation of ***Windows 7*** is therefore necessary in order to identify existing bugs, rate the performance of the OS as well as establish its usability.

2. HISTORY OF WINDOWS 7

Development of ***Windows 7*** started in 2006, before the completion of its predecessor, ***Windows Vista***. Following the release of ***Windows Vista***, it was confirmed by Microsoft on July 20, 2007 that "the internal name for the next version of the Windows Client OS was ***Windows 7*** [5]. It was then announced on October 13, 2008, that ***Windows 7*** would be the official name of the new OS [4].

3. WINDOWS 7 EXPECTED VERSIONS

Windows 7 will come in a variety of versions. Each version of ***Windows 7*** is specifically designed for particular kinds of users

3.1. Windows 7 Starter

This version is proposed to come without the *AERO* Glass Graphical User Interface (GUI). Microsoft says that ***Windows 7 Starter*** will be designed for users who have only basic computing requirements**.** ***Windows 7 Starter*** will be the only ***Windows 7*** version that will not have a 64-bit option. Microsoft had initially declared that ***Starter*** would limit a user to running three concurrent applications. However they eventually changed their minds due to user pressure as explained on page 17. ***Windows 7 Starter*** will not come with the so-called "easy networking" features that ***Home Premium*** will offer, or the multimedia codecs that ***Home Premium*** will include [6].

3.2. Windows 7 Home Basic

Windows 7 Home Basic, as presented by Microsoft will include: *live thumbnail previews*, an enhanced visual experience, advanced networking support (ad-hoc wireless networks and Internet connection sharing), as well as *Mobility Center* in addition to the features available

in the ***Starter*** version [6]. Similar to the ***Starter*** edition ***Home Basic*** will not be privileged with Aero Glass Graphical User Interface and advanced Window navigation.

3.3. Windows Home Premium

In addition to the features available in ***Home Basic, Home Premium*** is proposed to come with support for: *AERO Glass* and *Advanced Windows Navigation*, easy networking sharing across PCs and devices, improved media format support, enhancements to *Windows Media Center* and media streaming as well as multi-touch and improved handwriting recognition. Furthermore ***Home Premium*** will play DVDs without the need to install additional software. However, Microsoft has not officially said anything about Blu-ray support in ***Windows 7***. Microsoft has also added support for a number of media codecs, including WMV, WMA, MPEG-4 files, AAC and AVC/H.264 codecs. Microsoft has also added support for MPEG-2 Video and Dolby Digital Plus—but not in Windows Home Basic. That's another difference between the two [6]. ***Home Premium*** will have so called "premium" games as well as the capability to create home network groups.

3.4. Windows 7 Professional

Windows 7 Professional builds on ***Windows 7 Home Premium***, and adds the following features: ability to join a managed network with *Domain Join*, Remote Desktop host, better PC management with Group Policy, data protection with advanced network backup and Encrypting File System (EFS). Furthermore ***Professional*** provides access to some of the more advanced networking capabilities such as location-aware printing. ***Windows 7 Professional*** is recommended by Microsoft for small businesses [6].

3.5. Windows 7 Enterprise

Windows 7 Enterprise will only be available though volume licensing. The features that will be in the ***Enterprise*** version will also in be available in ***Windows 7 Ultimate***. Key features include: *BitLocker* data protection on internal and external drives, *DirectAccess* which provides seamless connectivity to your corporate network (this requires ***Windows Server 2008 R2***), *BranchCache* (also requires ***Windows Server 2008 R2***.) which reduces the time branch office workers have to wait to open files across the network as well as *AppLocker* which prevents unauthorized software from running. These features come in addition to those available in the ***Professional*** version [6].

3.6. Windows 7 Ultimate

According to Microsoft, all of the features in the other versions, both for business and consumer, are wrapped up in the ***Ultimate*** edition of ***Windows 7***. It is worth noting that Microsoft also said that ***Windows 7 Ultimate*** will have no extras attached to it as was the case with ***Windows Vista Ultimate*** [6]. This means that ***Windows 7 Ultimate*** will have no additional features that are unique to it as was the case with ***Vista.***

Microsoft decided to drop the 3 application limitation on ***Windows 7 Starter***, the edition that is expected to ship on most netbooks. This would have blocked users from running more than three applications at the same time. Microsoft spokesman Brandon LeBlanc announced the change saying that, "Based on the feedback we have received from partners and customers asking us to enable a richer small notebook PC experience with ***Windows 7 Starter*** ... we are going to enable ***Windows 7*** Starter customers the ability to run as many applications simultaneously as they would like, instead of being constricted to the 3 application limit of the previous Starter editions [9]."

This is evidence that Microsoft is trying to avoid the mistakes it made with ***Windows Vista***. They are really doing everything they can to remove any barrier to the windows 7 OS and by removing these barriers, they really are working to make as smooth a transition as possible into ***Windows 7***. Earlier editions of ***Windows XP Starter*** and ***Windows Vista*** Starter, both of which were sold only in a small number of markets outside the U.S., came with the 3 application restriction [7].

4. EVALUATION STRATEGIES

In this project a variety of tests will be carried out on ***Windows 7*** in order to determine ***Windows 7***'s a) performance against its predecessors such as ***Vista*** and ***XP*** b) security capabilities c) usability d) backup and search capabilities e) software compatibility and other operating system functionalities. Details of how the software works cannot be accessed since Windows is proprietary software. What this means is that "black box" or functional testing will be carried out. Hardware compatibility tests may also be conducted if various hardware platforms are provided to try and determine the minimum best hardware platform upon which the ***Windows 7*** gives the best output. Some of the tests to be carried out include:

4.1. Performance Testing

Microsoft claims that ***Windows 7*** will have faster, more responsive performance. They claim that ***Windows 7*** starts up, shuts down, resumes from standby, and responds faster. They also say that ***Windows 7*** provides fewer interruptions and can recover more quickly from

problems when they do occur. Furthermore Microsoft claims that ***Windows 7*** will help you fix problems when you want and if the operating system experiences a problem it automatically recovers [14]. However performance improvements are about more than speed. An example is if your laptop battery lasts longer with one operating system than another while running the same applications the longer battery saving OS is said to be more efficient. Microsoft also claims that, "***Windows 7*** comes with power-saving features, such as adaptive display brightness, which dims the display if you have not used your PC for a while thus increasing battery life [8]." In terms of faster performance the OS can be benchmarked and results are compared against other OS benchmarks to verify accuracy of these claims. Traeger et al (2008) are of the opinion that, "Benchmarking is critical when evaluating performance... [21]." They also argue that complex interactions between I/O devices, caches, kernel daemons, and other OS components result in behaviour that is difficult to analyze. Benchmarks are most often used to provide an idea of how fast some piece of software or hardware runs. The results obtained can significantly add to, or lessen, the value of a product be it monetary or otherwise. As an example the results may be used by potential consumers in making purchasing decisions, or by researchers to help determine a system's worth [21]. Traeger et al (2008) classify benchmarks into three categories and the categories are as follows:

- Macro-benchmarks: performance is tested against a particular workload that is meant to represent some real-world workload.
- Trace Replay: in this case a program replays operations which were recorded in a real scenario, with the hope that it is representative of real-world workloads.
- Micro-benchmarks: a few (typically one or two) operations are tested to isolate their specific overheads within the system [21].

Traeger et al further argue that useful file benchmarks should highlight the high-level as well as low level performance when they say that,"... we recommend using at least one macro benchmark or trace to show a high-level view of performance, along with several micro benchmarks to highlight more focused views [21]."

The state of the system as benchmark tests are being run can have significant effects on the results obtained. As a result when an appropriate system state is determined, it should always be documented accurately together with the results to allow reproducibility. Some major factors that can affect results are cache state, file system aging, and nonessential processes

running during the benchmark. Traeger et al argue that, "the state of the system's caches can affect the code paths that are tested and thus affect benchmark results. It is not always clear whether benchmarks should be run with "warm" or "cold" caches. On one hand, real systems do not generally run with completely cold caches. On the other hand, a benchmark that accesses too much cached data may be unrealistic as well. Because requests are mainly serviced from memory, the file or storage system will not be adequately exercised [21]." If cold cache results are desired, caches should be cleared before each run. This can be done by allocating and freeing large amounts of memory, remounting the file system, reloading the storage driver, or rebooting [21]. Rebooting can also be an effective method of clearing caches. Since a dual boot (running ***Windows* XP *SP3*** and ***Windows 7 RC Build 7100)*** will be used in these experiments, caches will automatically be cleared when the machine is restarted to run the other OS. This helps create identical runs, thus ensuring more stable results.

To ensure reproducibility of the results, all nonessential services and processes should be stopped before running the benchmark. These processes can cause anomalous results (outliers) or higher-than-normal standard deviations for a set of runs [21]. It is also essential to ensure that no users log into the test machines during a benchmark run, and to also ensure that no other traffic is consuming network bandwidth while running benchmarks that involve the network. Traeger et al recommend four important guidelines to running benchmarks properly:

- One should ensure that every benchmark run is identical.
- Each test should be run several times to ensure accuracy, and standard deviations or confidence levels should be computed to determine the appropriate number of runs.
- Tests should be run for a period of time sufficient for the system to reach steady state for the majority of the run.
- The benchmarking process should preferably be automated using scripts or available tools to minimize the mistakes associated with manual repetitive tasks [21].

Furthermore Sun Microsystems suggests that, "During competitive system software testing, it is important to ensure the underlying hardware and the benchmarking code is as close to identical as possible so that proper comparisons can be drawn [18]." This means that to ensure comparability:

- The same physical hardware should be used for all tests

- Identical benchmark source code should be compiled on both platforms
- Operating systems that will be installed should be used out of the box, with no special tuning

For comparison purposes, and because no source code is available for the two systems, the benchmarking methodology that will be adopted will be the "black box" approach.

4.2. Robustness Benchmarking

"Robustness benchmarking provides important information to both users and designers of off-the-shelf software for dependable systems [17]." It is common for PC software to crash or hang, requiring restarts or even machine reboots. While users may want more dependable software, they have not yet created a marketplace in which developers are under pressure to provide it. The focus of robustness benchmarking is to test the reliability or ability of an OS to handle unforeseen circumstances when application code provides invalid inputs to it [17]. This is because real world software is barely free of bugs. In this method, operating system calls are made with various combinations of valid and invalid parameters. The resultant stress on the OS reveals erroneous system responses, including the ability to crash the entire system from within user code. Examples of such situations are buffer overflow cases where a program uses more memory than the programmer designed it to use resulting in it writing outside its address space.

4.3. Security

IT personnel are concerned with system security and they are most comfortable working with systems that they use on a day to day basis. Thilmany, argues that, "If IT personnel have mastered a particular OS, they already know how to make it secure against hackers. That particular know-how does not necessarily extend to a new system [20]."

If employees are used to working with a particular system, a change to a new system can drastically lower productivity for a time. Thilmany further argues that, "…enterprises that do take on a new OS must consider training cost for IT staff and all employees who will use the system when looking at costs [20]." An evaluation of the features available in an OS can help to come up with an estimate of the costs that can be incurred when migrating from one OS to another as well as establishing the benefits of moving over to the new OS. Testing an OS before deployment can also assist in planning for the relevant hardware and software

upgrades as well as staff training. Cost of an OS also affects the decision that is made by a user when choosing an OS.

4.3.1. Data Encryption

Many accounts have been reported about companies losing control over sensitive information. In some industries, this can have great legal implications, while in other situations the issue is inconvenience. "... Smart compliance policy dictates that sensitive information be safeguarded in the event of a lost or stolen laptop. Furthermore, preventing sensitive information from being removed from corporate resources is a pillar of effective compliance management [10]."

The ***Enterprise*** and ***Ultimate*** editions of ***Windows 7*** contain a feature called *Bitlocker Drive Encryption* which encrypts all the data on the system volume and another one called *BitLocker To Go* that offers data protection on portable storage, such as USB flash drives. *Bitlocker Drive Encryption* was first implemented in ***Windows Vista***. Compromised systems may contain confidential information which may be more valuable than the hardware itself, if it reaches the right people. *BitLocker* makes it harder to access this confidential information on these systems [3].

With the current generation of OSes it is very simple to break into a laptop. One obvious way is to take the disk drive out of the compromised system and connect it to a second machine as an auxiliary (slave) drive. All data can now be accessed using the administrator (root) privileges of the second machine. "An even easier solution is to use a bootable floppy disk, CD, or USB key that contains a script that resets the Administrator (root) password [3]." It is a sad situation that such scripts and disks are available on-line, and anyone with an Internet connection can download them. Once the Administrator password is reset, the compromised system can be booted and the attacker can log in as the Administrator, giving him complete access to all information on the system.

Ferguson says that, "The classic solution to this problem is to run a low-level disk encryption driver with the key (passphrase) provided by the user, a token (smart card) or a combination of the two. The disadvantage of the classic solution is the additional user actions required each time the computer is used. Most users are unwilling to go through these extra steps, and thus most computers are unprotected [3]." *BitLocker* improves on the classic solution by disallowing the user actions during boot or wake-up from hibernation.

On the downside, hackers can go around this configuration of *BitLocker* by using hardware-based attacks. Hardware based attacks can be stopped but the process requires the use of a token such as a USB key and/or a user-memorized password or PIN [3]. These options are fully supported by *BitLocker*, and they improve the security of the system. *BitLocker* makes use of the Trusted Platform Module (TPM) a tamper-resistant chip mounted on the motherboard. [3]. It is worth noting that this TPM device is not yet available in most of the motherboards available on the market today but will be incorporated in most PCs in the near future. During the boot process the Platform Configuration Registers (PCRs) in the TPM are used to keep track of the code that runs. The key used to encrypt the disk is sealed against a particular set of PCR values. If an attacker boots into any other machine running the same type of OS, the machine will be fully functional but the PCR values will be different and the TPM will not be able unseal the key. The *BitLocker* disk cipher must be fast otherwise the intended users will not use it [3]. As part of this evaluation a performance analysis will be carried out in order to establish the delay introduced by this added security function.

According to Sams.net, Microsoft's security problems can be summed up in two words: user friendliness [16]. He argues that, "No other platform (not even ***Mac OS***) has been designed so expressly for this purpose. Over the years, the Microsoft team has invested enormous amounts of time and research to deliver ease and enjoyment of use. For example, Microsoft even conducted research to determine from which direction light should fall on an icon. This ease of use comes with a cost." Swap files and disk caches are devices that greatly enhance overall performance (they can compensate for sparse RAM resources). When a large swap is present, certain elements of a program need not be loaded into memory again. This results in increased speed and functionality. Unfortunately, it also results in poor security.

Any type of swapped memory system is insecure because traces of data are left within that swap file or swap area. A good example is the use of encryption like PGP. When done through the Windows environment, the passphrase is written into the swap file and is therefore retrievable [16].

Sams.net further argues that user friendliness has inhibited the development of a truly secure Microsoft operating system. Indeed, this is the greatest challenge facing Microsoft today. Microsoft must find a way to reconcile user friendliness with strong security [16]. An assessment will be made in this regard to find out whether there has been any effort by Microsoft to improve on this loophole in their latest OS (***Windows 7***).

4.3.2. Identification and Authentication of Devices

While the number of potential attackers over a network connection is much larger than those within physical proximity of a target system, it is important to consider the threats and security countermeasures available for securing device interfaces [23]. This is particularly relevant for mobile devices such as laptops that are potentially exposed to a large number of individuals. Interfaces present a threat vector for internal users intending to compromise systems or to gain unauthorized privileges without leaving readily identifiable traces. Wolthusen argues that, "While some OS mechanisms may impose certain dynamism such as temporal restrictions of device access, there are few limitations imposed on communicating through an interface once access has been granted [23]."

What this means is that current common OSes and application programs typically do not identify and authenticate devices and application programs. Wolthusen further argues that, "In many cases the underlying devices do not provide for such mechanisms themselves (e.g. in case of human interface devices attached via radio or infrared interfaces, these commonly employ only limited disambiguation), which can lead to undesirable interactions at both functional and security levels [23]." In other cases, the identification and authentication mechanisms do not establish the identity of the communicating devices. As an example, the Bluetooth pairing mechanism establishes only knowledge of the PIN code, not the identity of a device or even of a subject controlling such a device. This means that devices attached to a host system do not identify individual users but assume that the possession of the device implicitly identifies the user. Furthermore the system assumes that the user identity authenticated on the host system pre-determines the ownership of attached devices. Assessments will be carried out in this regard in order to verify whether there has been a step made towards the improvement of security in terms of devices that access the system via various interfaces.

4.3.3. User Account Control (UAC)

One of the main reasons why users detested ***Windows Vista*** were the incessant security notifications that it gave each time an application tried to change the state of the system. Microsoft says that in ***Windows 7***, you get to choose the messages you want to see thus giving one more control over messages [14]. However there have been growing concerns in different parts of the media that ***Windows 7*** may end up being less secure than ***Vista*** as this freedom allowed to the user may allow malicious control of their PCs remotely.

4.4. Software compatibility

There is no one perfect operating system (OS). By definition an OS is simply a system that runs a user's hardware and applications. If a company decides to use a new operating system for their business, they are concerned about the interoperability of the new OS with the already existing hardware and software. Thilmany says that, "It is important to test everything multiple times, including third-party products like backup solutions, before full deployment [20]." As a result establishing the type of applications and the system specifications that an operating system can support is a very important aspect when evaluating operating systems. This process may involve loading as many applications as possible to determine their compatibility with the new OS.

This attribute will be tested in various ways including installation of software such as *Application Servers* and *IDEs* on a new ***Windows 7*** installation to find out whether the software will install. Microsoft products such as *MS Office 2003* and *2007* will also be tested to find out whether they can run smoothly on the new platform as well as verify whether one of the two is superior. Tests will also be done using highly graphical games such as *Pro Evolution Soccer 2009* and *Need for Speed Underground* in order to find out how well ***Windows 7*** manages its graphics usage. Furthermore, upgrades will be tried on machines already running ***Vista*** or ***XP*** to find out whether this is possible. Software running on these machines will be tested to find out whether they have not crashed. Lower versions of Microsoft OS will be tested to find out whether they can be installed after ***Windows 7*** has been installed. In other words the researcher will be trying to find out whether a dual boot is possible with lower versions of Windows after ***Windows 7*** has been installed.

4.5. Hardware compatibility

Testing an operating system with various hardware systems within the organization is also an essential step as this helps to determine which hardware is compatible with the OS [20]. This attribute will not be easy to measure as people from different walks of life have varying uses for computers in their day to day activities. However this attribute will be measured against standard home operation conditions to determine the minimum hardware that can support ***Windows 7*** for an individual to fully exploit the available functionality in the OS. The minimum requirements will also be compared against ***Windows 7***'s predecessors' hardware requirements.

4.6. Installation Process

In many OSes, creating disk partitions, logical devices, and new file systems (includes formatting) are detailed processes and this slows operations. Sun Microsystems, Inc argues that, "Because these relatively uncommon tasks are only performed by system administrators, there is little pressure to simplify and speed such administrative tasks [18]." Mistakes are easy to make and can have undesirable consequences. As more users handle system administration tasks, it can no longer be assumed that users have undergone specialized training. Automation of system administration can help to reduce the impact of these mistakes to a great degree. Sun Microsystems argues that manual reconfiguration of disk space is virtually unnecessary, but it has to be a quick and easy process when it is needed. Administrators can add storage space to, or remove it from, an existing file system without unmounting, locking, or interrupting file system service. Administrators simply state their intent, such as make a new file system, rather than perform the constituent steps [18]. An assessment will be made to find out how much the OS installation has changed and whether users can configure new space into their existing drives without formatting their PCs.

4.7. Dual-Boot

Dual-boot systems allow a user to run more than one OS with no virtualization required. A single computer can share multiple operating systems but only one can be executed on the computer but not both at once. This is known as a dual boot system since you must boot up the computer with one OS or another. OSes are fully installed on a machine but on different partitions of a single hard drive or on separate hard drives. When the machine is booted, a user must choose which OS they intend to use. The chosen OS will start up. To change OSes, one would have to reboot the computer and select the other OS. With this solution, both OSes are fully functional, though the machine can only support one at a time.

Microsoft says that ***Windows 7*** can be installed on a computer that is already running ***Windows Vista*** in a dual-boot configuration [12]. However as previously mentioned each operating system must be installed on its own partition. Microsoft gives the following recommendations for setting up a dual boot:

- If a computer does not yet have an OS, one should partition the hard disk so each OS they want to install has a partition and then start by installing the oldest OS.
- Any programs and drivers that one needs to use must then be installed on each operating system that they want to use them in.

It is worth noting that some users prefer to use dual boot systems in order to harness the full power of their systems. Hence this functionality will be tested with ***Windows 7*** to find out how it handles dual boot with other Windows platforms as well as non Windows variants.

4.8. Virtualization

The use of dual boot systems comes with some major disadvantages. First, it is high maintenance since both Windows and Linux must be maintained on each machine. Second, it can be time consuming rebooting machines in order to change platforms. Furthermore imaging a number of computers can be a very time consuming task. A solution that can solve dual boot problems described above is the use of virtual machines [15]. According to Necaise, "A virtual machine is an application program executed on top of one operating system that allows you to run a different OS simultaneously [15]." The virtual machine provides a user with a complete computer running inside a window on their desktop. The user gets complete network support, mouse and keyboard controls and access to disk drives and parallel ports. In effect, the virtual machine is a complete PC running as an application on top of a physical PC.

4.8.1. Virtualization in Windows 7

Windows Virtual PC is the latest Microsoft virtualization technology designed for ***Windows 7***. It is the runtime engine for *Windows XP Mode* to provide a virtual Windows environment for ***Windows 7***. With *Windows Virtual PC, Windows XP Mode* applications can be seen and accessed from a ***Windows 7*** desktop. According to Microsoft ***Windows 7*** delivers a richer experience when users are connected to a virtual desktop - much closer to the experience provided by a native Windows desktop. For example, ***Windows 7*** provides multi-monitor support, bi-directional audio to enable Voice over Internet Protocol (VoIP) and speech recognition applications, and access to local devices, such as printers [19].

Microsoft also claims that it is easy to setup a *Windows XP Mode* environment. They say that once the *Windows Virtual PC* and the virtual ***Windows XP*** environment are installed, Windows Virtual PC provides a simple wizard to set up *Windows XP Mode* with just a few clicks. Applications can then be installed in *Windows XP Mode* just as one would normally

do on a physical PC. These applications can then be run directly from the ***Windows 7*** desktop, by just going to the Start menu [19].

Above are the claims made by Microsoft about how virtualization of ***Windows XP*** will be implemented to help counter the problem of software incompatibilities. This virtualization technology has been named *Windows Virtual PC*. Microsoft claims that software installed on a ***Windows XP*** virtual machine with ***Windows 7*** OS as the host OS will be directly accessible to the host. Microsoft says, "Users can launch and use their line of business applications installed in the *Windows XP Mode* directly from a ***Windows 7*** desktop, as if these are ***Windows 7*** capable applications [11]." This bold claim will be put to the test in this evaluation to find out whether these claims are true. Furthermore this virtualization extension/tool will be compared to existing tools such as VMware Virtual PC and Microsoft Virtual PC 2007 in order to find out which tool works best with the OS.

5. NEW FEATURES IN WINDOWS 7 THAT COULD ALSO BE EVALUATED

5.1. Enhanced Troubleshooting Tools

Windows 7 provides rich tools to identify and resolve technical issues, often by the end users themselves. If a help desk call is unavoidable, ***Windows 7*** includes several features and troubleshooting tools to help speed resolution.

- The Problem Steps Recorder allows end users to reproduce and record their experience with an application failure, with each step recorded as a screen shot along with accompanying logs and software configuration data. A compressed file is then created that can be forwarded to support staff to help troubleshoot the problem.
- ***Windows 7*** includes a suite of troubleshooting packs, collections of PowerShell scripts, and related information that can be executed remotely by IT professionals from the command line, and controlled on the enterprise basis through Group Policy Settings.
- ***Windows 7*** also includes Unified Tracing to help identify and resolve network connectivity issues in a single tool. Unified Tracing collects event logs and captures packets across all layers of the networking stack, providing an integrated view into what's happening in the ***Windows 7*** networking stack and aiding analysis and problem resolution [19]

6. Conclusion

A variety of features exist in operating systems that can be evaluated in order to give would be users an idea of how well the OS works in a real working environment. As discussed above the way in which an OS is evaluated depends on the availability of the source code. In the case of this a research the black box approach will be used since the source code cannot be accessed. This means that a variety of tools (available online and those built into the OS) will be used to assess the functionality of **Windows 7 Build 7100 RC.** However the internal functioning of the OS cannot be assessed.

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