

## Survey the most self-healing operating system



Raheleh Beheshti Nejad<sup>1</sup>, Samaneh Amini<sup>2</sup>

<sup>1</sup>Beheshti.raheleh@gmail.com, <sup>2</sup>Amini.s24@gmail.com

Paper Reference Number: 846

Name of the Presenter: Raheleh Beheshti Nejad

### Abstract

Along the development of computer system hardware the required operating systems also get more complex than before. Management of such complex operating system is too difficult or sometimes impractical for human beings. For this purpose self-managing concepts provide a solution for these systems to be automatic as far as possible. The self-managing application programs have the most function on self-managing operating system. One important functions of self-managing operating system relates to self-healing concept; providing the preservation, reformation, rehabilitation and development of operating system automatically and without user intervention. In this article, the self-healing operating of operating system known as self-healing concepts (Windows7, Windows Vista, Windows Server2008, Minix3 and Solaris) is studied and is introduced.

**Key words:** operating system, self-healing, self-management, self-protection

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### 1. Introduction

With the rapidly growing development of hard-wares, there has been an increasing need for advanced and reliable operating system. In accordance with this progress, protecting and repairing of this operating system get more complex and difficult. The operating system designers have found a resolution for this problem considering four main factors: 1) self-healing 2) self-protection 3) self-configuration 4) self-optimization

Self-healing is the capability of getting aware of system status and correction of both known and unknown faults. Self-protection is the power to detect, identify and protect system from happening attacks. Self-optimization is capability of managing and controlling system resources to reach out the most optimal functioning. Self-configuration relates to the automatic reconfiguration of the system components. Operating systems are vulnerable to the applications and hardware faults. One of the most important tasks of a self-healing operating system is to detect and fix errors. In this paper, we mentioned the operating system of stated self-healing that is famous. In section 2 we put in to consideration the mechanism of discussed self-healing concept. In the following sections,

the issues of self-healing in operating system of Windows 7, Windows Vista, Windows Server2008, Solaris and Minix3 are studied. In section 6 the conclusion is stated.

## 2. Related work

Corruption ineligance of operating system may affect reliability and function of user applications. Generally, software faults (systematic and programmatic faults) include following faults: 1) syntactic faults (input variable faults) 2) logical faults (paradox function and incorrect results) 3) servicing faults (real time faults) 4) communication and interaction faults (time out and access violation faults) 5) exception (I/O and security related faults)

The first step to avoid occurring of errors, detect and fix them without rebooting system is based on reduction of kernel size and movement of system drivers to higher-layer operating system architecture. Although this mechanism automatically fixes most of the operating system errors without user's intervention and also reduces almost operating system codes, yet some operating system errors remain uncontrollable requiring intervention by user. These errors include errors originated from the resource management occurring in locked administrations or processing in faulty status. The second step applies self-healing predictive mechanisms, by this way errors are predicated before occurring and also components configuration and prevention functions control errors is managed. The privileges are simple management, real time, easy repairing and more efficiency. In the third mechanism, a focused manager, manages the kernel errors. In this technology, all components isolate and dissimulate errors to prevent their propagation through other parts of the system. For this purpose a regular recovering program and code reloading technique is used. In the fourth mechanism of developing the first way, the operating system kernel takes three layer architecture to support self-healing factors. These three layers are: User layer, Supervisor layer and hypervisor layer (Fig. 1). In this mechanism a four phase self-healing process is suggested: 1) monitoring phase 2) analysis phase 3) detection phase 4) healing phase

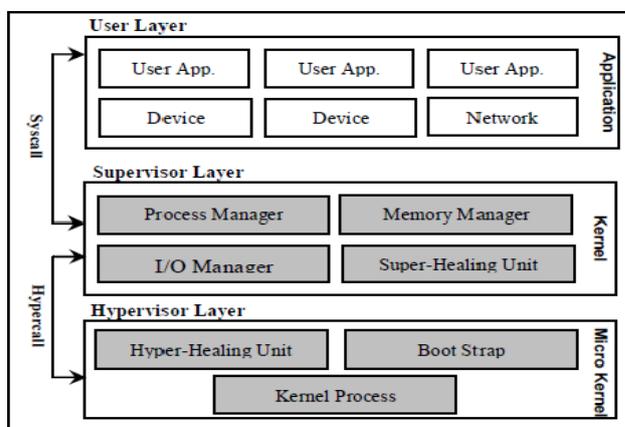


Fig1: Three layers architecture

### 3. A discovery in self-healing windows

#### 3.1- Windows Vista and Server2008

In windows Vista and Server2008 there is one feature known as self-healing NTFS. This feature is unique to systems supporting NTFS labeled file systems. The previous versions of Microsoft operating system such as XP, When operating system detecting faults in NTFS file systems, labeled as dirty and reboot system to fix errors. With NTFS self-healing property, NTFS application strings are created in background and start functioning. These strings function as an integrated package to repair faulty and incorrect data. In this method, just infected file(s) become inaccessible and the other programs can not reach them. But another Endeavour to reach is successful just after correction of errors. This will be done without locking any label or needing to reboot the operating system. Self-healing NTFS of Server2008 and Vista operating system is active by default. The fsutil repair command is used to activate or inactivate mentioned property. All these functions are implemented in background and without user notification unless he takes notice of it in system logging.

#### 3.2- Windows 7

Windows 7 has 6 versions which only three versions known as: Professional, Home Premium and Ultimate version are almost generally used. All versions support 32-bit and 64-bit architecture (except starter version). Microsoft Company in order to compete with other operating systems, reduced servicing expenditures and increased its servicing privileges and promoted some properties of its new operating system. These properties relate to automatically diagnosing of faults and system errors and also fixing of them. The parts added to windows 7 (addition to NTFS self-healing) let call it almost self-healing operating systems are:

##### 3.2.1- Action Center

Defect diagnosis: automatically diagnose and repair faults. In addition to the faults detected and fixed by the windows or user assistance, it is possible for user to diagnose and fix his intended faults. According to the subject, fault detection is divided into 5 main headlines (application soft-wares, hard-wares and sounds, network and internet, security and system, and operating system`s display)

##### 3.2.2- Restoring

The system restores, turns the operating system to the pervious reliable and usable status. This is done in two ways: in the first method a backup tool known as system image is used which requires a system image before operating system restoring. The second methods (advanced method) apply a restored image of the main windows during installation.

##### 3.2.3- Intelligent self-healing choices

By installation of window 7, a restoring system driver (100 MB space) is reserved automatically (Fig. 2). This driver includes boot files and they are required when you want to use Bit locker without TDM chip installation. Operating system uses this method to deal cases lead to the deletion of boot files. XP windows users encounter with lots of troubles due to deletion of Bootmgr or Ntdlr files which now can be shouted rapidly in this way.

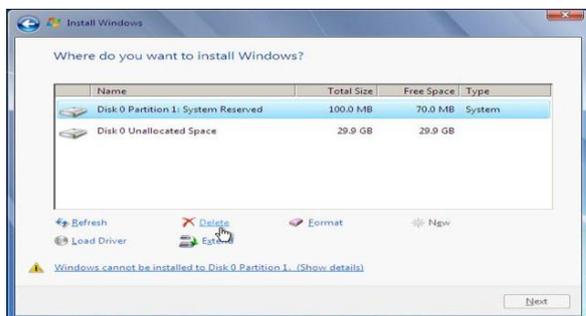


Fig.2: Windows 7 partition reserve

### 3.2.4-Booting time cases

At the time of booting Windows 7 by pressing F8 key, there are varieties of choices before you, one is “repair your computer” option by choosing it, a variety of functions for repairing the operating system are there for you. The first option of “Repair your computer” is startup repair, which automatically repairs lots of operating system’s common faults. The second option, “windows backup”, is a useful tool for creating a backup image of system regularly.

### 3.2.5- Automatic restoring

In case of windows 7 crashing, operating system starts restoring and repairing of itself automatically at the system rebooting time.

## 4. Minix3 operating system

Andrew Tanenbaum programmed this operating system for didactic objects and then Linux kernel was created on the basis of Minix. Minix is the compounding of the words (Mini) and (UNIX). Although Minix3 version is an example to complete Andrew’s book about operating system instructor, the intention for introducing this version is to create a serious and stable operating system with limits resources and high compatibilities. Minix3 supports lots of hardware platforms. Versions 1, 2, and 3 of this operating system were published on 8 may 2006 some its capabilities are X11, emacs, vi, cc, gcc, perl, python, ash, bash, zsh, ftp, ssh, telnet, pine and more than 400 Linux special soft-ware capable of being run in this operating system. With adding X11 (X windows system) property to Minix, it moved from being a command-oriented operating system to a graphical user interface operating system. Other capabilities and properties of this version, include it’s stability against faults due to hardware drivers and supports a larger domain of current drivers and runs them without performing separate process. By doing this, it debugs

system in the best way and consequently increases the capability of soft-ware programs performance. So it turned to be self-healing system. Self-healing process in MINIX3 (Failed driver's recovery) includes:

#### 4.1.1-Defect detection and repair

When user encounters a crash, system requires different techniques. So driver manager will display all the running drives and begins to start debugging and repairing system in case of detecting a fault.

##### 4.1.1.1-Run time defect detection

Drive manager considers methods of diagnosing runtime faults:

1. The administrator is able to detect, because this process is the parent of all service and drives (the way all UNIX systems let parent process collect the performed child function)
2. The driver manager can evaluate selected derives status alternatively. (Thorough the heart beat sent messages from the driver)
3. The driver managers is capable of commanding to shift faulty components with new ones, explicit updates are done if the administrator requests a dynamic update or if a trusted OS component files a complaint about a subordinate process.

##### 4.1.1.2-Applied policies in recovery

The high levels of recovery are (Fig.3):

- 1) An application requests the virtual file system (VFS) to perform an I/O operation.
- 2) The virtual file forwards the request to the intended driver.
- 3) The driver starts processing but before answering, it would be failed, so driver manager displays all drives, detects the crash and starts restoring.
- 4) Driver manager shifts the failed drive with its new copy and
- 5) Informs virtual system file of new setting.
- 6) The restarting request sends to the driver once again.
- 7) The I/O application doing ends successfully.

All these phases occur while commonly the operating system continues its operation and none of the operations need to be ended.

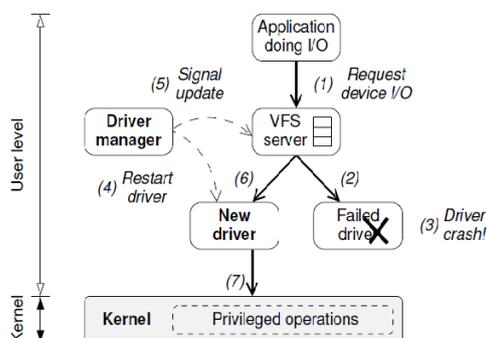


Fig 3: Basic idea underlying failure-resilient OS

## 5. Solaris operating system

Solaris operating system based on UNIX and an open coded operating system which programmed in 1992 by the sun company and it can be installed on the sun sparc, intel Pentium, cyrex, AMD hard-wares.

None of UNIX versions ever had the notability, user number and common expansibility of Solaris operating system. Solaris operating environment is a software package which includes: operating system (sun operating system) with a graphical environment and network service. It's different features are multi user, multi functioning, multi processing and also multi threading with properties like self- healing, self managing, real time functioning and the highest level of security among UNIX based operating systems. Solaris operating system is used as a data base server for Oracle, Informix, Jbase and also is the most secure and stable server for network services such as proxy E-mail, Web, DNS, DHCP, NFS, NIS, LDAP,...

Trusted Solaris for its high security is one of the most applicable UNIX for bank applications and military purpose. And also operates as an embedded operating system for much medical engineering equipment like MRI.

The first step in Solaris self healing is self diagnosing. It means that the system automatically is able to diagnose faults through checked signs. In this system the system manager or software administrator gets aware of fault directly by system file logging or this fault joints to a fault manager and reporter code as a mechanism and policies for diagnosis sub layers faults. In this operating system capable of predictive self- healing is due to the system's reports of created faults.

All these reports and other information needed to facilitate self- healing process are sent to software component called detection machine. Detection machines are run slowly in background to analyze error evaluation criteria and also to complete and predict detection processes.

When error prediction phases are completed, self healing architecture allows any operating system to respond to the current fault.

Solaris has some self healing operators actively shutting down the processor, physical memory and I/O devices.

With this reconfiguration, the self healing Solaris operating system can deactivate and isolate the crashed component rapidly and continue its backup services operation even before the system administrator could detect the fault.

## 6. Conclusion

Self healing process is one of the most factors that change the operating system architecture. Microsoft company is one of the companies changed the operating system architecture parallel to this evolution. Windows 7 is the Microsoft Company's production with the highest self-healing factors.

Among server operating system only windows Server2008 has a little of the capability of self healing. Minix3 operating system with its small kernel operates effectively against

faults caused by drivers and so it's known as a self healing operating system, Solaris operating system has been known as one of the strongest self-healing operating system by assistance of its fault prediction method.

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