



# International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 6, Issue 4, April 2018

## Performance Evaluation of Guest Operating System Following Obliteration of Pre-Installed Features

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**Abstract:** Virtual machines have provisions for users to run OS on top of other OS. However, its performance may not be the same as that of host OS. Yet, open source OS and apos; like Linux provide us means to remove certain features from the guest OS in order to increase its performance manifold, which leads to our own fine-tuned version of guest OS. This paper is aimed at studying the parameters affecting performance of guest OS and editing those features to produce its efficient version. Benchmarking and performance evaluations shall be done for this purpose.

**Keywords:** Linux; Operating system; Virtual machine; Guest OS; Host OS; Benchmarking; NMON

### I. INTRODUCTION

A virtual machine allows the host OS to set up an environment in which a guest OS can be run along with several other applications. The host OS creates an illusion such that the guest OS considers the hardware resources as native. An abstraction of the hardware resources of a single computer into distinct execution ecosystems is created, thereby creating the façade that every ecosystem is executing on its own private computer [1-9]. The ability of virtual machines to run guest operating systems can be used to test certain features of the guest OS, make modifications in its properties to alter its behaviour. This paper dives deep into the ways by which certain components of Ubuntu OS (running as guest OS), which if removed, alter the system performance consequently [10-14].

### II. TOOLS USED

#### 2.1 NMON

This tool is meant for benchmarking purposes which provides great deal of information using single command, either real time or saving data to a file [15].

#### 2.2 VMWare

This was used to create several VM's, with each VM having some feature of the guest OS removed. VMware is a non-free virtual machine application, which supports Ubuntu as both a host and guest operating system [16].

#### 2.3 Ubuntu 14.04 LTS

It was the guest OS for analysis. A default installation consists of general utilities and system tools [17]. Further details of the parameters of the VM are as follows: Memory: 7.8 GB |Processor: Intel@CoreTMi7-6700HQ2.60GHz |OS type: 64 bits |Disk: 18.9 GB.

#### 2.4 NMON Analyser

This tool converts NMON data file into human-readable graph format stored in spread sheets [18].

#### 2.5 NMON Visualiser

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This can be used to obtain further detailed graphs from the data contained in NMON file. Certain key features are: Java GUI (Swing) |Multiple files at once |Absolute and relative time ranges [19].

### III. METHODOLOGY

```

1 osho@ubuntu:sudo apt-get install nmon
2 osho@ubuntu:nmon -s 100 -c 20 -t -f
3 osho@ubuntu:ps -ef |grep nmon
4 osho 7877 2542 0 22:41 pts/9 00:00:00 nmon -s 100 -c
5 osho 8106 3781 0 22:43 pts/9 00:00:00 nmon -s 100 -c grep --
   color=auto nmon
6 osho@ubuntu:kill -9 3781
  
```

Figure 1: Code Snippet 1: Code to install and create NMON file for analysis.

1. The integer after s determines the frequency of seconds after which the NMON program is run.
2. The integer after -c determines the total no. of times the NMON program is run.
3. -t means top processes are included.
4. -f means the results are saved to a file with nmon extension in the same directory
5. The NMON process is run initially. After sufficient time has elapsed, the program needs to be killed explicitly [19] (Figures 1-3).

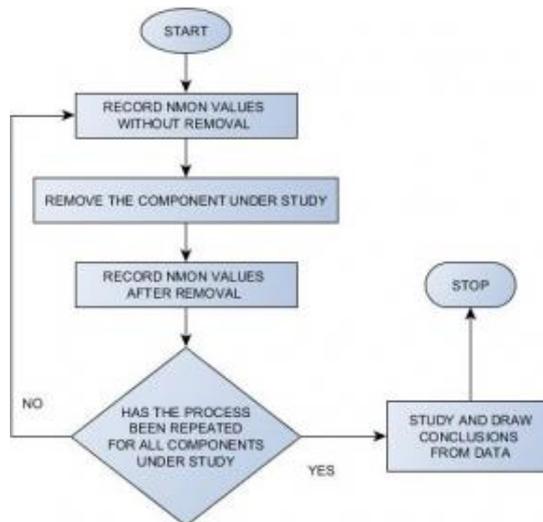


Figure 2: Course of action.

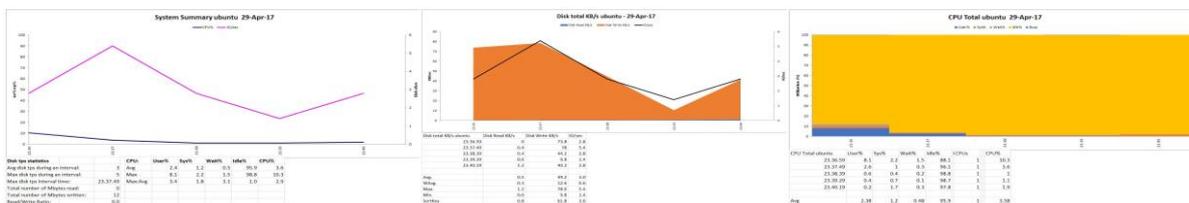


Figure 3: NMON graphs for original system.

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## IV. ORIGINAL SYSTEM

The System Summary graph can be used to observe the general trends in CPU%+ IO/sec(user + system) along with detailed information about disk transactions per second. The relevant parameters values can be observed from excel snap above. The disk usage (Disk total KB/s) for the system can be broken down primarily into the frequency of read and writes operations. The detailed analysis of user CPU usage, system CPU usage, waiting %, idle% and busy% can be determined from CPU Total graph. The comparisons for the three graphs have been listed separately as 3 bullet points in each subsection.

### 4.1 Removal stage 1: EMPATHY, EOG, EVINCE

#### 4.1.1 Empathy

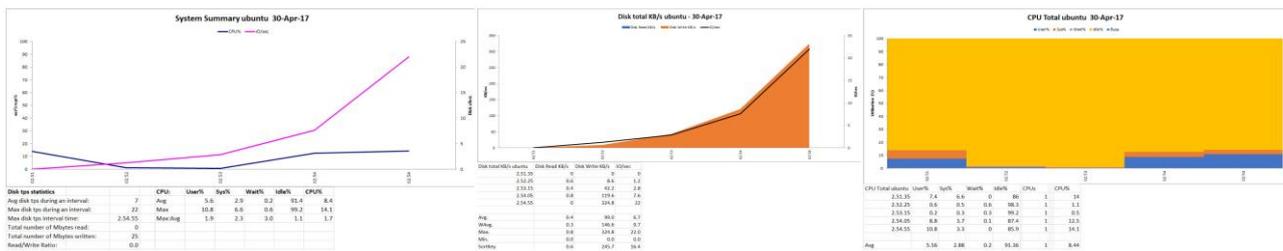
This offers instant messaging over audio, video, and text along with file sharing [20].

#### 4.1.2 EOG

Eye of GNOME serves as an image viewer for GNOME distro, equivalent to Photos app for Windows [21].

#### 4.1.3 EVINCE

Evince is a PDF document viewer that can be used for viewing images also [22]. It is similar to Adobe Reader.



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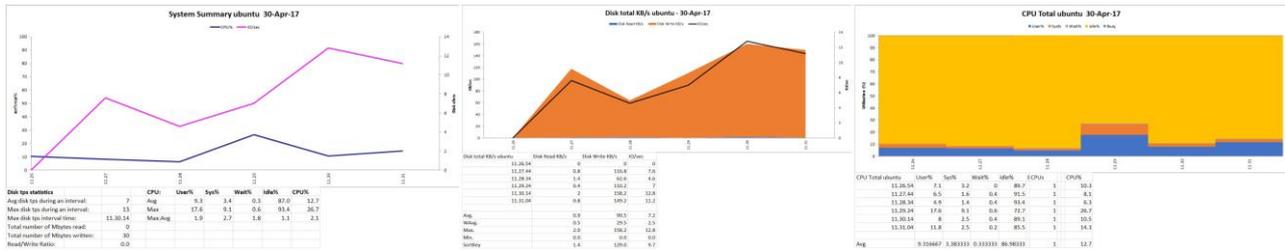


Figure 5: Results obtained after stage 2 removal.

## 4.2.2 Results from Figure 5

- The graph has two peaks for IO/sec with the maximum peak crossing the 90-unit mark. However, this graph has a drop followed by a subsequent rise, unlike the original system where only a major fall is observed. Thus, the IO operations have been delayed for an intermediate step.
- Disk write speed is an increasing curve while the original curve is falling. The area covered by the disk write KB/sec has greater value than before.
- This graph is different as initially, there is decreasing curve but a peak is obtained in between where maximum peak value for sys% beats the original system. User% never becomes zero, thus certain user operations keep the CPU utilised always.

## 4.3 Removal Stage 3: PRELOAD

### 4.3.1 Preload

It runs in background keeping track of most frequently used apps to cache them, thereby decreasing load time [24]. It prevents RAM from sitting idle and boosts performance.

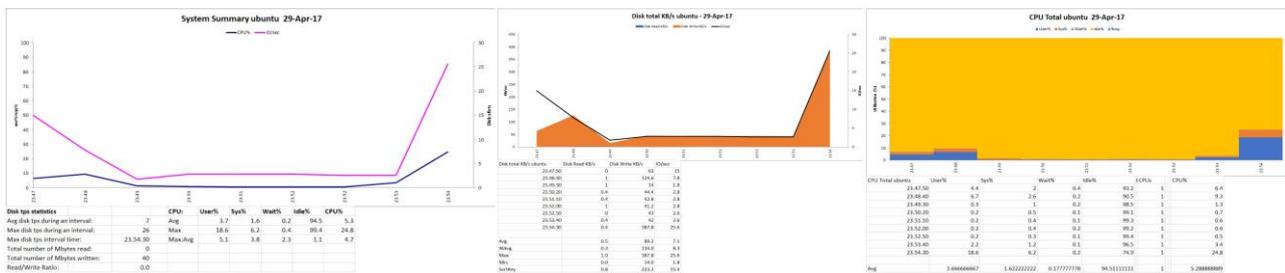


Figure 6: Results obtained after stage 3 removal.

## 4.3.2 Results from Figure 6

- A constant fall in values is followed by a subsequent constant curve. However, at the end there is a spike in the curve denoting sudden rise in IO operations. Similar trend is observed for CPU% too.
- There is a drop in disk usage initially. The area covered by orange is the least denoting that disk write has nearly demised for the initial stages of the graph.
- There is a stark peak in the ending which was absent in the original graph. The peak value reaches to a value of 30 units in this case as compared to 10 units in the original case. In the intermediate stages, the CPU is underutilised, indicating a decrease in performance.

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## 4.4 Removal Stage 4: SOFTWARE CENTRE/MANDB/GNOME MENUS/DESKTOP FILE UTILS

### 4.4.1 Software center

Ubuntu Software Center is a utility for installing, purchasing, and removing software in Ubuntu, a major part of Ubuntu's overall software handling [25].

### 4.4.2 Binary package "man-db" manual pager

It provides the "man" command meant for viewing manual pages along with commands to search manual page database [26].

### 4.4.3 GNOME panel

It is a highly configurable launcher and taskbar for GNOME. It is a desktop environment composed of free and open-source software that runs on Linux and most BSD derivatives [27].

### 4.4.4 Desktop file utils

This package contains command line tools for working with desktop entries, used by desktop environments [28].

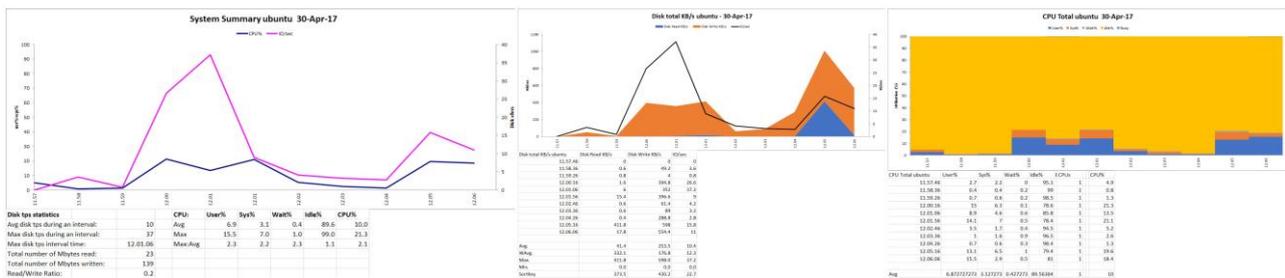


Figure 7: Results obtained after stage 4 removal.

### 4.4.5 Results from Figure 7

- The IO curve is more or less the same as the original graph. The CPU usage curve appears to be a bit jagged. Multiple crests and troughs are observed. There is a clear increase in CPU utilization on an average.
- There is a sharp increase in disk read speed at the end of the observation cycle. This shows memory reads have increased in this case.
- The graph appears to be a crowded building histogram. It is heavily populated with user usage.

## 4.5 Removal Stage 5: GCC, LIBC-BIN, LIBGLIB2.0-0, UNITY TWEAK TOOL AND BAMFDAEMON

### 4.5.1 GCC

It used as GNU C compiler platform which helps in compiling the c-programmes and also helps to generate an intermediate file to be executed [29].

### 4.5.2 LIBGLIB 2.0-0/LIBC-BIN

These are libraries/programs for GNU-C.

### 4.5.3 Bamfdaemon

Its main feature is that ATL+TAB switching of tabs. This functionality is just for extra ease.

### 4.5.4 Unity tweak tool

It is a settings manager for the Unity desktop and it provides easy to use interface to access some setting of desktop [30].

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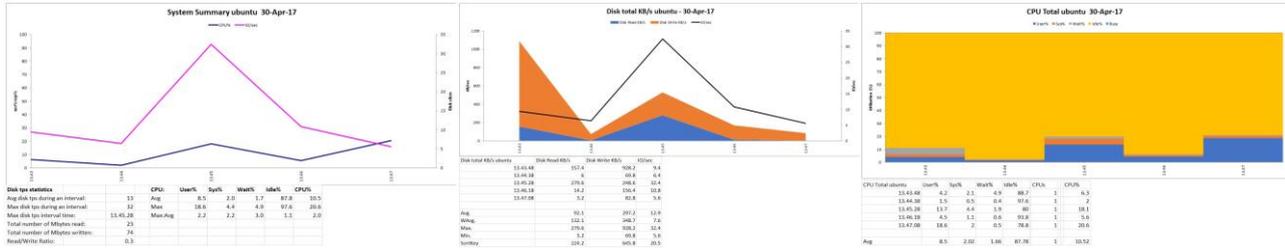


Figure 8: Results obtained after stage 5 removal.

### 4.5.5 Results from Figure 8

- The graph for IO is basically the original graph that has been shifted along the x axis. Therefore, the crests and troughs have been delayed in this case. The graph for CPU has a distant peak, which occurs at the same time.
- Areas occupied by both Disk Write KB/s and Disk Read KB/s are high and have similar configuration.
- There are 3 distinct peaks, each peak increasing in magnitude subsequently. The user % utilization of the CPU is dominant. The wait% is maximum in this case.

## 4.6 Removal Stage 6: DISABLING FLOPPY DRIVE, VIRTUAL OPTICAL DISK FILE, NETWORK, HARDWARE ACCELERATION

### 4.6.1 Virtual optical disk file

It means an .iso file i.e., a complete copy of CD's or DVD's contents.

### 4.6.2 Hardware acceleration

It causes hardware to perform more than what a normal CPU performance provides, thereby overclocking the system.

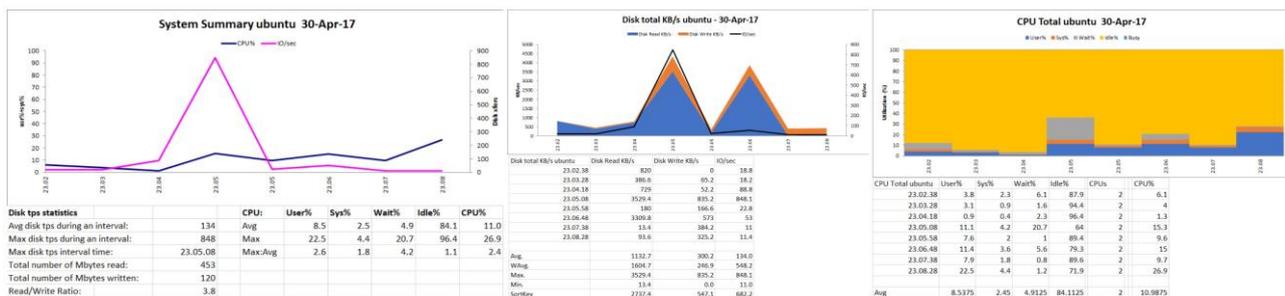


Figure 9: Results obtained after stage 6 removal.

### 4.6.3 Results from Figure 9

- This graph has a steeper and narrower peak than the previous graph. The CPU% curve has multiple peaks and goes on increasing.
- This is the first graph where the disk read KB/s dominates disk write KB/s and two distinct peaks are observed.
- The graph has multiple blocks. The graph has the maximum CPU wait %. The user CPU percentage remains at a constant high average value as compared to the original system.

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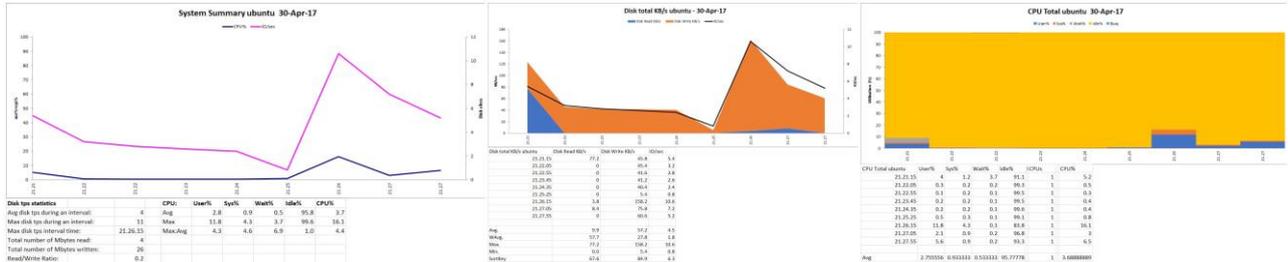


Figure 10: Results obtained after stage 7 removal.

## 4.7 Removal Stage 7: LYNX INSTEAD OF FIREFOX

### 4.7.1 LYNX

It is to be used as a replacement for Firefox.

### 4.7.2 Results from Figure 10

- A peak is observed at quite a later stage in the graph as compared to the original graph both for I/O curve as well as CPU curve. If the user wants to keep the load minimum in the initial stages of boot, then this component should be removed.
- In the initial stages, the disk read KB/s is significant however it goes down significantly later.
- There is long period of time for which there is no utilization of the CPU. The CPU is usually idle for the entire record cycle.

## 4.8 Removal Stage 8: AUDIO, NETWORK, SERIAL, USB

### 4.8.1 Serial port

A serial port is a serial communication interface through which information transfers in or out one bit at a time.

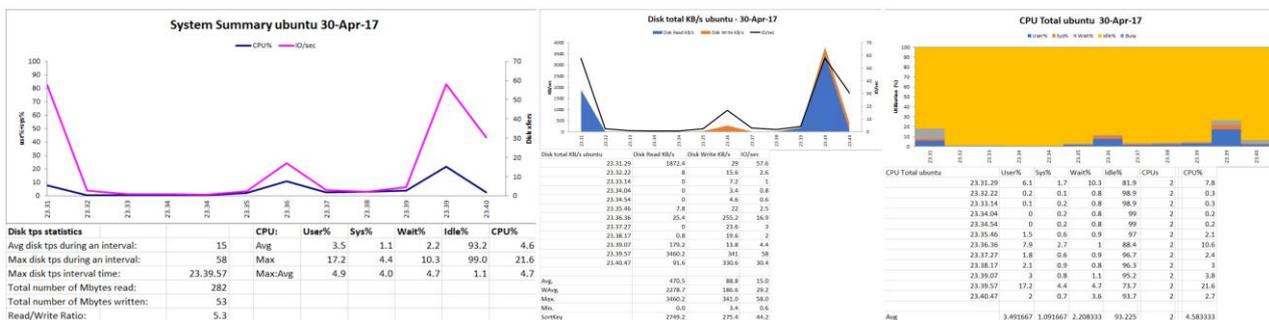


Figure 11: Results obtained after stage 8 removal.

### 4.8.2 Results from Figure 11

- The average value of IO/sec usage is extremely low for this graph. A minor peak is observed in the middle. A bigger peak is visible at the end but overall, the value of IO/sec remains low. CPU/sec is relatively higher than original.
- The majority of the graph is dominated by disk read KB/s. There is only one independent peak for disk write KB/s. The maximum peak value is 4000 KB/sec.
- The CPU is active in later stages of the record cycle also, while the CPU is more or less idle as far as the original graph is concerned.

## 4.9 Removal Stage 9: Sound Driver, Desktop Drivers, Gui Drivers

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## 4.9.1 GUI driver

This controls the system's video adapter.

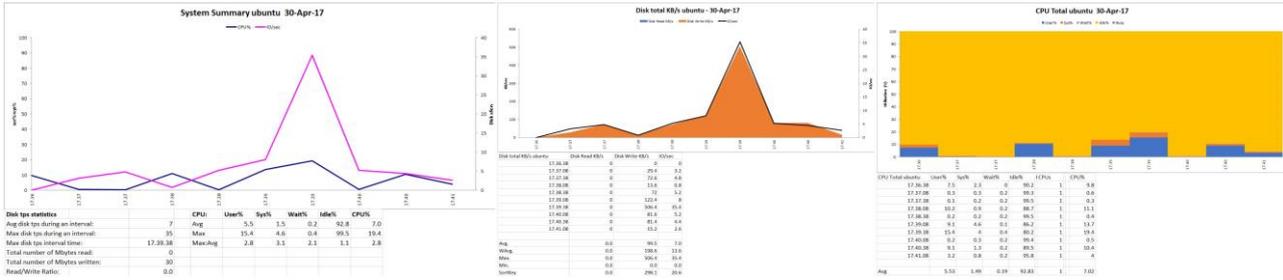


Figure 12: Results obtained after stage 9 removal.

## 4.9.2 Results from Figure 12

- For the first time, the curves for both IO/sec and CPU intersect thrice. The IO/sec has a distinct peak at 17.39 system time.
- The curve for disk read KB/s is nearly absent. The disk write KB/s curve closely follows the IO/sec graph.
- The graph has the maximum no. of distinct blocks. The troughs are characterized by 0 values for all the parameters.

## 4.10 Removal Stage 10: Bluetooth, Inet6-socket, Inetd-Updates, Printer Drivers

### 4.10.1 INET6

It provides an interface for creation and utilisation of sockets for socket programming [31].

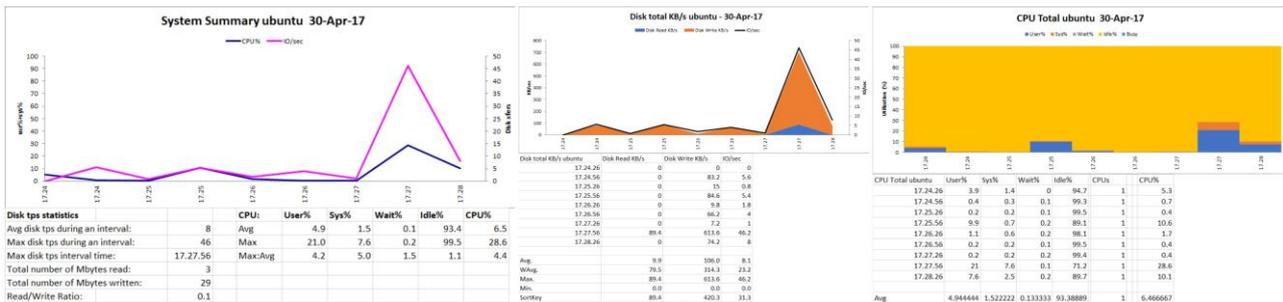


Figure 13: Results obtained after stage 10 removal.

### 4.10.2 UPDATE-INETD

This tool is used for enabling, disabling, removing or adding entries in specific files [32].

### 4.10.3 Results from Figure 13

- The graph has its major peak at the very end of the cycle of observation considering the IO/sec curve. The CPU% curve has its major peak co-incident with that of IO/sec curve.
- The disk/write has many bumps and creeks ultimately leading to a very high value at the end of the cycle. The disk read kb/sec curve comes into play only at the end.
- This graph does not differ much from the previous graph. The wait % is nearly zero.

## 4.11 Removal Stage 11: NTFS-3G, Network-Manager-Gnome, MySQL Common

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## 4.11.1 NTFS-3G

This is an open source version of MS-Windows NTFS, with support for read/write [33].

## 4.11.2 Binary package “MySQL-common” in Ubuntu

It is an agile, multi-user and sturdy multi-threaded SQL database server.

## 4.11.3 Network manager gnome

It co-ordinates all the network devices, connections while trying to maintain active network connectivity.

## 4.11.4 Results from Figure 14

- The curve of IO/sec nearly rests on the curve for CPU%. The CPU% also goes through many crests and troughs. The IO/sec acts as a strict upper bound for CPU%.
- The graph for disk read KB/sec and disk write KB/sec are nearly similar. The former is always less than or equal to the latter.
- The graph shows a segment where all parameter values are 0. Apart from the segment mentioned above, the graph is an alternative sequence of crests and troughs.

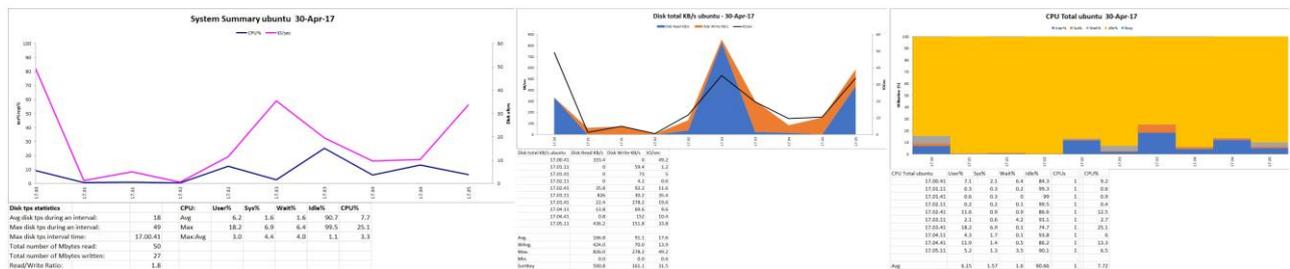


Figure 14: Results obtained after stage 11 removals.

## V. CONCLUSION

After examining the removal of all the above components, a virtual machine with maximum performance, least size can be constructed for simple general purpose performance. The components that can be removed fall under:

### • Components to Retain

NTFS-3G as a file system is imperative for Ubuntu. If Internet is needed, NETWORK MANAGER GNOME keeps on checking the system for network connectivity. Desktop and GUI drivers are essential for proper interfacing with the system. Lynx as a web browser is smaller in size than firefox and offers fluid CLI if only text based surfing is needed. GCC library is imperative for compilation purposes. PRELOAD is a must since it keeps on caching the frequently used as applications.

### • Components that May be Removed

EMPATHY can be removed since instant messaging can be done online. EOG may be removed since web browser can be used for viewing local images. Evince is also not needed since a web browser can be used as a pdf reader also. Google Docs, spread sheets and Prezi are better alternatives to the entire Libre Office Package. It keeps running in background and checks for updates which slows the system. If no updates are required, software centre maybe removed. Bamfdaemon is an unnecessary add-on. Unity tweak just makes the user interface more accessible. Obsolete drivers like that for floppy disks may be removed. Having done the above steps, a faster, lighter, more portable and smaller version of virtual machine is obtained that takes a lot less time to boot/restore. This can be used by students who are neophytes to linux environment and are willing to make usage of only certain utilities for general purpose programming purposes.



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