

Ubuntu Server Certified Hardware Self-Testing Guide (16.04 LTS)

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Introduction

The aim of this document is to provide the information needed to test a server on-site using the Canonical Server Test Suite without requiring an Internet connection and then submit the results of that testing to Canonical to meet the requirements for Server Hardware Certification.

Glossary

The following definitions apply to terms used in this document.

1 Gbps

1 Gigabit per second — Network speed for Gigabit Ethernet (1000 Mbps).

10 Gbps

10 Gigabits per second — Network speed for 10 Gigabit Ethernet (10,000 Mbps).

BMC

Baseboard Management Controller — A device in many server models that enables remote in- and out-of-band management of hardware.

CSM

Compatibility Support Module — A feature of many UEFI implementations that enables the machine to boot using older BIOS-mode boot loaders.

DHCP

Dynamic Host Control Protocol — A method for providing IP addresses to the SUT and Targets.

Greylist test

A test that must be performed but will not affect the granting of a certified status.

KVM

Kernel Virtual Machine — A system for running virtual machines on Ubuntu Server.

IPMI

Intelligent Platform Management Interface — A BMC technology for remotely connecting to a computer to perform management functions.

JBOD

Just a bunch of disks — A non-RAID disk configuration.

LAN

Local Area Network — The network to which your SUT and Targets are connected. The LAN does not need to be Internet accessible (though that is preferable if possible).

MAAS

Metal as a Service — A Canonical product for provisioning systems quickly and easily.

NIC

Network Interface Card — The network device(s).

PXE

Pre-boot Execution Environment — A technology that enables you to boot a computer using remote images for easy deployment or network-based installation.

RAID

Redundant Array of Independent Disks - Multi-disk storage providing redundancy, parity checking, and data integrity.

RAM

Random Access Memory — System memory.

SAN

Storage Area Network — Usually FibreChannel.

SUT

System Under Test — The machine you are testing for certification.

Target

A computer on the test LAN that the SUT can use for network testing. The Target must be running an `iperf3` server, but otherwise does not need any special configuration. The MAAS server may double as the Target.

Test case

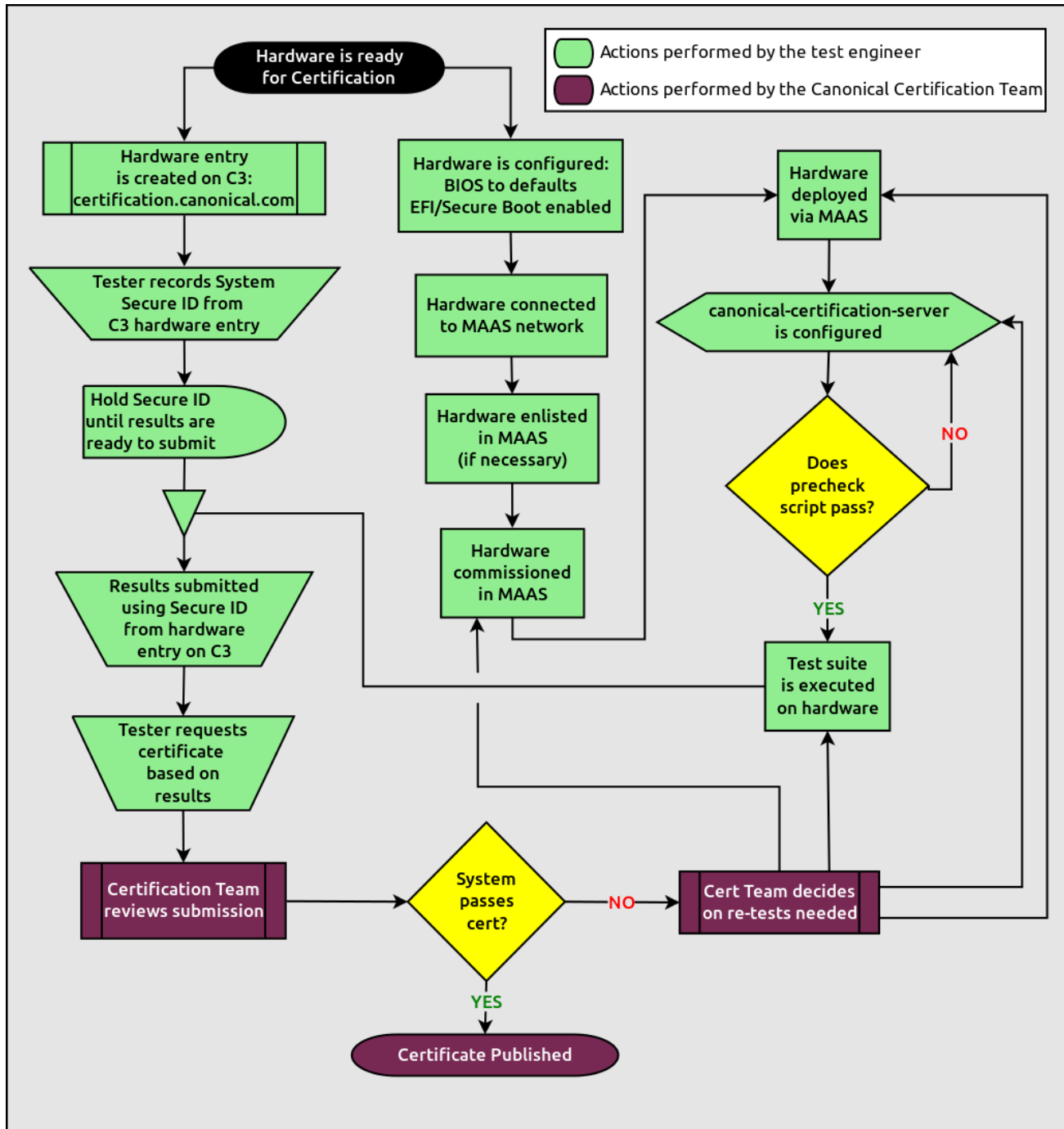
A test to be executed as part of the certification test suite. Test cases include things such as “CPU Stress” and “CPU Topology.”

Whitelist test

A test that *must* pass for the SUT to be granted a certified status.

Overview of the Certification Process

The certification process has certain prerequisites and procedures with which you should be familiar before beginning. Specifically, you should be aware of hardware requirements and the needs of the network test environment. There are steps you should perform before running the certification tests and before uploading the results. The following sub-sections briefly describe these requirements. Detailed descriptions appear later in this document. The following flowchart shows a “birds-eye view” of the certification process.



Hardware Requirements

- SUTs must contain at least 4 GiB of RAM and one hard disk, but using the maximum amount of RAM and the maximum number of disks is preferable. Likewise, if configurable, using the maximum number of CPUs is desirable.
- If SUT model is available with differing disk sizes, testing with the largest disk, or at least with a disk (or RAID array) over 2 TiB, is recommended.
- If the SUT has multiple disk controllers (such as a motherboard-based disk controller and a separate RAID controller), we strongly recommend that disk devices be connected to all controllers during testing.
- CPUs should support virtualization (VMX/SVM), when supported by CPU architecture.
- All firmware (BIOS/UEFI, NIC, storage controller, etc) should be shipping level, *not* development level.
- A monitor and keyboard for the SUT are helpful because they will enable you to monitor its activities. If necessary, however, certification can be done without these items.

Network Test Environment

- In addition to the SUT, the network must contain at least one other machine, which will run MAAS and an `iperf3` server; however, you may want to separate these two functions.
 - The MAAS Advanced NUC Installation and Configuration — Scripted (MANIACS) document (available from <https://certification.canonical.com>) describes how to configure a MAAS server. This server may be a standard part of the testing network or something you bring with you for testing purposes alone. A laptop or a small portable computer such as an Intel NUC is sufficient. MAAS version 1.7 or later is required for certification work; the older MAAS 1.5 lacks certain features that are becoming increasingly important. This document describes use of MAAS 1.9. If you use MAAS 1.7 or 1.8, some procedures will differ slightly.
- When testing multiple SUTs simultaneously, you will need multiple `iperf3` targets, one for each SUT. If your `iperf3` Target has a sufficiently fast NIC or multiple NICs, you can assign the computer multiple IP addresses and treat each one as a distinct Target. This topic is covered in more detail in Appendix E of the

MANIACS document. Alternatively, you can run network tests against a single `iperf3` Target sequentially; however, this approach complicates submission of results. Note that poor network infrastructure may make multiple simultaneous `iperf3` runs unreliable.

- The MAAS server computer should run Ubuntu 14.04 (Trusty Tahr) or later, and should be configured to deliver Ubuntu 16.04 images to its clients. Testing with fixed point releases, as described in the MANIACS document, is required.
- Ideally, the network should have few or no other computers; extraneous network traffic can negatively impact the network tests.
- Ideally, the MAAS server system should handle DNS and DHCP for the network. If other computers manage these tasks, be sure that they're configured to work with the MAAS server so that the SUT obtains its PXE-boot images from the MAAS server.
- Network cabling, switches, and the `iperf3` server should be capable of at least the SUT's best speed. For instance, if the SUT has 1 Gbps Ethernet, the other network components should be capable of 1 Gbps or faster speeds. If the local network used for testing is less capable than the best network interfaces on the SUT, those interfaces must be tested later on a more-capable network. If the test environment uses separate networks with different speeds, with the SUT cabled to multiple networks via different ports, you can specify multiple `iperf3` servers, as described later.
- If desired, the MAAS server may be run inside a virtual machine; however, it is advisable to run the `iperf3` server on "real" hardware so as to minimize the risk of network tests failing because of virtualization issues.

Before Running Test Cases

- The SUT must be properly configured and cabled.
- The SUT must have Ubuntu 16.04 installed on it. (This must be done via MAAS.) See the Installing Ubuntu on the System section below for details on how to do this.
- The `canonical-certification-server` package must be installed on the SUT together with all its dependencies. (This will normally be done via MAAS.) For more information about how to get all the packages, please refer to the Installing the Server Test Suite Packages section below.
- Be sure to have all the items described in the Equipment to Bring section below.

- Some manual network and disk configuration may be necessary. See the Running the Certification Tests section below.

Before Uploading Test Case Results

Prior to uploading results to Canonical's certification site, you must handle some preliminary tasks:

- You will need an account at the certification web site, <https://certification.canonical.com>.
 - The certification web site is the location where all the test case results will be uploaded once your testing session has finished.
 - *If you do not have an account for your company on the private certification web site, please contact your account manager who will work with the Server Certification Team to establish the account.*
- You must create a hardware entry (unless one already exists for the SUT) at the certification web site with a secure ID.
 - The secure ID is a string made from 15 alphanumeric characters that is used to make sure that only authorized parties upload results to the site and also to associate the results to the hardware being tested. This can be found on the hardware entry page on the Certification web site:

System 201601-20487

Secure ID for testing purposes: **a00D000000fe68DIAQ**

- For more information on creating the hardware entry, please see *Creating a Hardware Entry on C3* below.
- If the SUT lacks Internet access, the package `canonical-certification-submit` should be installed on the system from which you plan to submit results. Please see the section below titled Manually Uploading Test Results to the Certification Site for more information on this topic.

Initial Setup

Before you certify the hardware, you must perform some initial setup steps. These steps are preparing the hardware you'll bring, configuring the SUT for testing, installing Ubuntu, and installing the Server Test Suite.

Equipment to Bring

The requirements for running the tests for a server are minimal. Ensure that you have:

- Writable USB sticks with enough free space (> 256 MB). Each stick must contain a *single partition* with a *writable FAT* filesystem on it. Note that a USB stick with multiple partitions may cause problems, so if necessary you should repartition your device to have a single partition. Modern computers typically provide both USB 2 and USB 3 ports, which are tested separately. Thus, you're likely to need two USB sticks per computer, at least one of which must be a USB 3 device. If you need to test more than one computer then *bring enough USB sticks to test all the systems*.
- A data CD with some files written to it. This is required to test the system's optical drive read capabilities. Note that a movie DVD or an audio CD won't be useful in this case, as they are not in the right format for the test. If you need to test more than one computer then *bring one medium per system*.
- A computer to function as a MAAS server and `iperf3` target on the test LAN. This server will provision the SUT. The MAAS server can be a normal part of the test LAN or can be brought in specifically for testing SUTs on the test LAN. (Note, however, that the MAAS server for certification testing should ideally be configured to automatically install the Server Test Suite on the SUT, which will not be the case for a "generic" MAAS server.)

Hardware Setup

The following should be considered the minimum requirements for setting up the SUT and test environment:

- Minimum loadout
 - Minimum of 4 GiB RAM
 - 1 HDD or SSD (2 with minimal RAID)
 - 1 CPU of a supported type

- Recommended (preferred) loadout
 - Maximum supported number of HDDs or SSDs, especially if you can configure multiple RAID levels (e.g. 2 for RAID 0, 3 for RAID 5, and 6 for RAID 50)
 - The largest disk capacity available from the OEM — ideally, over 2 TiB on a single disk or RAID array.
 - Maximum amount of supported RAM
 - Maximum number of supported CPUs
- If possible, as many processors as the SUT will support should be installed.
 - Note that systems that ship with processors from different families (e.g. Broadwell vs. Skylake) will require extra testing.
 - CPU speed bumps and die shrinks do not require extra testing.
- The SUT should not contain any extraneous PCI devices that are not part of the certification.
 - This includes things like network, SAN and iSCSI cards.
 - Hardware RAID cards are allowed if they are used to provide RAID services to the SUT's onboard storage.
- The SUT should be running a release level BIOS/UEFI configured using factory default settings, with the following exceptions:
 - If the hardware virtualization options in the BIOS/UEFI are not enabled, enable them, save the settings and allow the SUT to reboot.
 - The SUT must be configured to PXE-boot by default.
 - If the SUT's firmware supports PXE-booting in UEFI mode, it must be configured to boot in UEFI mode, rather than in BIOS/CSM/legacy mode.
 - If the UEFI supports it, the SUT must be configured to boot with Secure Boot active.
- Storage should be properly configured.
 - If the SUT provides multiple disk controller devices (such as an on-board JBOD controller and a separate RAID controller), we strongly recommend that disks be plugged into all the controllers.

- Software RAID, including firmware-supported software RAID (aka “fake RAID”) should *not* be used. If hardware RAID is not available, configure the server for JBOD.
- Any additional HDDs or logical drives should be partitioned and mounted prior to testing. Partitions on those additional HDDs should, preferably, be a single partition that spans the entire disk.
- Some BIOS-only computers may have problems booting from disks over 2 TiB in size. If the SUT fails for this reason, it may pass with smaller disks (or a smaller RAID array), but this issue should be noted with the results submission.
- Disks must be configured for “flat” storage — that is, filesystems in plain partitions, rather than using LVM or bcache configurations. “Flat” storage was the only option with MAAS 1.8 and earlier, but MAAS 1.9 introduced LVM and bcache options.
- Disks with 4,096-byte *logical* sector sizes may require booting in EFI/UEFI mode. Note that disks with 4,096-byte *physical* sector sizes seldom cause problems, so long as the disk’s firmware translates those sectors into 512-byte logical sectors.
- The test environment should have a working network setup. Internet access is not required, and testing should work on any private or segregated LAN.
 - If possible, the test LAN’s speed should match or exceed the network speed of the SUT. For instance, a SUT with 1 Gbps onboard Ethernet should be connected to a LAN capable of at least 1 Gbps and a system with 10 Gbps Ethernet should be connected to a LAN capable of at least 10 Gbps. Connecting a SUT to a network with greater network speed is acceptable.
 - If the primary test network cannot meet these requirements, re-running the network tests in an environment that does match these requirements will be necessary.
 - Every network port must be cabled to the LAN and properly configured with either DHCP or static addressing. If a SUT has 4 NIC ports, then all 4 must be connected to the LAN.
 - It is very strongly recommended that SUT and Target machines be on a clean network (that is, one that is not full of other traffic), as extraneous network traffic could impact the network testing results.
 - If you’re testing multiple SUTs simultaneously, you may need as many `iperf3` targets as you have SUTs. Alternatively, you may need to re-run the network

tests on most of the SUTs, as the tests are likely to fail if the `iperf3` server is busy with another SUT's test. Note also the previous point — multiple simultaneous `iperf3` tests can cause failures of all of them, particularly if the network infrastructure is poor.

- The test LAN must have a working MAAS server that can provision and run the tests on the SUT. The MAAS Advanced NUC Installation and Configuration — Scripted (MANIACS) document, available at <https://certification.canonical.com>, describes the basics of the MAAS setup, but you may need to refer to additional documentation to complete the task if you're not already familiar with MAAS.
- The test LAN must have at least one system available to act as a Target for network testing with `iperf3`. Note that accessing an `iperf3` server that's reachable only via a router may not work, because routing tables are temporarily lost during network testing. The `iperf3` server is normally the same as the MAAS server, but this does not need to be the case. If the SUT has a faster network interface than the MAAS server, you should set up another computer that matches the SUT's network interface speed to function as an `iperf3` server.
- The SUT's BMC, if present, may be configured via DHCP or with a static IP address. If the BMC uses IPMI, MAAS will set up its own BMC user account (`maas`) when enlisting the SUT.

Installing Ubuntu on the System

Beginning with Ubuntu 14.04 (Trusty Tahr), server certification requires that the SUT be installable via MAAS. Therefore, the following procedure assumes the presence of a properly-configured MAAS server. The MAAS Advanced NUC Installation and Configuration — Scripted (MANIACS) document describes how to set up a MAAS server for certification testing purposes. This document describes use of MAAS 1.9. Using MAAS 1.7 or 1.8 is also acceptable, but some user interface details differ, particularly for MAAS 1.7.

Once the SUT and MAAS server are both connected to the network, you can install Ubuntu on the SUT as follows:

1. Unplug any USB flash drives or external hard disks from the SUT. (MAAS will attempt to install to a USB flash drive if it's detected before the hard disk. This is obviously undesirable.)

2. Power on the SUT and allow it to PXE-boot.
 - The SUT should boot the MAAS enlistment image and then power off.
 - You should see the SUT appear as a newly-enlisted computer in your MAAS server's node list. (You may need to refresh your browser to see the new entry.)
3. Check and verify the following items in the MAAS server's node details page:
 - If desired, change the node name for the SUT.
 - Check the SUT's power type and ensure it's set correctly (IPMI, AMT, etc.). If the SUT has no BMC, you can leave this section blank or set it to Wake-On-LAN (although the latter is finicky and so may require manual power control).
 - Note that manual power control is acceptable only on low-end servers that lack BMCs. If MAAS fails to detect a BMC that is present or if MAAS cannot control a BMC that is present, please consult the Canonical Server Certification Team.
4. Commission the node by clicking Take Action followed by Commission and then Go.
 - If the SUT has a BMC, the computer should power up, pass more information about itself to the MAAS server, and then power down again.
 - If the SUT does not have a BMC, you should manually power on the SUT after clicking the Commission Node button. The SUT should power up, pass more information about itself to the MAAS server, and then power down again.
5. On the MAAS server, verify that the SUT's Status is listed as Ready in the node list or on the node's details page. You may need to refresh the page to see the status update.
6. Click Take Action followed by Deploy. Options to select the OS version to deploy should appear.
7. Select the Ubuntu release you want to deploy. Normally, you'll pick a point release that you installed as described in the MANIACS document. This image will appear as an OS type of "Custom" and a description that specifies the point-release version. The normal procedure is to test with 16.04 GA and (once they become available) the latest point release. Appendix D - Point Release Testing, elaborates on this policy.
8. Click Go to begin deployment.
 - If the SUT has a BMC, it should power up and install Ubuntu. This process can take several minutes.

- If the SUT does not have a BMC, you should power it on manually after clicking Go. The SUT should then boot and install Ubuntu. This process can take several minutes.

If MAAS has problems in any of the preceding steps, the SUT might not pass certification. For instance, certification requires that MAAS be able to detect the SUT and, in most cases, set its power type information automatically. If you have problems with any of these steps, contact the Canonical Server Certification Team to learn how to proceed; you might have run into a simple misconfiguration, or the server might need enablement work.

Logging Into the SUT

Once the SUT is installed, you should be able to log into it using SSH from the MAAS server. Check the node details page to learn its primary IP address. (Using a hostname will also work if DNS is properly configured, but this can be fragile.) The username on the node is `ubuntu`, and you should require no password when logging in from the MAAS server or from any other computer and account whose SSH key you've registered with the MAAS server.

You should keep some details in mind as you continue to access the SUT:

- You should *not* install updates to the SUT unless they are absolutely necessary to pass certification. In that case, the Canonical Certification Team will make the determination of what updates should be applied.
- You should verify your SUT's version by typing `lsb_release -a`. The result includes both the main release version (such as 16.04) and the point release version (such as 16.04.2, on the *Description* line). You can also check your kernel version by typing `uname -r`. The kernel version changes with the Ubuntu release.
- By default, MAAS provides a DHCP server, and the SUT should use it to obtain an IP address. If necessary for your environment, you may manually change these settings on the SUT to use a static IP address.
- If you want to log in at the console or from another computer, the password is `ubuntu`, assuming the certification pre-seed files are used on the MAAS server. If you're using a "generic" MAAS installation, you must set the password manually. Testing at the console has certain advantages (described shortly).

- A MAAS installation configured for certification testing should provision the SUT with the Server Test Suite and related packages. If you're using a more "generic" MAAS setup, you'll have to install the certification software yourself, as described in Appendix A - Installing the Server Test Suite Manually.

Installing the Server Test Suite Packages

Two methods of installing the Server Test Suite are supported:

- Automatically by the MAAS server
- Using APT to retrieve the Server Test Suite packages on a SUT with full Internet access or with access to a mirrored APT repository on a local computer such as the MAAS server

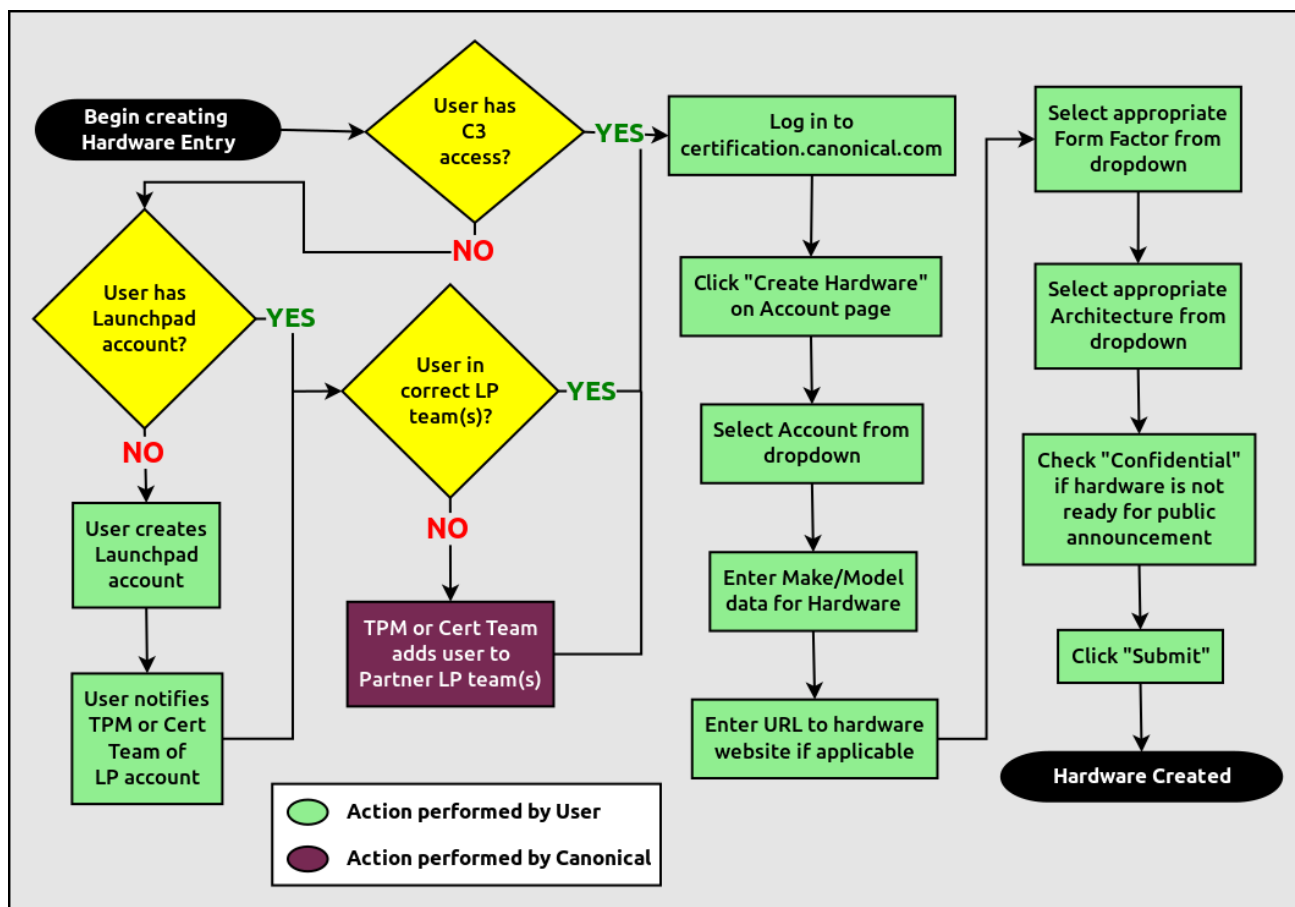
If MAAS is fully configured as described in the *MAAS Advanced NUC Installation and Configuration — Scripted (MANIACS)* document, it should deploy the Server Test Suite automatically. If MAAS doesn't deploy the Server Test Suite properly, you can do so manually, as described in Appendix A - Installing the Server Test Suite Manually.

Creating a Hardware Entry on C3

In order to upload test results to the certification web site (<http://certification.canonical.com>, or C3 for short) you need to create a hardware entry for the system which you will be certifying. If the SUT has no direct Internet connection, you can put off creating the C3 entry until after the test (although doing it before testing is fine, too). If you don't plan to submit the results, you should not create a C3 entry for the machine. To create an entry you can go directly to:

<https://certification.canonical.com/hardware/create-system>

If you have problems accessing this site, contact your account manager.



The process of creating an entry is outlined in the preceding flowchart. When creating an entry, you must enter assorted pieces of information:

1. Fill in the details:

- **Account** — The name of your account. If the account is incorrect or can't be set, please contact your account manager for assistance. This field is never published; it is for internal use only.
- **Make** — The manufacturer of the system, e.g. Dell, HP, as you would like it to appear on the public web site.
- **Model** — The name of the system itself, e.g ProLiant DL630 or PowerEdge R210, as you would like it to appear on the public web site.
- **Aliases** — This is used for alternate marketing names for a server. This field is only accessible to the Canonical Server Certification Team. If you need to add

items to this field, please contact your account manager. These appear publicly as separate entries in the database (e.g. Server1000, Alias1001 and Alias1002 all point to the same system, but appear as three separate entries on the public web site).

- **Codenames** — This is for your internal reference and identifies the internal code name associated with the SUT. This data is *never* published and is visible only to you and to Canonical.
- **Web site** — This optional field links to the system information on the manufacturer's web site. This field is published publicly and is a way for potential customers to directly access information about your hardware on your own web site.
- **Comment** — This optional field holds any comment you want to make about the hardware, including things like tester name, test location, etc. These comments are never made public, they are for internal use only.
- **Form factor** — The type of system: Laptop, Server, etc. This is not published directly, but determines where your system is displayed on the public site. Client form factors appear in one place while server form factors appear elsewhere on the public certification site. You may select any of the Server form factors you like except for Server SoC, which is reserved for System on Chip certifications.
- **Architecture** — The CPU architecture of the SUT. This is used internally and is not published.
- **Confidential** — Defaults to False (unchecked). Check the box if the system has not been publicly announced yet or should remain unpublished for any reason. This will cause the entire entry to *not* be published to the public web site.

2. Click Submit.

3. Note the "Secure ID for testing purposes" value. You'll need this when submitting the test results. (Note that this value is unique for each machine.)

Running the Certification Tests

You can initiate a testing session in a server as follows:

1. Launch `iperf3` on the Target server(s) you plan to use by typing:

```
$ iperf3 -s
```

2. Connect to the SUT via SSH or log in at the console. A standard MAAS installation creates a user called `ubuntu`, as noted earlier. You can test using either a direct console login or SSH, but an SSH login may be disconnected by the network tests or for other reasons.
3. Before testing you must ensure that all network ports are cabled to a working LAN and configured in `/etc/network/interfaces` using the appropriate configuration (static or DHCP) for your test environment. If you edit this file, either reboot or bring up the interfaces you add with `ifup` before running tests.
4. If the SUT provides the suitable ports and drives, plug in a USB 2 stick, plug in a USB 3 stick, and insert a suitable data CD in the optical drive. Note that USB testing is not required for blades that provide USB ports only via specialized dongles. These media must remain inserted *throughout the test run*, because the media tests will be kicked off partway through the run.
5. If the system doesn't have Internet access, or if that access is slow:
 - Copy the image you downloaded from <http://cloud-images.ubuntu.com/trusty/current/trusty-server-cloudimg-i386-disk1.img> (as noted in *Appendix A*) to any directory of the SUT.
 - Supply the full path under the section labeled "environment" in `/etc/xdg/canonical-certification.conf`. For example:

```
[environment]
KVM_TIMEOUT:
KVM_IMAGE: /home/ubuntu/trusty-server-cloudimg-i386-disk1.img
```

6. If necessary, edit the `/etc/xdg/canonical-certification.conf` file on the SUT so as to specify your `iperf3` server(s). For example:

```
TEST_TARGET_IPERF = 192.168.0.2,172.24.124.7
```

If you configured your MAAS server as described in the MANIACS document, the `TEST_TARGET_IPERF` line should already be set appropriately. If your environment includes multiple `iperf3` servers, you can identify them all, separated by commas. The test suite will attempt to use each server in sequence until one results in a

passed test or until they are all exhausted. You can use this feature if your environment includes separate networks with different speeds or simply to identify all of your `iperf3` servers. (Note that `iperf3` refuses a connection if a test is ongoing, so you can list multiple `iperf3` servers and let the test suite try them all until it finds a free one.)

7. While editing `/etc/xdg/canonical-certification.conf`, you may optionally enter the SUT's Secure ID in the `[transport:c3]` section. This can simplify submission of results at the end of the test; however, this will work only if the SUT has full Internet access.
8. If you're running the test via SSH, type `screen` on the SUT to ensure that you can reconnect to your session should your link to the SUT go down, as may happen when running the network tests. If you're disconnected, you can reconnect to your session by logging in and typing `screen -r`. This step is not important if you're running the Server Test Suite at the console.
9. Verify that all your disks are mounted. Type `df -h` to view the mounted disks, and compare the output to the disk devices available to you, as shown by `ls /dev/sd*`. (Some exotic disk devices may appear under other device names, such as `/dev/nvme*`.) If `ls /dev/sd*` shows a disk with no mounted partitions, you should partition the disk (one big disk-spanning partition is best), create a filesystem on it, and mount it (subdirectories of `/mnt` work well). Repeat this process for each unmounted disk.
10. Prior to running the certification tests, you should double-check that the server's configuration is correct by running the `canonical-certification-precheck` script, which tests the critical configuration details that may be set incorrectly. Information on most of these details is displayed, followed by a summary, such as the following:

```
ubuntu@brennan: ~
eth1 - 172.24.126.4/22 172.24.127.255
lxcbr0 - 10.0.3.1/24 global

All interfaces seem to be on the same subnet

===== KVM Image Check =====
Local image /home/ubuntu/trusty-server-cloudimg-i386-disk1.img exists.

===== Report =====

Ubuntu_Version ----- Ubuntu 16.04 LTS
Arch ----- amd64
EFI_Mode ----- This is an EFI Mode installa
tion
CCS_Version ----- 0.21+201603081614~ubuntu16.0
4.1
SID_Check ----- a00D000000dpNFPIAU
Installed_Ram ----- 3958584
Virtualization_Support ----- Passed
NICs_enabled ----- Passed
IPERF ----- Failed
Network_Subnets ----- Passed
KVM_Image_Check ----- Passed

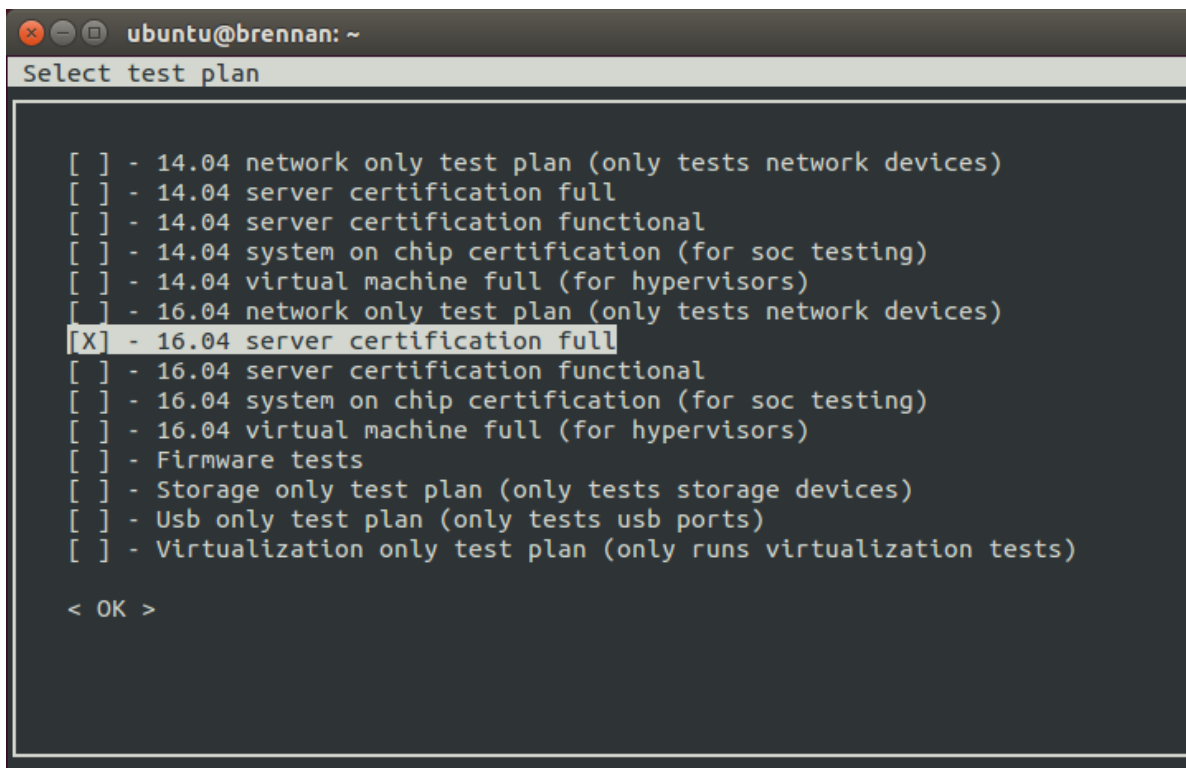
ubuntu@brennan:~$
```

Summary results are color-coded, with white for information, green for passed results, yellow for warnings, and red for problems that should be corrected. In the preceding output, the Installed RAM value was displayed in yellow because the system's RAM is a bit shy of 4 GiB; and the `iperf` line is in red because the script detected no `iperf3` server. If your terminal supports the feature, you can scroll up to see details of any warnings or failures.

11. Correct any problems identified by the `canonical-certification-precheck` script.
12. Run:

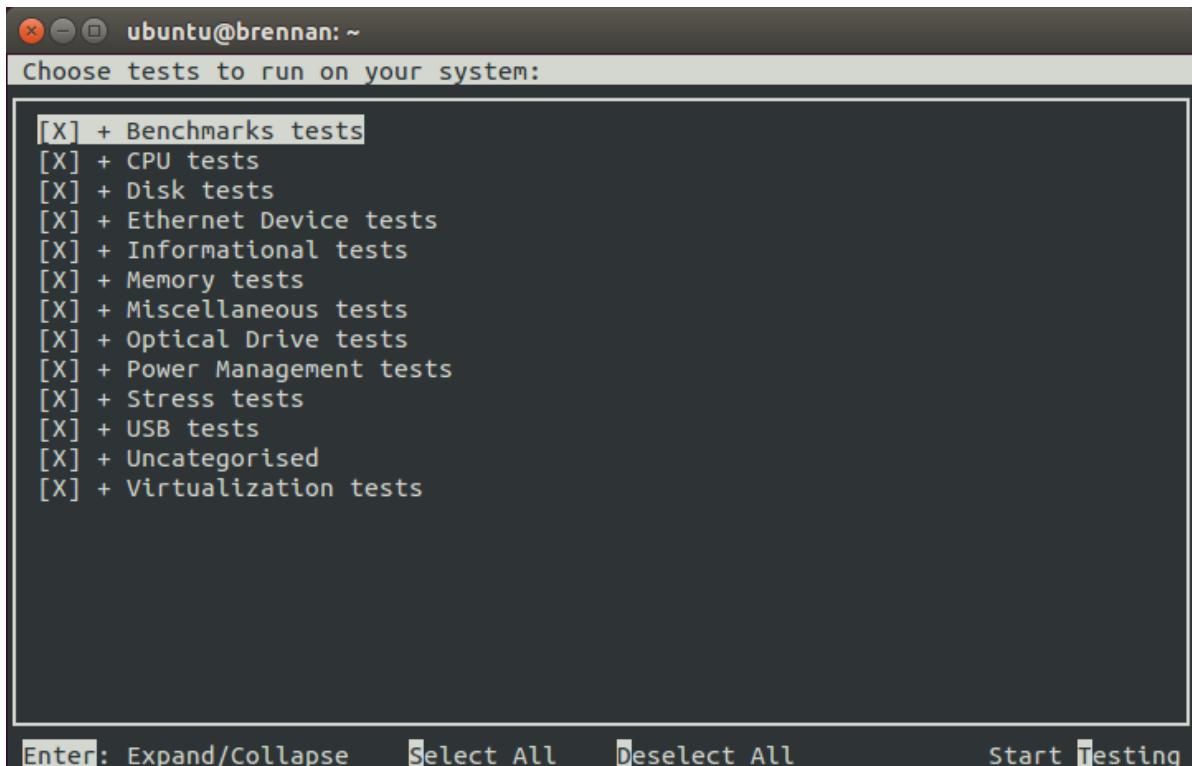
```
$ canonical-certification-server
```

13. A welcome message will be displayed. Make sure to read the message and follow its instructions.
14. Press the Enter key. The system will display a Suite Selection screen:



```
ubuntu@brennan: ~  
Select test plan  
[ ] - 14.04 network only test plan (only tests network devices)  
[ ] - 14.04 server certification full  
[ ] - 14.04 server certification functional  
[ ] - 14.04 system on chip certification (for soc testing)  
[ ] - 14.04 virtual machine full (for hypervisors)  
[ ] - 16.04 network only test plan (only tests network devices)  
[X] - 16.04 server certification full  
[ ] - 16.04 server certification functional  
[ ] - 16.04 system on chip certification (for soc testing)  
[ ] - 16.04 virtual machine full (for hypervisors)  
[ ] - Firmware tests  
[ ] - Storage only test plan (only tests storage devices)  
[ ] - Usb only test plan (only tests usb ports)  
[ ] - Virtualization only test plan (only runs virtualization tests)  
  
< OK >
```

15. Select the *16.04 server certification full* item and deselect the other items. (These other test plans exist to enable easy re-running of subsets of tests that often fail in some environments or to run tests on Ubuntu 14.04.)
16. Use the arrow keys to highlight the *<OK>* option and then press Enter.
17. After a few seconds, a test selection screen will appear, as shown below. You should ordinarily leave all the tests selected. (Tests that are irrelevant for a given computer, such as tests of the optical drive on computers that lack this hardware, are automatically ignored.) If a test is hanging or otherwise causing problems, please contact the Canonical Server Certification Team for advice on how to proceed. Using this screen is fairly straightforward, but Appendix C - Using the Test Selection Screen covers the details.



18. Press the `T` key to start testing. The screen will begin displaying a scrolling set of technical details about the tests as they are performed.
19. The full test suite can take several hours to complete, depending on the hardware configuration (amount of RAM, disk space, etc). During this time the computer may be unresponsive. This is due to the inclusion of some stress test cases. These are deliberately intensive and produce high load on the system's resources.
20. If at any time during the execution you are *sure* the computer has crashed (or it reboots spontaneously) then after the system comes back up you should run the `canonical-certification-server` command again and respond `y` when asked if you want to resume the previous session.
21. If any tests fail or do not run, the test selection screen will reappear, but it will show only those tests that failed or did not run. You can use this opportunity to re-run a test if you believe it failed for a transient reason, such as if your `iperf3` server crashed or was unavailable. Note that the presence of a test in this list does not necessarily mean that the test failed; tests that were skipped for harmless reasons can also appear in this list.

22. When the test run is complete, you should see a summary of tests run, a note about where the `submission*` files have been stored, and a prompt to submit the results to `certification.canonical.com`. If you're connected to the Internet, typing `y` at this query should cause the results to be submitted. You will need either a Secure ID value or to have already entered this value in the `/etc/xdg/canonical-certification.conf` file.

23. Copying the results files off of the SUT is advisable. This is most important if the automatic submission of results fails; however, having the results available as a backup can be useful because it enables you to review the results off-line or in case of submission problems that aren't immediately obvious. The results are stored in the `~/.local/share/checkbox-ng` directory. The upcoming section, *Manually Uploading Test Results to the Certification Site*, describes how to perform this task.

You can review your results locally by loading `submission_<DATECODE>.html` in a web browser. This enables you to quickly spot failed tests because they're highlighted in red with a "FAILED" notation in the Result column, whereas passed tests acquire a green color, with the word "PASSED." Note, however, that *a failed test does not necessarily denote a failed certification*. Reasons a test might fail but still enable a certification to pass include the following:

- A test may be a greylist test, as described in the *Ubuntu Server Hardware Certification Coverage* document, available from <https://certification.canonical.com>.
- Some tests are known to produce occasional false positives — that is, they claim that problems exist when in fact they don't.
- Some test environments are sub-optimal, necessitating that specific tests be re-run. This can happen with network tests or if the tester forgot to insert a removable medium. In such cases, the specific test can be re-run rather than the entire test suite.

Consult your account manager if you have questions about specific test results.

Manually Uploading Test Results to the Certification Site

If you can't upload test results to the certification site from the certification program itself, you must do so manually, perhaps from another computer. To upload the results, you should have the Server Test Suite and `canonical-certification-submit` installed on the system from which you plan to submit results. The Server Test Suite is part of the default install on all Ubuntu Desktop systems. At this time, there is no mechanism for submitting results from an OS other than Ubuntu.

To add the Hardware Certification PPA, install `canonical-certification-submit`, and submit the results, follow these instructions:

1. Add the Hardware Certification PPA:

```
$ sudo apt-add-repository ppa:hardware-certification/public
$ sudo apt-get update
```

2. Install the package:

```
$ sudo apt-get install canonical-certification-submit
```

3. Run the following command:

```
$ canonical-certification-submit --secure_id <SUT_SECURE_ID> \
  <PATH_TO>/submission_<DATECODE>.xml
```

where:

- `<SUT_SECURE_ID>` can be found on your system's page on the certification web site (<http://certification.canonical.com>) by looking next to "Secure ID for testing purposes":

System 201601-20487

Secure ID for testing purposes: **a00D000000fe68DIAQ**

- <PATH_TO> refers to the location of the submission_{datecode}.xml file (which should be contained in the ~/.local/share/checkbox-ng directory you copied to the USB key).
- <DATECODE> is a date code. Note that if you re-run the certification suite, you're likely to see multiple submission_<DATECODE>.xml files, each with a different date code, one for each run. Ordinarily, you should submit the most recent file.

You should see output similar to the following for a successful submission:

```
$ canonical-certification-submit --secure_id a00D000000XndQJIAZ \  
  ~/.local/share/checkbox_ng/submission_2016-03-23T19\:06\:18.244727.xml  
Successfully sent, submission status at  
https://certification.canonical.com/submissions/status/20409
```

Once results submission is complete, use the provided link in the output to review the results and confirm that they are correct.

Requesting a Certificate

Once you've uploaded the data to the certification site, you should review it in the web interface. If you're satisfied that there are no problems, you can request a certificate:

1. Click the date link under the Created column in the Submissions section. The result should be a page showing most of the same information as the previous page, but in a different format, and restricted to that one test run.
2. Click the Request Certificate link. The result should be a page with a few radio buttons in which you can enter information:
 - Status is fixed at In Progress.
 - Release indicates the Ubuntu release used for testing, and for which the certificate will be issued.
 - Level indicates the type of certification:
 - Certified is for hardware that's ready to be deployed with Ubuntu. This is the option to choose for server hardware as that typically does not ship with a pre-installed operating system.
 - Certified Pre-installed is for hardware that ships with a (possibly customized) version of Ubuntu. This option is used almost exclusively for

Client hardware such as desktops, laptops and tablets that typically ship with a pre-installed operating system.

- Is Private should be checked if the certification should be kept private. Note that this check box affects the certificate only, not the entry for the computer as a whole on <http://certification.canonical.com>. Other public pre-existing certificates, or those issued in the future, will remain public.
3. Click Submit. You'll see a new screen in which you can (and in one case *must*) enter more information. In particular, you can click:
- Link Bug to link to a bug on <https://bugs.launchpad.net>. This option is available only to Canonical engineers.
 - Create Note or Create Note from Template to create a note. Most systems will have at least three notes:
 - A note titled "Tester" with the name of the person who did the testing is required.
 - A note titled "Test Notes" is usually present. It describes test-specific quirks, such as why a failure should be ignored (say, if a network test failed because of local network problems but succeeded on re-testing). If the *miscellanea/get-maas-version* test fails, be sure to specify the version of MAAS used to deploy the SUT.

In most cases, the "Private" check box should be checked for your notes.

Appendix A - Installing the Server Test Suite Manually

Ordinarily, MAAS will install the Server Test Suite onto the SUT as part of the provisioning process. If the MAAS server is not configured to do this, you may use APT to do the job after deploying the SUT. In order to do this, your lab must have Internet access or a local APT repository with both the main Ubuntu archives and the relevant PPAs. You can install the necessary tools using `apt-get`.

Log in to the server locally or via SSH or KVM and run the following commands:

```
$ sudo apt-add-repository ppa:hardware-certification/public
$ sudo apt-add-repository ppa:firmware-testing-team/ppa-fwts-stable
$ sudo apt-get update
$ sudo apt-get install canonical-certification-server
```

If you want to run the test suite from an Ubuntu live medium, you must also enable the universe repository:

```
$ sudo apt-add-repository universe
```

Note that running the test suite from a live medium is not accepted for any certification attempt; this information is provided to help in unusual situations or when debugging problems that necessitate booting in this way.

During the installation, you may be prompted for a password for `mysql`. This can be set to anything you wish; it will not be used during testing.

At this point, the test suite and dependencies should be installed.

Appendix B - Re-Testing and Installing Updated Tests

Occasionally, a test will fail, necessitating re-testing a feature. For instance, if a USB flash drive is defective or improperly prepared, the relevant USB tests will fail. Another common source of problems is network tests, which can fail because of busy LANs, flaky switches, bad cables, and so on. When this happens, you must re-run the relevant test(s).

Although it's often possible to re-run a test by directly executing a single test script, the preferred method is:

1. Re-run `canonical-certification-server`.
2. Use one of the abbreviated testing whitelists (such as *Network-only*) or adjust the set of tests to be run (as described in *Appendix C*).
3. Submit the resulting `submission.xml` file to the C3 site.

You can then request a certificate based on the main results (the one with the most passed tests) and refer to the secondary set of results in the certificate notes. This procedure ensures that all the necessary data will be present on C3. It also ensures that (sometimes subtle) problems will be avoided; for instance, network tests may not be valid if network ports that are not being tested are active. The `canonical-certification-server` framework ensures that such potential problems are avoided.

From time to time, a test will be found to contain a bug or need to be updated to deal with a problem. In such cases, it is often impractical to wait for the fix to work its way down through Ubuntu's packaging system, or even through the PPAs in which some of the relevant tools are distributed. In such cases, the usual procedure for replacing the script or file is as follows:

1. Consult with the Server Certification Team about the problem; *do not* install an updated script from some other source!
2. Obtain the updated file (typically a script) from the Server Certification Team. Store it on the SUT in the home directory of the test account. For instance, the new script might be `/home/ubuntu/newscript`. If necessary, give the new file execute permissions.
3. On the SUT, rename or delete the original file, as in:

```
$ sudo rm /usr/lib/2013.canonical.com\:checkbox/bin/oldscript
```

4. Create a symbolic link from the new script to the original name, as in:

```
$ sudo ln -s /home/ubuntu/newscript \  
/usr/lib/2013.canonical.com\:checkbox/bin/oldscript
```

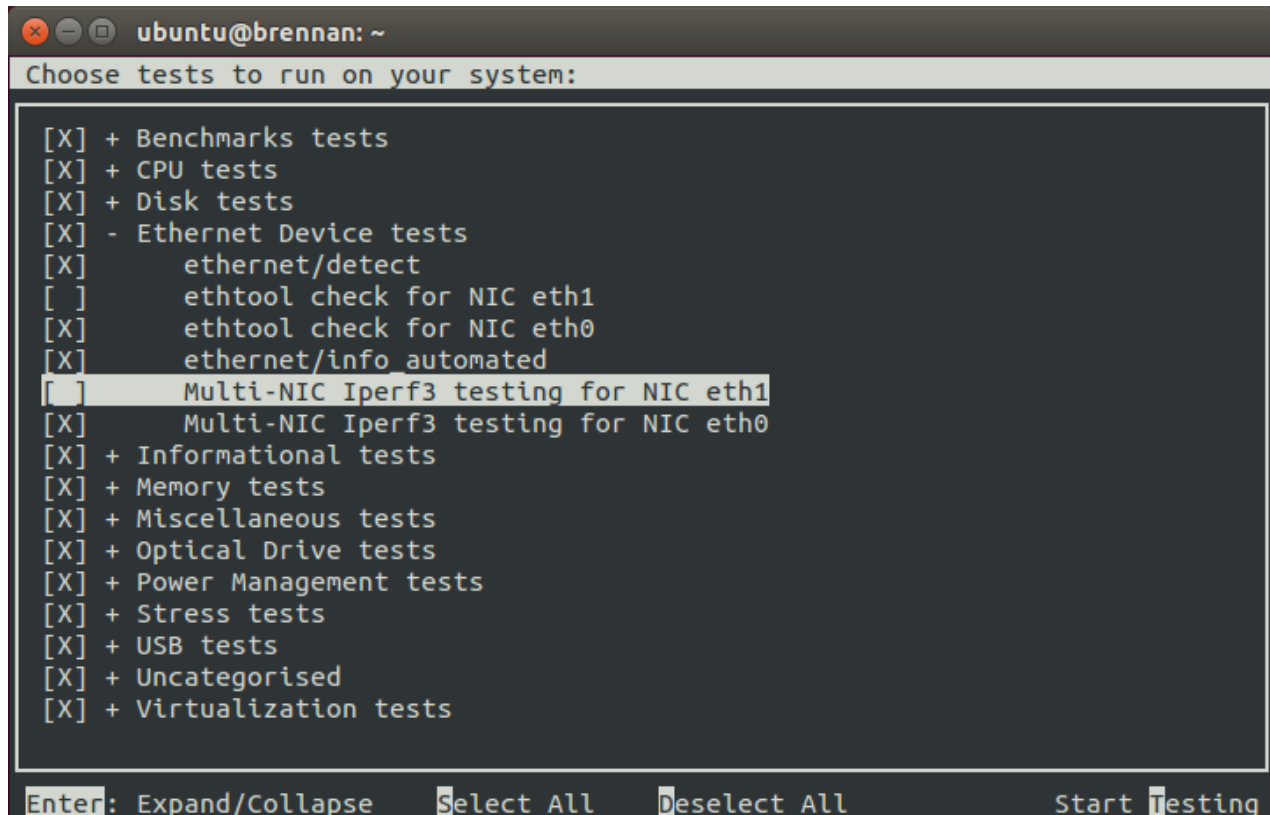
5. Run the tests again, using the canonical-certification-server user interface.

In some cases, another procedure might be necessary; for instance, a bug fix might require installing a new Debian package with the `dpkg` command, or you might need to edit a configuration file. The Canonical Server Certification Team can advise you about such requirements.

Appendix C - Using the Test Selection Screen

It may be necessary for you to deselect some of the tests which are to be run for certification. This is unlikely, though, and you should only do it when so instructed.

The test selection screen looks like this:



```
ubuntu@brennan: ~
Choose tests to run on your system:

[X] + Benchmarks tests
[X] + CPU tests
[X] + Disk tests
[X] - Ethernet Device tests
[X]   ethernet/detect
[ ]   ethtool check for NIC eth1
[X]   ethtool check for NIC eth0
[X]   ethernet/info automated
[ ]   Multi-NIC Iperf3 testing for NIC eth1
[X]   Multi-NIC Iperf3 testing for NIC eth0
[X] + Informational tests
[X] + Memory tests
[X] + Miscellaneous tests
[X] + Optical Drive tests
[X] + Power Management tests
[X] + Stress tests
[X] + USB tests
[X] + Uncategorized
[X] + Virtualization tests

Enter: Expand/Collapse  Select All  Deselect All  Start Testing
```

Initially a list of test categories appears. Highlighting one of these categories and then pressing the Enter key expands the category to show the individual tests it contains. (The preceding figure shows the *Ethernet Device tests* category so expanded.)

Every category and test suite name is preceded by brackets that contain either an X character or nothing to identify whether the test suite has been selected or not. You can select or deselect either an individual test or all the tests in a category by pressing the Spacebar. For instance, with *Ethernet Device tests* highlighted, pressing the Spacebar will deactivate (or re-activate) all of the Ethernet tests. You can select or de-select an

individual test, such as the *Multi-NIC Iperf3 testing for NIC eth1* test, by highlighting it and pressing the Spacebar.

Once you've chosen the tests you want to run, press the *T* key to begin the testing process.

Appendix D - Point Release Testing

Ordinarily, 16.04 certification requires testing two releases:

- Ubuntu 16.04 GA — That is, the version that was released in April of 2016.
- The current point release — That is, version 16.04.2 or whatever is the latest release in the 16.04 series. Obviously, a point-release test will not be possible until 16.04.1 becomes available.

In theory, compatibility will only improve with time, so a server might fail testing with 16.04 GA because it uses new hardware that had not been supported in April of 2016, but pass with the latest version. Such a server would be certified for that latest version, but not for the original GA release. If such a situation arises, testing should also be done with intervening releases so as to determine the earliest working version of Ubuntu.

If a server fails certification with a more recent release but works with an earlier one, this situation is treated as a regression; a bug report should be filed and note made of the problem in the certificate request. Please notify your TPM about such problems to facilitate their resolution.

Because Ubuntu 16.04.1 uses the same 4.4.0 kernel series as 16.04 GA, testing 16.04.1 is required only if 16.04 GA fails. (Although 16.04 GA and 16.04.1 use the same kernel series, 16.04.1 ships with a later kernel within that series, so it might fix a bug that blocks 16.04 GA certification.)

If the procedure for installing point releases, as described in the MANIACS document (available from <https://certification.canonical.com>), fails, then you should consult the Server Certification Team.

Appendix E - Troubleshooting Tips

Submitting Results

If submitting results from the Server Test Suite itself fails, you can use the `canonical-certification-submit` program, as described earlier, in Manually Uploading Test Results to the Certification Site. You can try this on the SUT, but if network problems prevented a successful submission, you may need to bring the files out on a USB flash drive or other removable medium and submit them from a computer with better Internet connectivity.

Inconsistent Message when Submitting Results

If you receive a message that looks like the following when using `canonical-certification-submit`, please be sure to save the `submission.xml` file and contact your account manager:

```
2014-04-28 10:55:33,894 CRITICAL Error: Inconsistent message
```

Network Problems

Network problems are common in testing. These problems can manifest as complete failures of all network tests or as failures of just some tests. Specific suggestions for fixing these problems include:

- **Check cables and other hardware** — Yes, this is very basic; but bad cables can cause problems. For instance, one bad cable at Canonical resulted in connections at 100 Mbps rather than 1 Gbps, and therefore failures. Some of these failures were identified in the output as the lack of a route to the host. Similarly, if a switch connecting the SUT to the `iperf3` server is deficient, it will affect the network test results.
- **Use the simplest possible network** — Complex network setups and those with heavy traffic from computers uninvolved in the testing or those with multiple switches, bridges, etc., can create problems for network testing. Simplifying the network in whatever way is practical can improve matters.

- **Check the iperf3 server** — Ensure that the server computer is up and that the `iperf3` server program is running on it. Also ensure that the computer has no issues, such as a runaway process that's consuming too much CPU time.
- **Verify the iperf3 server is not overworked** — The `iperf3` server program refuses connections if it's already talking to another client. Thus, a SUT may fail its network test if the `iperf3` server is already in use. You may need to re-run the network tests on one or more SUTs if this is the case. Note that a faster `iperf3` server (say, one with a 10 Gbps NIC used to test 1 Gbps SUTs) requires special configuration to handle multiple simultaneous connections, as described in the MANIACS guide.
- **Ensure the iperf3 server is on the SUT's local network** — The network tests temporarily remove the default route from the routing table, so the `iperf3` server must be on the same network segment as the SUT.
- **Check the SUT's network configuration** — A failure to configure the network ports in `/etc/network/interfaces` will cause a failure of the network tests. Likewise, a failure to bring up a network interface before testing will cause the test to fail, even if `canonical-certification-server` detects the interface.
- **Check your DHCP server** — A sluggish or otherwise malfunctioning DHCP server can delay bringing up the SUT's network interfaces (which repeatedly go down and come up during testing). This in turn can cause network testing failures.

If you end up having to re-run the network tests, either do so from within `canonical-certification-server` or be sure to bring down all the network interfaces except the one you're testing before using `iperf3` manually. The way Linux manages network interfaces makes it difficult to ensure that network traffic will be restricted to a single network port if more than one is active.

Issues During Testing

The testing process should be straightforward and complete without issue. Should you encounter problems during testing, please contact your account manager. Be sure to save the `~/.local/share/checkbox-ng` and `~/.cache/plainbox` directory trees as they will contain logs and other data that will help the Server Certification Team determine if the issue is a testing issue or a hardware issue that will affect the certification outcome.

If possible, please also save a copy of any terminal output or tracebacks you notice to a text file and save that along with the previously-noted directories. (Feel free to send us a photo of the screen taken with a digital camera.)