

# Ubuntu Server

## for IBM zSystems and LinuxONE

What's New - October 2022

Frank Heimes, Tech. Lead Z, Canonical Ltd.



Ubuntu on Big Iron: [ubuntu-on-big-iron.blogspot.com](https://ubuntu-on-big-iron.blogspot.com)



# Canonical



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# Ubuntu Server for IBM zSystems and LinuxONE



(s390x)

[Mission and Philosophy](#) - In a nutshell

**Freedom to download Ubuntu - study, use, share, (re-)distribute, contribute, improve and innovate it!**

Mapped to Ubuntu Server for IBM Z and LinuxONE (s390x) - the goal is:

- to expand Ubuntu's ease of use to the s390x architecture (IBM Z and LinuxONE)
- unlock new workloads, especially in the Open Source, Cloud and container space
- to tap into new client segments
- quickly exploit new features and components - in two ways:
  - promptly supporting new hardware
  - releases built and based on the latest kernels, tool-chain and optimized libraries
- provide parity across architectures, in terms of release and feature parity and closing gaps
- provide a uniform user experience and look-and-feel
- be part of the collective world-wide Open Source power in action
- deal with upstream work and code only - no forks
- offer a radically new subscription pricing with drawer-based pricing, or alternatively provide entry-level pricing based on up to 4 IFLs

# Ubuntu for IBM Z and LinuxONE - Release cadence



16.04 16.10 17.04 17.10 18.04 18.10 19.04 19.10 20.04 20.10 21.04 21.10 22.04 22.10

in development

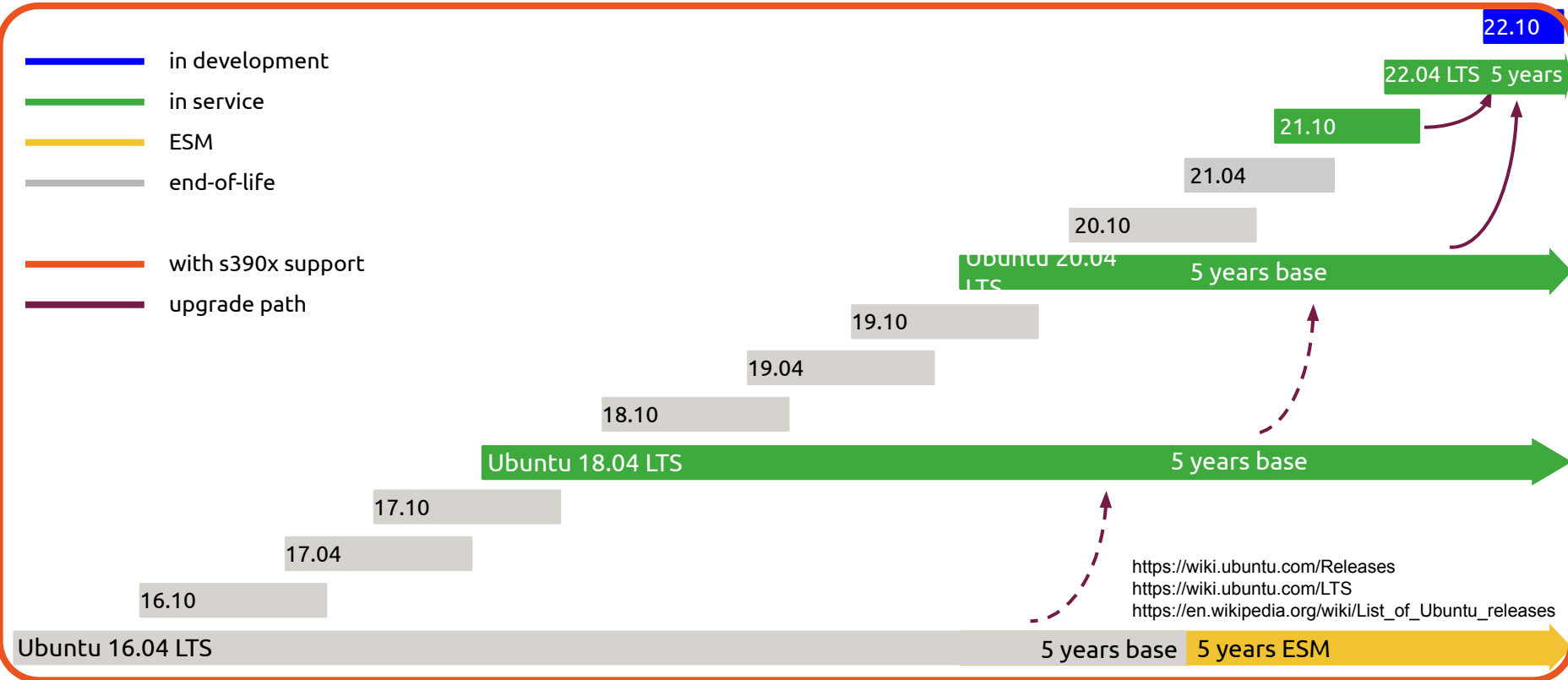
in service

ESM

end-of-life

with s390x support

upgrade path



<https://wiki.ubuntu.com/Releases>  
<https://wiki.ubuntu.com/LTS>  
[https://en.wikipedia.org/wiki/List\\_of\\_Ubuntu\\_releases](https://en.wikipedia.org/wiki/List_of_Ubuntu_releases)

# Ubuntu Release Naming Scheme

- in development
- end-of-life
- in service
- ESM
- with s390x support



The official Ubuntu release number is 'xx.yy', whereas 'xx' represents the year (minus 2000) and 'yy' the month of the release within in that year.

So Ubuntu's first release, made available in 2004 October (October: 10th month) was Ubuntu 4.10.

Since the actual release date is not known until it's ready and humans tend to prefer names rather than numbers, a set of code-names are used by developers and testers during the development phase:

<u>Adjective</u>	<u>Animal</u>	<u>Version</u>	<u>Adjective</u>	<u>Animal</u>	<u>Version</u>
Warty	Warthog	4.10	Natty	Narwhal	11.04
Hoary	Hedgehog	5.04	Oneiric	Ocelot	11.10
Breezy	Badger	5.10	<b>Precise</b>	<b>Pangolin</b>	<b>12.04 LTS</b>
<b>Dapper</b>	<b>Drake</b>	<b>6.06 LTS</b>	Quantal	Quetzal	12.10
Edgy	Eft	6.10	Raring	Ringtail	13.04
Feisty	Fawn	7.04	Saucy	Salamander	13.10
Gutsy	Gibbon	7.10	<b>Trusty</b>	<b>Tahr</b>	<b>14.04 LTS</b>
<b>Hardy</b>	<b>Heron</b>	<b>8.04 LTS</b>	Utopic	Unicorn	14.10
Intrepid	Ibex	8.10	Vivid	Vervet	15.04
Jaunty	Jackalope	9.04	Wily	Werewolf	15.10
Karmic	Koala	9.10	<b>Xenial</b>	<b>Xerus</b>	<b>16.04 LTS</b>
<b>Lucid</b>	<b>Lynx</b>	<b>10.04 LTS</b>	Yakkety	Yak	16.10
Maverick	Meerkat	10.10	Zesty	Zapus	17.04

<u>Adjective</u>	<u>Animal</u>	<u>Version</u>
Artful	Aardvark	17.10
<b>Bionic</b>	<b>Beaver</b>	<b>18.04 LTS</b>
Cosmic	Cuttlefish	18.10
Disco	Dingo	19.04
Eoan	Ermine	19.10
<b>Focal</b>	<b>Fossa</b>	<b>20.04 LTS</b>
Groovy	Gorilla	20.10
Hirsute	Hippo	21.04
Impish	Indri	21.10
<b>Jammy</b>	<b>Jellyfish</b>	<b>22.04 LTS</b>
Kinetic	Kudu	22.10

The development codename of a release has a name like "Adjective Animal". Warty Warthog (Ubuntu 4.10) was the [first](#) Ubuntu release. In general, people refer to the release using the adjective, like "warty" or "breezy". The names live on in one hidden location---the archive release name in /etc/apt/sources.list and seen on the download mirror network.

# Ubuntu 18.04 LTS (Bionic Beaver)



- The codename for the current LTS (Long Term Support) release 18.04 is 'Bionic Beaver' or in short 'Bionic': <https://launchpad.net/ubuntu/bionic>
- Bionic Release Schedule: <https://wiki.ubuntu.com/BionicBeaver/ReleaseSchedule>  
Release date: April, 26th 2018
- Updated major components:
  - Kernel 4.15 (linux-generic) + HWE kernels
  - Qemu-KVM 2.11.x / Libvirt (libvirt-bin) 4.0.0
  - LXD 3.0.0 (incl. clustering support)
  - GCC 7.3 → 7.4 (gcc 5, 6, 8 universe) / GDB 8.1
  - Python 3.6.5 → 3.6.7 (and 2.7.15, but not installed by default)
  - Perl 5.26
  - Ocaml 4.05
  - netplan 1.10 / netplan.io 0.36 → 0.97 (replacing ifupdown)
  - CDO 'Queens' (Canonical Distribution of Openstack)
  - Openssl 1.1.0.g → 1.1.1
  - docker.io 17.12.1 → 18.09.5
  - Open vSwitch 2.9 → 2.9.2
  - cloud-init 18.2.14 → 19.1.1
  - MongoDB 3.6.3
  - Postgresql 10+
  - Redis 4.0.9
  - chrony 3.2 (replacing ntpd)
  - glibc (libc-bin) 2.27
  - s390-tools 2.3.0
  - llvm 6.0
- In order to download Ubuntu Server 18.04 LTS for IBM Z and LinuxONE, please visit: <https://www.ubuntu.com/download/server/s390x>

# Ubuntu 18.04 LTS (Bionic Beaver)



## Non-complete list of s390x-specific new features and enhancements

- improvements for IBM z14, z14 ZR1, LinuxONE Rockhopper II and LinuxONE Emperor II (1725260) (1736100)
- s390-tools major version upgrade to v2.3.0 (1735447)
- cryptsetup rebase and enhancements in support of dm-crypt (1724592)
- protected key support for dm-crypt (1741904)
- TLB enhancements (1732426) (1732452)
- TOD-Clock Epoch Extension Support (1732437) (1732691)
- DASD multi-queue (1732446) support and block layer discard support (1732440)
- Improved memory handling (1734120)
- support for new crypto hardware CEX6S (1735437)
- AP bus kernel API for KVM (1732449)
- CPU-MF/perf improvements (1735433)
- CPACF enhancements for acceleration for AES-GCM (1735438) (1735439)
- HiperSocket connections (1735604)
- parted update for fdasd/vfnc (1737150)
- openssl-ibmca rebase (1747626)
- opencryptoki rebase for EP11 and ECC enhancement (1751272)
- lock optimization enhancement (1747877)
- libica upgrade for z14 and ECC support (1737159) and to use PRNO-TRNG to seed SHA512-DRBG (1754617)
- auto detect layer2 setting in qeth driver (1747639)
- Kernel support for STHYI/LPAR (1736093)
- rebase libpfm4 for z13/z13s CPU-MF hardware counters (1741905)

• more hw specific support,  
• better hw exploitation,  
• initial introduction of general zkey / protected key support  
• further enhancements and new crypto features (in regards to PE)

Ubuntu Server

For an overall 18.04 release description, please see the official release notes: <https://wiki.ubuntu.com/BionicBeaver/ReleaseNotes>

# Ubuntu 20.04 LTS (Focal Fossa)



- The codename for 20.04 is 'Focal Fossa' or just 'Focal': <https://launchpad.net/ubuntu/focal>
- Ubuntu Server Long-Term Support (LTS) release
- Release Schedule: <https://wiki.ubuntu.com/FocalFossa/ReleaseSchedule>  
Final Release: Apr, 23rd 2020 (Release Candidate: Apr 16th 2020, Beta Apr 2nd 2020)
- Release Notes: <https://wiki.ubuntu.com/FocalFossa/ReleaseNotes> (s390x-specifics)
- Major components (planned):
  - Kernel 5.4
  - qemu-kvm 4.2+
  - libvirt 6.0+
  - glibc 2.31
  - binutils 2.34
  - docker 19.03.8
  - gcc 9.3 (default; gcc10 in universe)
  - gdb 9.1
  - LLVM 7,8,9,10
  - python 3.8.2 / (2.7.17 in universe)
  - golang 1.13
  - s390-tools 2.12+
  - smc-tools 1.2.2
  - openssl 1.1.1f
  - openssl-ibmca 2.1.0
  - opencryptoki 3.13.0
  - libica 3.6.1
  - qclib 2.1.0
  - apt 2.0.1
  - snapd 2.44
  - cloud-init 20.1.10
  - php 7.4+



# Ubuntu Server 20.04 (Focal Fossa)



Non-complete list of 20.04 s390x-specific new features and enhancements (since 19.10):

- Starting with Ubuntu Server 20.04 the architectural level set was changed to z13 (LP:1836907). This has a significant impact: Ubuntu Server for s90x now has improved and more instructions that got introduced with z13 hardware; at the same time support for zEC12/zBC12 got dropped and the minimum supported hardware is now IBM z15 and LinuxONE Rockhopper (I) and LinuxONE Emperor (I).
- Secure Execution, a Trusted Execution Environment (TEE) for IBM Z and LinuxONE is now supported. It can only be used with IBM z15 and LinuxONE III. With Secure Execution (or the virtualized protected environment aka 'provtirt') workloads can run virtualized in full isolation with protection for both internal and external memory using hardware assisted encryption (CPACF MSA 6 and CPACF crypto) (LP:1835531), qemu (LP:1835546) and s390-tools (LP:1834534).
- The toolchain was significantly upgraded to gcc 9.3, gdb 9.1, LLVM 10, and key libraries (OpenSSL, libica3, openssl, qclib, etc.)
- Change of minimal architectural requirement to z13, with that zEC12/zBC12 support got dropped
- Expanded hardware support for z15 in general, on-chip compression (deflate), CPACF MSA 6 and
- CryptoExpress CEX7 and several libraries (OpenSSL, libica3, openssl, qclib, etc.)
- Secure Execution, a Trusted Execution Environment (TEE), support for pervasive encryption
- using hardware assisted guest memory encryption
- in addition virtualization stack updates of qemu-kvm, libvirt, incl. crypto passthrough and more
- tool-chain updates to gcc 9.3, gdb 9.1, LLVM 10, and key library updates incl. crypto libraries and glibc
- several kernel optimizations and kernel config adjustments
- subiquity is the new default installer for Ubuntu Server for s390x
- and with that 'autoinstall' supersedes 'preseed'
- Secure boot (for SCSI IPL) and IPL from NVMe (20.04.2)
- Finally ZPCI enhancements (pciutil -reset (LP:1863768) and fixes, like write through (LP:1866162) got picked up in Linux with that only a small configuration change of CONFIG\_NR\_FUNCTIONS to 512, but also further kernel config option changes, like CONFIG\_NR\_CPUS and CONFIG\_NUMA\_EMU (LP:1864196), CONFIG\_NET\_SWITCHDEV (LP:1865452) and disabling HIBERNATION and PM (LP:1867753).



Stability



Security



Features

Please also see the official release notes: <https://wiki.ubuntu.com/FocalFossa/ReleaseNotes>

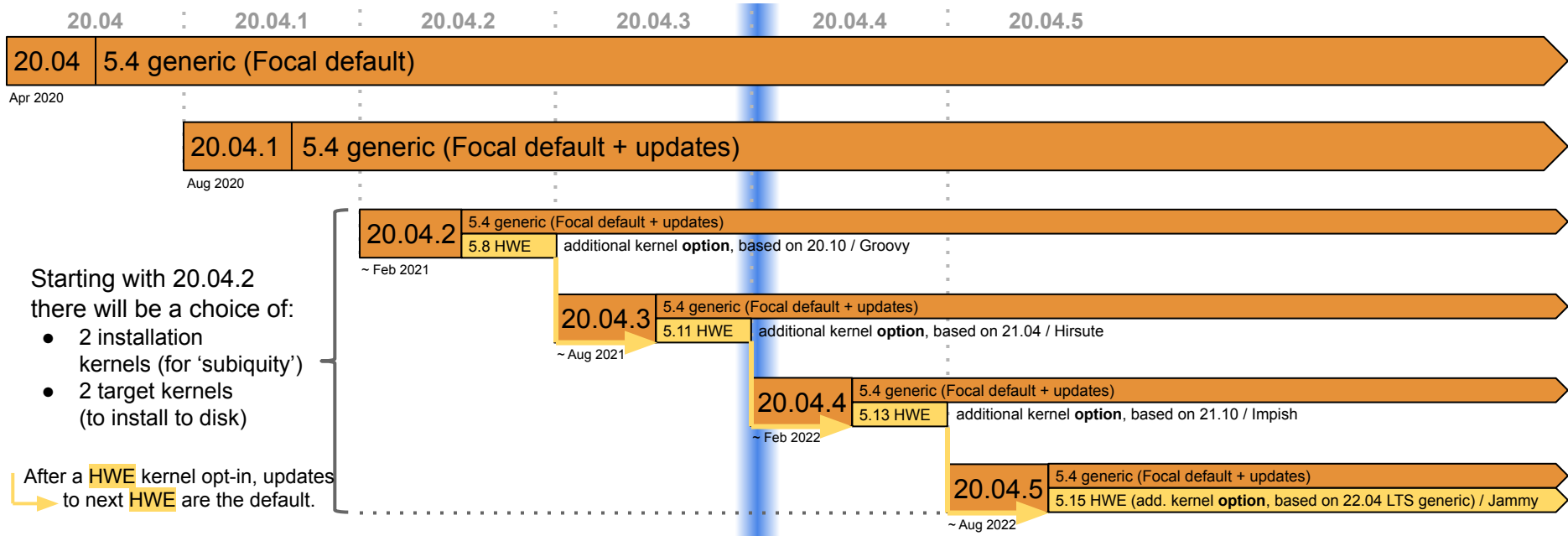
Ubuntu Server



# Ubuntu 20.04.x LTS Kernel Support Schedule

This is a distilled view of the 20.04.x Ubuntu Kernel Support Schedule.

Depending on the installed LTS 'point' release, it's either possible to use the generic and default Kernel (always until EOL) or optionally the HWE Kernel (HWE upgrade path need to be followed, starting with '.2').



Starting with 20.04.2 there will be a choice of:

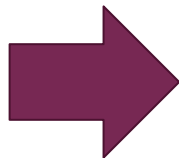
- 2 installation kernels (for 'subiquity')
- 2 target kernels (to install to disk)

After a HWE kernel opt-in, updates to next HWE are the default.

# Upgrade Path to 20.04



Ubuntu Server 19.10  
Ubuntu Server 18.04 LTS



Ubuntu Server 20.04.x LTS

Always from **latest non-LTS to current LTS** and from **previous LTS to current LTS**.  
**'do-release-upgrade'** is the recommended tool to use.

Join the webinar: "Migrating your infrastructure to Ubuntu 20.04 LTS - how, when and why?"

Blog: [How to upgrade from Ubuntu 18.04 LTS to 20.04 LTS today](#)

Wiki: [https://help.ubuntu.com/community/FocalUpgrades#Ubuntu\\_Servers](https://help.ubuntu.com/community/FocalUpgrades#Ubuntu_Servers)

# Ubuntu Server - live installer (subiquity)



ubuntu releases

## Ubuntu 20.04 LTS (Focal Fossa)

### Select an image

Ubuntu is distributed on four types of images described below.

<h4>Server install image</h4> <p>The server install image allows you to install Ubuntu permanently on a computer for use as a server. It will not install a graphical user interface.</p>	<p><a href="#">64-bit PC (AMD64) server install image</a> Choose this if you have a computer based on the AMD64 or EM64T architecture (e.g., Athlon64, Opteron, EM64T Xeon, Core 2). Choose this if you are at all unsure.</p> <p><a href="#">64-bit ARM (ARMv8/AArch64) server install image</a> For 64-bit ARMv8 processors and above.</p> <p><a href="#">PowerPC64 Little-Endian server install image</a> For POWER8 Little-Endian computers, such as Power Systems S8xxL/LC Linux-only servers.</p> <p><a href="#">IBM System z server install image</a> For IBM System z series mainframes, such as IBM LinuxONE.</p>
---	--

<https://ubuntu.com/download/server/s390x>

Installer update available [ Help ]

Version 20.03.1 of the installer is now available (19.12.1.5 is currently running).

You can read the release notes for each version at:

<https://github.com/CanonicalLtd/subiquity/releases>

If you choose to update, the update will be downloaded and the installation will continue from here.

[ Update to the new installer ]  
[ Continue without updating ]  
[ Back ]

<https://ubuntu.com/server/docs/install/general>

<https://ubuntu.com/server/docs/install/autoinstall>

# Ubuntu Server - live installer (subiquity)



Willkommen! Bienvenue! Welcome! Добро пожаловать! Welkom!

[ Help ]

Use UP, DOWN and ENTER keys to select your language.

- [ Asturianu ▶ ]
- [ Bahasa Indonesia ▶ ]
- [ Català ▶ ]
- [ Deutsch ▶ ]
- [ English ▶ ]
- [ English (UK) ▶ ]
- [ Español ▶ ]
- [ Français ▶ ]
- [ Galés ▶ ]
- [ Hrvatski ▶ ]
- [ Latviski ▶ ]
- [ Lietuviškai ▶ ]
- [ Magyar ▶ ]
- [ Nederlands ▶ ]
- [ Norsk bokmål ▶ ]
- [ Polski ▶ ]
- [ Suomi ▶ ]
- [ Svenska ▶ ]

# Ubuntu Server - live installer 'Zdev' (subiquity)



```
Zdev setup [ Help ]

0.0.0400 ▶
0.0.0592 ▶

qeth
0.0.0600:0.0.0601:0.0.0602 enc600 ▶
0.0.0603:0.0.0604:0.0.0605 ▶

dasd-eckd
0.0.1607 ▶
  ◀ (close)
  Enable
  Disable

zfcp-host
0.0.f00b online ▶
0x50050763060b16b6:0x4026400600000000 sdb sg1
0x50050763061b16b6:0x4026400600000000 sda sg0
0.0.f10b online ▶
0x50050763060b16b6:0x4026400600000000 sdd sg3
0x50050763061b16b6:0x4026400600000000 sdc sg2

[ Continue ]
[ Back ]
```





# Ubuntu Server - live installer (subiquity)

```
Installer shell session activated.
```

```
This shell session is running inside the installer environment. You
will be returned to the installer when this shell is exited, for
example by typing Control-D or 'exit'.
```

```
Be aware that this is an ephemeral environment. Changes to this
environment will not survive a reboot. If the install has started, the
installed system will be mounted at /target.
```

```
root@ubuntu-server:/# uname -a
```

```
Linux ubuntu-server 5.4.0-42-generic #46-Ubuntu SMP Fri Jul 10 00:21:32 UTC 2020
s390x s390x s390x GNU/Linux
```

```
root@ubuntu-server:/# lsdev --online
```

TYPE	ID	ON	PERS	NAMES
zfcplib	0.0.f00b	yes	yes	
zfcplib	0.0.f10b	yes	yes	
zfcplib	0.0.f00b:0x50050763060b16b6:0x4026400600000000	yes	no	sdb sg1
zfcplib	0.0.f00b:0x50050763061b16b6:0x4026400600000000	yes	no	sda sg0
zfcplib	0.0.f10b:0x50050763060b16b6:0x4026400600000000	yes	no	sdd sg3
zfcplib	0.0.f10b:0x50050763061b16b6:0x4026400600000000	yes	no	sdg sg2
qeth	0.0.0600:0.0.0601:0.0.0602	yes	no	enc600
generic-ccw	0.0.0009	yes	no	

```
root@ubuntu-server:/#
```



# Ubuntu Server - live installer (subiquity)

```
Installer shell session activated.
```

```
This shell session is running inside the installer environment. You will be returned to the installer when this shell is exited, for example by typing Control-D or 'exit'.
```

```
Be aware that this is an ephemeral environment. Changes to this environment will not survive a reboot. If the install has started, the installed system will be mounted at /target.
```

```
root@ubuntu-server:/# lsb_release -d
```

```
Description:    Ubuntu 20.04.1 LTS
```

```
root@ubuntu-server:/# uname -a
```

```
Linux ubuntu-server 5.4.0-42-generic #46-Ubuntu SMP Fri Jul 10 00:21:32 UTC 2020  
s390x s390x s390x GNU/Linux
```

```
root@ubuntu-server:/# snap list
```

Name	Version	Rev	Tracking	Publisher	Notes
core18	20200724	1884	latest/stable	canonical*	base
snappd	2.45.2	8539	latest/stable	canonical*	snappd
subiquity	20.07.1+git2.5de9df3e	1969	latest/stable/...	canonical*	classic

```
root@ubuntu-server:/# █
```





# Ubuntu Server - autoinstall (user-data 'yaml')

```
$ cat /var/log/installer/autoinstall-user-data
```

```
# cloud-config
```

```
autoinstall:
```

```
  version: 1
```

```
  refresh-installer:
```

```
    update: yes
```

```
  reporting:
```

```
    builtin:
```

```
      type: print
```

```
  apt:
```

```
    preserve_sources_list: false
```

```
    primary:
```

```
      - arches: [amd64, i386]
```

```
        uri: http://archive.ubuntu.com/ubuntu
```

```
      - arches: [default]
```

```
        uri: http://ports.ubuntu.com/ubuntu-ports
```

```
  keyboard:
```

```
    layout: en
```

```
    variant: us
```

```
  locale: en_US
```

```
  identity:
```

```
    hostname: zvmguest
```

```
    password: "$6$ebJ1f8wxED22bTL4F46P0"
```

```
    username: ubuntu
```

```
user-data:
```

```
  timezone: America/Boston
```

```
  users:
```

```
    - name: ubuntu
```

```
      password: "$6$KwuxED22bTL4F46P0"
```

```
      lock_passwd: false
```

```
  early-commands:
```

```
    - chzdev dasd -e 1234
```

```
  network:
```

```
    version: 2
```

```
    ethernets:
```

```
      enc600:
```

```
        addresses: [10.11.12.23/24]
```

```
        gateway4: 10.11.12.1
```

```
        nameservers:
```

```
          addresses: [10.11.12.1]
```

```
  ssh:
```

```
    install-server: true
```

```
    allow-pw: true
```

```
    authorized-keys: ['ssh-rsa meQwtZ
```

```
user@workstation # ssh-import-id lp:user']
```

⇒ /var/log/installer/autoinstall-user-data

# Ubuntu Server Live Installer (subiquity / autoinstall)



The installation process changed with 20.04 for s390x (further improved with every point release), and the documentation was reworked and updated and can now be found here:

The landing page is the official **Ubuntu Server Guide for 20.04 LTS** (chapter 'Installation'):

Ubuntu Server Guide - 20.04 LTS:

- [http: https://ubuntu.com/server/docs/install/general](https://ubuntu.com/server/docs/install/general)
- [pdf: https://assets.ubuntu.com/v1/10d22089-ubuntu-server-guide.pdf](https://assets.ubuntu.com/v1/10d22089-ubuntu-server-guide.pdf)

The step-by-step examples from the Ubuntu Server guide about the **live installer** (subiquity) can also be found as separate documents at 'discourse', where it's possible to comment:

- [Interactive live server installation on IBM Z LPAR \(s390x\)](#)
- [Interactive live server installation on IBM z/VM \(s390x\)](#)

There also also step-by-step guides for **autoinstall**,

the new way of doing non-interactive installations (succeeding preseed):

- [Non-interactive IBM Z LPAR \(s390x\) installation using autoinstall](#)
- [Non-interactive IBM z/VM \(s390x\) installation using autoinstall](#)



# HW compression (NXU) support in Ubuntu 20.04



- Ubuntu Server 20.04 LTS advantages:
  - Hardware assisted compression supported is built-in.
  - Hence tools like gzip/gunzip, tar -czf, compression in IBM Java 8 SR6+, and everything that uses zlib (since it's a user space instruction) - even your kernel decompress after each boot - gets a nice speed up out of the box.
  - Significant speed-ups of 20x to 40x (zlib/DEFLATE) - *for free* (on z15) !
- Latest supported hw compression function is DEFLATE, which is supported by default with Ubuntu 20.04 (s390x), too: `CFLAGS="-O2 -DDFLTCC and -DDFLTCC_LEVEL_MASK=0x7e"` is used (means hardware acceleration compression is enabled for compression levels 1-6).

- If unsure check with:

```
$ strings /usr/bin/gzip | grep DFLTCC$  
DFLTCC
```

```
$ strings /usr/lib/s390x-linux-gnu/libz.so* | grep DFLTCC$  
DFLTCC
```



# Ubuntu 22.04 (Jammy Jellyfish)



- The codename for 22.04 is 'Jammy Jellyfish' or simply 'Jammy': <https://launchpad.net/ubuntu/jammy>
- Ubuntu Server LTS aka long term support release
- Release Schedule: <https://discourse.ubuntu.com/t/jammy-jellyfish-release-schedule>

Final Release: Apr, 21st 2022 (Release Candidate: Apr 14th 2022, Beta Mar 31st 2022)

- Release Notes: <https://discourse.ubuntu.com/t/jammy-jellyfish-release-notes/> (draft)
- Major components:

- |  |                       |                         |
|--|-----------------------|-------------------------|
| ○ Kernel 5.15                              | ○ smc-tools 1.7.0     | ○ s390-tools 2.20+      |
| ○ qemu 6.2                                 | ○ openssl 3.0.2       | new packages/libraries: |
| ○ libvirt 8.0.0                            | ○ openssl-ibmca 2.2.3 | ○ libzpc 1.0.0          |
| ○ virt-manager 4.0.0                       | ○ libica 4.0.1        | ○ libzdn 0.4.0          |
| ○ glibc 2.35                               | ○ opencryptoki 3.17+  |                         |
| ○ binutils 2.38                            | ○ cryptsetup 2.4.3    |                         |
| ○ gcc-default 11.2 (12, 10, 9 in universe) | ○ cloud-init 22.1     |                         |
| ○ gdb 12.0                                 | ○ docker.io 20.10.12  |                         |
| ○ LLVM 14 default (11, 12, 13 and 15 exp.) | ○ netplan 1.10.1      |                         |
| ○ python 3.10                              | ○ util-linux 2.37     |                         |
| ○ go / golang 1.18                         | ○ PHP 8.1             |                         |
| ○ ruby 3.0                                 | ○ qclib 2.3.0         |                         |
| ○ valgrind 3.18.1                          | ○ systemd 249         |                         |

# Ubuntu 22.04 (Jammy Jellyfish)



Non-complete list of 22.04 s390x-specific new features and enhancements (since 21.10):

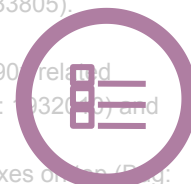
- Like with every new Ubuntu release (respectively its kernel) the s390-tools package needs to be upgraded, this time to 1.13 (Bug: 1929024), including zdsfs transparent data set conversion, allowing Linux to transparently read and write EBCDIC-encoded data as ASCII (Bug: 1926749), the integration option for the zkey repository into an enterprise key-mangement system with a KMIP interface (Bug: 1932177) and changes in the Secure Execution Header defaults for plaintext control flags, PCF (Bug: 1932177).
- In addition to moving to gcc 11.2 as default, further main updates, like updating to glibc 2.36 (that deprecates some optimizations from 12 (Bug: 1926709)) and z15 support (Bug: 1853277).
- And more updates, like the s390-tools package (Bug: 1853277) and the s390-tools libraries (Bug: 1929184).
- Updated kernel to 5.15, s390-tools upgraded and aligned, incl. refinements like storage key
- Kernel, s390-tools and libraries now with support for IBM z16 hardware, like the updated tool-chain as well, especially gcc, gdb/binutils and LLVM.
- like the updated tool-chain as well, especially gcc, gdb/binutils and LLVM.
- QEMU/KVM virtualization stack and Secure Execution updated, incl. in-kernel crypto, libica, checking, access register mode enablement and GISA guest interrupt handling.
- Significant cryptography updates - entire s390x crypto stack got updated, incl. Multi-MAC support
- openssl-ibmca, opencryptoki and cryptsetup. (Bug: 1913300).
- New network capabilities added with HSCI (HiperSockets Converged Interface) Multi-MAC support
- For enhanced KVM and z/OS interoperation and Shared Memory Communication (SMC) EID
- (Enterprise ID), statistics and SMC-R v2 support.
- Various library updates, like qclib, glibc, PCRE2 and Eigen, Leading to further performance
- improvements on s390x, as well as the brand new (s390x-only) libraries: libzpc and libzDNN.
- And support for SMC (Bug: 1853290) and the smc-tools package updated to the latest v1.6.0, including some fixes on the (Bug: 1853290).



Stability



Security

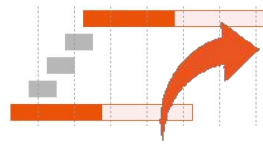


Features

Please also see the official release notes: <https://discourse.ubuntu.com/t/jammy-jellyfish-release-notes>

# What's a point(-release)?

Regular respin and hardware enablement for 2+ years



- **What** is a Point Release?

Ubuntu LTS point releases provide users with a new kernel (except “.1”) as well as a roll up of previous package updates and security patches. In total 5 point releases are made available per LTS release.

- **Goals** (as outlined in the [Ubuntu Point Release Process](#))

- Refresh hardware support in LTS releases for carefully-selected hardware
- Roll up accumulated stable updates into updated images to reduce download requirements for new deployments
- Maintain stability of existing installations

- This nowadays 10 year old blog post on '[The Art of Release](#)' (by Mark Shuttleworth) is still relevant today, covers a **brief summary of point-releases**, and finally shows Canonicals reliable release history over the last decade:

*"We also committed, for the first time, to a regular set of point releases for 8.04 LTS. These will start three months after the LTS, and be repeated every six months until the next LTS is out. These point releases will include support for new hardware as well as rolling up all the updates published in that series to date. So a fresh install of a point release will work on newer hardware and will also not require a big download of additional updates."*

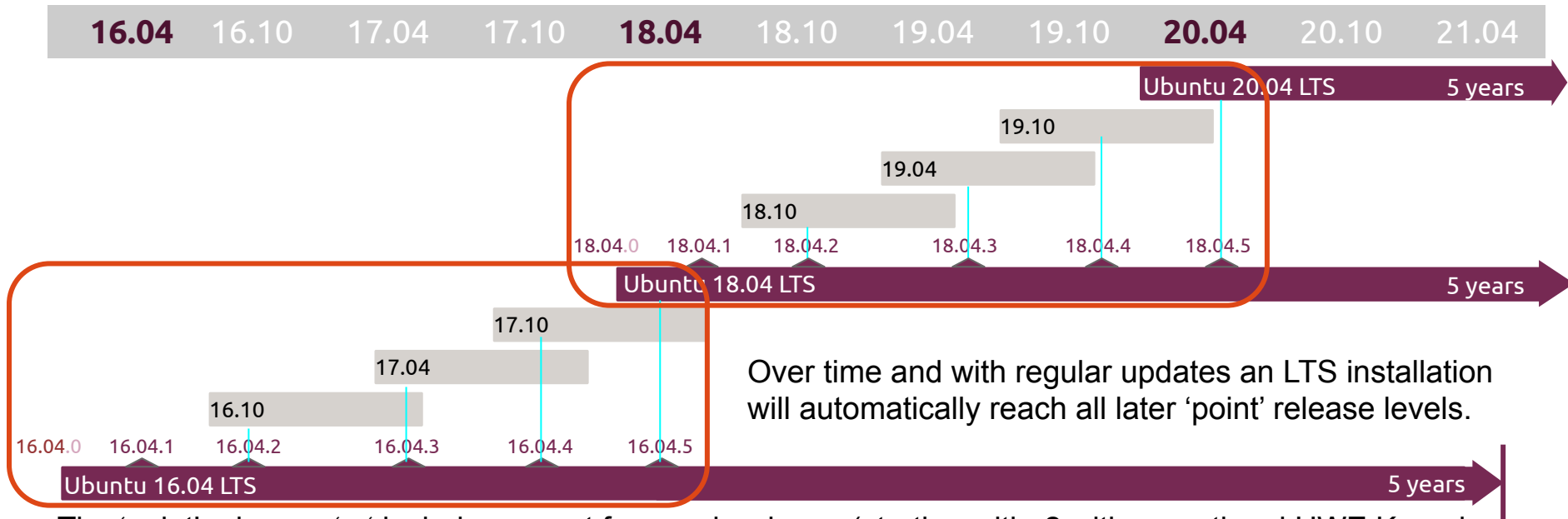
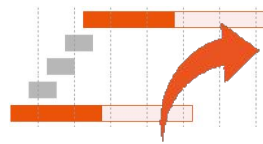
<https://wiki.ubuntu.com/Releases>

<https://wiki.ubuntu.com/PointReleaseProcess>

<http://www.markshuttleworth.com/archives/146>

# Ubuntu LTS 'point' Releases

Regular respin and hardware enablement for 2+ years



Over time and with regular updates an LTS installation will automatically reach all later 'point' release levels.

The 'point' releases '▲' include support for new hardware (starting with .2 with an optional HWE Kernel, that's available in addition to the default and GA kernel), as well as rolling up all the updates published in that series to date. So a fresh install of a point release will work on newer hardware and will also not require a big download of additional updates.

<https://wiki.ubuntu.com/Releases>

<https://www.markshuttleworth.com/archives/146>






# IBM z16 and LinuxONE Emperor 4 & Canonical Ubuntu

**IBM:** We built the powerful and secure platform for business.

**Canonical:** We built our best Open Source Ubuntu LTS distribution.

Make the most out of your zNext by using Ubuntu Server 22.04 LTS for IBM zSystems.



-  IBM z16 hardware support added to Ubuntu kernel, drivers, core libraries and tool, math. libraries and tool-chain.
-  Renewal of the entire crypto stack, incl. CryptoExpress 8S, openssl 3, libica4, openssl-ibmca, openCryptoki, cryptsetup
-  Updated tool-chain, incl. optimizations and support with gcc 11.2, gdb 12 / binutils 2.38, LLVM 14 and Go 1.18
-  New network capabilities: HSCI Multi-MAC and SMC Enterprise ID, statistics and SMC-R v2 support.
-  QEMU/KVM virtualization stack and Secure Execution updates, optimized existing and added some new libraries.



# Ubuntu Server Certified Hardware (s390x)



## **z16 A01**

- LPAR (DPM & classic)
- z/VM

## **z15 T01 / z15 T02**

- LPAR (DPM & classic)
- z/VM

## **z14 M01-M05 / z14 ZR1**

- LPAR (DPM & classic)
- z/VM

## **z13 / z13s**

- LPAR (DPM & classic)
- z/VM

## **zBC12 / zEC12**

- LPAR
- z/VM

## **LinuxONE Emperor 4 LA1**

- LPAR (DPM & classic)
- z/VM

## **LinuxONE III / LinuxONE LT2**

- LPAR (DPM & classic)
- z/VM

## **LinuxONE Emperor II / Rockhopper II**

- LPAR (DPM & classic)
- z/VM

## **LinuxONE Emperor / Rockhopper**

- LPAR (DPM & classic)
- z/VM

LPAR certifications cover KVM too,  
since KVM is intergral to Ubuntu Server.

<https://certification.ubuntu.com/certification/server/models/?query=&vendors=IBM&release=16.04+LTS>

<https://certification.ubuntu.com/certification/server/models/?query=&vendors=IBM&release=18.04+LTS>

<https://certification.ubuntu.com/certification/server/models/?query=&vendors=IBM&release=20.04+LTS>

# IBM Z and LinuxONE - Tested platforms



## IBM tested and Partner certified Linux environments












IBM has tested and certified Linux environments of distribution partners. You can review the statements of the individual Linux distribution for each hardware.

Check the statements of the individual release for each hardware.

Some are out of service, and extended support may be available. Please contact your distribution partner. You can obtain a Support Line contract for remote technical support or a contract with a third-party provider.

### Certified by Linux partner

For detailed version levels see the information on the original [site](#).  
Overview shows Linux distributions in service.  
Extended support is available for Linux distributions that are out of service.

	z16™	z15™	z14® (all models)	z13®	z13s®	zEnterprise® – zEC12, zBC12
	Emperor 4	LinuxONE III	Emperor II Rockhopper II	Emperor	Rockhopper	
Ubuntu 22.04						
Ubuntu 20.04						
Ubuntu 18.04						
Ubuntu 16.04						

[Table got cut to incl. Ubuntu OS only and the hardware that is supported by Ubuntu.]

**Please see more details and all footnotes at:**

<https://www.ibm.com/it-infrastructure/z/os/linux-tested-platforms>

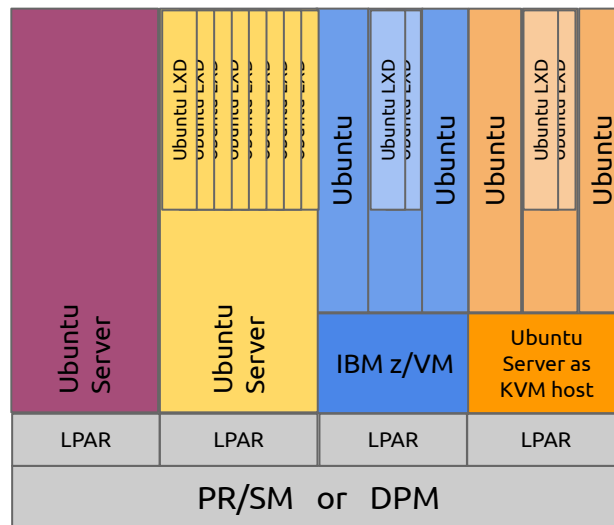
<https://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

# Where to run Ubuntu Server on Z and LinuxONE



- **Logical Partition (LPAR)**
- **z/VM guest**
- **KVM virtual machine**
- **Container (on an Ubuntu host)**
- IBM zEC12/zBC12, z13\*/z13s\* and newer resp. the equivalent LinuxONE systems and zPDT
- HMC in classic or DPM mode

\* requires Ubuntu Server 20.04 LTS or newer



# Deploying Ubuntu Server on Ubuntu KVM



A Linux installation on KVM is similar (if not equal) for all Linux platforms, incl IBM Z and LinuxONE. However the tooling can be more or less convenient - here are the options provided by Ubuntu:

- `kvm` - `kvm`-enabling command-line wrapper for `qemu-system-<arch>`
- `virsh` - command-line management user interface for KVM (and other hypervisors)
- `virt-manager` - graphical management user interface for KVM (and other hypervisors)
- `virt-inst` - cli tools to provision new KVM (and other) virtual machines, part of `virt-tools`
- **uvt-kvm** - part of the `uv-tools`, Ubuntu virtualisation front-end for `libvirt` and KVM
- **LXD** - the scope of LXD v4.2 was expanded to KVM, now beyond container management
- CDO - Charmed Distribution of OpenStack with Nova KVM support
- **multipass** - get an instant Ubuntu VM with a single command (<https://multipass.run/>)

Depending on the tool and needs the virtual machines may be installed by:

- booting with the installer kernel and `initrd`
- directly booting from the ISO image or
- booting the installer over the network via PXE boot

Installations can be interactive using 'd-i' or non-interactive using 'preseed'.

In addition **Cloud images** are available and can directly be started (no need to install) by:

- downloading the Cloud image manually and starting it with for example `virsh`
- or using `uvt-simplestreams-libvirt` to just get and sync it from the image archive

# uv-tool (an Ubuntu hidden treasure ;-)



One-Liner example for 18.04 / bionic - already **released**:

```
$ NAME=bionic; uvt-simplestreams-libvirt sync release=$NAME label=release  
arch=$(arch) && uvt-kvm create $NAME-vm release=$NAME label=release && uvt-kvm  
wait $NAME-vm && uvt-kvm ssh $NAME-vm
```

```
Welcome to Ubuntu 18.04.2 LTS (GNU/Linux 4.15.0-54-generic s390x)
```

```
System information as of Sun Jul 14 13:44:22 UTC 2019
```

```
...
```

```
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.
```

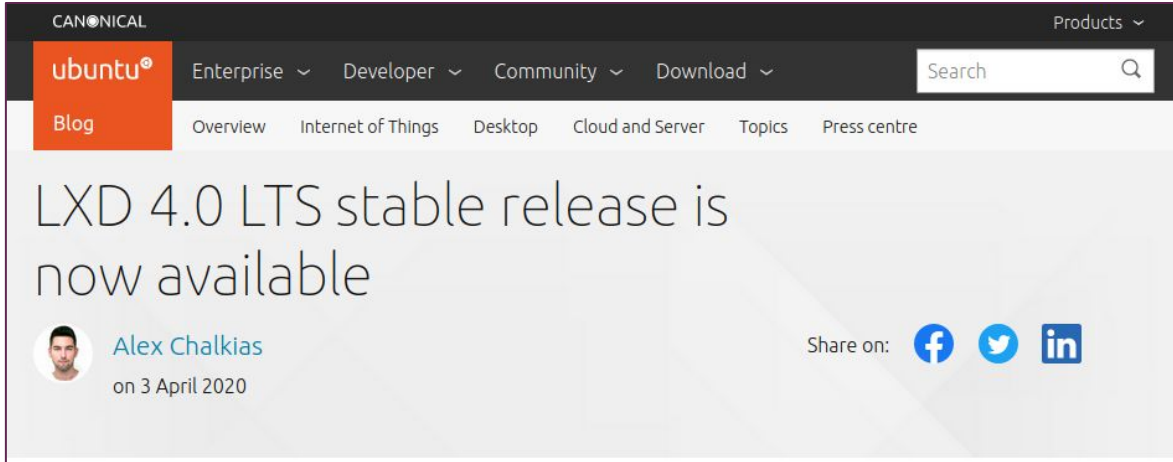
```
ubuntu@bionic-vm:~$
```

Notice that 'daily' images  
are not produced for all  
Ubuntu releases,  
just for those that are in  
active development.

One-Liner example for 19.10 / eoan - currently in development / **daily**:

```
$ NAME=eoan; uvt-simplestreams-libvirt sync release=$NAME label=daily  
arch=$(arch) && uvt-kvm create $NAME-vm release=$NAME label=daily && uvt-kvm  
wait $NAME-vm && uvt-kvm ssh $NAME-vm
```

# LXD (>=4.2+) and Multipass (>=1.6.2 with LXD)



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## LXD 4.0 LTS stable release is now available

Alex Chalkias on 3 April 2020

Share on: [f](#) [t](#) [in](#)

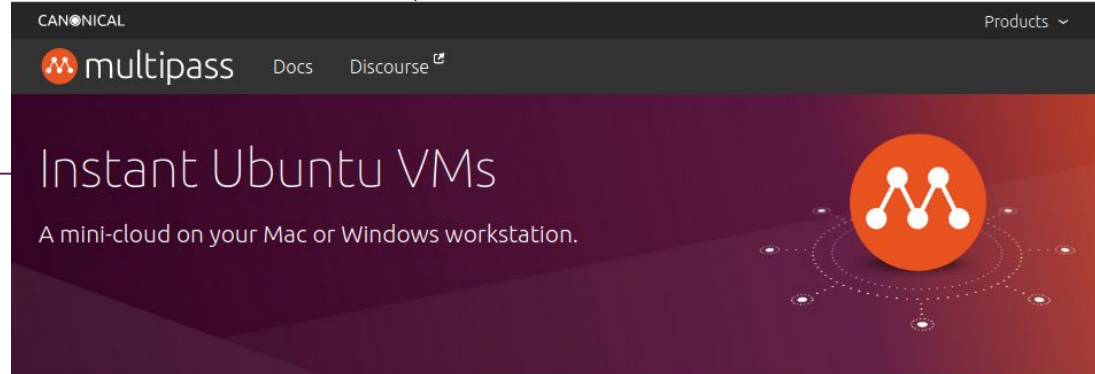
The stable release of LXD, the machine container hypervisor, is now available. LXD 4.0 is the third LTS release for LXD and will be supported for 5 years, until June 2025. This version comes with a significant amount of new features including adding virtual machines (VMs) support, the introduction of projects and improved networking, storage and security capabilities.

<https://linuxcontainers.org>

```
$ snap info lxd
$ sudo snap install lxd
$ sudo lxd init # --auto
```

YouTube video:  
[LXD on an IBM mainframe](#)  
by Stephane Graber

<https://multipass.run>



CANONICAL Products ▾

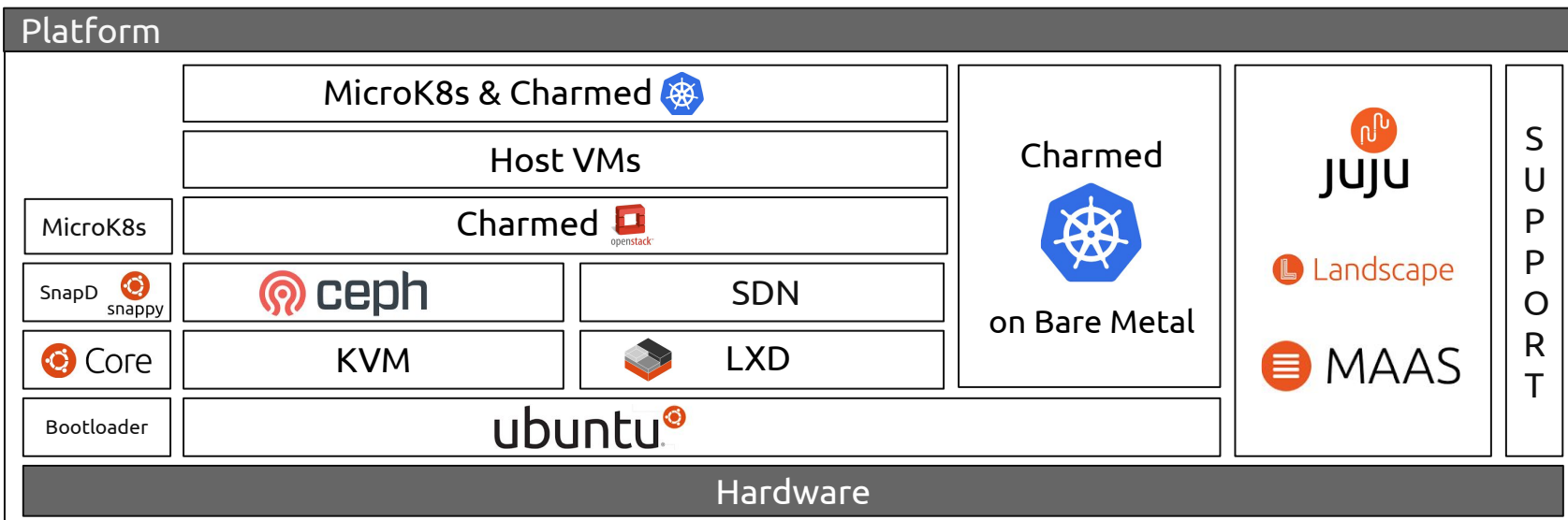
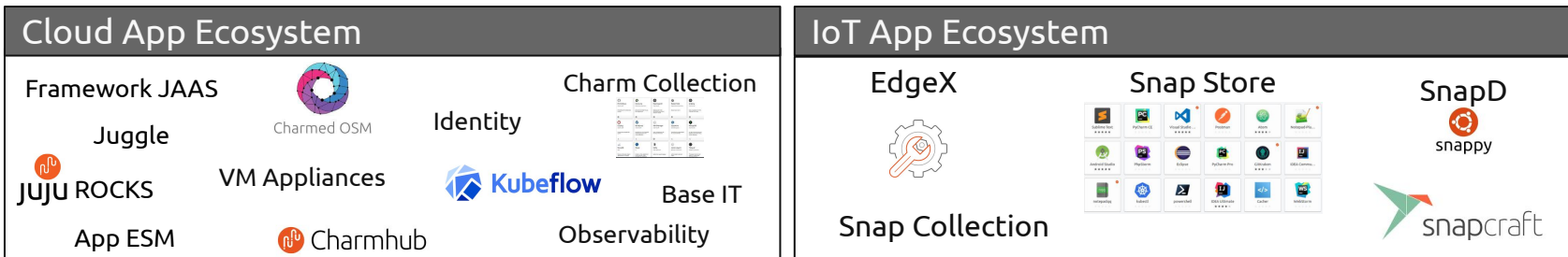
multipass Docs Discourse

## Instant Ubuntu VMs

A mini-cloud on your Mac or Windows workstation.

```
$ snap info multipass
$ sudo snap install multipass
```

# Canonical Platform Summary



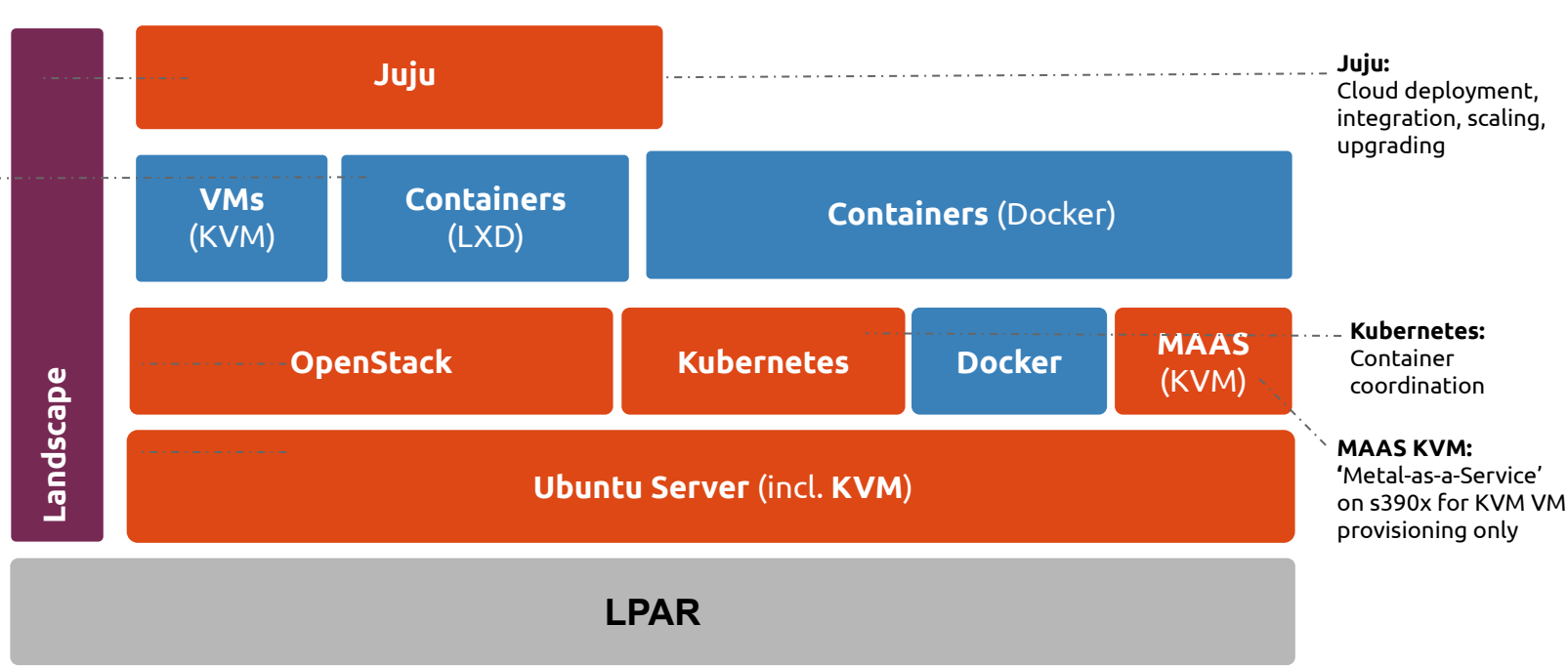
# Cloud Solution Stack: Enabling Operations at Scale

**Landscape:**  
Systems management  
& patching

**LXD:**  
Pure-container  
hypervisor

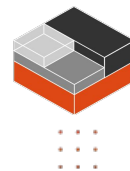
**Ubuntu OpenStack:**  
Canonical-produced  
optimized and interop  
tested openstack  
packages

Enterprise-class,  
hyperscale server  
operating system



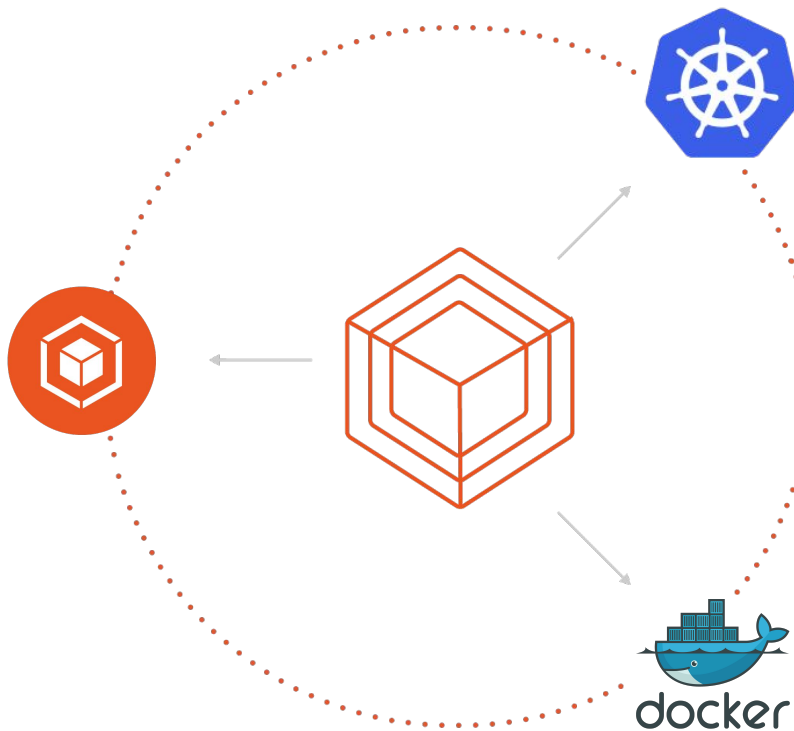


# Ubuntu - The #1 Platform for Containers



## LXD

A pure-container hypervisor that runs unmodified Linux guest operating systems with VM-style operations.



## Canonical's Distribution of Kubernetes

Pure Kubernetes tested across the widest range of clouds with modern metrics and monitoring, brought to you by Canonical

## Docker Engine on Ubuntu

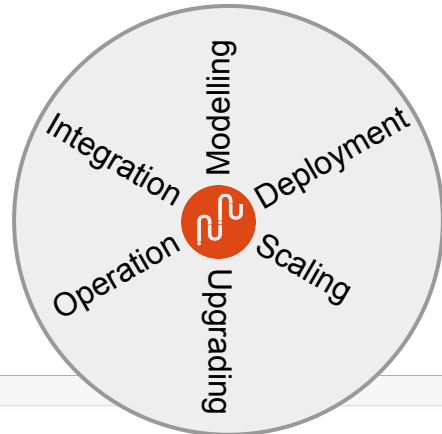
Docker Engine is a lightweight container runtime with robust tooling that builds and runs your containers. **Over 65% of all Docker-based scale out operations run on Ubuntu.**

We help enterprises run containers at scale, on public, private and bare metal clouds.

# Juju - The Services Modeling Tool

Brings all our Open Source Packages and IBM Software

Several OSS Charms & Bundles have been enabled for POWER and Z, where the code base got ported.



- MySQL
- MariaDB
- OpenStack
- RabbitMQ
- Wordpress
- HaProxy
- MemCache
- Kubernetes ...



<https://jujucharms.com/q/?tags=ibm>  
<https://jaas.ai/u/ibmcharmners>

Store Demo About Features Community Docs Get started

<https://jaas.ai/openstack-base/bundle>

Open source.  
Solution-driven.

Model, build and scale your environments on any cloud.

[Browse the store >](#)

# IBM zSystems and LinuxONE Hypervisors



**LPAR**  
PR/SM | DPM

**IBM**  
**z/VM**

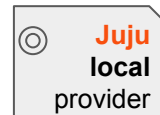
**KVM**

**LXD**  
lxc | KVM

# IBM Z & LinuxONE - Juju Deployment Options



- 'manual cloud' = list of pre-installed hosts
  - LPARs, z/VM guests, KVM VMs, LXD containers, ...
- 'local Cloud' = LXD
  - before: Cloud experience inside a pre-installed Ubuntu host automatically using LXD containers
  - now with LXD v3: Cloud experience cross pre-installed Ubuntu hosts on a low latency network
- MAAS 'bare metal' <sup>1</sup> or KVM (former MAAS Pods) <sup>2</sup>
  - Cloud experience cross pre-defined Ubuntu hosts
  - integration with other platforms managed by MAAS

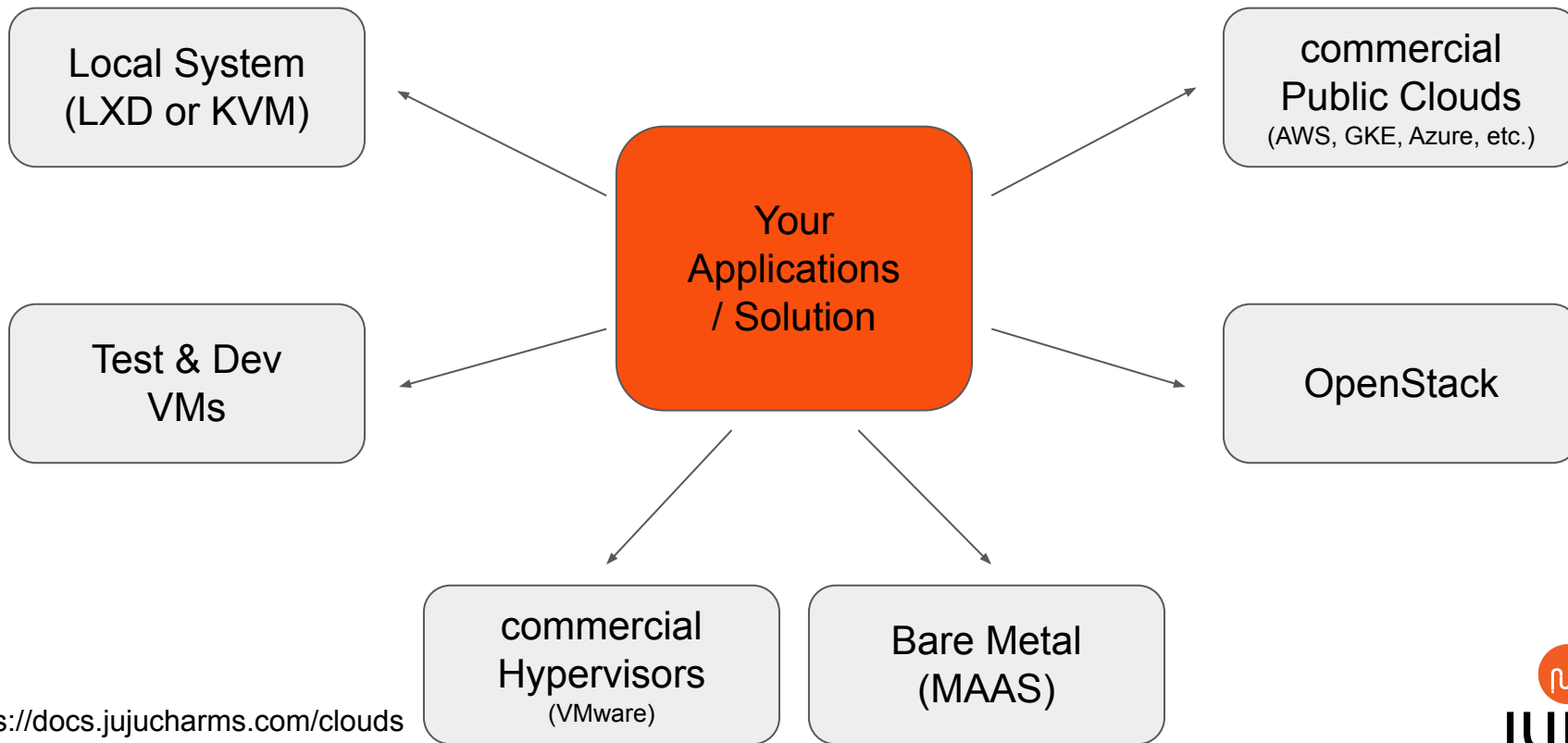


<sup>1</sup> MAAS for LPARs requires HMC in DPM mode

<sup>2</sup> MAAS KVM support for s390x available since 2.5.3, recommended is using 2.6.x



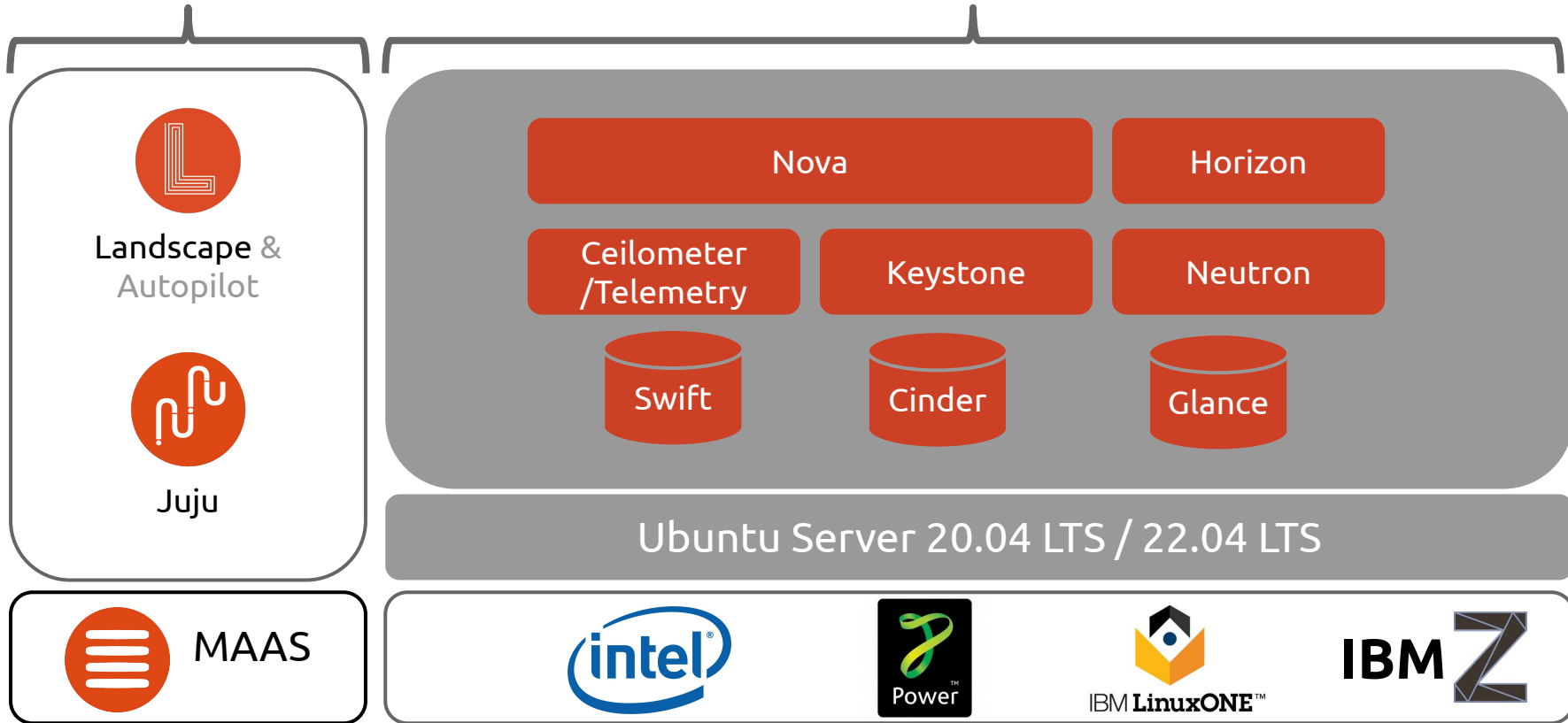
# Juju - Allows Reuse Across Clouds



# Canonical Distribution of OpenStack (CDO)

Management &  
Automation

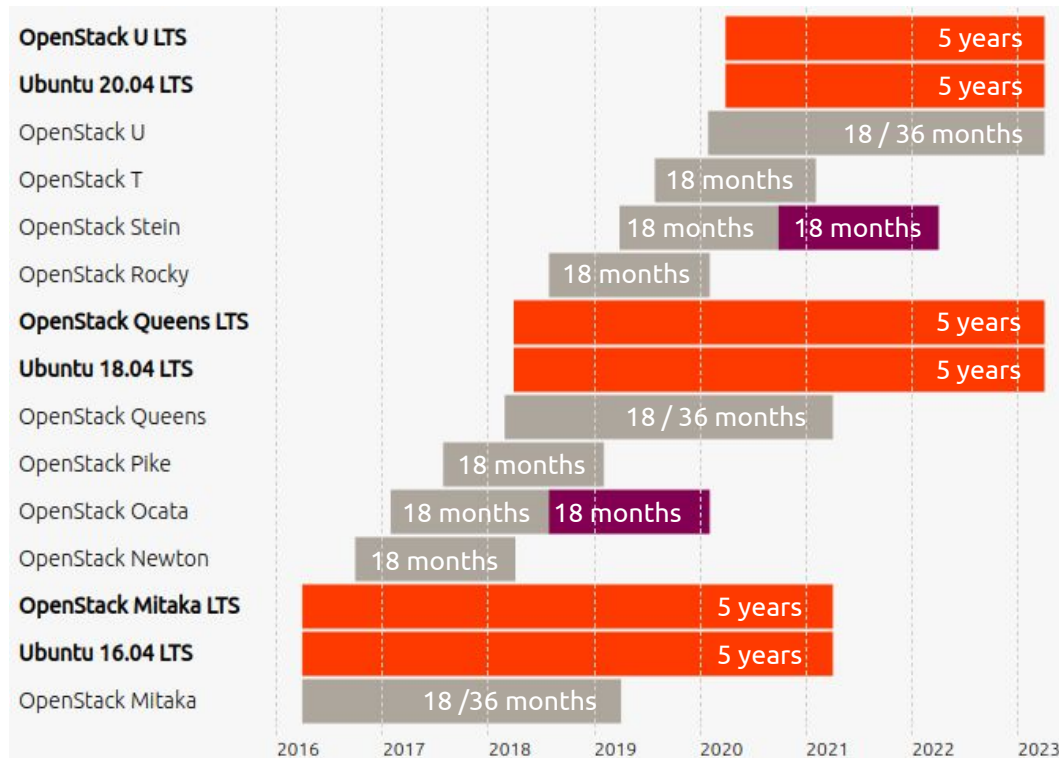
Infrastructure  
Services



# Ubuntu OpenStack Release Cycle

Canonical's *Ubuntu Cloud archive* allows users the ability to install newer releases of Ubuntu OpenStack on an Ubuntu Server as they become available up through the next Ubuntu LTS release.

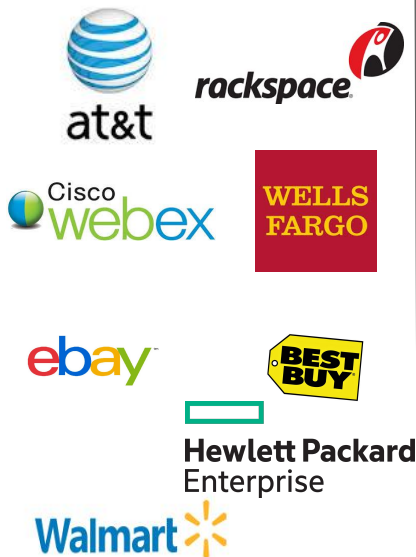
The Ubuntu OpenStack support lifecycle is as follows:



# Ubuntu & OpenStack



Ubuntu + 'own' OpenStack



Ubuntu OpenStack + 'own' tooling



Canonical OpenStack



Canonical OpenStack fully managed to agreed SLA



BootStack

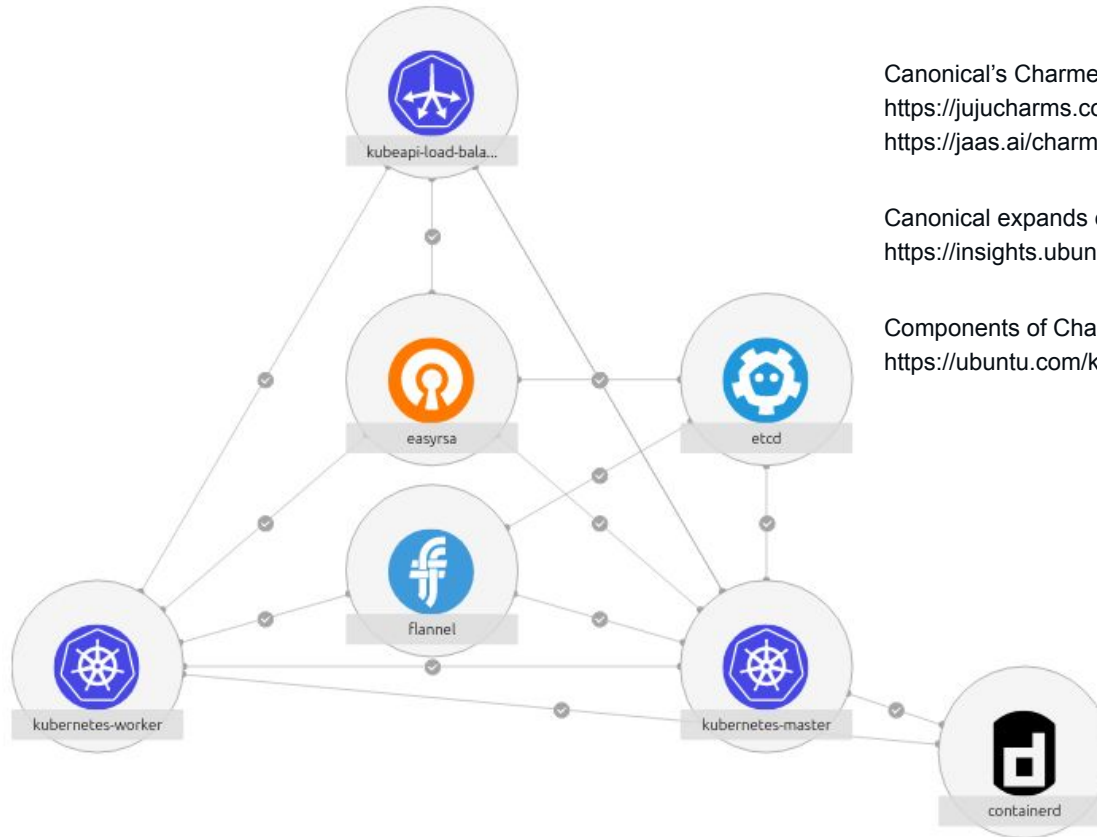
Canonical OpenStack

Ubuntu OpenStack

Ubuntu



# CK - Charmed Kubernetes



Canonical's Charmed Distribution Of Kubernetes (CDK):

<https://jujucharms.com/canonical-kubernetes/>

<https://jaas.ai/charmed-kubernetes>

Canonical expands enterprise container portfolio:

<https://insights.ubuntu.com/2016/09/27/canonical-expands-enterprise-container-portfolio/>

Components of Charmed Kubernetes 1.20

<https://ubuntu.com/kubernetes/docs/1.20/components>

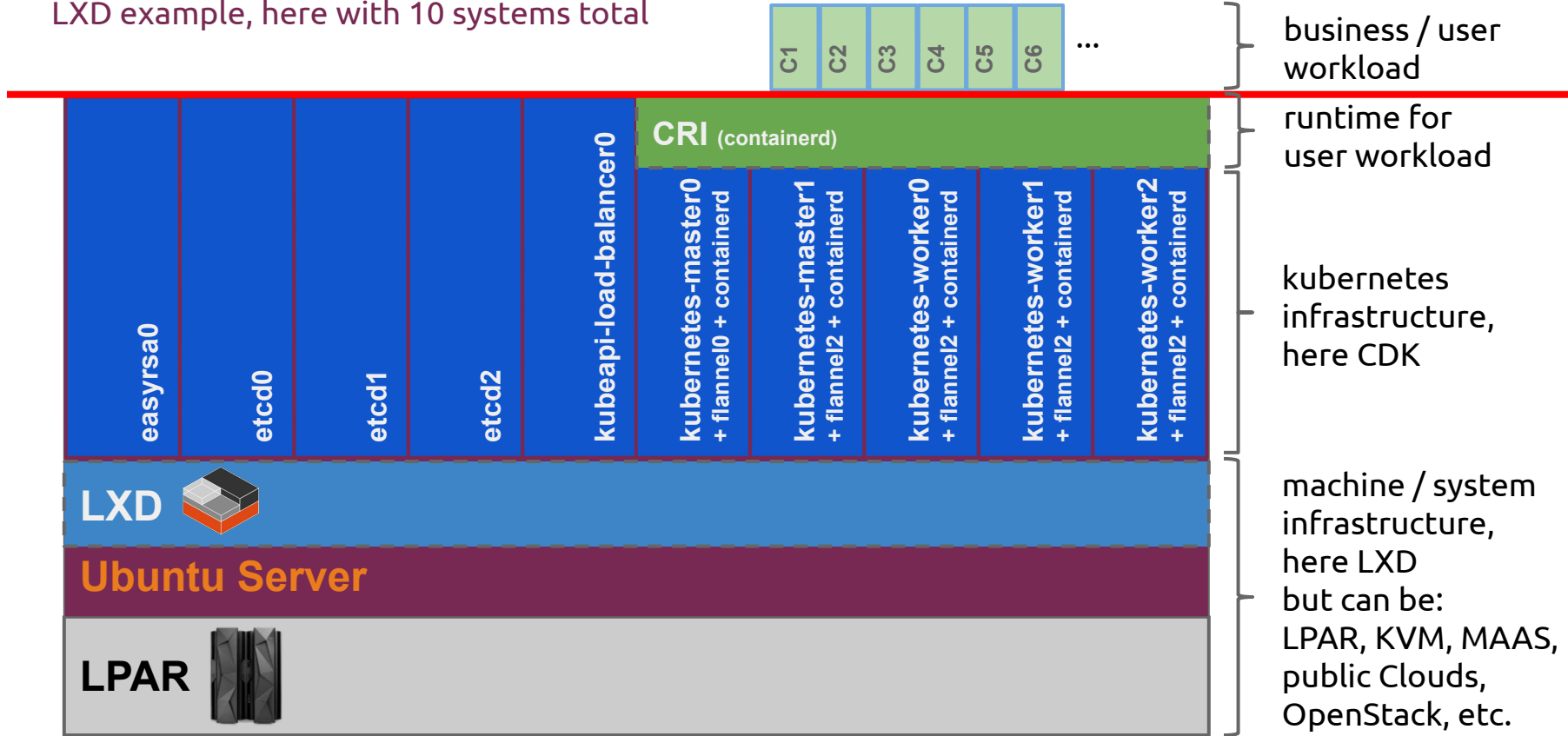


kubernetes



# CK Infrastructure Example using LXD

LXD example, here with 10 systems total





# Kubernetes/CK - juju status (cli)

```
Terminal File Edit View Search Terminal Help
ubuntu@silp15:~$ juju status
please enter password for admin on lxd-controller:
Model Controller Cloud/Region Version SLA Timestamp
cdk lxd-controller localhost/localhost 2.6.5 unsupported 03:01:24-04:00

App Version Status Scale Charm Store Rev OS Notes
containerd active 5 containerd jujucharms 2 ubuntu
easysrsa 3.0.1 active 1 easysrsa jujucharms 254 ubuntu
etcd 3.2.10 active 3 etcd jujucharms 434 ubuntu
flannel 0.10.0 active 5 flannel jujucharms 425 ubuntu
kubeapi-load-balancer 1.14.0 active 1 kubeapi-load-balancer jujucharms 649 ubuntu exposed
kubernetes-master 1.15.0 waiting 2 kubernetes-master jujucharms 700 ubuntu
kubernetes-worker 1.15.0 active 3 kubernetes-worker jujucharms 552 ubuntu exposed

Unit Workload Agent Machine Public address Ports Message
easysrsa/0* active idle 0 10.220.114.37
etcd/0* active idle 1 10.220.114.150 2379/tcp Healthy with 3 known peers
etcd/1 active idle 2 10.220.114.39 2379/tcp Healthy with 3 known peers
etcd/2 active idle 3 10.220.114.132 2379/tcp Healthy with 3 known peers
kubeapi-load-balancer/0* active idle 4 10.220.114.188 443/tcp Loadbalancer ready.
kubernetes-master/0 waiting idle 5 10.220.114.92 6443/tcp Waiting for 6 kube-system pods to start
  containerd/4 active idle 10.220.114.92 Container runtime available.
  flannel/4 active idle 10.220.114.92 Flannel subnet 10.1.9.1/24
kubernetes-master/1* waiting idle 6 10.220.114.164 6443/tcp Waiting for 6 kube-system pods to start
  containerd/3 active idle 10.220.114.164 Container runtime available.
  flannel/3 active idle 10.220.114.164 Flannel subnet 10.1.47.1/24
kubernetes-worker/0 active idle 7 10.220.114.207 80/tcp,443/tcp Kubernetes worker running.
  containerd/0* active idle 10.220.114.207 Container runtime available.
  flannel/0* active idle 10.220.114.207 Flannel subnet 10.1.12.1/24
kubernetes-worker/1 active idle 8 10.220.114.105 80/tcp,443/tcp Kubernetes worker running.
  containerd/2 active idle 10.220.114.105 Container runtime available.
  flannel/2 active idle 10.220.114.105 Flannel subnet 10.1.93.1/24
kubernetes-worker/2* active idle 9 10.220.114.113 80/tcp,443/tcp Kubernetes worker running.
  containerd/1 active idle 10.220.114.113 Container runtime available.
  flannel/1 active idle 10.220.114.113 Flannel subnet 10.1.28.1/24

Machine State DNS Inst id Series AZ Message
0 started 10.220.114.37 juju-85c847-0 bionic Running
1 started 10.220.114.150 juju-85c847-1 bionic Running
2 started 10.220.114.39 juju-85c847-2 bionic Running
3 started 10.220.114.132 juju-85c847-3 bionic Running
4 started 10.220.114.188 juju-85c847-4 bionic Running
5 started 10.220.114.92 juju-85c847-5 bionic Running
6 started 10.220.114.164 juju-85c847-6 bionic Running
7 started 10.220.114.207 juju-85c847-7 bionic Running
8 started 10.220.114.105 juju-85c847-8 bionic Running
9 started 10.220.114.113 juju-85c847-9 bionic Running

ubuntu@silp15:~$
```

juju status or better  
watch -c juju status --color  
indicates that the deployment is fine.  
Nothing marked in red (or yellow),  
no workload states *error* or *blocked*.

# Kubernetes/CK Juju GUI - applications



File Edit View History Bookmarks

Juju GUI

https://10...

Juju

Login

Username

Password

Find your username and password with  
`juju show-controller --show-password`

[jujucharms.com](http://jujucharms.com)

File Edit View History Bookmarks Tools Help

cdk - Juju GUI

https://10.220.114.76:17070/gui/u/admin/cdk

Juju / admin / cdk

Search the store

7 applications | 10 machines | status

**canonical kubernetes**  
Bundle details Get started

- 1 easysrsa
- 3 etcd
- 5 flannel
- 5 containerd
- 3 kubernetes-worker
- 1 kubeapi-load-balancer
- 2 kubernetes-master

# MicroK8s

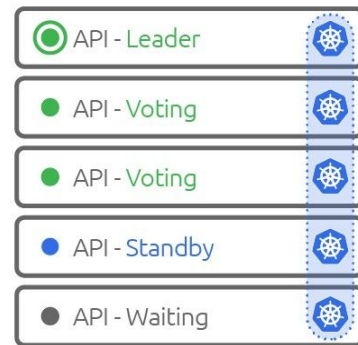
MicroK8s



Low-operation, minimal production Kubernetes, for development, Cloud, clusters, workstations, servers, Edge and IoT.

- Smallest, fastest, fully-conformant Kubernetes that tracks upstream releases and makes clustering (optional) trivial.
- Default single node or optionally multi-node cluster setup possible.
- Goal is to eliminate everyday administration from Kubernetes clusters. Install, cluster, and then just watch it fly - one may alter MicroK8s configuration, but many people don't bother.
- Automatic data store, API services and leader election.
- MicroK8s also runs in an immutable container, so your Kubernetes itself is fully containerised.
- MicroK8s can update automatically, with rollback on failure.
- Defaults to the most widely used Kubernetes options, hence it 'just works' with no additional config needed.
- Try it out ([Howto](#)) - and provide some feedback (<https://github.com/ubuntu/microk8s>) !

```
$ sudo snap install --classic
```



# Why Canonical Kubernetes?



**Pure upstream**, latest & greatest versions



**100% compatible** with Google's Kubernetes



**Operates** on AWS, Azure, GCE, OpenStack, VMWare, LXD, KVM, ...



**Secured.** TLS, (Kernel Live patching), confinement



**Upgradable** between each Kubernetes Release



**Cost effective** at scale



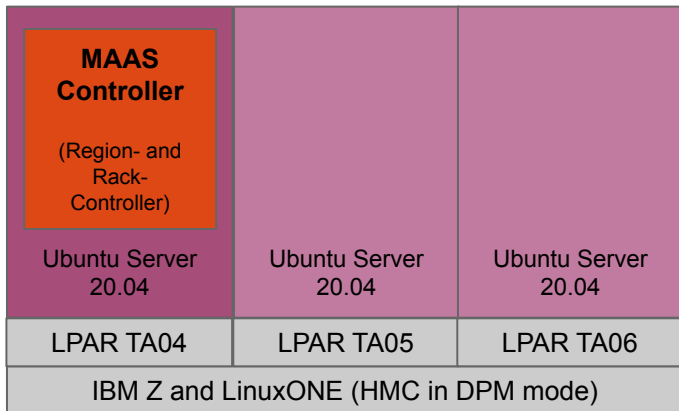
**Bare metal** operations with MAAS (tbd, today KVM only on s390x)



- 1 Manage your environment
- 2 Discover & manage your network
- 3 Manage your resources
- 4 Configure your hardware
- 5 Install your operating system

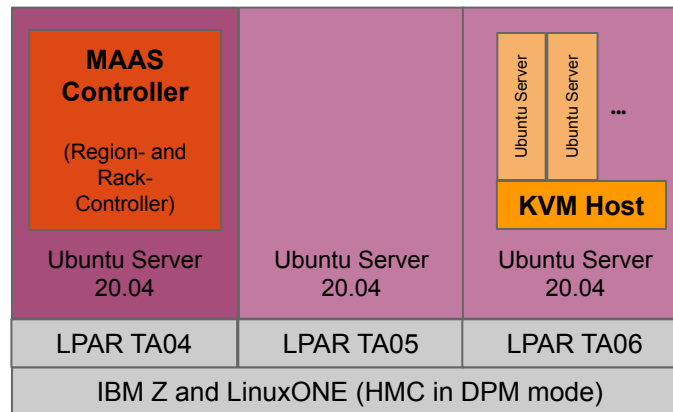


# MAAS DPM/LPAR and KVM - Example Environments



Managing LPARs only.

## Managing LPARs and KVM VMs







# MAAS - IBM Z and LinuxONE

- Ability to build heterogeneous cloud including IBM Z managed by MAAS
- Full private cloud experience with MAAS + Juju
- Cross LPARs / servers experience (Cloud regions and HA zones)
- Resources allocated only when needed
- Benefits from IBM Z scale-up functionality

## MAAS LPAR (DPM)

- 1** Manage LPARs from MAAS on Z systems running in DPM mode
- 2** Pre-define LPARS, but register LPARs as 'machines' to MAAS
- 3** OS deployment into LPARs using MAAS UI or API (e.g. using Juju)

## MAAS KVM (Pods)

- 1** Prepare or MAAS deploy an LPAR that can act as KVM host
- 2** Configure KVM (virsh or LXN) and register KVM in MAAS
- 3** KVM VMs are created and VMs deployed using MAAS UI or API

More efficient use of resources by dynamically allocating hardware !

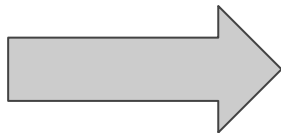


MAAS

The **API** of MAAS  
Is what provides the  
most value.



Service  
orchestration



Machine  
configuration

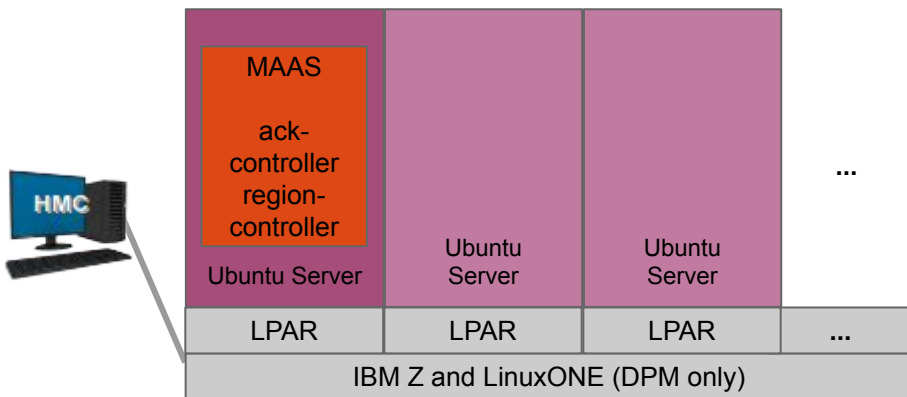


Manual setup



# MAAS on IBM Z or LinuxONE - Resources

- How do I configure and use IBM Z with MAAS?  
<https://maas.io/docs/snap/3.0/ui/power-management#heading--configure-use-ibm-z>
- MAAS 3.0 - What's New - IBM Z DPM/LPAR  
<https://maas.io/docs/snap/3.0/ui/whats-new-in-maas#heading--ibm-z-dpm>
- MAAS on Discourse  
<https://discourse.maas.io>
- MAAS on IBM Z - Show and tell (by Lee Trager)  
<https://drive.google.com/file/d/1MZyhLL1znKeg4ARWePcywDOg1Wzeu4SY/view>  
<https://people.canonical.com/~fheimes/maasz/MAAS%20on%20IBM%20Z.mkv>



The screenshot shows the MAAS web interface. The top navigation bar includes 'Machines', 'Devices', 'Controllers', 'Pods', 'Images', 'DNS', 'AZs', 'Subnets', 'Settings', 'admin', and 'Logout'. The main content area shows 'Machines' with '1 machine available' and '1 selected'. A table lists the machine details:

Filters	FQDN   IP	MAC	POWER	STATUS	OWNER, TAGS	ZONE	CORES
	humane-orca.maas	192.168.122.202 (PXE)	Off	18.04 LTS	admin	default	1

A dropdown menu is open, showing actions: Commission..., Acquire..., Deploy..., Release..., Abort..., Power on..., Test hardware..., Rescue mode..., Mark broken, Lock, Set zone..., Set resource pool..., and Delete... Below the table, it shows 'MAAS name: s11p11 MAAS' and 'MAAS version: 2.5.3 (7533-g65952b418-0ubuntu1-18.04.1)'. At the bottom, there are links for 'View release notes', 'View documentation', 'Legal Information', and 'Give feedback', along with the copyright notice: '© 2019 Canonical Ltd. Ubuntu and Canonical are registered trademarks of Canonical Ltd.'

# 3 Complementary Automation Tools



**PHYSICAL and KVM  
PROVISIONING**  
+  
**DYNAMIC  
RE-PURPOSING**



**SERVICES  
MODELING,  
DEPLOYMENT**  
+  
**SCALING**



**ADMINISTRATION**  
+  
**AUDIT**  
+  
**COMPLIANCE**

More than you ever wanted to know about:

# Hardware cryptographic support for IBM Z and LinuxONE with Ubuntu Server (70+ pages)



## Hardware cryptographic support for IBM Z and IBM LinuxONE with Ubuntu Server

Klaus Bergmann, Reinhard Buendgen, Uwe Denneler, Jonathan Furminger,  
Frank Heimes, Manfred Gnirss, Christian Rund, Patrick Steuer, Arwed Tschoeke

August 2, 2017



### Abstract

This article summarizes our experiences with the setup, configuration and usage of OpenSSL, PKCS#11 and its related components for exploiting hardware-assisted cryptographic operations on IBM LinuxONE and IBM Z for clear key operations. The required steps are described, as well as findings in the areas of performance improvement using OpenSSH, Apache HTTP server and IBM Java. Based on our positive experiences we recommend that you should make use of these capabilities whenever performing cryptographic workloads on Ubuntu Server for IBM Z and IBM LinuxONE.

The paper is available via [IBM Techdocs WP102721](http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102721)  
'Hardware cryptographic support for IBM Z and  
IBM LinuxONE with Ubuntu Server':  
<http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102721>

Ubuntu Server



# Hardware cryptography with Ubuntu on s390x

**Enable** hardware assisted cryptography support on Ubuntu Server for s390x with a few easy steps (same for all Ubuntu Server for s390x releases)

For Ubuntu Server  $\geq$  **22.04** that uses **openssl 3** (it's different for 21.10 and earlier!) do:

**Install** the required **packages** for the hardware crypto support:

```
sudo apt-get install libica-utils libica? openssl-ibmca
```

**Optional:** Create a backup of the default openssl configuration file:

```
sudo cp -p /etc/ssl/openssl.cnf{,_(date +%Y-%m-%d_%H:%M:%S).backup}
```

**Replace** the existing OpenSSL configuration file with the one that is included as sample (one line):

```
sudo cp /usr/share/doc/openssl-ibmca/examples/openssl.cnf.sample \  
/etc/ssl/openssl.cnf
```

**Alternatively,** one may re-generate a sample and copy this one over:

```
ibmca-engine-opensslconfig # generates: ./openssl.cnf.ibmca  
...  
sudo cp ./openssl.cnf.ibmca /etc/ssl/openssl.cnf
```

# Hardware cryptography with Ubuntu on s390x

What did we get: “openssl engine -c”



```
$ openssl engine
(dynamic) Dynamic engine loading support
(ibmca) Ibmca hardware engine support

$ openssl engine -c
(dynamic) Dynamic engine loading support
(ibmca) Ibmca hardware engine support
[RSA, DSA, DH, RAND, DES-ECB, DES-CBC, DES-OFB, DES-CFB, DES-EDE3, DES-EDE3-CBC,
DES-EDE3-OFB, DES-EDE3-CFB, AES-128-ECB, AES-192-ECB, AES-256-ECB, AES-128-CBC,
AES-192-CBC, AES-256-CBC, AES-128-OFB, AES-192-OFB, AES-256-OFB, AES-128-CFB,
AES-192-CFB, AES-256-CFB, id-aes128-GCM, id-aes192-GCM, id-aes256-GCM, SHA1, SHA256,
SHA512, ED25519, ED448, X25519, X448]

$ openssl ciphers -s -v -stdname
TLS_AES_256_GCM_SHA384 - TLS_AES_256_GCM_SHA384  TLSv1.3 Kx=any          Au=any
Enc=AESGCM(256) Mac=AEAD
... # about 30 cipher suites will be listed here
```

# Hardware cryptography with Ubuntu on s390x

What does "icainfo" show on z15 CPACF + CEX7S + Ubuntu Server 20.04 LTS



## Cryptographic algorithm support

function	hardware		software
	dynamic	static	
SHA-1	no	yes	yes
SHA-224	no	yes	yes
SHA-256	no	yes	yes
SHA-384	no	yes	yes
SHA-512	no	yes	yes
SHA-512/224	no	yes	yes
SHA-512/256	no	yes	yes
SHA3-224	no	yes	no
SHA3-256	no	yes	no
SHA3-384	no	yes	no
SHA3-512	no	yes	no
SHAKE-128	no	yes	no
SHAKE-256	no	yes	no
GHASH	no	yes	no
P_RNG	no	yes	yes
DRBG-SHA-512	no	yes	yes
ECDH	yes	yes	no
ECDSA Sign	yes	yes	no
ECDSA Verify	yes	yes	no
ECKGEN	yes	yes	no
Ed25519 Keygen	no	yes	no
Ed25519 Sign	no	yes	no
Ed25519 Verify	no	yes	no
Ed448 Keygen	no	yes	no
Ed448 Sign	no	yes	no
Ed448 Verify	no	yes	no
X25519 Keygen	no	yes	no
X25519 Derive	no	yes	no
X448 Keygen	no	yes	no
X448 Derive	no	yes	no
RSA ME	yes	no	no
RSA CRT	yes	no	no
DES ECB	no	yes	yes
DES CBC	no	yes	yes
DES OFB	no	yes	no
DES CFB	no	yes	no
DES CTR	no	yes	no
DES CMAC	no	yes	no
3DES ECB	no	yes	yes
3DES CBC	no	yes	yes
3DES OFB	no	yes	no
3DES CFB	no	yes	no
3DES CTR	no	yes	no
3DES CMAC	no	yes	no
AES ECB	no	yes	yes
AES CBC	no	yes	yes
AES OFB	no	yes	no
AES CFB	no	yes	no
AES CTR	no	yes	no
AES CMAC	no	yes	no
AES XTS	no	yes	no
AES GCM	no	yes	no

No built-in FIPS support.



# Pervasive encryption: Protecting data at rest



Optimistic Usage of zkey in Ubuntu Server (subiquity live) Installer (20.04 or newer)

- Protecting data at rest in the context of Pervasive Encryption is very popular and well documented:
  - Pervasive Encryption for Data Volumes: [HTML](#) or [PDF](#)
- It is straight forward, but requires manual steps to setup - even just for supplemental (data) volumes.
- But it becomes much more challenging in case the **root** filesystem (and **swap**) should be encrypted the same way!
- But here is where the ***optimistic usage of zkey*** of the **installer** (subiquity) of **Ubuntu Server 20.04.1** (or higher) simplifies this **root and swap encrypted setup** *tremendously*!
- **pre-reqs** for the optimistic usage of zkey in Ubuntu's installer (debian-installer aka d-i) is:
  - CryptoExpress adapter (5S or higher) with at least one domain
  - an initial master key configured (either with TKE or the 'IBM CCA Host Libraries and Tools')
  - and either ECKD/DASD or an zFCP/SCSI disk storage

# Pervasive encryption: Protecting data at rest

Optimistic Usage of zkey in Ubuntu Server (subiquity live) Installer (20.04 or newer)



```
Guided storage configuration [ Help ]
Configure a guided storage layout, or create a custom one:
(X) Use an entire disk
    [ 0x6005076306 multipath device 64.000G  ]
      ffd6b6000000
      0000002606
[X] Set up this disk as an LVM group
    [X] Encrypt the LVM group with LUKS
        Passphrase: *****
        Confirm passphrase: *****
[ Done ]
[ Back ]
```

# Pervasive encryption: Protecting data at rest

Optimistic Usage of zkey in Ubuntu Server (subiquity live) Installer (20.04 or newer)



Storage configuration

[ Help ]

## FILE SYSTEM SUMMARY

MOUNT POINT	SIZE	TYPE	DEVICE TYPE
[ /	31.490G	new ext4	new LVM logical volume ▶ ]
[ /boot	1.000G	new ext4	new partition of multipath device ▶ ]

## AVAILABLE DEVICES

DEVICE	TYPE	SIZE
[ ubuntu-vg (new, encrypted)	LVM volume group	62.980G ▶ ]
free space		31.490G

[ Create software RAID (md) ▶ ]

[ Create volume group (LVM) ▶ ]

[ Done ]

[ Reset ]

[ Back ]

# Pervasive Encryption: Protecting Data in Flight

Different approaches and use cases



- OpenSSL and libcrypto:
  - de-facto standard TLS and crypto libraries used by many projects, no IBM Z specific configuration required
  - exploitation of IBM Z CPACF and SIMD code by libcrypto (w/o ibmca engine)
  - focus on TLS 1.2 and 1.3 ciphers
  - support for z14 AES-GCM accepted for openssl version 1.1.1
- IPsec:
  - transparently uses CPACF through the in-kernel crypto API
  - Kernel 4.15 and later use new CPACF instruction for AES-GCM
- IBM Java 8 / JCE (Partner Archive)
  - IBM Java 8 service refresh 5 and later use z14 CPACF instructions
  - exploitation of IBM Z CPACF and SIMD code



all-in with  
Ubuntu 18.04  
or higher

Ubuntu Server



# Secure Boot (aka Secure IPL)

- Secure boot attributes to the Pervasive Encryption effort
- The IBM z15 and LinuxONE III hardware introduce secure boot (for SCSI IPL): requires a Kernel 5.3+ and s390-tools 2.9 (rec. 2.11) → Ubuntu 20.04 LTS
- HMC's Load task and Activation Profile come with a new check-box: 'Enable Secure Boot for Linux' in case 'SCSI Load' is selected.
- For Linux (on s390x) two new sysfs entries got introduced:  
`/sys/firmware/ipl/has_secure` - "1" indicates hw support for secure boot, otherwise "0"  
`/sys/firmware/ipl/secure` - "1" indicates that secure IPL was successful, otherwise "0"
- zipl bootloader supports secure-boot with the "`--secure`" argument (0: secure boot disabled, 1: enabled, `auto`: enabled if environment supports secure boot)
- Ubuntu signs the kernel and the stage3 part of zipl bootloader (using X.509)
- Ubuntu Server on s390x defaults to secure-boot (starting with 19.10) - in case the underlying environment supports it and 'SCSI Load' is used.
- Secure boot is supported by the new Ubuntu live installer (subiquity).



# Secure Execution (aka protected virtualization)

- The general idea behind secure execution is to **protect data in-use**
- It's a firmware based Trusted Execution Environment (TEE), that provides support for full isolation of KVM guests using hw assisted guest memory encryption and state protection.
- Protection is provided against guest data corruption and theft, bad and malicious console usage, bad and malicious hypervisor administrators and even buggy or compromised hypervisors and with that it's helpful to achieve compliance, especially for Cloud service providers.
- Allows customers to run their critical / sensitive workloads in house or in Clouds with the same maximum level of privacy and protection - since even admins can't access the data!
- The general idea: If you are unsure if you can guarantee or trust the hypervisor, an **Ultravisor** is needed -- the Ultravisor is largely based on firmware and uses special hardware instructions.
- Hardware z15 LinuxONE III (with FC 115 - free of charge) and kernel, qemu and (s390-)tools support.
- → Ubuntu 20.04 LTS is the first release that supports Secure Execution !



# Inherent Ubuntu Security Features

General settings - not platform specific

ubuntu<sup>®</sup> wiki

Edit Info Subscribe Attachments **More Actions:** frank-heimes Logout Help

## Features

[Ubuntu Security Team](#) • [Roadmap](#) • [Getting Involved](#) • [Knowledge Base](#) • [FAQ](#) • [Contacts](#)

### Matrix

By Default	16.04 LTS (Xenial Xerus)	18.04 LTS (Bionic Beaver)	19.10 (Eoan Ermine)	20.04 (Focal Fossa)
No Open Ports	policy	policy	policy	policy
Password hashing	sha512	sha512	sha512	sha512
SYN cookies	kernel & sysctl	kernel & sysctl	kernel & sysctl	kernel & sysctl
Automatic security updates	enabled	enabled	enabled	enabled
Kernel Livepatches	16.04 LTS Kernel	18.04 LTS Kernel	--	--
Filesystem Capabilities	kernel & userspace (default on server)	kernel & userspace (default on server)	kernel & userspace (default on server)	kernel & userspace (default on server)
Configurable Firewall	ufw	ufw	ufw	ufw

For example:

- fstack Protector (gcc)
- Heap Protector (glibc)
- Pointer Obfuscation (glibc)
- ASLR types (Stack, libs/mmap, exec, BRK, VDSO) (kernel)
- Built as PIE (gcc)
- Built with Fortify Source (gcc)
- Built with
- -fstack-clash-protection (gcc)
- 0-address protection (kernel)
- /dev/mem protection (kernel)

# ESM - Extended Security Maintenance



**Extended Security Maintenance** provides ongoing security fixes for Ubuntu LTS, for the Linux kernel and essential packages beyond the 5-year basic maintenance: <https://ubuntu.com/esm>

Ubuntu ESM is available for **Ubuntu Advantage for Infrastructure** (UA-I) Essential, Standard and **Advanced** customers. (Subscriptions for IBM Z and LinuxONE are always UA-I Advanced). Ubuntu Advantage for Infrastructure covers physical servers, virtual machines, containers (and desktops).

Existing UA customers can retrieve their credentials through the Ubuntu Advantage portal: <https://ubuntu.com/advantage>

ESM continues security updates for:

- high and critical CVEs (Common Vulnerabilities and Exposures), in the Ubuntu base OS
- with Ubuntu LTS (14.04 and) 16.04 for up to 3 years after the end of base support
- with Ubuntu LTS 18.04 and later (*until further announcement*) for up to 5 years.

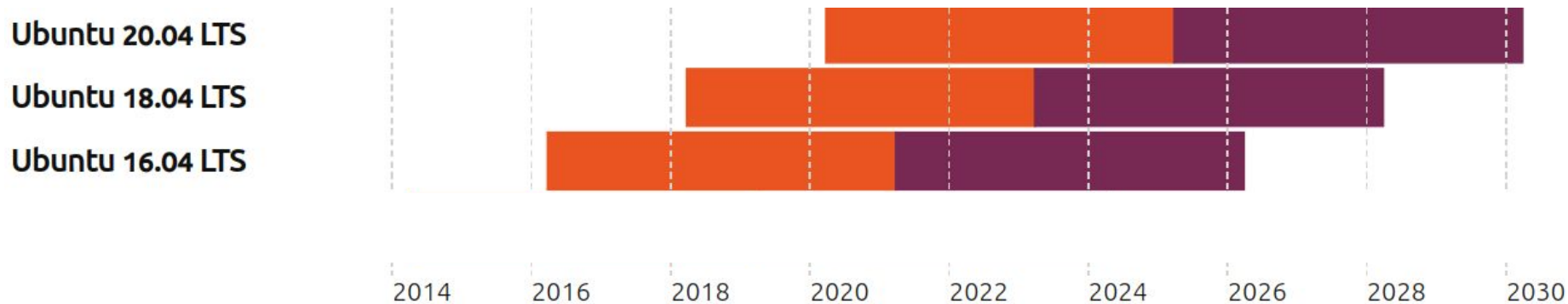
<https://ubuntu.com/advantage>

<https://ubuntu.com/security/esm>

<https://ubuntu.com/blog/ubuntu-16-04-lts-transitions-to-extended-security-maintenance-esm>



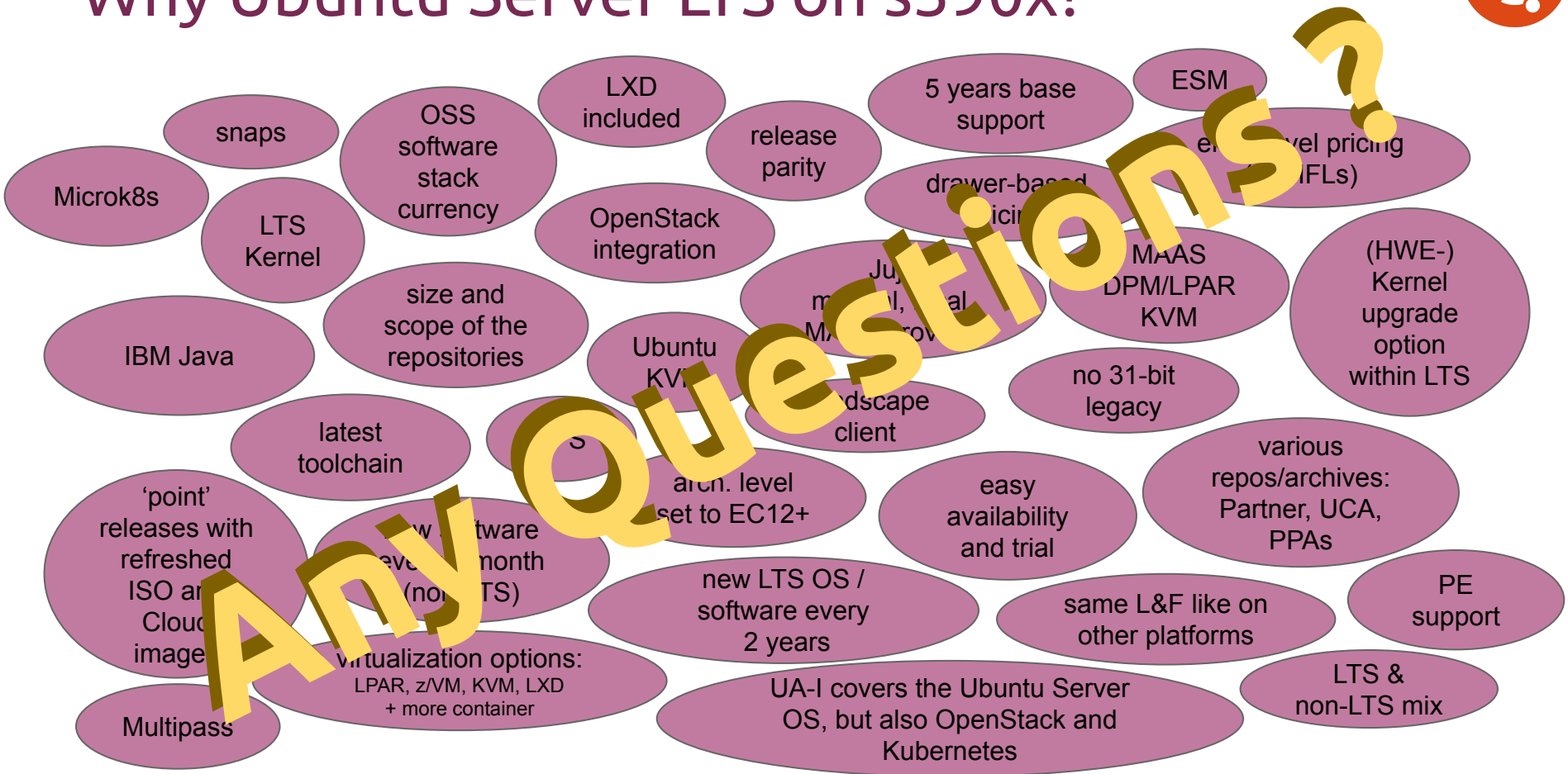
# ESM - Consistent Lifecycle



- Hardware and maintenance updates
- Interim release Standard Support
- Extended Security Maintenance (ESM)



# Why Ubuntu Server LTS on s390x?



# Thank you!

Thanks a lot - and stop by at:

<https://ubuntu-on-big-iron.blogspot.com>



# Why Ubuntu on IBM Z and LinuxONE - In a Nutshell



Use the most wide-spread Linux OS not only on your workstation, but also on your IBM Z Server and get the most out of your IBM Z server with current and close to upstream packages, tool-chain and kernels, one of the broadest Linux package archives and a cost efficient way to run your workloads based on a new drawer-based pricing option.

In addition see this non-exhaustive list of Ubuntu on IBM Z's unique features and values:

- Arch. level set of zEC12 - compiled for zEC12 and higher; exploiting all zEC12 features by default
- Point Releases - Ubuntu LTS releases with regular package updates and updated ISO images
- Parity - Release and feature parity across all platforms, includes same look-and-feel
- Two kernels - for stability (default) or exploitation of latest IBM Z hardware facilities and features (HWE)
- Snaps - platform and distribution agnostic packaging system on top of debs, perfectly suited for ISVs
- ZFS - feature-rich file-system with snapshot capabilities, provided as native Kernel module
- Juju/Charms - for service orchestration; modelling, deployment, scaling and upgrade, even of bundles of services
- LXD - allows to handle containers like full virtual machines, but with (machine) container performance
- CDK - Canonicals Distribution of Kubernetes; infrastructure runs on KVM or LXD, container on docker or containerd
- CDO - Canonical's Distribution of OpenStack, supporting single and cross LPAR scenarios with KVM and LXD
- Cloud and LXD images - pre-packages and ready to to use KVM Cloud and LXD container images
- Deployment - broad options with LPAR (DPM & classic), IBM z/VM, Ubuntu KVM, LXD/LXC, Docker, CDO, CDK
- Security Certifications - for FIPS 140-2, Common Criteria (EAL2), DISA STIG and CIS
- Ubuntu Advantage - Infrastructure, UA-I (Enterprise-level support for Ubuntu Server on IBM Z, incl. CDO, CDK)



# Documentation - get involved

The screenshot shows the Ubuntu Discourse forum homepage. The top navigation bar includes 'Website', 'Download', and 'Donate'. The main header features the Ubuntu logo, a search icon, and a user profile icon. Below the header, there are filters for 'all categories', 'Categories', 'Latest', 'New (4)', 'Unread (16)', and 'Top', along with a '+ New Topic' button. The main content area is divided into three columns: 'Category', 'Topics', and 'Latest'. The 'Category' column lists 'Announcements', 'Documentation', and 'Desktop' with their respective statistics. The 'Topics' column shows a list of recent topics, including 'Simple copy and paste feature gone from Nautilus in Eoan?', 'Desktop Team Updates - Monday 13th April 2020', 'Focal Fossa - Mascot & Wallpapers', and 'Enhancing our ZFS support on Ubuntu 19.10 - an introduction'.

<https://discourse.ubuntu.com>

The screenshot shows the Ubuntu Server Documentation page. The top navigation bar includes 'Products' and a search icon. The main header features the Ubuntu logo, 'Enterprise', 'Developer', 'Community', and 'Download' dropdown menus. Below the header, there are tabs for 'Server', 'Overview', 'Hyperscale', and 'Docs'. The main content area is divided into two columns: 'Install' and 'Storage'. The 'Install' column lists various installation and management topics, including 'Installation', 'Installation - Advanced', 'Installation - iSCSI', 'Package Management', 'Kernel Crash Dump', 'Reporting Bugs', and 'Upgrade - Introduction'. The 'Storage' column lists 'Device Mapper Multipathing - Attributes Table' and 'Device Mapper Multipathing - Components Table'. The right column contains the main content, including the heading 'Welcome to the *Ubuntu Server Guide!*', the sub-heading 'Changes, Errors, and Bugs', and a disclaimer: 'This is the preliminary and in development for the next Ubuntu LTS, Focal Fossa. Contents may have errors and omissions.' Below the disclaimer, there is a note: 'If you find any errors or have suggestions for improvements to pages, please use the link at the bottom of each topic titled: "Help improve this document in the forum." This link will take you to the Server Discourse Forum for the specific page you are viewing. There you can share your comments or let us know about bugs with each page.'

<https://ubuntu.com/server/docs>

# Cloud Native & Confidential Computing on IBM Z & LinuxONE with Ubuntu 20.04 (webinar)

The image shows a webinar title slide with a dark red and purple gradient background. The main title is 'Security, Cloud Native & Ubuntu Confidential Computing' in white text. Below it, the subtitle is 'IBM Z and LinuxONE with Ubuntu 20.04'. The date '26 October, 2020' is displayed. At the bottom, there is a white bar containing the names of the speakers: Viktor Mihajlovski, IBM; Rohit Panjala, Associate Offering Manager at IBM; and Frank Heine, IT Architect at Canonical. The IBM logo is on the right, and the Canonical and Ubuntu logos are at the bottom right. A video player interface is visible at the bottom left, showing a play button, a progress bar at 00:00 / 40:58, and a volume icon.

Security, Cloud Native & Ubuntu  
Confidential Computing

IBM Z and LinuxONE with Ubuntu 20.04

26 October, 2020

Viktor Mihajlovski, IBM  
Rohit Panjala, Associate Offering Manager at IBM  
Frank Heine, IT Architect at Canonical

IBM

CANONICAL ubuntu

<https://www.brighttalk.com/webcast/6793/440529/cloud-native-confidential-computing-on-ibm-z-linuxone-with-ubuntu-20-04>