#### 

## Testing Docker image zipcpu:0.62 01/20/20

\*\*\*\*\*\*\*\*\*\*\*\*\*\*DRAFT\*\*\*\*\*\*\*\*\*\*

The docker image starts with ubuntu:16.04. Adds several package needed to support Starting the docker image on Ubuntu 16.04 ws009. The Dockerfile found at Appendix A was The Dockerfile used to create the docker image. The file build.sh found at Append B was the command run to create the docker image zipcpu:0.62. Current packages installed is 609, the list of packages is found at Appendix C. The lines in the Dockerfile is what installs the dependencies to install zipcpu, verilator, autofpga, icestorm, nextpnr, and yosys.

RUN apt-get update && apt-get -y install gawk wget git-core diffstat unzip texinfo qcc-multilib \

build-essential chrpath socat cpio python python3-pip python3-pexpect \

xz-utils debianutils iputils-ping libsdl1.2-dev xterm tar locales \
bison flex autoconf automake libtool libgmp3-dev \
libmpfr-dev libmpfr-doc libmpfr4 libmpfr4-dbg libmpc-dev libelf-dev bc \
ncurses-dev ctags mercurial gperf \
clang libreadline-dev tcl-dev libffi-dev pkg-config libftdi-dev libboost-all-dev \
cmake libeigen3-dev

```
File Edit Tabs Help

vidal@ws009:~/docker-examples/zipcpu/src$ docker run -it --rm -v $PWD/yocto/outp

ut:/home/zipcpu/yocto/output zipcpu:0.62
```

The boot time is extremely quick.

```
File Edit Tabs Help

vidal@ws009:~/docker-examples/zipcpu/src$ docker run -it --rm -v $PWD/yocto/outp

ut:/home/zipcpu/yocto/output zipcpu:0.62
zipcpu@52c207b78e62:/$
```

On the host system user vidal is 1000 in group 1000. This matched in the Dockerfile with the lines # The running container writes all the build artefacts to a host directory (outside the container).

- # The container can only write files to host directories, if it uses the same user ID and
- # group ID owning the host directories. The host\_uid and group\_uid are passed to the docker build
- # command with the --build-arg option. By default, they are both 1000. The docker image creates
- # a group with host\_gid and a user with host\_uid and adds the user to the group. The symbolic

# # name of the group and user is cuteradio. ARG host\_uid=1000 ARG host\_gid=1000

Setup the enviorment to work on catzip.

```
File Edit Tabs Help
vidal@ws009:~/docker-examples/zipcpu/src$ docker run -it --rm -v $PWD/yocto/outp
ut:/home/zipcpu/yocto/output zipcpu:0.62
zipcpu@a9221c1b52c6:/$ cd /home/zipcpu/yocto/output/catzip/
zipcpu@a9221c1b52c6:~/yocto/output/catzip$ . ./dockerenv.sh
/usr/local/share/zipcpu/sw/install/cross-tools/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin
zipcpu@a9221c1b52c6:~/yocto/output/catzip$
```

Execute the autofpga program.

```
File Edit Tabs Help

zipcpu@a9221c1b52c6:~/yocto/output/catzip/auto-data$ make

autofpga -d -o . global.txt bkram.txt buserr.txt clockpll40.txt pic.txt pwrcount
.txt version.txt hbconsole.txt gpio.txt dlyarbiter.txt zipbones.txt sdramdev.txt

mem_sdram_bkram.txt sdramscope.txt

Opened autofpga.dbg

ADDING CLOCK: clk, i_clk, at 400000000 Hz

All clocks enumerated

ADDING BUS: wb (default)

Files toplevel.v and ../rtl/catzip/toplevel.v differ

Files main.v and ../rtl/catzip/main.v differ

Files regdefs.h and ../sw/host//regdefs.h differ

Files board.h and ../sw/board//board.h differ

Files board.ld and ../sw/board//board.ld differ

zipcpu@a9221c1b52c6:~/yocto/output/catzip/auto-data$
```

Create the catzip.bin using yosys, nexpnr, icepack and icetime.

```
File Edit Tabs Help
zipcpu@a9221c1b52c6:~/yocto/output/catzip/rtl/catzip$ make
Building cpudefs.h
Building design.h
verilator -O3 -Mdir ./obj-pc -trace -cc -y cpu -y ../hexbus -y ../pport main.v
cd ./obj-pc; make -f Vmain.mk
make[1]: Entering directory '/home/zipcpu/yocto/output/catzip/rtl/catzip/obj-pc'
/usr/bin/perl /usr/local/share/verilator/bin/verilator includer -DVL INCLUDE OPT
=include Vmain.cpp > Vmain ALLcls.cpp
          -MMD -I/usr/local/share/verilator/include -I/usr/local/share/verilator
/include/vltstd -DVL PRINTF=printf -DVM COVERAGE=0 -DVM SC=0 -DVM TRACE=1 -Wno-s
ign-compare -Wno-uninitialized -Wno-unused-but-set-variable -Wno-unused-paramete
 -Wno-unused-variable -Wno-shadow
                                          -c -o Vmain ALLcls.o Vmain ALLcls.cpp
/usr/bin/perl /usr/local/share/verilator/bin/verilator includer -DVL INCLUDE OPT
include Vmain__Dpi.cpp Vmain__Trace.cpp Vmain__Syms.cpp Vmain__Trace__Slow.cpp=
> Vmain ALLsup.cpp
         -MMD -I/usr/local/share/verilator/include -I/usr/local/share/verilator
/include/vltstd -DVL PRINTF=printf -DVM COVERAGE=0 -DVM SC=0 -DVM TRACE=1 -Wno-s
ign-compare -Wno-uninitialized -Wno-unused-but-set-variable -Wno-unused-paramete
 -Wno-unused-variable -Wno-shadow
                                          -c -o Vmain ALLsup.o Vmain ALLsup.cpp
      Archiving Vmain__ALL.a ...
ar r Vmain ALL.a Vmain ALLcls.o Vmain ALLsup.o
ar: creating Vmain ALL.a
ranlib Vmain ALL.a
make[1]: Leaving directory '/home/zipcpu/yocto/output/catzip/rtl/catzip/obj-pc'
yosys -ql simple.log -p synth_ice40 -blif catzip.blif -json catzip.json -top top
level ...
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:83.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:84.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:85.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:86.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:87.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:88.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:89.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:90.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:91.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:92.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:93.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:94.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:95.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:96.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:97.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:98.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:100.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:101.
Warning: wire '\w_gx_char' is assigned in a block at ../hexbus/hbgenhex.v:102.
```

When the catzip is created icetime checks the clock used passes.

```
File Edit Tabs Help
Info: [ 17916,
                 18672)
Info: [ 18672,
Info: [ 19428,
Info: [ 20184,
Info: [ 20940,
Info: [ 21696,
                 19428)
                 20184)
                 20940)
                 21696)
                 22452)
                 23208) | ***************************
Info: [ 22452,
                 23964) | *********************************
Info: [ 23208,
3 warnings, 0 errors
icepack catzip.asc catzip.bin
icetime -d hx8k -c 40 catzip.asc
// Reading input .asc file..
// Reading 8k chipdb file..
// Creating timing netlist..
// Timing estimate: 16.03 ns (62.39 MHz)
  Checking 25.00 ns (40.00 MHz) clock constraint: PASSED.
zipcpu@a9221c1b52c6:~/yocto/output/catzip/rtl/catzip$
```

Create the simulator using verilator.

```
File Edit Tabs Help

e/verilator/include -I/usr/local/share/verilator/include/vltstd -DNEW_VERILATOR
-I../../rtl/catzip -I../../rtl/catzip/obj-pc/ -I/usr/local/share/verilator/include -I/usr/local/share/verilator/include/vltstd -c sdramsim.cpp -o obj-pc/sdramsim.o

g++ -I../../rtl/catzip -I../../rtl/catzip/obj-pc/ -I/usr/local/share/verilator/include -I/usr/local/share/verilator/include/vltstd obj-pc/verilated.o obj-pc/verilated_vcd_c.o ../../rtl/catzip/obj-pc/Vmain__ALL.a obj-pc/automaster_tb.o obj-pc/zipelf.o obj-pc/memsim.o obj-pc/byteswap.o obj-pc/pportsim.o obj-pc/sdramsim.o ../../rtl/catzip/obj-pc/Vmain__ALL.a -lelf -o pc-main_tb
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sim/verilated$
```

Create the software to communicate with the simulator or FPGA.

```
File Edit Tabs Help

zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/host$ make
```

The pc-files are the green ones needed to communicate with simulator or FPGA.

```
File Edit Tabs Help
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/host$ ls
arch.sh
                  jpeg.sh
                                  rdsdram.cpp
                                                          testscope.sh
blu.bin
                  llcomms.cpp
                                  red.bin
                                                          test_sim102218.sh
                  llcomms.h
blu-out.8
                                  red-out.8
                                                          ttybus.cpp
                                  regdefs.cpp
byteswap.cpp
                  Makefile
                                                          ttybus.h
byteswap.h
                  netpport.cpp
                                  regdefs.h
                                                          twoc.cpp
                                  remoterunjpeg.sh
convertrgb.m
                  obj-pc
                                                          twoc.h
cputest_hello.sh
                  pc-rdsdram
                                  rem_sim_hw_test.sh
                                                          wbregs.cpp
devbus.h
                  pc-sdramscope
                                  rem_test_sim102218.sh
                                                          wr_pattern.sh
disp_rgb.m
                  pc-wbregs
                                  resetbus.cpp
                                                          wrsdram.cpp
exe_wbregs.c
                  pc-wrsdram
                                  rgb.m
                                                          wr_test.sh
fpga_C.png
                  pc-zipdbg
                                  rgb_pack.bin
                                                          zipdbg.cpp
fwddwt.png
                  pc-zipload
                                  runjpeg.sh
                                                          zipelf.cpp
fwdtmp.png
                  pc-zipstate
                                  scopecls.cpp
                                                          zipelf.h
grn.bin
                  port.h
                                  scopecls.h
                                                          zipload.cpp
grn-out.8
                  pptest.cpp
                                  sdramscope.cpp
                                                          zipstate.cpp
hexbus.cpp
                  rd_bytes.c
                                  sim_hw_test.sh
                                                          zopcodes.cpp
hexbus.h
                  rd_pattern.sh
                                  testbanks.sh
                                                          zopcodes.h
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/host$
```

#### Creare the libcatzip.a

```
File Edit Tabs Help

zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/zlib$ make

zip-gcc -03 -I. -I../../rtl/catzip -c udiv.c -o obj-zip/udiv.o

zip-gcc -03 -I. -I../../rtl/catzip -c umod.c -o obj-zip/umod.o

zip-gcc -03 -I. -I../../rtl/catzip -c syscalls.c -o obj-zip/syscalls.o

zip-gcc -03 -I. -I../../rtl/catzip -ffreestanding -c crt0.c -o obj-zip/crt0.o

zip-ar -cru libcatzip.a obj-zip/udiv.o obj-zip/umod.o obj-zip/syscalls.o obj-zip/crt0.o

zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/zlib$
```

Create cputest, hello, and jpeg programs which execute on the simulator or FPGA.

```
File Edit Tabs Help

zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/board$ make
Building dependency file(s)
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -c -Wa,-nocis -fno-builtin cputest.
c -o obj-zip/cputest.o
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -T boardram.ld -fno-builtin -Wl,-Ma
p=obj-zip/cputest.map obj-zip/cputest.o -o cputest
zip-gcc -03 -c hello.c -o obj-zip/hello.o
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -Tboardram.ld -L../zlib -Wl,-Map=ob
j-zip/hello.map obj-zip/hello.o -lc -lcatzip -o hello
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -c jpeg.c -o obj-zip/jpeg.o
zip-gcc -03 -c lifting.c -o obj-zip/lifting.o
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -Tboardram.ld -L../zlib obj-zip/lifting.o
zip-gcc -03 -I../zlib -I../../rtl/catzip -I. -Tboardram.ld -L../zlib obj-zip/lifting.o -Wl,-Map=obj-zip/jpeg.map obj-zip/jpeg.o -lc -lcatzip -o jpeg -lgcc
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sw/board$
```

Determing the ip of docker container.

```
File Edit Tabs Help
vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$ ./pc-wbreg
s -p 8363 -n 172.17.0.3 version
00800010 ( VERSION) : [....] 20200116
vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$

roup default
    link/ether 02:42:ac:11:00:03 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 172.17.0.3/16 brd 172.17.255.255 scope global eth0
    valid_lft forever preferred_lft forever
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sim/verilated$
```

#### Start the simulator

```
File Edit Tabs Help

zipcpu@a9221c1b52c6:~/yocto/output/catzip/sim/verilated$ ./pc-main_tb

Listening on port 8363

Listening on port 8364

> T

CMD: Only sent 0 bytes of 3!
```

#### Check the build date.

```
File Edit Tabs Help
vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$ ./pc-wbreg
s -p 8363 -n 172.17.0.3 version
00800010 ( VERSION) : [....] 20200116
vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$
```

#### The cputest program

```
File Edit Tabs Help

vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$ ./cputest_
hello.sh
```

#### Results of cputest

```
File Edit Tabs Help
< A02000001W40f
> A02000001K00000000
POLL = 1
RCVD: 18 bytes
< A02000005W1000000
> A02000005K00000000
POLL = 1
RCVD: 11 bytes
< A0200001R
> A02000001R0000060f
POLL = 1
RCVD: 0 bytes
< [CLOSED]
Accepted CMD connection
POLL = 1
RCVD: 12 bytes
< A02000001Wf
> A02000001K00000000
POLL = 1
RCVD: 0 bytes
< [CLOSED]
Running CPU self-test
SIM Instructions Is this a simulator?
CIS Instructions Supported
Break test #1
                              Pass
Break test #2
                              Pass
Break test #3
                              Pass
Early Branch test
                              Pass
Trap test/AND
                               Pass
Trap test/CLR
                               Pass
Overflow test
                               Pass
Carry test
                               Pass
Loop test
                               Pass
Shift test
                              Pass
Pipeline test
                              Pass
Mem-Pipeline test
                              Pass
Conditional Execution test Pass
No-waiting pipeline test
                              Pass
Conditional Branching test
                              Pass
Ill Instruction test, NULL PC Pass
Ill Instruction test, two Pass
Comparison test, ==
                               Pass
Comparison test, !=
                               Pass
                               Pass
CC Register test
Multi-Arg test
                               Pass
Multiply test
                               Pass
```

```
File Edit Tabs Help
RCVD: 11 bytes
< A02000005W
> A02000005K00000000
POLL = 1
RCVD: 14 bytes
< A02000001W41e
> A02000001K00000000
POLL = 1
RCVD: 11 bytes
< A02000005W
> A02000005K00000000
POLL = 1
RCVD: 14 bytes
< A02000001W41f
> A02000001K00000000
POLL = 1
RCVD: 11 bytes
< A02000005W
> A02000005K00000000
POLL = 1
RCVD: 14 bytes
< A02000001Wc00
> A02000001K00000000
POLL = 1
RCVD: 14 bytes
< A02000001W40f
> A02000001K00000000
POLL = 1
RCVD: 18 bytes
< A02000005W1000000
> A02000005K00000000
POLL = 1
RCVD: 11 bytes
< A02000001R
> A02000001R0000060f
POLL = 1
RCVD: 0 bytes
< [CLOSED]
Accepted CMD connection
POLL = 1
RCVD: 12 bytes
< A02000001Wf
> A02000001K00000000
POLL = 1
RCVD: 0 bytes
< [CLOSED]
Multiply HI-word test
                                 Hello, World
zipcpu@a9221c1b52c6:~/yocto/output/catzip/sim/verilated$
```

zipcpu@a9221c1b52c6:~/yocto/output/catzip/rtl/catzip\$ md5sum catzip.bin a7e9e8c6687702feecbe4fbf7b918797 catzip.bin zipcpu@a9221c1b52c6:~/yocto/output/catzip/rtl/catzip\$ scp catzip.bin devel@192.168.1.69:~/testbuilds/catzip/rtl/catzip/

The authenticity of host '192.168.1.69 (192.168.1.69)' can't be established. ECDSA key fingerprint is

SHA256:Bbi9VZShq4oPPLO/2sdVWLqT9dfufvoWSumdyGevmZk.

Are you sure you want to continue connecting (yes/no)? yes Warning: Permanently added '192.168.1.69' (ECDSA) to the list of known hosts. devel@192.168.1.69's password:

catzip.bin 100% 132KB 131.9KB/s 00:00

devel@mypi3-16:~/testbuilds/catzip/rtl/catzip \$ md5sum catzip.bin a7e9e8c6687702feecbe4fbf7b918797 catzip.bin

Load the catzip.bin on catboard.

```
File Edit Tabs Help
devel@mypi3-16:~/testbuilds/catzip/rtl/catzip $ sudo config cat catzip.bin
GPIO 25 not exported, trying to export...
GPIO 17 not exported, trying to export...
GPIO 22 not exported, trying to export...
OK: SPI driver loaded
Setting GPIO directions
out
out
in
Setting output to low
Reseting FPGA
Checking DONE pin
Continuing with configuration procedure
263+1 records in
263+1 records out
135100 bytes (135 kB, 132 KiB) copied, 0.0180811 s, 7.5 MB/s
Setting output to high
Checking DONE pin
devel@mypi3-16:~/testbuilds/catzip/rtl/catzip $
```

```
File Edit Tabs Help

devel@mypi3-16:~/testbuilds/catzip/sw/host $ ./arm-netpport

Listening on port 8363

Listening on port 8364
```

```
File Edit Tabs Help
> A02000001K00000000
< A02000005W
> A02000005K00000000
< A02000001Wc00
> A02000001K00000000
< A02000001W40f
> A02000001K00000000
< A02000005W1000000
> A02000005
> K00000000
< A0200001R
> A02000001R0000060f
Command port disconnect
Command port is now connected
< A02000001Wf
> A02000001K00000000
Command port disconnect
 Running CPU self-test
 SIM Instructions Pass
CIS Instructions Supported
Break test #1 Pass
 Break test #2
                                       Pass
 Break test #3
                                       Pass
 Early Branch test
                                       Pass
                                       Pass
 Trap test/AND
 Trap test/CLR
                                       Pass
 Overflow test
                                        Pass
 Carry test
                                        Pass
 Loop test
                                        Pass
 Shift test
                                       Pass
 Pipeline test
                                       Pass
 Mem-Pipeline test
                                       Pass
 Conditional Execution test Pass
No-waiting pipeline test Pass
Conditional Branching test Pass
 Ill Instruction test, NULL PC Pass
 Ill Instruction test, two Pass
Comparison test, == Pass
Comparison test, != Pass
CC Register test Pass
Multi-Arg test Pass
 Multi-Arg test
                                       Pass
 Multiply test
                                        Pass
```

```
File Edit Tabs Help

Section 0: 01000000 - 01003e94

Writing to MEM: 01000000-01003e94

Clearing the CPUs registers

Setting PC to 01000000

The CPU should be fully loaded, you may now start it (from reset/reboot) with:

> wbregs cpu 0x0f

CPU Status is: 0000060f

020000000 ( )-> 00000000f
```

#### File Edit Tabs Help A02000005K00000000 A02000001W419 > A02000001K00000000 < A02000005W > A02000005K00000000 < A02000001W41a A02000001K00000000 A02000005W A02000005K00000000 A02000001W41b A02000001K00000000 A02000005W A02000005K00000000 A02000001W41c A02000001K00000000 A02000005W A02000005K00000000 A02000001W41d A02000001K00000000 A02000005W A02000005K00000000 A02000001W41e A02000001K00000000 A02000005W > A02000005K00000000 < A02000001W41f > A02000001K00000000 < A02000005W > A02000005K00000000 < A02000001Wc00 > A02000001K00000000 < A02000001W40f > A02000001K00000000 < A02000005W1000000 > A02000005 > K00000000 < A02000001R > A02000001R0000060f Command port disconnect Command port is now connected < A02000001Wf > A02000001K00000000 Command port disconnect Hello, World!

Check the build date

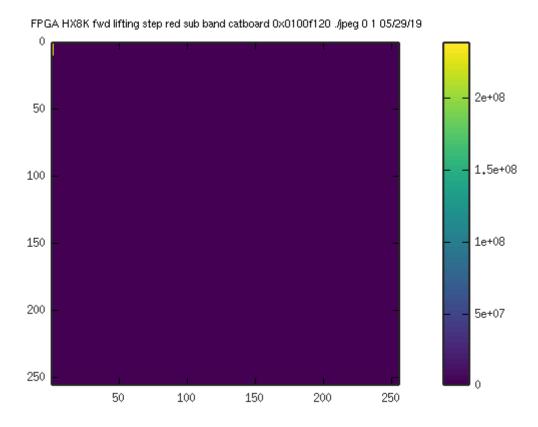
```
File Edit Tabs Help

vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$ ./pc-wbreg

s -p 8363 -n mypi3-16 version
00800010 ( VERSION) : [....] 20200120

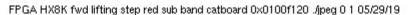
vidal@ws009:~/docker-examples/zipcpu/src/yocto/output/catzip/sw/host$
```

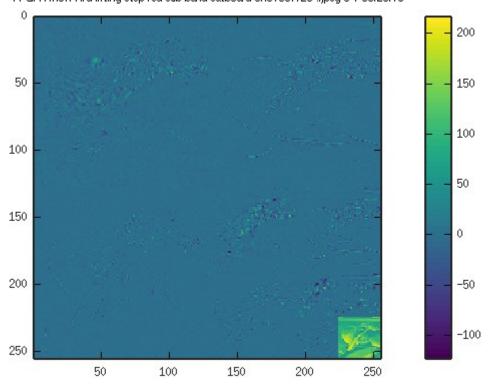
#### zipcpu ver 752bcc



y2= 2.52058e+08

zipcpu ver 006f4c





y2= 246,835

### Appendix A: Dockerfile.

# Copyright 2019, Burkhard Stubert (DBA Embedded Use)

# In any directory on the docker host, perform the following actions:

- # \* Copy this Dockerfile in the directory.
- # \* Create input and output directories: mkdir -p yocto/output yocto/input
- # \* Build the Docker image with the following command:
- # docker build --no-cache --build-arg "host\_uid=\$(id -u)" --build-arg "host\_gid=\$(id -g)" \
- # --tag "cuteradio-image:latest".
- # \* Run the Docker image, which in turn runs the Yocto and which produces the Linux rootfs,
- # with the following command:
- # docker run -it --rm -v \$PWD/yocto/output:/home/zipcpu/yocto/output zipcpu:0.62

# Use Ubuntu 16.04 LTS as the basis for the Docker image. FROM ubuntu:16.04

# Install all the Linux packages required for Yocto builds. Note that the packages python3, # tar, locales and cpio are not listed in the official Yocto documentation. The build, however, # without them.

RUN apt-get update && apt-get -y install gawk wget git-core diffstat unzip texinfo gcc-multilib \ build-essential chrpath socat cpio python python3 python3-pip python3-pexpect \ xz-utils debianutils iputils-ping libsdl1.2-dev xterm tar locales \

bison flex autoconf automake libtool libgmp3-dev \

libmpfr-dev libmpfr-doc libmpfr4 libmpfr4-dbg libmpc-dev libelf-dev bc \

ncurses-dev ctags mercurial gperf \

clang libreadline-dev tcl-dev libffi-dev pkg-config libftdi-dev libboost-all-dev \

```
cmake libeigen3-dev
#The following packages are needed when creating zipcpu:06
#with docker-fpga-builder
    clang libreadline-dev tcl-dev libffi-dev pkg-config libftdi-dev libboost-all-dev \
#
    cmake libeigen3-dev
# By default, Ubuntu uses dash as an alias for sh. Dash does not support the source command
# needed for setting up the build environment in CMD. Use bash as an alias for sh.
RUN rm /bin/sh && ln -s bash /bin/sh
# Set the locale to en_US.UTF-8, because the Yocto build fails without any locale set.
RUN locale-gen en US.UTF-8 && update-locale LC ALL=en US.UTF-8 LANG=en US.UTF-8
ENV LANG en_US.UTF-8
ENV LC_ALL en_US.UTF-8
ENV USER_NAME zipcpu
ENV PROJECT zipcpu
# The running container writes all the build artefacts to a host directory (outside the container).
# The container can only write files to host directories, if it uses the same user ID and
# group ID owning the host directories. The host_uid and group_uid are passed to the docker build
# command with the --build-arg option. By default, they are both 1001. The docker image creates
# a group with host_gid and a user with host_uid and adds the user to the group. The symbolic
# name of the group and user is cuteradio.
ARG host uid=1000
ARG host_gid=1000
RUN groupadd -g $host_gid $USER_NAME && useradd -g $host_gid -m -s /bin/bash -u $host_uid
$USER_NAME
# Perform the Yocto build as user cuteradio (not as root).
# NOTE: The USER command does not set the environment variable HOME.
RUN git clone https://github.com/develone/icestorm.git icestorm \
  && cd icestorm \
  && make -j$(nproc) \
  && make install \
  && cd .. && rm -rf icestorm
RUN git clone https://github.com/develone/nextpnr nextpnr \
  && cd nextpnr \
  && cmake -DARCH=ice40 -DBUILD_GUI=OFF -DCMAKE_INSTALL_PREFIX=/usr/local . \
  && make -j$(nproc) \
  && make install \
  && cd .. && rm -rf nextpnr
RUN git clone https://github.com/develone/yosys.git yosys \
  && cd yosys \
  && make -j$(nproc) \
  && make install \
  && cd .. && rm -rf yosys
```

```
#/using ver from mypi3-15
RUN git clone https://git.veripool.org/git/verilator \
  && cd verilator && git checkout v3.926 \
  && autoconf \
  && ./configure --prefix /usr/local \
  && make \
  && make install \
  && cd ../\
  && rm -rf verilator
#/using ver from mypi3-15
RUN git clone https://github.com/develone/zipcpu.git \
  && cd zipcpu && git checkout 006f4c \
  && make \
  && tar -cvf /usr/local/share/zipcpu.tar ../zipcpu \
  && cd /usr/local/share \
  && tar -xvf zipcpu.tar \
  && rm -f zipcpu.tar
RUN git clone https://github.com/develone/autofpga.git autofpga \
  && cd autofpga \
  && make \
  && cp sw/autofpga /usr/local/bin \
  && cd .. && rm -rf autofpga
# By default, docker runs as root. However, Yocto builds should not be run as root, but as a
# normal user. Hence, we switch to the newly created user cuteradio.
USER $USER_NAME
# Create the directory structure for the Yocto build in the container. The lowest two directory
# levels must be the same as on the host.
ENV BUILD_INPUT_DIR /home/$USER_NAME/yocto/input
ENV BUILD_OUTPUT_DIR /home/$USER_NAME/yocto/output
RUN mkdir -p $BUILD_INPUT_DIR $BUILD_OUTPUT_DIR
Appendix B: build.sh
#!/bin/bash
docker build -t="zipcpu:0.62".
Appendix C: list of packages.
______
Desired=Unknown/Install/Remove/Purge/Hold
|/ Err?=(none)/Reinst-required (Status,Err: uppercase=bad)
ii adduser
                        3.113+nmu3ubuntu4
                                                          add and remove users and
                                                   all
groups
ii apt
                      1.2.32
                                           amd64
                                                    commandline package manager
```

ii autoconf	2.69-9	all aı	ıtomatic configure script builde
ii automake	2.09-9 1:1.15-4ubuntu1	an at	Tool for generating GNU
		dII	1001 for generating GNO
Standards-compliant Make ii autotools-dev	20150820.1	all	Undata infrastructura for
	20150820.1	all	Update infrastructure for
config.{guess,sub} files	0.4-1	<del>1</del> C 4	Delieu haar aastaa
ii base-files	9.4ubuntu4.11	amd64	Debian base system
miscellaneous files	2.5.00	10.4	D.1. 1
ii base-passwd	3.5.39	amd64	Debian base system master
password and group files	10111	10.4	
ii bash	4.3-14ubuntu1.4	amd64	GNU Bourne Again SHell
ii bc	1.06.95-9build1	amd64	GNU bc arbitrary precision
calculator language			
ii binfmt-support	2.1.6-1	amd64	Support for extra binary
formats			
ii binutils	2.26.1-1ubuntu1~16.04.8	ame	d64 GNU assembler, linker
and binary utilities			
ii bison	2:3.0.4.dfsg-1	amd64	YACC-compatible parser
generator			
ii bsdutils	1:2.27.1-6ubuntu3.9	amd6	4 basic utilities from
4.4BSD-Lite			
ii build-essential	12.1ubuntu2	amd64	4 Informational list of build
essential packages			
ii bzip2	1.0.6-8ubuntu0.2	amd64	high-quality block-sorting
file compressor - utilities	2.0.0 04044440.		mgn quanty orden corumg
ii ca-certificates	20170717~16.04.2	all	Common CA certificates
ii chrpath	0.16-1	amd64	Tool to edit the rpath in ELF
binaries	0.10 1	umao+	1001 to cuit the 1puth in EE1
ii clang	1:3.8-33ubuntu3.1	amd64	C, C++ and Objective-C
compiler (LLVM based)	1.5.0-55ubuntu5.1	amuo4	c, C + and Objective-C
ii clang-3.8	1:3.8-2ubuntu4	amd64	C, C++ and Objective-C
	1.5.0-2ubuiitu4	alliu04	C, C++ and Objective-C
compiler (LLVM based)	3.5.1-1ubuntu3	amd64	grass platform open
ii cmake	3.5.1-1ubuiitu3	alliu64	cross-platform, open-
source make system	25111 . 2	11	
ii cmake-data	3.5.1-1ubuntu3	all	CMake data files (modules,
templates and documentati	·	_	
ii coreutils	8.25-2ubuntu3~16.04	amd	
ii cpio	2.11+dfsg-5ubuntu1.1	amd6	4 GNU cpio a program to
manage archives of files			
ii cpp	4:5.3.1-1ubuntu1	amd64	GNU C preprocessor (cpp)
ii cpp-5	5.4.0-6ubuntu1~16.04.12	ame	d64 GNU C preprocessor
ii dash	0.5.8-2.1ubuntu2	amd64	POSIX-compliant shell
ii dbus	1.10.6-1ubuntu3.5	amd64	simple interprocess
messaging system (daemon	n and utilities)		
ii debconf	1.5.58ubuntu2	all	Debian configuration
management system			-
ii debianutils	4.7	amd64	Miscellaneous utilities specific
to Debian			1
ii dh-python	2.20151103ubuntu1.2	all	Debian helper tools for
packaging Python libraries			
ii diffstat	1.61-1	amd64	produces graph of changes
introduced by a diff file	1.01 1		produces Braph of changes
ii diffutils	1:3.3-3	amd64	File comparison utilities
ii diiiddis	I.J.J <sup>-</sup> J	ama0 <del>4</del>	i ne companison unnues

ii dpkg	1.18.4ubuntu1.6	amd64 Debian package
1 0	1.10.4ubuntu1.0	amuo4 Debian package
management system ii dpkg-dev	1.18.4ubuntu1.6	all Debian package
development tools	1.10.400011101.0	all Debian package
ii e2fslibs:amd64	1.42.13-1ubuntu1.1	amd64 ext2/ext3/ext4 file
system libraries	1.42.13-1ubuntu1.1	dilido4 Ext2/Ext3/Ext4 file
ii e2fsprogs	1.42.13-1ubuntu1.1	amd64 ext2/ext3/ext4 file
system utilities	1.42.13-1ubuntu1.1	dilido4 Ext2/Ext3/Ext4 file
ii exuberant-ctags	1:5.9~svn20110310-1	1 amd64 build tag file
indexes of source code de		1 dilido4 build tag file
ii fakeroot	1.20.2-1ubuntu1	amd64 tool for simulating
superuser privileges	1.20.2-1ubuntu1	ando+ tool for simulating
ii file	1:5.25-2ubuntu1.3	amd64 Determines file type using
"magic" numbers	1.3.23-2dbdiitd1.3	ando4 Determines the type using
ii findutils	4.6.0+git+20160126-2	amd64 utilities for finding
filesfind, xargs	4.0.0 · git · 20100120-2	amdo4 dumities for imamig
ii flex	2.6.0-11	amd64 fast lexical analyzer generator
ii fontconfig-config	2.11.94-0ubuntu1.1	all generic font
configuration library - co		all generic font
ii fonts-dejavu-core	2.35-1	all Vera font family derivate with
additional characters	2.33-1	all vera folit faililly defivate with
ii g++	4:5.3.1-1ubuntu1	amd64 GNU C++ compiler
ii g++-5	5.4.0-6ubuntu1~16.04.12	
ii gawk	1:4.1.3+dfsg-0.1	amd64 GNU awk, a pattern
scanning and processing l		amuo+ Givo awk, a pattern
ii gcc	4:5.3.1-1ubuntu1	amd64 GNU C compiler
ii gcc-5	5.4.0-6ubuntu1~16.04.12	
ii gcc-5-base:amd64	5.4.0-6ubuntu1~16.04.12	
Compiler Collection (base		04.12 anido4 GCC, the GIVO
ii gcc-5-multilib	5.4.0-6ubuntu1~16.04	.12 amd64 GNU C compiler
(multilib support)	5.4.0-0dbdilld1*10.04	anido4 GNO C compiler
ii gcc-6-base:amd64	6.0.1-0ubuntu1	amd64 GCC, the GNU
Compiler Collection (base		umdo4 GGG, the Give
ii gcc-multilib	4:5.3.1-1ubuntu1	amd64 GNU C compiler
(multilib files)	4.5.5.1-1ubuntu1	anido4 Gro C complici
ii git	1:2.7.4-0ubuntu1.7	amd64 fast, scalable, distributed
revision control system	1.2.7.4 Oubuntu1.7	undo-
ii git-core	1:2.7.4-0ubuntu1.7	all fast, scalable, distributed
revision control system (c		dii idst, scalable, distributed
ii git-man	1:2.7.4-0ubuntu1.7	all fast, scalable, distributed
revision control system (r		un rust, sculusic, distributed
ii gnupg	1.4.20-1ubuntu3.3	amd64 GNU privacy guard - a
free PGP replacement	1. 1.20 Tubuntub.6	umas i Sive privacy guard a
ii gperf	3.0.4-2	amd64 Perfect hash function generator
ii gpgv	1.4.20-1ubuntu3.3	amd64 GNU privacy guard -
signature verification tool		unido i Givo privacy gadra
ii grep	2.25-1~16.04.1	amd64 GNU grep, egrep and fgrep
ii gzip	1.6-4ubuntu1	amd64 GNU compression utilities
ii hostname	3.16ubuntu2	amd64 utility to set/show the host
name or domain name		amas. admity to seasing we first
ii icu-devtools	55.1-7ubuntu0.4	amd64 Development utilities for
International Components		2 cveropment durities for

Configure network interfaces   1.29ubuntu4	ii ifupdown	0.8.10ubuntu1.4	amd6	4 high level tools to	
metapackage ii initscripts         2.888sf-59.3ubuntu2         amd64         scripts for initializing and soluting down the system ii init-system-helpers ystems         1.29ubuntu4         all helper tools for all init helper tools for all init system-helpers ystems         ii init-system-helpers of initializing and the proper denote of initializing and the property of the property	configure network interfaces				
in intscripts   2.88dsf-59.3ubuntu2   amd64   scripts for initializing and shutting down the system in init-system-helpers systems   1.29ubuntu4   all   helper tools for all init system-helpers systems   1.14.0-5ubuntu3   amd64   boot sequence organizer using LSB initd script dependency information   ii proute2   4.3.0-1ubuntu3.16.04.5   amd64   networking and traffic control tools   ii iputils-ping   3.20121221-5ubuntu2   amd64   DHCP client for automatically obtaining an IP address   ii isc-dhcp-client   4.3.3-5ubuntu12.10   amd64   common files used by all of the isc-dhcp packages   ii javascript-common   11   all   Base support for JavaScript library packages   ii lass descript-common   11   all   Base support for JavaScript library packages   ii lass descript-common   11   amd64   pager program similar to more   ii lib32asan2   5.4.0-6ubuntu1~16.04.12   amd64   AddressSanitizer a fast memory error detector (32bit)   ii lib32atomic1   5.4.0-6ubuntu1~16.04.12   amd64   Support library   32bit   ii lib32gec5-dev   5.4.0-6ubuntu1~16.04.12   amd64   GCC support library (32bit)   ii lib32genp1   5.4.0-6ubuntu1~16.04.12   amd64   GCC support library (32bit)   ii lib32gmp2   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP   GOMP) support library (32bit)   ii lib32gmp2   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP   GOMP) support library (32bit)   ii lib32gmp2   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP   GOMP) support library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32gmp3   amd64   amd64   GCC Q		.29ubuntu4	amd64	System-V-like init utilities -	
Shutting down the system					
ii init-systems   1.29ubuntu4   all   helper tools for all init systems   ii inserv   1.14.0-5ubuntu3   amd64   boot sequence organizer using LSB init.d script dependency information   ii iproute2   4.3.0-1ubuntu3.16.04.5   amd64   networking and traffic control tools   ii iproute2   4.3.3-5ubuntu2   amd64   DHCP client for automatically obtaining an IP address   ii isc-dhcp-client   4.3.3-5ubuntu12.10   amd64   DHCP client for automatically obtaining an IP address   ii isc-dhcp-common   4.3.3-5ubuntu12.10   amd64   DHCP client for automatically obtaining an IP address   ii isc-dhcp-common   11   all   Base support for JavaScript library packages   ii krb5-locales   1.13.2+dfsg-5ubuntu2.1   all   Internationalization support for MIT Kerberos   ii less   481-2.1ubuntu0.2   amd64   pager program similar to more   ii lib32asan2   5.4.0-6ubuntu1~16.04.12   amd64   support library providing _atomic built-in functions (32bit)   ii lib32atomic1   5.4.0-6ubuntu1~16.04.12   amd64   GCC support library (32bit)   ii lib32gcc1   1:6.0.1-0ubuntu1   amd64   GCC support library (32bit)   ii lib32gcc5-dev   5.4.0-6ubuntu1~16.04.12   amd64   GCC support library (32bit)   ii lib32gmp1   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP (GOMP) support library (32bit)   ii lib32gmp1   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP (GOMP) support library (32bit)   ii lib32gmp1   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32quadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32guadmath0		2.88dsf-59.3ubuntu2	amde	scripts for initializing and	
Systems					
In inserv		1.29ubuntu4	all	helper tools for all init	
using LSB init.d script dependency information in iproute2         4.3.0-1ubuntu3.16.04.5         amd64         networking and traffic control tools           ii iputils-ping reachability of network hosts ii isc-dhcp-client         4.3.3-5ubuntu12.10         amd64         Tools to test the reachability of network hosts ii isc-dhcp-client         4.3.3-5ubuntu12.10         amd64         DHCP client for automatically obtaining an IP address ii isc-dhcp-common         4.3.3-5ubuntu12.10         amd64         DHCP client for automatically obtaining an IP address ii isc-dhcp-common         1.1         all Base support for JavaScript library packages ii javascript-common         1.1         all Base support for JavaScript library packages ii javascript-common         1.13.2+dfsg-5ubuntu2.1         all Internationalization           support for MIT Kerberos ii less         481-2.1ubuntu0.2         amd64         AddressSanitizer a fast memory error detector (32bit) ii lib32asan2         5.4.0-6ubuntu1~16.04.12         amd64         AddressSanitizer a fast memory error detector (32bit) ii lib32clikrts5         5.4.0-6ubuntu1~16.04.12         amd64         Intel Cilk Plus language extensions (32bit) ii lib32gcc1         1:6.0.1-0ubuntu1         amd64         GCC support library (32bit) ii lib32gcopt         5.4.0-6ubuntu1~16.04.12         amd64         GCC support library (32bit) ii lib32jcmpX0         5.4.0-6ubuntu1~16.04.12         amd64         GCC Quad-Precision Math Library (32bit) ii lib32mAx0         5.4.0-6ubuntu1~16.04.12         amd64         GCC Quad-Precision Math Library (32bit) ii l					
ii proute2			amd64	boot sequence organizer	
control tools         ii putils-ping         3:20121221-5ubuntu2         amd64         Tools to test the           reachability of network hosts         4.3.3-5ubuntu12.10         amd64         DHCP client for           ii isc-dhcp-client         4.3.3-5ubuntu12.10         amd64         DHCP client for           automatically obtaining an IP address         1         all         Bases upport for           ii isc-dhcp-common         4.3.3-5ubuntu12.10         all         Bases upport for JavaScript           library packages         11         all         Internationalization           support for MIT Kerberos         1 libs2class         481-2.1ubuntu0.2         amd64         AddressSanitizer — a           fast memory error detector (32bit)         5.4.0-6ubuntu1~16.04.12         amd64         AddressSanitizer — a           fast memory error detector (32bit)         ii lib32atomic1         5.4.0-6ubuntu1~16.04.12         amd64         support library           ii lib32gikhts5         5.4.0-6ubuntu1~16.04.12         amd64         GCC support library           libi Version)         5.4.0-6ubuntu1~16.04.12         amd64         GCC support library           libi J32gport         5.4.0-6ubuntu1~16.04.12         amd64         GCC OpenMP           (GOMP) support library (32bit)         5.4.0-6ubuntu1~16.04.12         amd64 <td></td> <td><u> </u></td> <td></td> <td></td> <td></td>		<u> </u>			
ii iputils-ping	<u> </u>	4.3.0-1ubuntu3.16.04.5	amd	l64 networking and traffic	
reachability of network hosts it isc-dhcp-client					
ii isc-dhcp-client	<u> </u>		am	nd64 Tools to test the	
Automatically obtaining an IP address   ii isc-dhcp-common	<u> </u>				
i isc-dhcp-common   4.3.3-5ubuntu12.10   amd64   common files used by all of the isc-dhcp packages   ii javascript-common   11   all   Base support for JavaScript   library packages   ii krb5-locales	-		am	d64 DHCP client for	
by all of the isc-dhcp packages   ii javascript-common   11					
ii javascript-common				amd64 common files used	
library packages   1.13.2+dfsg-5ubuntu2.1   all   Internationalization   support for MIT Kerberos   1.13.2+dfsg-5ubuntu2.1   amd64   pager program similar to more   il lib32asan2   5.4.0-6ubuntu1~16.04.12   amd64   AddressSanitizer a fast memory error detector (32bit)   ii lib32atomic1   5.4.0-6ubuntu1~16.04.12   amd64   support library providingatomic bullt-in fructions (32bit)   ii lib32clikrts5   5.4.0-6ubuntu1~16.04.12   amd64   Intel Cilk Plus language extensions (32bit)   ii lib32gcc1   1:6.0.1-0ubuntu1   amd64   GCC support library (32 bit development files)   ii lib32gcc1   5.4.0-6ubuntu1~16.04.12   amd64   GCC support library (32 bit development files)   ii lib32gomp1   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP (GOMP) support library (32bit)   ii lib32gtm1   5.4.0-6ubuntu1~16.04.12   amd64   GCC OpenMP (GOMP) support library (32bit)   ii lib32mpx0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32quadmath0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-Precision Math Library (32bit)   ii lib32ubsan0   5.4.0-6ubuntu1~16.04.12   amd64   GCC Quad-P					
		11	all	Base support for JavaScript	
support for MIT Kerberos ii less	, i				
ii less 481-2.1ubuntu0.2 amd64 pager program similar to more ii lib32asan2 5.4.0-6ubuntu1~16.04.12 amd64 AddressSanitizer a fast memory error detector (32bit) ii lib32atomic1 5.4.0-6ubuntu1~16.04.12 amd64 support library providingatomic built-in functions (32bit) ii lib32cilkrts5 5.4.0-6ubuntu1~16.04.12 amd64 Intel Cilk Plus language extensions (32bit) ii lib32gcc1 1:6.0.1-0ubuntu1 amd64 GCC support library (32 bit Version) ii lib32gcc5-dev 5.4.0-6ubuntu1~16.04.12 amd64 GCC support library (32 bit development files) ii lib32gcmp1 5.4.0-6ubuntu1~16.04.12 amd64 GCC OpenMP (GOMP) support library (32bit) ii lib32im1 5.4.0-6ubuntu1~16.04.12 amd64 GNU Transactional Memory Library (32bit) ii lib32mpx0 5.4.0-6ubuntu1~16.04.12 amd64 GCC Quad-Precision Math Library (32bit) ii lib32guadmath0 5.4.0-6ubuntu1~16.04.12 amd64 GCC Quad-Precision Math Library (32bit) ii lib32stdc++6 5.4.0-6ubuntu1~16.04.12 amd64 GNU Standard C++ Library v3 (32 bit Version) ii lib32ubsan0 5.4.0-6ubuntu1~16.04.12 amd64 GNU Standard C++ Library v3 (32 bit Version) ii lib32ubsan0 5.4.0-6ubuntu1~16.04.12 amd64 UBSan undefined behaviour sanitizer (32bit) ii lib32tidc++6 Library v3 (32 bit Version) ii libacl1:amd64 2.2.52-3 amd64 Access control list shared library ii libalgorithm-diff-perl 1.19.03-1 amd64 module to find differences between files ii libalgorithm-diff-xs-perl 0.04-4build1 amd64 module to find differences		1.13.2+dfsg-5ubuntu2.1	al	l Internationalization	
more  ii lib32asan2					
Ii lib32asan2	ii less 4	81-2.1ubuntu0.2	amd64	pager program similar to	
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ii libarchive13:amd64 3.1.2-11ubuntu0.16.04.7 amd64 Multi-format	
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ii libasan2:amd64 5.4.0-6ubuntu1~16.04.12 amd64 AddressSanitizer a fast memory error detector	
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ii libasound2:amd64	
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ii libasound2-data 1.1.0-0ubuntu1 all Configuration files and	
profiles for ALSA drivers	
ii libasound2-dev:amd64 1.1.0-0ubuntu1 amd64 shared library for	
ALSA applications development files ii libasyncns0:amd64	
service query library	
ii libatm1:amd64 1:2.5.1-1.5 amd64 shared library for ATM	
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ii libatomic1:amd64 5.4.0-6ubuntu1~16.04.12 amd64 support library	
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ii libattr1:amd64 1:2.4.47-2 amd64 Extended attribute shared	
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ii libaudit1:amd64 1:2.4.5-1ubuntu2.1 amd64 Dynamic library for	
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ii libblkid1:amd64 2.27.1-6ubuntu3.9 amd64 block device ID	
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ii libboost-atomic1.58.0:amd64 1.58.0+dfsg-5ubuntu3.1 amd64 atomic data types, operations, and memory ordering constraints	
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ii libboost-thread1.58.0:amd64	1.58.0+dfsg-5ubuntu3.1	amd64	portable C++
multi-threading			
ii libboost-thread1.58-dev:amd64	1.58.0+dfsg-5ubuntu3.1	amd64	4 portable C++
multi-threading			
ii libboost-thread-dev:amd64	1.58.0.1ubuntu1	amd64	portable C++
multi-threading (default version)			•
ii libboost-timer1.58.0:amd64	1.58.0+dfsg-5ubuntu3.1	amd64	C++ wall clock
and CPU process timers			
ii libboost-timer1.58-dev:amd64	1.58.0+dfsg-5ubuntu3.1	amd64	C++ wall
clock and CPU process timers	1.50.0 disg susumusii		, , , , , , , , , , , , , , , ,
	1.58.0.1ubuntu1	amd64	C++ wall clock and
CPU process timers (default version)	1.50.0.14541141	umaor	G - Wall clock and
± '	.0.1ubuntu1 a	md64 Boo	st C++ Libraries
development tools (default version)	.o.rubuntur	iiido4 boo	of C++ Libraries
ii libboost-wave1.58.0:amd64	1.58.0+dfsg-5ubuntu3.1	amd64	C99/C++
	1.50.0 disg-5ubullus.1	alliu04	C33/C11
preprocessor library	1 FO O dfog Eubuptur 1	am dC	4 C00/C++
ii libboost-wave1.58-dev:amd64	1.58.0+dfsg-5ubuntu3.1	amd6	4 C99/C++
preprocessor library	150011 . 1	10.4	C00/C++
ii libboost-wave-dev:amd64	1.58.0.1ubuntu1	amd64	C99/C++
preprocessor library (default version)	10		f DCD
ii libbsd0:amd64	?-1 amd6	4 utility fu	nctions from BSD
systems - shared library		10.	
		amd64 hig	h-quality block-
sorting file compressor library - runtin		10.4	
	Oubuntu11 an	nd64 GNU	C Library: Shared
libraries			
		amd64 GN	IU C Library:
Development Libraries and Header Fil	es		

1.1 6 1	2.22.0.1	10.4	CNILLO I II DO LI
ii libc6-dev-i386	2.23-0ubuntu11	amd64	GNU C Library: 32-bit
development libraries for AM		10.4	CNILCI'I WOO
ii libc6-dev-x32	2.23-0ubuntu11	amd64	GNU C Library: X32
ABI Development Libraries f		16.4	CNIII CI 11 22 1 1
ii libc6-i386	2.23-0ubuntu11	amd64	GNU C Library: 32-bit
shared libraries for AMD64	2.22 01	30 4	CNIII C I thurana VOO ADI
ii libc6-x32	2.23-0ubuntu11	amd64	GNU C Library: X32 ABI
Shared libraries for AMD64	0.00 hata10 2ht0.10	6.04.1 amo	ICA golovy ACCII aut
ii libcaca0:amd64	0.99.beta19-2ubuntu0.16	0.04.1 aiii	d64 colour ASCII art
library ii libcaca-dev	0.99.beta19-2ubuntu0.16.0	4.1 amd6	4 development files
for libcaca	0.55.Deta15-2ubuntu0.10.0	4.1 dillu04	4 development files
ii libcap2:amd64	1:2.24-12	amd64 I	POSIX 1003.1e
capabilities (library)	1,2,24-12	aiiiu04 i	1003.1e
ii libcap2-bin	1:2.24-12	amd64 PC	SIX 1003.1e capabilities
(utilities)	1,2,24-12	alliu04 FC	531X 1003.1e capabilities
ii libcap-ng0:amd64	0.7.7-1	amd64	An alternate POSIX
capabilities library	0.7.7-1	anido+ 1	thi diternate 1 OSIA
-	2.23-0ubuntu11	amd64 G	NU C Library: Binaries
ii libcc1-0:amd64	5.4.0-6ubuntu1~16.04.12		<u> </u>
GDB	5.4.0 Oubantu1 10.04.12	- unide	of GGG cer plugili for
ii libc-dev-bin	2.23-0ubuntu11	amd64	GNU C Library:
Development binaries	<b>-1.2</b> 5 045411411	umao i	GIVE C Elbrury.
ii libcilkrts5:amd64	5.4.0-6ubuntu1~16.04.12	2 amd6	54 Intel Cilk Plus
language extensions (runtime			22202 2222 2 200
ii libclang1-3.8:amd64	1:3.8-2ubuntu4	amd64	C interface to the
clang library		-	
ii libclang-common-3.8-dev	1:3.8-2ubuntu4	amde	64 clang library -
Common development packa			5
ii libcomerr2:amd64	1.42.13-1ubuntu1.1	amd64	common error
description library			
ii libcryptsetup4:amd64	2:1.6.6-5ubuntu2.1	amd64	4 disk encryption
support - shared library			
ii libcurl3:amd64	7.47.0-1ubuntu2.14	amd64	easy-to-use client-side
URL transfer library (OpenSS	SL flavour)		
ii libcurl3-gnutls:amd64	7.47.0-1ubuntu2.14	amd6	4 easy-to-use client-
side URL transfer library (Gn	uTLS flavour)		
ii libdb5.3:amd64	5.3.28-11ubuntu0.2	amd64	Berkeley v5.3
Database Libraries [runtime]			
ii libdbus-1-3:amd64	1.10.6-1ubuntu3.5	amd64	simple interprocess
messaging system (library)			
ii libdebconfclient0:amd64	0.198ubuntu1	amd64	4 Debian
Configuration Management S	• • •	• /	
ii libdevmapper1.02.1:amd64		ı10 a	md64 Linux Kernel
Device Mapper userspace libi	-		
ii libdns-export162	1:9.10.3.dfsg.P4-8ubunt	u1.15 amo	l64 Exported DNS
Shared Library	1.10.4.1	11 5	1 . 1 11
ii libdpkg-perl	1.18.4ubuntu1.6	•	okg perl modules
ii libdrm2:amd64	2.4.91-2~16.04.1	amd64	Userspace interface to
kernel DRM services runtir		1	C4
ii libdrm-amdgpu1:amd64	2.4.91-2~16.04.1	amd	.64 Userspace
interface to amdgpu-specific	kemei DKIVI Services runtii	iie	

ii libdrm-common	2.4.91-2~16.04.1	all Userspace interface to
kernel DRM services comr	non files	
ii libdrm-dev:amd64	2.4.91-2~16.04.1	amd64 Userspace interface
to kernel DRM services de	*	
ii libdrm-intel1:amd64	2.4.91-2~16.04.1	amd64 Userspace interface
to intel-specific kernel DRM		
ii libdrm-nouveau2:amd64	2.4.91-2~16.04.1	amd64 Userspace
interface to nouveau-specific		
ii libdrm-radeon1:amd64	2.4.91-2~16.04.1	amd64 Userspace interface
to radeon-specific kernel DR		
ii libedit2:amd64	3.1-20150325-1ubuntu	2 amd64 BSD editline and
history libraries		
ii libeigen3-dev	3.3~beta1-2	all lightweight C++ template
library for linear algebra		
ii libelf1:amd64	0.165-3ubuntu1.2	amd64 library to read and
write ELF files	0.40= 0.1	10.
ii libelf-dev:amd64	0.165-3ubuntu1.2	amd64 libelf1 development
libraries and header files		
ii libencode-locale-perl	1.05-1	all utility to determine the locale
encoding	0.45.4.0	
ii liberror-perl	0.17-1.2	all Perl module for error/exception
handling in an OO-ish way	240 = 1 24004	- 104 771 4 6
ii libexpat1:amd64	2.1.0-7ubuntu0.16.04.	5 amd64 XML parsing C
library - runtime library	0.4.0.7.1	4.5 10.4 YEAR 1
ii libexpat1-dev:amd64	2.1.0-7ubuntu0.16.0	4.5 amd64 XML parsing C
library - development kit	1 20 2 4 1 4 4	164
ii libfakeroot:amd64	1.20.2-1ubuntu1	amd64 tool for simulating
superuser privileges - shared		
ii libfdisk1:amd64	2.27.1-6ubuntu3.9	amd64 fdisk partitioning
library	2.2.4.4	
ii libffi6:amd64	3.2.1-4	amd64 Foreign Function Interface
library runtime	2.2.1.4	
ii libffi-dev:amd64	3.2.1-4	amd64 Foreign Function Interface
library (development files)	0.22.2	and (A Doubne dule for file leaking
ii libfile-fcntllock-perl	0.22-3	amd64 Perl module for file locking
with fcntl(2)	6.04.1	-11
ii libfile-listing-perl	6.04-1	all module to parse directory
listings	1 7 1 4	and CA Even Localors Audio Codes
ii libflac8:amd64	1.3.1-4	amd64 Free Lossless Audio Codec
- runtime C library	2.6.0.11	and CA static library for flar (a fact
ii libfl-dev:amd64	2.6.0-11	amd64 static library for flex (a fast
lexical analyzer generator)	1 20 1	all Fortu AEM Interference
ii libfont-afm-perl	1.20-1	all Font::AFM - Interface to
Adobe Font Metrics files	2 11 04 Oubuntul 1	amd64 ganaria fant
ii libfontconfig1:amd64	2.11.94-0ubuntu1.1	amd64 generic font
configuration library - runtim		and CA V11 fact an adding library
ii libfontenc1:amd64	1:1.1.3-1	amd64 X11 font encoding library
ii libfreetype6:amd64	2.6.1-0.1ubuntu2.4	amd64 FreeType 2 font
engine, shared library files	0.20 45:131	amdC4 I throw totill 3
ii libftdi1:amd64	0.20-4build1	amd64 Library to control and
program the FTDI USB conti		omd(4 Development (2) - ( 12) (
ii libftdi-dev	0.20-4build1	amd64 Development files for libftdi

ii libgcc1:amd64	1:6.0.1-0ubuntu1	amd64 GCC support library
ii libgcc-5-dev:amd64	5.4.0-6ubuntu1~16.04.12	11
library (development files)	5. 1.0 Ododina 10.0 1.12	unido i ded support
ii libgcrypt20:amd64	1.6.5-2ubuntu0.5	amd64 LGPL Crypto library
- runtime library	1.0.5 Zabantao.5	unido! ESI E Siypto nordiy
ii libgdbm3:amd64	1.8.3-13.1	amd64 GNU dbm database
routines (runtime version)	1.0.5 15.1	diffeo i Give doin database
ii libgl1-mesa-dev:amd64	18.0.5-0ubuntu0~16.04.	.1 amd64 free
implementation of the OpenGI		
ii libgl1-mesa-dri:amd64	18.0.5-0ubuntu0~16.04.1	
implementation of the OpenGI		unido i free
ii libgl1-mesa-glx:amd64	18.0.5-0ubuntu0~16.04.	1 amd64 free
implementation of the OpenGI		1 amas i nec
ii libglapi-mesa:amd64	18.0.5-0ubuntu0~16.04.1	amd64 free
implementation of the GL API		umao i mee
ii libglib2.0-0:amd64	2.48.2-0ubuntu4.4	amd64 GLib library of C
routines		
ii libglib2.0-bin	2.48.2-0ubuntu4.4	amd64 Programs for the GLib
library		110811111111111111111111111111111111111
ii libglib2.0-data	2.48.2-0ubuntu4.4	all Common files for GLib
library	_,	
ii libglib2.0-dev	2.48.2-0ubuntu4.4	amd64 Development files for
the GLib library		1
ii libglu1-mesa:amd64	9.0.0-2.1	amd64 Mesa OpenGL utility
library (GLU)		1 3
ii libglu1-mesa-dev:amd64	9.0.0-2.1	amd64 Mesa OpenGL utility
library development files		1
ii libgmp10:amd64	2:6.1.0+dfsg-2	amd64 Multiprecision
arithmetic library	J	-
ii libgmp3-dev	2:6.1.0+dfsg-2	amd64 Multiprecision arithmetic
library developers tools	g	-
ii libgmp-dev:amd64	2:6.1.0+dfsg-2	amd64 Multiprecision
arithmetic library developers to	ools	
ii libgmpxx4ldbl:amd64	2:6.1.0+dfsg-2	amd64 Multiprecision
arithmetic library (C++ binding	gs)	
ii libgnutls30:amd64	3.4.10-4ubuntu1.6	amd64 GNU TLS library -
main runtime library		
ii libgnutls-openssl27:amd64	3.4.10-4ubuntu1.6	amd64 GNU TLS library
- OpenSSL wrapper		
ii libgomp1:amd64	5.4.0-6ubuntu1~16.04.12	amd64 GCC OpenMP
(GOMP) support library		
ii libgpg-error0:amd64	1.21-2ubuntu1	amd64 library for common
error values and messages in G	-	
ii libgssapi3-heimdal:amd64	9	-4ubuntu1.16.04.1 amd64
Heimdal Kerberos - GSSAPI s		
ii libgssapi-krb5-2:amd64	1.13.2+dfsg-5ubuntu2.1	amd64 MIT Kerberos
runtime libraries - krb5 GSS-A		
ii libhcrypto4-heimdal:amd64		g-4ubuntu1.16.04.1 amd64
Heimdal Kerberos - crypto libr	_	4.1 4.40.04.4
ii libheimbase1-heimdal:amd6	G	sg-4ubuntu1.16.04.1 amd64
Heimdal Kerberos - Base libra	ry	

ii libheimntlm0-heimdal:amo	164 1 7~git2015092	0+dfsø-411	buntu1.16.04.1 amd64
Heimdal Kerberos - NTLM s	O	.o · a156 -ta	buntui:10.04.1 umu04
ii libhogweed4:amd64	3.2-1ubuntu0.16.04	<b>l.</b> 1	amd64 low level
cryptographic library (public-	-key cryptos)		
ii libhtml-format-perl	2.11-2	all	module for transforming
HTML into various formats			
ii libhtml-form-perl	6.03-1	all	module that represents an
HTML form element			
ii libhtml-parser-perl	3.72-1	amd64	collection of modules that
parse HTML text documents	2.22.2	11	_ ,,
ii libhtml-tagset-perl	3.20-2	all	Data tables pertaining to
HTML	E 02.2	11	
ii libhtml-tree-perl	5.03-2	all	Perl module to represent and
create HTML syntax trees	C 01 1	-11	IITTDl:-:
ii libhttp-cookies-perl	6.01-1	all	HTTP cookie jars
ii libhttp-daemon-perl	6.01-1	all	simple http server class module of date conversion
ii libhttp-date-perl routines	6.02-1	all	module of date conversion
	6.11-1	all	perl interface to HTTP style
ii libhttp-message-perl messages	0.11-1	dII	peri interface to HTTP style
ii libhttp-negotiate-perl	6.00-2	all	implementation of content
negotiation	0.00-2	an	implementation of content
ii libhwloc5:amd64	1.11.2-3	amd	Hierarchical view of the
machine - shared libs	1.11.2 5	unia	04 Illetaremear view of the
ii libhwloc-dev:amd64	1.11.2-3	amo	d64 Hierarchical view of the
machine - static libs and head		dill	ao : Inclurement view of the
ii libhwloc-plugins	1.11.2-3	amd6	4 Hierarchical view of the
machine - plugins		umuo	1110101011001 11011 01 010
ii libhx509-5-heimdal:amd64	4 1.7~git20150920	)+dfsg-4ub	untu1.16.04.1 amd64
Heimdal Kerberos - X509 suj	S	0	
ii libibverbs1	1.1.8-1.1ubuntu2	amd	64 Library for direct
userspace use of RDMA (Infi	iniBand/iWARP)		J
ii libibverbs-dev	1.1.8-1.1ubuntu2	am	d64 Development files for
the libibverbs library			-
ii libice6:amd64	2:1.0.9-1	amd64	X11 Inter-Client Exchange
library			
ii libicu55:amd64	55.1-7ubuntu0.4	ar	nd64 International
Components for Unicode			
ii libicu-dev:amd64	55.1-7ubuntu0.4	a	md64 Development files for
International Components for			
ii libidn11:amd64	1.32-3ubuntu1.2	ar	nd64 GNU Libidn library,
implementation of IETF IDN			
ii libio-html-perl	1.001-1	all	open an HTML file with
automatic charset detection	20244	11	
ii libio-socket-ssl-perl	2.024-1	all	Perl module implementing
object oriented interface to S		. 4 45	104 5 1100
ii libisc-export160	1:9.10.3.dfsg.P4-8ubur	ntu1.15	amd64 Exported ISC
Shared Library	0.46.4.4	10.4	
ii libisl15:amd64	0.16.1-1	amd64	manipulating sets and
relations of integer points bou	-	10	amdC4 CNITT
ii libitm1:amd64	5.4.0-6ubuntu1~16.04	.12	amd64 GNU Transactional
Memory Library			

ii libjs-excanvas	0.r3-4	all H7	TML5 Canvas for Internet
Explorer	0,15 1		TIVILO GUIIVUS FOI IIICETIICE
ii libjson-c2:amd64	0.11-4ubuntu2	amd6	4 JSON manipulation
library - shared library	0.11 Tubuntu2	dillao	
ii libjsoncpp1:amd64	1.7.2-1	amd64	library for reading and
writing JSON for C++	11712 1		normy for reading and
ii libk5crypto3:amd64	1.13.2+dfsg-5ubu	ntu2.1	amd64 MIT Kerberos
runtime libraries - Crypto Libra	ary		
ii libkeyutils1:amd64	1.5.9-8ubuntu1	amde	64 Linux Key
Management Utilities (library)			
ii libkmod2:amd64	22-1ubuntu5.2		libkmod shared library
ii libkrb5-26-heimdal:amd64	1.7~git2015092	20+dfsg-4ubuntı	ı1.16.04.1 amd64
Heimdal Kerberos - libraries			
ii libkrb5-3:amd64	1.13.2+dfsg-5ubunt	:u2.1 aı	md64 MIT Kerberos
runtime libraries			
ii libkrb5support0:amd64	1.13.2+dfsg-5ub	untu2.1	amd64 MIT Kerberos
runtime libraries - Support libr	2	_	
ii libldap-2.4-2:amd64	2.4.42+dfsg-2ubur	ntu3.7	amd64 OpenLDAP
libraries			
ii libllvm3.8:amd64	1:3.8-2ubuntu4	amde	Modular compiler and
toolchain technologies, runtime	-		
ii libllvm6.0:amd64	1:6.0-1ubuntu2~16	.04.1 a	md64 Modular compiler
and toolchain technologies, rur			10.
ii liblsan0:amd64	5.4.0-6ubuntu1~16.0	)4.12 ar	nd64 LeakSanitizer a
memory leak detector (runtime	·	10.	
ii libltdl7:amd64	2.4.6-0.1	amd64	System independent dlopen
wrapper for GNU libtool	2.4024	10.4	
ii libltdl-dev:amd64	2.4.6-0.1	amd64	System independent
dlopen wrapper for GNU libtoo		11	1.1
ii liblwp-mediatypes-perl	6.02-1	all	module to guess media type
for a file or a URL	0.00.0	11	TIMEDO 1: C
ii liblwp-protocol-https-perl	6.06-2	all	HTTPS driver for
LWP::UserAgent	0.0 101 0 1 4 0	1	IC4 E 1 T
ii liblz4-1:amd64	0.0~r131-2ubuntu2	amd	Fast LZ compression
algorithm library - runtime	E 1 1-l-l- + 20120C	1.4. Oh	1C4 W7 f
ii liblzma5:amd64	5.1.1alpha+201206	14-2ubuntu2	amd64 XZ-format
compression library ii liblzo2-2:amd64	2.00.1.2	amdC1	data compression library
	2.08-1.2 1:5.25-2ubuntu1.3	amd64	data compression library d64 File type
ii libmagic1:amd64		dille	d64 File type
determination library using "m ii libmailtools-perl	2.13-1	all M	[anipulate email in perl
±	2.13-1	dII IV	lanipulate email in perl
programs ii libmnl0:amd64	1.0.3-5	amd64	minimalistic Netlink
communication library	1.0.5-5	alliu04	minimansuc Neumk
ii libmount1:amd64	2.27.1-6ubuntu3.9	am	d64 device mounting
library	2.27.1 <b>-</b> 0ubuntu3.3	aiii	do4 device mounting
ii libmpc3:amd64	1.0.3-1	amd64	multiple precision complex
floating-point library	1.0.5-1	aniu04	multiple precision complex
ii libmpc-dev:amd64	1.0.3-1	amd64	multiple precision
complex floating-point library		a111u04	maniple precision
ii libmpdec2:amd64	2.4.2-1	amd64	library for decimal
floating point arithmetic (runting		uniu04	norary for accumum
mounis point artuinene (runti	inc morary)		

ii libmpfr4:amd64	3.1.4-1	an	nd64	multiple precision floating-
point computation				
ii libmpfr4-dbg:amd64	3.1.4-1		amd64	multiple precision
floating-point computation (debu				
ii libmpfr-dev:amd64	3.1.4-1	ä	amd64	multiple precision
floating-point computation devel	±			_
1	3.1.4-1	all	multip	ple precision floating-point
computation documentation				
ii libmpx0:amd64	5.4.0-6ubuntu1~16.04.	12	amo	d64 Intel memory
protection extensions (runtime)				10.
ii libncurses5:amd64	6.0+20160213-1ubunt	u1	an	nd64 shared libraries
for terminal handling	0.0.00.000.00.1			
ii libncurses5-dev:amd64	6.0+20160213-1ubu	ntu1	ć	amd64 developer's
libraries for ncurses	0.0.004.0004.0.4.1	_		104
ii libncursesw5:amd64	6.0+20160213-1ubun	ıtu1	a	md64 shared libraries
for terminal handling (wide chara	'	11	1	
1 1	5.09-1	all	modu	le providing low-level
HTTP connection client	1.00.1	11	n 1	11 11
ii libnet-smtp-ssl-perl	1.03-1	all	Peri	module providing SSL
support to Net::SMTP	1 70 1L:131	_	JC 4	David david fa Ca
ii libnet-ssleay-perl	1.72-1build1	ä	amd64	Perl module for Secure
Sockets Layer (SSL) ii libnettle6;amd64	2.2.1		a dC /	l les slessel
	3.2-1ubuntu0.16.04.1		amd64	low level
cryptographic library (symmetric ii libnuma1;amd64	2.0.11-1ubuntu1.1		amd64	Libraries for
	2.0.11-1u0uIIIu1.1		amuo4	Libraries for
controlling NUMA policy ii libnuma-dev:amd64	2.0.11-1ubuntu1.1		amde	54 Development files
for libnuma	2.0.11-1ubuiitu1.1		amuc	54 Development mes
ii libobjc4:amd64	5.4.0-6ubuntu1~16.04.1	2	amd	64 Runtime library for
GNU Objective-C applications	J.4.0-0ubuntu1 10.04.1		ania	04 Runtime library for
ii libobjc-5-dev:amd64	5.4.0-6ubuntu1~16.04	1 1 2	an	nd64 Runtime library
for GNU Objective-C application		.,	un	realitime notary
ii libogg0:amd64	1.3.2-1	an	nd64 (	Ogg bitstream library
ii libopenmpi1.10	1.10.2-8ubuntu1		amd64	high performance
message passing library shared				
ii libopenmpi-dev	1.10.2-8ubuntu1		amd64	high performance
message passing library heade				8 F
ii libp11-kit0:amd64	0.23.2-5~ubuntu16.04.	1	amd	l64 library for loading
and coordinating access to PKCS	S#11 modules - runtime			, e
ii libpam0g:amd64	1.1.8-3.2ubuntu2.1		amd64	l Pluggable
Authentication Modules library				
ii libpam-modules:amd64	1.1.8-3.2ubuntu2.1		ame	d64 Pluggable
Authentication Modules for PAM	1			
ii libpam-modules-bin	1.1.8-3.2ubuntu2.1		amd6	4 Pluggable
Authentication Modules for PAM	I - helper binaries			
ii libpam-runtime	1.1.8-3.2ubuntu2.1		all	Runtime support for the
PAM library				
ii libpciaccess0:amd64	0.13.4-1		amd64	Generic PCI access
library for X				
ii libpcre16-3:amd64	2:8.38-3.1		amd64	Perl 5 Compatible
Regular Expression Library - 16	bit runtime files			

ii libpcre32-3:amd64	2:8.38-3.1	amd64	Perl 5 Compatible
Regular Expression Library - 32 b			1
	2:8.38-3.1	amd64	Perl 5 Compatible Regular
Expression Library - runtime files			1 0
ii libpcre3-dev:amd64	2:8.38-3.1	amd64	Perl 5 Compatible
Regular Expression Library - dev	elopment files		
ii libpcrecpp0v5:amd64	2:8.38-3.1	amd64	Perl 5 Compatible
Regular Expression Library - C++	runtime files		
ii libperl5.22:amd64	5.22.1-9ubuntu0.6	amd64	4 shared Perl library
ii libpipeline1:amd64	1.4.1-2	amd64	pipeline manipulation
library			
ii libpng12-0:amd64	1.2.54-1ubuntu1.1	amd6	64 PNG library -
runtime			
ii libpng12-dev:amd64	1.2.54-1ubuntu1.1	amd	64 PNG library -
development			-
ii libpopt0:amd64	1.16-10	amd64	lib for parsing cmdline
parameters			
ii libprocps4:amd64	2:3.3.10-4ubuntu2.4	amde	library for accessing
process information from /proc		10.4	
ii libpthread-stubs0-dev:amd64	0.3-4	amd64	pthread stubs not
provided by native libc, developm		10.4	1 D 1 A 1' 1' '
ii libpulse0:amd64	1:8.0-0ubuntu3.10	amd64	PulseAudio client
libraries	1.0 0 0	a dC	C4 Dulas Audia aliant
ii libpulse-dev:amd64	1:8.0-0ubuntu3.10	amde	PulseAudio client
development headers and libraries ii libpulse-mainloop-glib0:amd64			amd64 PulseAudio
client libraries (glib support)	1.0.0-000011103.10	,	aiiid04 FuiseAudi0
ii libpython2.7:amd64	2.7.12-1ubuntu0~16.04	0 21	md64 Shared Python
runtime library (version 2.7)	2.7.12-1ubuntuo 10.04	.5 ai	Shared 1 yellon
ii libpython2.7-dev:amd64	2.7.12-1ubuntu0~16.0	04 9	amd64 Header files
and a static library for Python (v2		74.5	undo- freuder mes
ii libpython2.7-minimal:amd64		6.04.9	amd64 Minimal
subset of the Python language (ve		0,0,1,0	111111111111111111111111111111111111111
ii libpython2.7-stdlib:amd64	2.7.12-1ubuntu0~16.0	04.9	amd64 Interactive
high-level object-oriented language	ge (standard library, versio	on 2.7)	
ii libpython3.5:amd64	3.5.2-2ubuntu0~16.04.9	,	nd64 Shared Python
runtime library (version 3.5)			Ţ
ii libpython3.5-dev:amd64	3.5.2-2ubuntu0~16.04	<b>1.</b> 9	amd64 Header files and
a static library for Python (v3.5)			
ii libpython3.5-minimal:amd64	3.5.2-2ubuntu0~16.	.04.9	amd64 Minimal
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ii libpython3.5-stdlib:amd64	3.5.2-2ubuntu0~16.04		amd64 Interactive
high-level object-oriented languag	- '	on 3.5)	
ii libpython3-dev:amd64	3.5.1-3	amd64	header files and a static
library for Python (default)			
ii libpython3-stdlib:amd64	3.5.1-3	amd64	interactive high-level
object-oriented language (default			
ii libpython-dev:amd64	2.7.12-1~16.04	amd6	header files and a
static library for Python (default)	0.5.40.4.40.04	1.0	
ii libpython-stdlib:amd64	2.7.12-1~16.04	amd6	interactive high-level
object-oriented language (default	pytnon version)		

ii libquadmath0:amd64	5.4.0-6ubuntu1~16.04.1	12 amd64	GCC Quad-
Precision Math Library			•
ii libreadline6:amd64	6.3-8ubuntu2	amd64 GN	U readline and
history libraries, run-time librar	ies		
ii libreadline6-dev:amd64	6.3-8ubuntu2	amd64 Gi	NU readline and
history libraries, development fi	les		
ii libreadline-dev:amd64	6.3-8ubuntu2	amd64 GN	NU readline and
history libraries, development fi	les		
ii libroken18-heimdal:amd64	1.7~git20150920+dfs	sg-4ubuntu1.16.04.1	amd64
Heimdal Kerberos - roken supp	ort library		
ii librtmp1:amd64	2.4+20151223.gitfa8646d	-1ubuntu0.1 amd6	4 toolkit for
RTMP streams (shared library)			
ii libsasl2-2:amd64	2.1.26.dfsg1-14ubuntu0.1	amd64	Cyrus SASL -
authentication abstraction librar	9		
ii libsasl2-modules:amd64	2.1.26.dfsg1-14ubuntu	0.1 amd64	Cyrus SASL -
pluggable authentication modul			
ii libsasl2-modules-db:amd64	2.1.26.dfsg1-14ubunt	u0.1 amd64	Cyrus SASL -
pluggable authentication modul			
ii libsdl1.2debian:amd64	1.2.15+dfsg1-3ubuntu0.	.1 amd64	Simple
DirectMedia Layer	4.5.45.16.4.5.1	10.4	1 20 16 16
ii libsdl1.2-dev	1.2.15+dfsg1-3ubuntu0.1	amd64 Si	mple DirectMedia
Layer development files	24401	10.4	1.11 1
ii libseccomp2:amd64	2.4.1-0ubuntu0.16.04.2	amd64	high level
interface to Linux seccomp filte		ICA CELL	. 1 1
ii libselinux1:amd64	2.4-3build2	amd64 SELi	nux runtime shared
libraries	2.2.41:132	JC4 CE1	r :1:
ii libsemanage1:amd64	2.3-1build3	amd64 SE	Linux policy
management library	2.2.15:142	all Camer	man filas fau
ii libsemanage-common	2.3-1build3	all Comr	non files for
SELinux policy management lib ii libsensors4:amd64	1:3.4.0-2	amd64 library	to read
temperature/voltage/fan sensors		alliu64 library	to read
ii libsepol1:amd64		amd64 SELinux	library for
manipulating binary security po		diliu04 SELIliux	illulary for
ii libsigsegv2:amd64	2.10-4	amd64 Library	for handling page
faults in a portable way	2.10-4	amuo4 Endrary	Tor nanding page
ii libslang2:amd64	2.3.0-2ubuntu1.1	amd64 S-L	ang programming
library - runtime version	2.3.0-2ubuntu1.1	anido+ 5-L	ang programming
ii libslang2-dev:amd64	2.3.0-2ubuntu1.1	amd64 S	-Lang
programming library, developm		umao i	24.19
ii libsm6:amd64	2:1.2.2-1	amd64 X11 Ses	ssion Management
library			
ii libsmartcols1:amd64	2.27.1-6ubuntu3.9	amd64 s	mart column output
alignment library			1
ii libsndfile1:amd64	1.0.25-10ubuntu0.16.04.2	amd64	Library for
reading/writing audio files			J
ii libsqlite3-0:amd64	3.11.0-1ubuntu1.3	amd64 SQ	Lite 3 shared
library			
ii libss2:amd64	1.42.13-1ubuntu1.1	amd64 com	nmand-line
interface parsing library			
ii libssl1.0.0:amd64	1.0.2g-1ubuntu4.15	amd64 Se	cure Sockets Layer
toolkit - shared libraries			

ii libstdc++-5-dev:amd64	5.4.0-6ubuntu1~16.	04.1	.2 a	ımd64	4 GNU Standard
C++ Library v3 (development fi ii libstdc++6:amd64	5.4.0-6ubuntu1~16.04	1.12	am	d64	GNU Standard
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ii libsystemd0:amd64 library	229-4ubuntu21.23		amde	04	systemd utility
ii libtasn1-6:amd64	4.7-3ubuntu0.16.04.3		amd6	4	Manage ASN.1
structures (runtime)					
ii libtcl8.6:amd64	8.6.5+dfsg-2		amd64	Tcl (	(the Tool Command
Language) v8.6 - run-time libra	9				
ii libtext-unidecode-perl	1.27-1		all Te	xt::U	nidecode US-
ASCII transliterations of Unico ii libtimedate-perl	2.3000-2	7	all coll	oction	n of modules to
manipulate date/time information		a	iii (011	ectioi	ii oi iiiodules to
ii libtinfo5:amd64	6.0+20160213-1ubuntu	1	amo	164	shared low-level
terminfo library for terminal ha					
ii libtinfo-dev:amd64	6.0+20160213-1ubunt	tu1	an	nd64	developer's
library for the low-level termin					
		ıll			ry support script
ii libtsan0:amd64	5.4.0-6ubuntu1~16.04.1	12	amd	64	ThreadSanitizer a
Valgrind-based detector of data ii libtxc-dxtn-s2tc0:amd64	0~git20131104-1.1		amo	1 <i>C</i> 1	Texture
compression library for Mesa	0/~g1(20131104-1.1		dillo	104	Texture
ii libubsan0:amd64	5.4.0-6ubuntu1~16.04	12	ame	d64	UBSan
undefined behaviour sanitizer (		•	uiii	u0 1	OBoun
ii libudev1:amd64	229-4ubuntu21.23		amd64	1	libudev shared
library					
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URI strings	201122		10.		
ii libusb-0.1-4:amd64	2:0.1.12-28		amd64	use	erspace USB
programming library ii libusb-dev	2:0.1.12-28	ar	md64 u	coren	aco IICD
programming library developm		aı	iiiu04 u	serspa	ace USB
ii libustr-1.0-1:amd64	1.0.4-5		amd64	Micro	o string library:
shared library	_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				yy ·
ii libutempter0:amd64	1.1.6-3		amd64	priv	ileged helper for
utmp/wtmp updates (runtime)					
ii libuuid1:amd64	2.27.1-6ubuntu3.9		amd64	J	Jniversally Unique ID
library	12521 . 02		10.4		1 1 1·1 <i>C</i>
ii libvorbis0a:amd64	1.3.5-3ubuntu0.2		amd64	(	decoder library for
Vorbis General Audio Compres ii libvorbisenc2:amd64	1.3.5-3ubuntu0.2		amd6	1	encoder library for
Vorbis General Audio Compres			aiiiuo	+	encoder norary for
ii libwind0-heimdal:amd64	1.7~git20150920+c	dfsg.	-4ubuntu1.1	6.04.	1 amd64
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ii libwrap0:amd64	7.6.q-25		amd64	Wiet	se Venema's TCP
wrappers library					
ii libwww-perl	6.15-1	all	l simp	le and	d consistent interface
to the world-wide web	C 01 1		-11	امدداد	an of wohote test
ii libwww-robotrules-perl	6.01-1		all d	ıataba	se of robots.txt-
derived permissions ii libx11-6:amd64	2:1.6.3-1ubuntu2.1		amd64	7	K11 client-side library
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ii libx11-data	2:1.6.3-1ubuntu2.1	all X11 client-side library
ii libx11-dev:amd64	2:1.6.3-1ubuntu2.1	amd64 X11 client-side
library (development headers)		
ii libx11-doc	2:1.6.3-1ubuntu2.1	all X11 client-side library
(development documentation)		
ii libx11-xcb1:amd64	2:1.6.3-1ubuntu2.1	amd64 Xlib/XCB interface
library		
ii libx11-xcb-dev:amd64	2:1.6.3-1ubuntu2.1	amd64 Xlib/XCB interface
library (development headers)		
ii libx32asan2	5.4.0-6ubuntu1~16.04.12	amd64 AddressSanitizer a
fast memory error detector (x3	•	
ii libx32atomic1	5.4.0-6ubuntu1~16.04.12	amd64 support library
providingatomic built-in fu	nctions (x32)	
ii libx32cilkrts5	5.4.0-6ubuntu1~16.04.12	amd64 Intel Cilk Plus
language extensions (x32)		
ii libx32gcc1	1:6.0.1-0ubuntu1	amd64 GCC support library
(x32)		
ii libx32gcc-5-dev	5.4.0-6ubuntu1~16.04.12	amd64 GCC support
library (x32 development files	)	
ii libx32gomp1	5.4.0-6ubuntu1~16.04.12	amd64 GCC OpenMP
(GOMP) support library (x32)		•
ii libx32itm1	5.4.0-6ubuntu1~16.04.12	amd64 GNU Transactional
Memory Library (x32)		
ii libx32quadmath0	5.4.0-6ubuntu1~16.04.12	amd64 GCC Quad-
Precision Math Library (x32)		·
ii libx32stdc++6	5.4.0-6ubuntu1~16.04.12	amd64 GNU Standard C++
Library v3 (x32)		
ii libx32ubsan0	5.4.0-6ubuntu1~16.04.12	amd64 UBSan undefined
behaviour sanitizer (x32)		
ii libxau6:amd64	1:1.0.8-1	amd64 X11 authorisation library
ii libxau-dev:amd64	1:1.0.8-1	amd64 X11 authorisation library
(development headers)	111.0.0 1	unido! IIII addioilbadion iibiai y
ii libxaw7:amd64	2:1.0.13-1	amd64 X11 Athena Widget
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ii libxcb1:amd64	1.11.1-1ubuntu1	amd64 X C Binding
ii libxcb1-dev:amd64	1.11.1-1ubuntu1	amd64 X C Binding,
development files	1.11.1 Idodiita	umdo4 A C Dinding,
ii libxcb-dri2-0;amd64	1.11.1-1ubuntu1	amd64 X C Binding, dri2
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ii libxcb-dri2-0-dev:amd64	1.11.1-1ubuntu1	amd64 X C Binding, dri2
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ii libxcb-dri3-0:amd64	1.11.1-1ubuntu1	amd64 X C Binding, dri3
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ii libxcb-dri3-dev:amd64	1 11 1 1ubuntu1	amd64 V C Binding dri2
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ii libxcb-glx0:amd64	1.11.1-1ubuntu1	amd64 X C Binding, glx
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ii libxcb-glx0-dev:amd64	1.11.1-1ubuntu1	amd64 X C Binding, glx
extension, development files	1 11 1 1 1 1 1	ICA Y O D' T'
ii libxcb-present0:amd64	1.11.1-1ubuntu1	amd64 X C Binding,
present extension		

ii libxcb-present-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding,
present extension, development			
ii libxcb-randr0:amd64	1.11.1-1ubuntu1	amd64	X C Binding, randr
extension			
ii libxcb-randr0-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding, randr
extension, development files			
ii libxcb-render0:amd64	1.11.1-1ubuntu1	amd64	X C Binding, render
extension			
ii libxcb-render0-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding,
render extension, development f	iles		· ·
ii libxcb-shape0:amd64	1.11.1-1ubuntu1	amd64	X C Binding, shape
extension			<i>O</i> <sup>2</sup> 1
ii libxcb-shape0-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding,
shape extension, development fi		umus .	11 3 2
ii libxcb-sync1:amd64	1.11.1-1ubuntu1	amd64	X C Binding, sync
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ii libxcb-sync-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding, sync
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ii libxcb-xfixes0:amd64	1.11.1-1ubuntu1	amd64	X C Binding, xfixes
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ii libxcb-xfixes0-dev:amd64	1.11.1-1ubuntu1	amd64	X C Binding,
xfixes extension, development f		104 37	11.0
ii libxcomposite1:amd64	1:0.4.4-1	amd64 X	11 Composite
extension library			
ii libxdamage1:amd64	1:1.1.4-2	amd64 X	11 damaged region
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ii libxdamage-dev:amd64	1:1.1.4-2	amd64 X	K11 damaged region
extension library (development l	•		
ii libxdmcp6:amd64	1:1.1.2-1.1	amd64 X1	.1 Display Manager
Control Protocol library			
ii libxdmcp-dev:amd64	1:1.1.2-1.1	amd64 X	X11 authorisation
library (development headers)			
ii libxext6:amd64	2:1.3.3-1	amd64 X11	miscellaneous
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ii libxext-dev:amd64	2:1.3.3-1	amd64 X11	miscellaneous
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ii libxfixes3:amd64	1:5.0.1-2	amd64 X11	miscellaneous 'fixes'
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ii libxfixes-dev:amd64	1:5.0.1-2	amd64 X1	1 miscellaneous 'fixes'
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ii libxft2:amd64	2.3.2-1	amd64 FreeTy	pe-based font
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ii libxi6:amd64	2:1.7.6-1	amd64 X11 Iı	nput extension library
ii libxinerama1:amd64	2:1.1.3-1		1 Xinerama extension
library	2.1.1.5 1	umuo+ 20	11 Amerana extension
ii libxml2:amd64	2.9.3+dfsg1-1ubuntu0.6	amd64	GNOME XML
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library	2.0122±dfag_1ubuntu0.1	amd64	Dorl interface to
ii libxml-libxml-perl	2.0123+dfsg-1ubuntu0.1	amd64	Perl interface to
the libxml2 library	.] 1 11 1	ת וו	d module for
ii libxml-namespacesupport-per		all Per	rl module for
supporting simple generic name	spaces		

ii libxml-parser-perl XML files	2.44-1build1	amd64	Perl module for parsing
ii libxml-sax-base-perl and filters	1.07-1	all b	ase class for SAX drivers
ii libxml-sax-expat-perl	0.40-2	all P	Perl module for a SAX2
driver for Expat (XML::Pars	•		
ii libxml-sax-perl	0.99+dfsg-2ubuntu1	all	Perl module for using
and building Perl SAX2 XM			
ii libxmu6:amd64 library	2:1.1.2-2	amd64	X11 miscellaneous utility
ii libxmuu1:amd64	2:1.1.2-2	amd64	X11 miscellaneous
micro-utility library			
ii libxpm4:amd64	1:3.5.11-1ubuntu0.	16.04.1 am	nd64 X11 pixmap
library			
ii libxrandr2:amd64	2:1.5.0-1	amd64	X11 RandR extension
library			
ii libxrender1:amd64	1:0.9.9-0ubuntu1	amd6	4 X Rendering
Extension client library			
ii libxshmfence1:amd64	1.2-1	amd64	X shared memory fences
- shared library			
ii libxshmfence-dev:amd64	1.2-1	amd64	X shared memory
fences - development files			
ii libxt6:amd64	1:1.1.5-0ubuntu1	amd64	X11 toolkit intrinsics
library			
ii libxtables11:amd64	1.6.0-2ubuntu3	amd64	9
ii libxtst6:amd64	2:1.2.2-1	amd64	X11 Testing Record
extension library			
ii libxv1:amd64	2:1.0.10-1	amd64	X11 Video extension
library			
ii libxxf86dga1:amd64	2:1.1.4-1	amd64	X11 Direct Graphics
Access extension library		10.4	7744 YF 00 11
ii libxxf86vm1:amd64	1:1.1.4-1	amd64	X11 XFree86 video
mode extension library		10.4	
ii libxxf86vm-dev:amd64	1:1.1.4-1	amd64	X11 XFree86 video
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ii linux-libc-dev:amd64	4.4.0-171.200	amd64	4 Linux Kernel Headers
for development	1.2.0.2-1	JC 4	Na dolon consiler and
ii llvm-3.8	1:3.8-2ubuntu4	amd64	Modular compiler and
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ii locales		all GN	NU C Library: National
Language (locale) data [sup]	1:4.2-3.1ubuntu5.4	amd64	system login tools
ii login ii lsb-base	9.20160110ubuntu0.2	all	system login tools Linux Standard Base init
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ii m4	1.4.17-5	amd64 mac	ro processing language
ii make	4.1-6		ty for directing compilation
ii makedev	2.3.1-93ubuntu2~ubur		
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	2.2.8-1  1.10.2-8ubuntu1 es	2.2.8-1  1.10.2-8ubuntu1 es	2.2.8-1 amd64  1.10.2-8ubuntu1 amd64 es	2.2.8-1 amd64 Generic  1.10.2-8ubuntu1 amd64 high performance  1.10.2-8ubuntu1 all high performance  1.7.2p2-4ubuntu2.8 amd64 secure sets amachines  2.2g-1ubuntu4.15 amd64 Secure Social Socia

ii python? 7 dov	2.7.12-1ubuntu0~16	04.0	amd64	Header files and a
ii python2.7-dev static library for Python (v2.7		.04.9	alliu04	Heduel IIIes allu d
ii python2.7-minimal	<i>)</i> 2.7.12-1ubuntu0∼	16 04 9	amd64	Minimal subset of
the Python language (version		10.04.5	anido+	William Subset of
ii python3	3.5.1-3	amd64	interactiv	e high-level object-
oriented language (default pyt		amao+	micractiv	e ingii-ievei object-
ii python3.5	3.5.2-2ubuntu0~16.04	0 2	ımd64 I	nteractive high-level
object-oriented language (vers		. <i>.</i>	111111111111111111111111111111111111111	interactive ingli-lever
ii python3.5-dev	3.5.2-2ubuntu0~16.0	na 9	amd64	Header files and a
static library for Python (v3.5		J <b>4.</b> 3	alliu04	fieduci files aliu a
ii python3.5-minimal	, 3.5.2-2ubuntu0~1	6.04.9	amd64	Minimal subset of
the Python language (version				
ii python3-dev	3.5.1-3	amd64	header	files and a static
library for Python (default)				
ii python3-minimal	3.5.1-3	amde	54 minir	nal subset of the
Python language (default pyth			-	
ii python3-pexpect	4.0.1-1	all	Pvthon 3	module for
automating interactive applica			- <i>y</i>	
ii python3-pip	8.1.1-2ubuntu0.4	all	alterna	tive Python package
installer - Python 3 version of		-		and a superior
ii python3-pkg-resources	20.7.0-1	all	Packa	ge Discovery and
Resource Access using pkg_re				8
ii python3-ptyprocess	0.5-1	all	Run a su	bprocess in a pseudo
terminal from Python 3				ar a promo
ii python3-setuptools	20.7.0-1	all	Python?	B Distutils
Enhancements	201110 2	Q.I.I	1 ) (11011)	
ii python3-wheel	0.29.0-1	all	built-pac	kage format for
Python			· · ·	8
ii python-dev	2.7.12-1~16.04	amd	l64 head	ler files and a static
library for Python (default)				
ii python-minimal	2.7.12-1~16.04	ar	nd64 m	inimal subset of the
Python language (default vers				
ii python-pip-whl	8.1.1-2ubuntu0.4	al	l alterr	native Python
package installer		-		
ii readline-common	6.3-8ubuntu2	al	ll GNU	readline and history
libraries, common files				
ii rename	0.20-4	all I	Perl extensio	n for renaming
multiple files				
	3.1.1-3ubuntu1.2	amd64	fast, ve	ersatile, remote (and
local) file-copying tool				
, 1, 0	.2.2-7	amd64	The GNU se	ed stream editor
ii sensible-utils	0.0.9ubuntu0.16.04.1	all		es for sensible
alternative selection				
ii sgml-base	1.26+nmu4ubuntu1	al	ll SGM	IL infrastructure and
SGML catalog file support				
ii shared-mime-info	1.5-2ubuntu0.2	a	md64 F	reeDesktop.org
shared MIME database and sp		u.	· · · ·	r·o
<u> </u>	1.7.3.1-1	amd64	multipurpo	ose relay for
bidirectional data transfer			Par Po	J
ii systemd	229-4ubuntu21.23	amo	d64 svst	em and service
manager			- ,	
J				

ii systemd-sysv	229-4ubuntu21.23	am	nd64 system and service
manager - SysV links	22 <i>9</i> -4u0untu21.23	an	1004 System and service
ii sysvinit-utils	2.88dsf-59.3ubuntu2	amd	l64 System-V-like utilities
ii sysv-rc	2.88dsf-59.3ubuntu2	all	System-V-like runlevel
change mechanism	2.00001 00.000011102	uii	System v interamever
ii tar	1.28-2.1ubuntu0.1	amd64	GNU version of the tar
archiving utility	1,20 2.140411440.1	unido i	GIVE VEISION OF the tar
ii tcl	8.6.0+9	amd64 T	ool Command Language
(default version) - shell	0.0.0	umuo+ 1	oor Communa Danguage
ii tcl8.6	8.6.5+dfsg-2	amd64	Tcl (the Tool Command
Language) v8.6 - shell	0.0.5 10136 2	umuo+	Ter (the 1001 Communa
ii tcl8.6-dev:amd64	8.6.5+dfsg-2	amd	64 Tcl (the Tool Command
Language) v8.6 - developm	9	aniu	104 Tel (the 1001 Command
ii tcl-dev:amd64	8.6.0+9	amd64	Tool Command Language
		dillu04	Tool Command Language
(default version) - development to d		amdC4	Mictae Venemala TCD vynapacy
ii tcpd	7.6.q-25	amd64	Wietse Venema's TCP wrapper
utilities	6.04.11	11	• 6
ii tex-common	6.04ubuntu1	all	common infrastructure for
building and installing TeX		10.4	-
ii texinfo	6.1.0.dfsg.1-5	amd64	Documentation system for
on-line information and pri	-		
ii tzdata	2019c-0ubuntu0.16.04	all	time zone and daylight-
saving time data			
ii ubuntu-keyring	2012.05.19	all	GnuPG keys of the Ubuntu
archive			
ii ucf	3.0036	all Upc	late Configuration File(s):
preserve user changes to co			
ii unzip	6.0-20ubuntu1	amd64	De-archiver for .zip files
ii util-linux	2.27.1-6ubuntu3.9	amd64	miscellaneous system
utilities			
ii wget	1.17.1-1ubuntu1.5	amd64	retrieves files from the web
ii x11-common	1:7.7+13ubuntu3.1	al	l X Window System
(X.Org) infrastructure			
ii x11proto-core-dev	7.0.31-1~ubuntu16	5.04.2	all X11 core wire
protocol and auxiliary head	ers		
ii x11proto-damage-dev	1:1.2.1-2	all	X11 Damage extension
wire protocol			5
ii x11proto-dri2-dev	2.8-2	all	X11 DRI2 extension wire
protocol			
ii x11proto-fixes-dev	1:5.0-2ubuntu2	all	X11 Fixes extension wire
protocol	1.5.0 245411442	uii	THE TIMES CALCULATION WITE
ii x11proto-gl-dev	1.4.17-1	all	X11 OpenGL extension wire
protocol	1.7.1/ 1	un	ATT Openon extension wife
ii x11proto-input-dev	2.3.1-1	all	X11 Input extension wire
protocol	2.3.1-1	an	ATT Input extension wire
*	1.0.7-0ubuntu1	all	X11 XKB extension wire
ii x11proto-kb-dev	1.0./-OUDUIILU I	dll	VII VVD EXIGIIZIOII MILE
protocol	7201	<sub>2</sub> 11	V11 various sytopsis
ii x11proto-xext-dev	7.3.0-1	all	X11 various extension wire
protocol	1 0040	-	1 3744 571 34 3
ii x11proto-xf86vidmode-c	lev 2.3.1-2	al	l X11 Video Mode
extension wire protocol			
ii x11-utils	7.7+3	amd64	X11 utilities

ii xauth	1:1.0.9-1ubuntu2	amd	164 X authentication utility
ii xbitmaps	1.1.1-2	all	Base X bitmaps
ii xdg-user-dirs	0.15-2ubuntu6.16.04.1		amd64 tool to manage well
known user directories			
ii xml-core	0.13+nmu2	all	XML infrastructure and XML
catalog file support			
ii xorg-sgml-doctools	1:1.11-1	all	l Common tools for building
X.Org SGML documentatio	n		
ii xterm	322-1ubuntu1	amde	64 X terminal emulator
ii xtrans-dev	1.3.5-1	all	X transport library (development
files)			
ii xz-utils	5.1.1alpha+20120614-2ub	untu2	amd64 XZ-format
compression utilities			
ii zlib1g:amd64	1:1.2.8.dfsg-2ubuntu4.	1	amd64 compression library -
runtime			
ii zlib1g-dev:amd64	1:1.2.8.dfsg-2ubuntu	4.1	amd64 compression library
- development			
/ Name	Version	Archite	cture Description
Status=Not/Inst/Conf-files/Unpacked/halF-conf/Half-inst/trig-aWait/Trig-pend			