

# X86 EMULATION

## A LOOK INTO EXAGEAR

by Tobias Schaaf

**E**ltechs ExaGear desktop is a virtual machine that implements a software-based x86 Linux container on ARM and allows you to run Intel x86 applications directly. It is like QEMU but 4.5 times faster. You can even run Windows applications on your ARM device if you install Wine. When ExaGear was first announced, I had doubts about its capabilities, and never thought I would actually use it. However, when I installed it a short time ago, I was actually surprised, and want to share my experience and results with x86 emulation on ARM devices using ExaGear.

### Overview

ExaGear is not free, and a license must be purchased from Eltechs at <http://bit.ly/YbPqc5>. ExaGear comes with installable Debian packages and a stripped-down Ubuntu 12.04 x86 image. The package should work on all Debian-based systems such as the official Ubuntu 14.04 images from HardKernel, as well as any Debian image, such as my ODROID GameStation Turbo image.

ExaGear works by running x86 applications on your ARM-based ODROID board using the kernel and drivers coming from your board. It seems to simply translate x86 function calls into ARM equivalents, and for this purpose, it is rather efficient.

### What can you do

Since ExaGear comes with a minimal Ubuntu 12.04 image, you can install and (theoretically) run any program that is compatible with Ubuntu 12.04, which gives a wide range of applications. Basically everything that's in the Ubuntu repository can be installed, including applications that come from Ubuntu partners, like Zentyal and Steam. Generally, everything that runs under the native Linux window management runs surprisingly fast with ExaGear.

### What can't you do

Although you can install everything that come with or exists for Ubuntu 12.04, you are still limited with what you can do with ExaGear. For instance, you can't use any hardware-accelerated applications since the drivers do not support this. Anything that requires OpenGL, for example, will only run in software emulation through MESA software version of



**Exagear runs x86 applications on ARM devices, including the ODROID family**

OpenGL. This means that not all functions are supported, and the graphics are rather slow.

For example, you can install Steam on the ODROID, but you can't run it, since some functions are missing and it won't start. Any applications that requires fancy graphics won't run, and the same applies to Windows applications. Although you can run many Windows x86 applications, those that use heavy DirectX components like 3D games won't work, or will be very slow, and actually will make your ODROID run very hot.

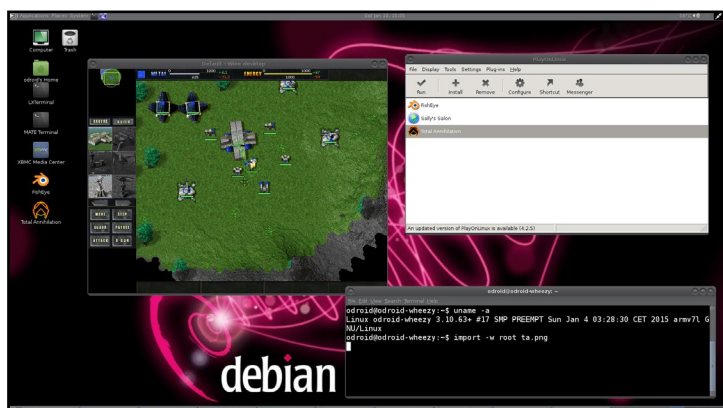
### Real examples

With all that said, you might wonder, what is ExaGear good for and what can you expect? Check out Figure 1 for an example of ExaGear working. As you can see,— it is quite capable but with some limitations.

I have found that many programs have issues with the sound. If there are multiple sound samples playing at the same time the sound gets scratchy with audible delays. So, although gaming is possible to a certain degree, don't expect it to be perfect.

### Skype and TeamViewer

One of the most useful things that you can do with ExaGear is to run applications that are widely used in x86 envi-



**Figure 1 - Windows game Total Annihilation running on the ODROID-U3**

ronments, but that do not exist for ARM. Skype and Teamviewer are two of the best examples. As previously mentioned, if a program does not require any special mechanism, they run perfectly fine on ODROID devices.

Both programs can be used without any restrictions. I have already made calls using Skype on my TV using an ODROID-U3 already, even with a camera for a video call, which runs flawlessly. The same experience applies to for TeamViewer, which in fact uses Wine, and means that it's actually running a Windows application directly on the ODROID. As shown in Figure 2, you can even run both Skype and TeamViewer simultaneously.

## Shortcuts

The “normal” way to start a program with ExaGear would be to open a Terminal session and type in the command “exagear”. After that, you are in the x86 environment, where you once again can start certain applications via a command line, for example, typing “skype” to start Skype.

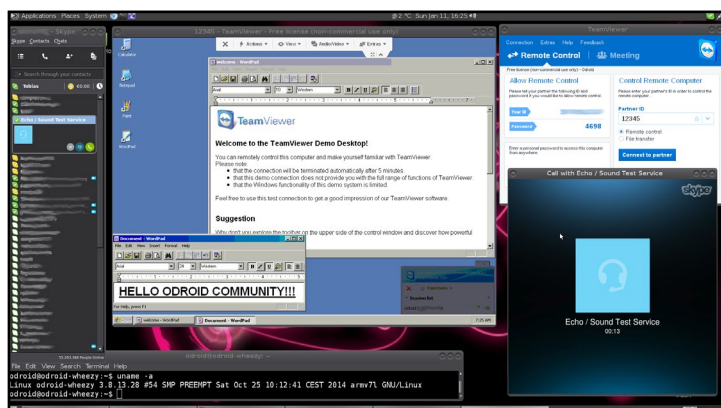
Although this method works, it's a little bit complicated, especially since you can not close this terminal window without terminating the x86 program as well. Therefore, I want to show you how to start programs directly from your ARM environment without using the exagear command.

## Skype

The first thing to do is to find out how programs are started via ExaGear, and see if we can replicate it. To determine this, start Skype using the “normal” method, which assumes that you already have Skype installed in your ExaGear environment. First, start Skype from the terminal:

```
$ exagear
```

Starting the shell in the guest image `/opt/exagear/images/ubuntu-1204lts`



**Figure 2 - Skype and TeamViewer running simultaneously using ExaGear on an ODROID-U3**

```
$ skype
```

Open a new terminal, or a new tab in your current terminal window, and type:

```
$ ps aux | grep skype
```

You will find a line similar to this:

```
odroid    3125   5.7  15.1 828424 314764 ?        S1
16:00    2:59 /opt/exagear/bin/ubt_x32a32_al --path-
prefix /opt/exagear/images/ubuntu-1204lts --vpaths-
list /opt/exagear/images/ubuntu-1204lts/.exagear/
vpaths-list --hifd-base 4095 -f /usr/bin/skype -
skype
```

If your terminal is too short, you might not see the full command line. In that case, use this command instead, which redirects the output to a file called `skype.txt`, which you can open with any text editor.

```
$ ps aux | grep skype > skype.txt
```

Among other information, we can see the command that is used to start Skype:

```
/opt/exagear/bin/ubt_x32a32_al --path-prefix /opt/
exagear/images/ubuntu-1204lts --vpaths-list /opt/
exagear/images/ubuntu-1204lts/.exagear/vpaths-list
--hifd-base 4095 -f /usr/bin/skype -- skype
```

Let's experiment to see if this command actually works. Quit Skype, then open a new terminal session so that you are no longer in the ExaGear environment, and try out this newly found command.

If everything works as intended, you will see Skype start up normally, which means that it was launched directly from your

ARM environment without the extra step of opening the ExaGear environment first. Although this does not seem much of a difference, since you are still using the terminal to start Skype, it's just the first step.

To make things easier, let's prepare a start shortcut for Skype. We don't actually have to do that much work, since such a starter already exists in the ExaGear environment. Let's use that instead of rewriting everything. To do so, open a new terminal and logon as root:

```
$ su
Password:
$ echo "/opt/exagear/bin/ubt_x32a32_al --path-prefix
/opt/exagear/images/ubuntu-1204lts --vpaths-list /
opt/exagear/images/ubuntu-1204lts/.exagear/vpaths-
list --hifd-base 4095 -f /usr/bin/skype - skype" > /
usr/local/bin/skype
$ chmod +x /usr/local/bin/skype
$ cp /opt/exagear/images/ubuntu-1204lts/usr/share/
applications/skype.desktop /usr/local/share/applica-
tions/
$ cp /opt/exagear/images/ubuntu-1204lts/usr/share/
pixmap/skype.png /usr/local/share/pixmap
```

Once these steps are completed, we already have everything that we need in order to start Skype. If you open the program list by clicking the Start button and navigate to Internet, you should find a new icon labelled "Skype". From now on, whenever you want to start Skype, just click on that icon, just like you would in a real x86 environment, and after a short wait, Skype will start up just like a native ARM application.

## TeamViewer

Running TeamViewer directly from a shortcut works similarly to Skype, but is slightly more complicated. TeamViewer has a small problem, since it needs the TeamViewer daemon service, called `teamviewerd`, to start before the actual TeamViewer program. The TeamViewer daemon may only be started as root, so we would have to start ExaGear as the root user, then start the `teamviewerd` service, then logon a second time as a normal user in ExaGear, and finally start TeamViewer. We want to end up with the same simple and direct way of starting TeamViewer as we have with Skype already, so let's apply some Linux magic in order to get it working as desired. To begin, open a new terminal and create the following script:

```
$ su
Password:
$ cat <<EOF > /etc/init.d/teamviewerd_exagear
#!/bin/sh
### BEGIN INIT INFO
```

```
# Provides:          teamviewerd_exagear
# Required-Start:    $local_fs $remote_fs
# Required-Stop:
# X-Start-Before:
# Default-Start:     2 3 4 5
# Default-Stop:      0 1 6
# Short-Description: starts teamviewer daemon
# Description: Starts the teamviewer daemon for
teamviewer useage through exagear.
### END INIT INFO
set -e
case "$1" in
  start)
    # only run as root
    if [ `id -u` -eq 0 ];
    then
        /opt/exagear/bin/ubt_x32a32_al
--path-prefix /opt/exagear/images/ubuntu-1204lts
--vpaths-list /opt/exagear/images/ubuntu-1204lts/.
exagear/vpaths-list --hifd-base 4095 -f /opt/team-
viewer/tv_bin/teamviewerd -- /opt/teamviewer/tv_bin/
teamviewerd
    fi
    ;;
  stop)
    PID=`ps aux | grep "/opt/exagear/bin/ubt_
x32a32_al --path-prefix /opt/exagear/images/ubuntu-
1204lts --vpaths-list /opt/exagear/images/ubuntu-
1204lts/.exagear/vpaths-list --hifd-base 4095 -f /
opt/teamviewer/tv_bin/teamviewerd -- /opt/teamview-
er/tv_bin/teamviewerd" | grep -v grep | awk '{print
$2}'`
    if [ ! -z $PID ];
    then
        kill $PID
    fi
    ;;
  *)
    echo "Usage: $N {start|stop}" >&2
    exit 1
    ;;
esac
exit 0
EOF
$ chmod +x /etc/init.d/teamviewerd_exagear
$ update-rc.d teamviewerd_exagear defaults
```

This creates a service script that can be started as root, which can also run each time you start your ODROID:

```
$ service teamviewerd_exagear start
```

Then, we create a launcher shortcut for TeamViewer, like we did for Skype:

```
$ su
Password:
$ cp /opt/exagear/images/ubuntu-1204lts/usr/share/
applications/teamviewer-teamviewer10.desktop /usr/
local/share/applications/
$ cp /opt/exagear/images/ubuntu-1204lts/opt/team-
viewer/tv_bin/desktop/teamviewer.png /usr/local/
share/pixmaps/
$ cp /usr/local/bin/skype /usr/local/bin/teamviewer
$ pico /usr/local/bin/teamviewer
$ pico /usr/local/share/applications/teamviewer-
teamviewer10.desktop
```

For the last two steps, we need to edit the files slightly. In the file `/usr/local/bin/teamviewer`, replace the word “skype” two times with the word “teamviewer”, then save the file by pressing Ctrl-X, answering with “y” for yes, then pressing Enter twice. Next, in the file `/usr/local/share/applications/teamviewer-teamviewer10.desktop`, change the Icon patch to include just “teamviewer” and nothing else, then save that file as well. Now, we can either start the `teamviewerd_exagear` service manually, or reboot the ODROID and then launch TeamViewer in the same way as we did with Skype, using the Start button’s Internet submenu.

## Caveats

There are some quirks with ExaGear that make things a little bit harder to use. For example, the file access in the ExaGear environment is somewhat slow. Starting TeamViewer can take anywhere from 30 seconds up to a minute on an ODROID-U3, which happens regardless of whether you’re using an eMMC module or SD card. You should occasionally

run “apt-get update” in your ExaGear environment in order to update the package lists, or else some packages may not be installed during the TeamViewer or Skype installation.

If you perform a system update using “apt-get upgrade” and/or “apt-get dist-upgrade” command, you might encounter several issues, since the image was highly modified. I noticed that a few things were forgotten, such as altering the `inittarfs-tools` to disable the creation of an `initrtd.img` file, which isn’t possible anyway. Also, some packages will fail to update, which requires some Linux expertise to fix, but an upgrade is probably not really necessary once everything is working.

Another issue is that ExaGear distributes tasks over all CPU cores, which is generally a very good thing since it uses all the power it can get, but it also can lead to a very hot CPU if an application uses a lot of CPU power. For example, I was running a Windows application called Blender on my XU3 using ExaGear and Wine, which resulted in all 8 cores running at 100%, and even with the fan spinning at its maximum speed, the temperature rose to over 94°C (200°F)!

Overall, I really like what you can do with ExaGear, and although I was very skeptical when it was first announced, I have to say it’s doing a very good job.

## Wine

If you use ExaGear with Wine, a very convenient program is PlayOnLinux, which allows you to easily configure and install Windows applications under Wine. If you try to run full-screen applications such as games using Wine, you need to configure Wine to run in a fake desktop with a size of 800x600 or 1024x768, rather than allow it to run natively in Linux. PlayOnLinux may spare you some of these resolution problems, especially with the C1, which cannot change resolutions on the fly. PlayOnLinux also makes recovery easier when a program hangs, since it is able to actually close the specific program.

# PEW PEW

## SHOOT ‘EM UP FUN WITH SPACE AND ASTEROIDS!

by Bruno Doiche

When classic games are re-invented on modern hardware, they are just the best! Pew Pew is a multi-directional shoot ‘em up for Android. It’s basically megatons of enemies with many different game modes, combined with sweet smooth retro graphics. Win medals, unlock ships, and compete on the online ladder.

<https://play.google.com/store/apps/details?id=com.jyaif.pewpew>

## ANDROID GAMING

