# Will your open source project run on a mainframe? Or on a smartwatch?

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**CPOSC 2024** 

**Otherwise known as:** 

# Open Source Software Development for non-x86 architectures

# l work on mainframes

No, not those ones.



# Hack the mainframe?

No, not movie mainframes.

(but <u>An Ode to Movie Mainframes</u> is a lot of fun, and includes that scene from *Tomorrow Never Dies*)



# Yeah! Well.

This one is made out of  $\text{LEGO}^{\mathbb{R}}$ 



# There we go!

#### IBM z16 and LinuxONE 4





# I like Linux

# I'm focusing on Linux development 🐧

20:33 < cfowler> I think its safe to say that once a new weird platform gets full linux support then its mature enough to use

# The Official **Ubuntu** Official Book

Matthew Helmke Elizabeth K. Joseph José Antonio Rey

Ninth Edition

Foreword by Mark Shuttleworth, founder of ubuntu®

#### Also, I spoke at CPOSC in 2009 - hello again!



#### Non-x86\_64 architectures you'll likely encounter today

Name	Known as…	Common form factors
ARM	aarch64 / arm64	Microcontrollers, embedded, desktops, servers
IBM Z	s390x	Servers
Power	ppc64le	Servers
RISC-V	riscv64	Microcontrollers, embedded, desktops, servers

# Why do various hardware architectures exist?







#### Differing needs and priorities

- Speed
- Reliability
- Cost
- Size
- Tooling
- Power

...

# What does it mean for Linux to run on these architectures?

Thousands of packages make up a Linux distribution.

Does that mean they all need to be recompiled?

## Yes.

#### All the packages are recompiled.

## So, my software is already ported then? Job done! Ta-da!

#### Ok, maybe, but...

#### Your software must meet the following criteria

- Be part of the Linux distribution, and in a repository where they're building for other architectures
- Be important enough for the distribution developers to fix if it breaks on a specific architecture (instead of just being removed)
- Be simple enough for the distribution developers to fix

So HOW do you test it yourself? Glad you asked!

## **Cross-compiling**

"A cross compiler is a compiler capable of creating executable code for a platform other than the one on which the compiler is running." (wikipedia)

**QEMU** is the most popular, most broadly supported open source emulation software, and it's built into a lot of tools, CI systems, and instructions for building for other architectures.

You may also come across **Unicorn**, which is based on QEMU but has a focus on emulating CPU operations (rather than the full environment).

Specific architecture tooling collections often also have their own emulation tools and environments.

### **Cross-compiling: Limitations**

- Doesn't include all features of an architecture
- Lacks full environment (including boot environment, disk, network)
- Limited ability to test interoperability with peripheral devices
- May run slowly

#### Architecture-native environment

Depending on the architecture, this may be:

- A Single Board Computer (SBC) owned by your project for testing (like a Raspberry Pi, or a VisionFive 2)
- A virtual machine hosted by a provider that has servers made available to community members (programs exist for IBM Z, Power)

#### **Architecture-native environment: Limitations**

- Have to get access to one (though there are many programs that make this free for open source projects)
- It's helpful to have a well-connected hosting environment
- Must configure your Linux environment, and keep it up to date
- Still may not have access to every feature and peripheral device you want to test
  - A Raspberry Pi is just one of many types of ARM processor
  - A virtual machine provided to the community for IBM Z may not have all the hardware permutations available to test (though you can ask!)

## **Programming Languages**

Confirm support for the compiler/interpreter on the architecture (most are these days)

High level vs. low level languages

Are you taking advantage of any hardware-specific features in the language? Compression? Cryptography? AI/ML features?

Numbers may trip you up: assumptions around signed vs. unsigned integers, memory addressing



But my code is fairly basic compared to other apps. More people need to know that Intel/AMD x64 isn't the only architecture in town, and simple things like using `printf("%lu")` to print a `size\_t` or assuming `char` is always unsigned will cause your code not to compile on PowerPC or ARM.

#C #Cplusplus #Linux

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## Let's build a pipeline!

## Free-to-Open-Source-Projects CI Systems (2024)

	ARM	IBM Z	Power	RISC-V
CircleCl	Hosted	Self-hosted	Self-hosted	
GitLab (CE)	Hosted	Self-hosted	Self-hosted	
GitHub Actions	Hosted	Self-hosted (unofficial)	Self-hosted (unofficial)	
Jenkins	Self-hosted	Hosted (OSU)	Hosted (OSU)	Self-hosted
Launchpad PPAs	Hosted	Hosted	Hosted	Hosted
openSUSE Build Service (OBS)	Hosted	Hosted	Hosted	Hosted
Travis Cl	Hosted	Hosted	Hosted	

## Linux Distributions WG (find your people)

Feel like the only one who works on or cares about a specific architecture?

We created a Working Group with the Linux Foundation's Open Mainframe Project.

Linux Distributions Working Group		Pa / L
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Save for later

Watching

#### 1eetinas

ated by Elizabeth Joseph, last modified just a moment ago

eetings are held on the 2nd Tuesday of the month. Announcements for upcoming meetings ith joining information and precise time are sent to the mailing list and tracked on the team lendar.

#### 2 March 2023

cording: https://zoom.us/rec/share/metgrwTil0O6gaKVbhHTzZO5TPH4QSAvkrwQKCkKW43HroCmNXLlU04BPmiJVSg\_.tKhDgksvgwdvXvTv

endees

- Elizabeth (Lvz) K. Joseph (IBM)
- Gayathri Berli (Debian)
- Vignesh (Redpanda upstream)
- Marcela Maslanova (SUSE)
- David Edelsohn (IBM)
- Neil Hanlon (Rocky Linux)
- Sarah Julia Kriesh (openSUSE)

#### Agenda

- On Debian librsvg depends on Cairo, Cairo depends on Pixman, so Gayathri has been working on the dependency chain to make sure all the support is in place
- Outstanding gtk bug: https://bugs.debian.org/cgi-bin/bugreport.cgi?bug=1057782 & https://gitlab.gnome.org/GNOME/gtk/-/issues/6260 - but do we really need this on s390x?
- All good from Rocky Linux and SUSE
- Vignesh brought up a dependency chain request via pytorch, which resulted in... https://github.com/pytorch/pytorch/issues/99305 VM request was made for Apache Arrow, which Lyz granted yesterday: https://github.com/apache/arrow/issues/20102

## **Developer Resources: ARM**

- Documentation
- Education (learning paths, training)
- Community (blogs, forums, chat)
- Tools (Arm Development Studio, Hardware/Software success kits)

https://www.arm.com/developer-hub



## **Developer Resources: IBM Z**

- Free access to s390x-native Virtual Machines
- Links to the various CI systems that offer free access to open source software projects

https://openmainframeproject.org/news/developer-resourc es-for-linux-on-s390x/

Further community resources for various aspects of IBM Z/LinuxONE at <u>https://community.ibm.com/z</u>



#### **Developer Resources: Power**

- Various programs for different members of the community (Partners, companies, individuals, etc)
- Documentation around QEMU usage for your development efforts
- *"The OpenPOWER hub providers ... provide free access to OpenPOWER hardware for development and testing on the platform. Each provider has specific configurations available."*

https://community.ibm.com/community/user/powerdeveloper/blogs/l inda-alkire-kinnunen/2022/08/08/accelerate-your-open-source-devel opment-with-acces

Learn more about the OpenPower community which features working groups, chat, documentation, forums and more at <u>https://openpowerfoundation.org/</u>



## **Developer Resources: RISC-V**

Application for free developer boards to projects, criteria for application include:

- Have clear impact contributing patches, testing, or documentation to a significant, established upstream community
- Are proposed by proven open-source software contributors who provide a link to their documented track record in GitHub, GitLab, etc.

#### https://riscv.org/risc-v-developer-boards/details/

• The RISC-V community also has technical forums, chat, mailing lists, documentation





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- Drew Fustini, RISC-V Ambassador

