Linux Rexx Tech Stacks <= A Gig?

Rexx Language Association Symposium 2023

Exploring the Feasibility of Running a Rexx Tech Stack Workstation on a Zero Series Pi SBC

Presenter: Tony Dycks
Last Revised: May 15, 2023

Overview

- Goal of Presentation
- Current State of SBC Market
- Criteria for SBC Workstation
- Selected Single Board Computer and Peripherals
- Candidates for Linux OS Platforms
- Installation Experiences with OS Candidates
- Selected Linux OS Platform
- Rexx Software Stack Selections
- Building Regina Rexx Source Tarball
- Building Rexx/CURL Source Tarball
- Building Rexx/CURL Debian Packages
- Experiences with Rexx Software Selections
- Finding and Recommendations
- List of Resources
- Acknowledgments

Goal of Presentation

Explore and Determine Feasibility of Running a Rexx Development Workstation on a Limited Resource Single Board Computer with the Following Challenges:

What SBC Hardware and Peripherals can Be Used?
What OS Platforms can be Installed and Used?
Is a Window Manager Usable on this Type of Environment?
What Windows Managers can be Used?
What were some of the limitations of using this Type of Environment?
What Types of Rexx Programs run Successfully on this Environment?

Current State of SBC Market

- SBC Electronic Components Supply Chain Issues have drastically affected the availability of **SBCs**
- Particularly **RAM Memory Chips**
- **ARM CPU Chips** are Quite Abundant
- ARM CPUs are the **most Widely Used Processors** in Today's Market
- Examples: Cell Phones, SBCs, Robotics, Drones, plus More
- **Demand for SBCs has soared** and has exceeded many of the Manufacturers Supply Chains
- Thus, **Prices** of these Components have risen significantly
- Since the End of First Quarter 2023, Some Minor decreases in Pi Prices
- Some **Historical Examples** follow ...

Current State of SBC Market

THE RexX LANGUAGE ASSOCIATION

Manufacturer	Model (RAM)	Previous Cost	Current Cost USD	Source
Raspberry Pi	4B (4GB)	$59 November 2020	$146 May 2023	Amazon
Raspberry Pi	Zero W (512MB)	$10 March 2017	$46 May 2023	Amazon
Libre Tech	Le Potato (2GB)	$35 February 2017	$35 May 2023	Amazon
Orange Pi	Zero 2 (1GB)	$19 March 2021	$36 May 2023	Amazon
Banana Pi	P2 Zero (512MB)	$16 August 2018	$40 May 2023	Amazon

Criteria for SBC Workstation

- **SBC Price Ceiling**: < $50 USD for the Board
- **SBC Case**: Around $15 USD for a Fan Cooled Case
- **Storage**: < $20 USD micro SDXC Card of at least 64GB (A1 or A2 Rating)
- **USB**: Enough Ports for a Keyboard Connection (1 Port)
- **HDMI**: Use Existing Monitor rather than a Headless Connection
- **Other Workstation Criteria**:
  - **Enough RAM Memory** to Concurrently Run a “Bare Bones” Window Manager, Rexx Programs (Shell), GUI Based Web Browser & Libre Office
  - **512MB** was too small; Decided on **1 GB Minimum**
  - Use Existing Raspberry Pi USB Keyboard, Mouse and Power Supply
- **OS Platform**: Linux (Either 32-bit or **64-bit**)

Selected Single Board Computer and Peripherals

>>> Selections <<<

SBC: Orange Pi Zero M2 1GB SBC ($45 including shipping)

Case: eleUniverse Orange Pi Zero 2 Case N500, Metal Case with 5V 3010 Cooling Fan and 4pcs Aluminum Heat-sinks

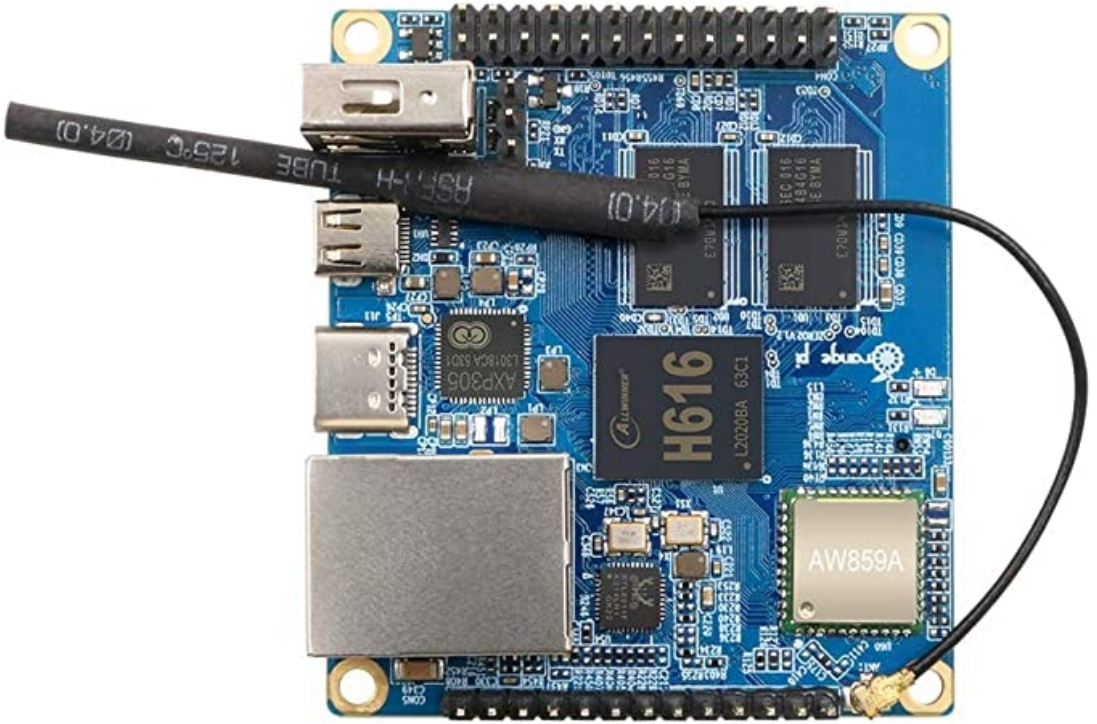
SD Card: SanDisk Ultra micro SDXC 64GB A1 UHS-I Card with Adapter

OS Platform: Debian Linux 10 aarch64 Buster 2.2 Download from Orange Pi Wiki

Selected Single Board Computer and Peripherals

THE RexX LANGUAGE ASSOCIATION

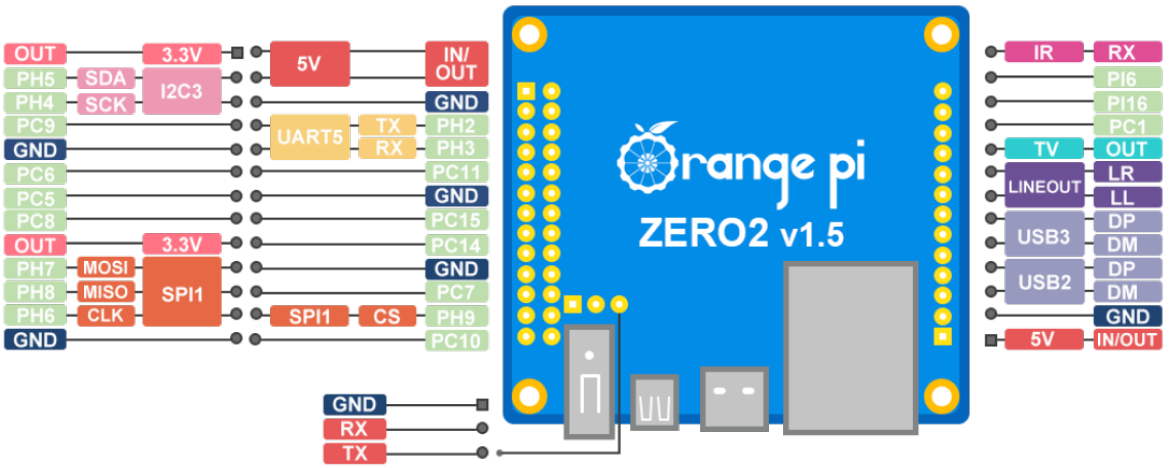
SBC Screenshot:



Selected Single Board Computer and Peripherals

THE RexX LANGUAGE ASSOCIATION

SBC Pin-out Diagram:



Selected Single Board Computer and Peripherals

THE RexX LANGUAGE ASSOCIATION

SBC Case Screenshot:

Selected Single Board Computer and Peripherals

Hardware Features of Orange Pi Zero 2

colspan=2	**Hardware Introduction**
CPU	Allwinner H616 64-bit high-performance Quad-core Cortex-A53 processor
GPU	Mali G31 MP2 Supports OpenGL ES 1.0/2.0/3.2、OpenCL 2.0
Memory(SDRAM)	1GB DDR3 (Shared with GPU)
Onboard Storage	TF card slot、2MB SPI Flash
Onboard Network	Support 1000M/100M/10M Ethernet
WIFI+BT	* AW859A Chip、Support IEEE 802.11 a/b/g/n/ac、BT5.0
Video Outputs	• Micro HDMI 2.0a • TV CVBS output, Support PAL/NTSC（Via 13pin interface board）
Audio output	• Micro HDMI • 3.5mm audio port (Via 13pin interface board)
Power Source	USB Type C interface input
USB 2.0 Ports	3*USB 2.0 HOST（Two of them are via 13pin interface board）
26pin header	With I2Cx1、SPIx1、UARTx1 and multiple GPIO ports
13pin header	With USB 2.0 HOSTx2、TV-OUT、LINE OUT、IR-RX、and 3*GPIO ports
Debug serial port	UART-TX、UART-RX and GND
LED	Power led & Status led

THE RexX LANGUAGE ASSOCIATION

Notes on Peripheral Devices and Storage Used:

- Used Existing **Raspberry Pi USB Keyboard** and **Mouse**
- **USB Mouse** Connected to the Keyboard
- Connected Dell HDMI Monitor to mini HDMI port via an **Adapter**
- **Internet Connection**: CAT 5 Cable to Ethernet Port
- Did not Attempt to Configure **WiFi**
- **San Disk Ultra** 64GB micro SDXC A1 Rated Card or …
- **Amazon Basics** 64GB micro SDXC A2 Rated Card
- **7-Zip** Used to Extract .img File from .7z Archives
- **Balena Etcher** Used to Burn OS Images to micro SDXC Cards
- **FileZilla** FTP Client Used to Transfer Files from USB Thumb Drive from Windows PC on the Same Local Area Network via SFTP to the Orange Pi Storage Card

Candidates for Linux OS Platform

Candidates Considered / Selected:

1) Armbian Jammy 22.11 CLI (Update Issues)
2) Armbian Bullseye 22.11 CLI (Update Issues)
3) Ubuntu 20.04 Server (Orange Pi Wiki Kernel v4.9)
4) Debian Buster Server 2.2 (Orange Pi Wiki K v4.9)
5) Debian Bullseye Server 3.06 (Orange Pi Wiki)

Installation Experiences with OS Candidates

Findings with Candidates Considered / Selected:

1) Armbian Jammy 22.08 CLI <== Issues with Initial Boot of SBM
2) Armbian Bullseye 22.08 CLI <== Issues with Initial Boot of SBM
3) Ubuntu 20.04 Server (Orange Pi Wiki) <== More Failed Initial Boots than OK
4) Debian Buster Server 2.2 (Orange Pi Wiki) <== Booted OK > 90% of Time
5) Debian Bullseye Server 3.06 <== Issues with Initial Boot of SBM

Selected Linux OS Platform

Findings with Debian 10 Buster 2.2:

Pros

- **Consistent Initial Boot** of Flashed micro SDXC Card
- **Consistent Startup** and Reboot After Installation Setup
- Very Few Issues with **User ID Setup** and **Added Software Installations**
- The Installed **Rexx** and **Java** Products Ran OK Sans Major Issues

Cons

- **No Debian Package** for Java OpenJDK 8 (**Open JDK 11** is the Default)
- Used **Adoptium.net Open JDK 8 Tarball** Gzip Download
- Some Issues with use of **UFW** (Uncomplicated Firewall) Software
- Stems from Transition away from legacy **iptables** Firewall
- **Older Linux Kernel** (4.9 works ok; no success with booting for kernel versions 5 and 6)

Selected Linux OS Platform

Download Links for Linux Distros, Orange Pi Zero 2 User Manual and Java OpenJDK 8 Tarball:

Linux Distros

- Orange Pi Wiki: Debian
  - https://drive.google.com/drive/folders/1Xk7b1jOMg-rftowFLExynLg0CyuQ7kCM
- Orange Pi Wiki: Ubuntu
  - https://drive.google.com/drive/folders/1ohxfoxWJ0sv8yEHbrXL1Bu2RkBhuCMup
- Armbian CLI Releases:
  - https://www.armbian.com/orange-pi-zero/

Orange Pi Zero 2 User Manual

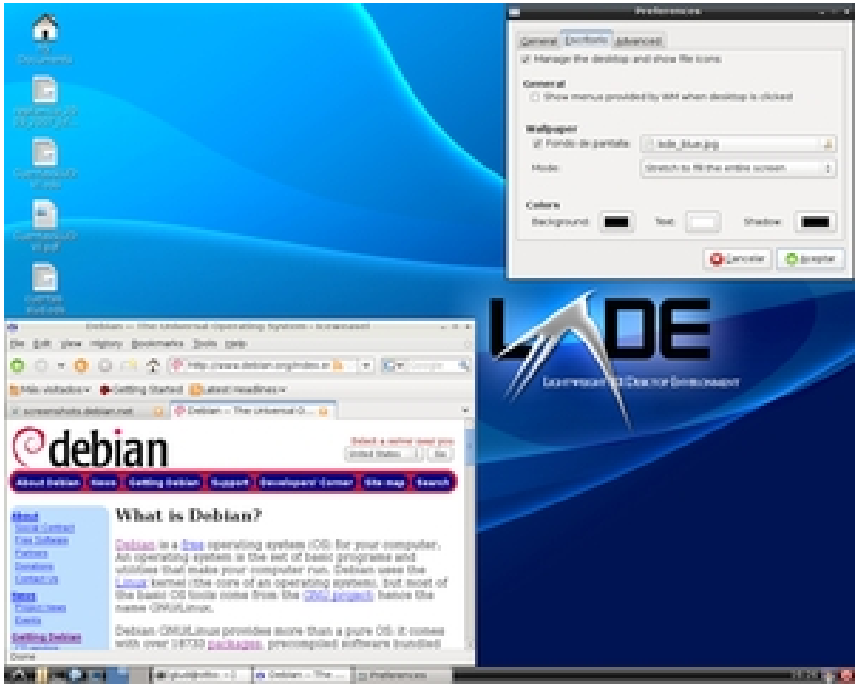
- PDF Download Link:
  - https://drive.google.com/drive/folders/1T7NCV5ZBg1TrB1q_QUQ93GMbq0IlKLFn?usp=sharing

OpenJDK8 Binary Tarball (aarch64)

- Adoptium.net Download Link (Use Drop downs to Select OS, CPU Architecture and Version)
  - https://adoptium.net/download/

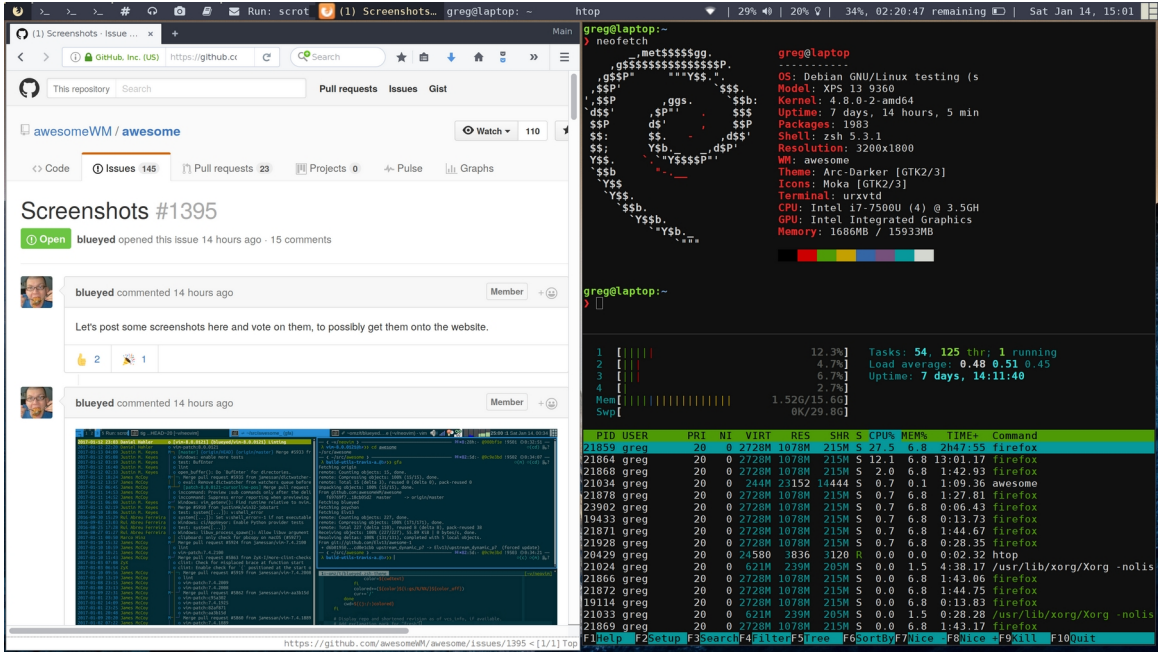
Selected Linux OS Platform

Sample LXDE Debian Screenshot:



Selected Linux OS Platform

Sample Awesome WM Screenshot:



Rexx Software Stack Selections

Rexx Packages List of Installations:

Net Rexx
- NetRexx-4.04-GA

ooRexx
- ooRexx-5.0.0-12583.raspbianpios64.aarch64.deb

BSF4ooRexx
- BSF4ooRexx_install_v850-20230109-beta.zip

Regina
- regina-rexx-3.9.5.tar.gz

Rexx/CURL
- RexxCURL-2.1.0.tar.gz

Rexx Software Stack Selections

Supporting and Prerequisite Packages List of Installations:

Net Rexx
- Adoptium OpenJDK 8 Tarball

ooRexx
- Debian Packages: libncurses-dev

BSF4ooRexx
- LibreOffice and Debian OpenJDK 11 JRE Package: (apt install libreoffice)

Regina
- Debian Package: build-essential (for gcc Compiler Suite and Build utilities)

Rexx/CURL
- Debian Package: libcurl4-openssl-dev

Building Regina Rexx Source Tarball

Extract and Build Regina Rexx from a Bash Command Shell:

$ cd /usr/local
$ sudo cp $HOME/Downloads/regina-rexx-3.9.5.tar.gz .
$ sudo tar xvzf regina-rexx-3.9.5
$ cd regina-rexx-3.9.5
$ sudo ./configure –prefix=/usr
$ sudo make
$ sudo make install

(ooRexx 5 binaries reside in /usr/local/bin)
Install ooRexx and BSF4ooRexx prior to building Regina (BSF4ooRexx Install uses **rxqueue** Binary)

Test Regina Rexx Version:
$ regina -v

Building Rexx/CURL Source Tarball

Extract and Build Regina Rexx/CURL from a Bash Command Shell:

$ cd /usr/local
$ sudo apt install libcurl4-openssl-dev
$ sudo cp $HOME/Downloads/RexxCURL-2.1.0.tar.gz .
$ sudo tar xvzf RexxCURL-2.1.0.tar.gz
$ cd RexxCURL-2.1.0
$ sudo ./configure –prefix=/usr
$ sudo make
$ sudo make install

(ooRexx 5 binaries reside in /usr/local/bin)
Install ooRexx and sBF4ooRexx prior to building Regina

Test Rexx/CURL Utility Version:
$ rexxcurl -v

Test programs can be found in /usr/share/rexxcurl

Building Rexx/CURL Debian Packages

After Steps from the Previous Slide; Stay in the Same Directory:

$ sudo apt install fakeroot debhelper
$ sudo make deb

Creates the Following **Debian Package** .deb Files:

rexxcurl-doc_2.1.0-1_all-Debian-10.deb
rexxcurl-regina-dev_2.1.0-1_arm64-Debian-10.deb
rexxcurl-regina-lib_2.1.0-1_arm64-Debian-10.deb
rexxcurl-regina-tools_2.1.0-1_arm64-Debian-10.deb

Directory:

/usr/local/RexxCURL-2.1.0/packages/DEB

Findings and Recommendations

- **System Response** was Good for the Following **Window Managers**:
  - **LXDE** (GTK Based Desktop; Super-set Used on Raspberry Pis)
  - **LxQT** (QT Variant of LXDE; Super-set Used on LUbuntu Distro)
  - **i3** (Minimalist Tiling Window Manager for X11)
  - **Enlightenment** WM (Can Be Installed as Tiling or Windowing)
  - **Awesome** WM (Lua Based Configuration Window Manager)
  - **JWM** (Joe's Window Manager; XML Based Configuration)
  - **BSPWM** (Binary Tree Based Tiling WM)

Findings and Recommendations

- Failed or Bad Response for the Following Window Managers:
  - **LUbuntu Desktop** (Hang on Attempt to Start DM)
  - **IceWM** (Very Slow and Incomplete Build of Window Menu)
- Window Managers that require Configuration File Mods:
  - **Awesome** (Lua Code), **i3, BSPWM** (Text Files), **JWM** (XML)
- Decent Desktop Response but a Messy Start Menu:
  - **Enlightenment**

Findings and Recommendations

- Installing Full Desktop And Window Managers Debian Meta Packages:
  - **LXDE** $ sudo apt install lxde-desktop (Most like Raspbian)
  - **LxQt** $ sudo apt install lxqt-desktop (Most like LUbuntu)
- Installing The Lightweight X11 Based Window Managers sans a DM:
  - Prerequisite **X11**: $ sudo apt install xorg xinit (startx Security issues with Ubuntu Focal Fossie)
  - **i3**: $ sudo apt install i3 (Plenty of Documentation exists for Customization of Configuration)
  - **Enlightenment**: $ sudo apt install enlightenment terminology
  - **Awesome**: $ sudo apt install awesome (GitHub Sites for Added Custom Widget)
  - **JWM**: $ sudo apt install jwm (Documentation and GitHub Sites for XML Menu Customization)
  - **bspwm**: $ sudo apt install bspwm (GitHub Site and Other Websites for Shell Script Configuration)
- Popular Window Managers Not Considered Due to Their RAM Requirements:
  - **GNOME**, **KDE**, **MATE**, **Budgie, Cinnamon** and **Unity** (>= 4GB RAM)
- Other Possible WM Candidates for Consideration for the Orange Pi Zero 2:
  - **XMonad**, **GnuStep**, **Ratpoison** and **DWM**

Findings and Recommendations

- **Observations for the Following Applications**:
  - **LibreOffice**: Decent Response when using less than 3 concurrent Windows; noticeable slowdown with 4 or more Open Windows. Built this Impress presentation on the Orange Pi Zero 2. Performance started to degrade after adding more than 20 slides. System Freeze When Editing These Slides concurrent with an Open Chromium Web Browser.
  - **Web Browsers**: **Falkon** Web Browser ran much faster than **Chromium** or **Firefox;** decent download speeds on all using CAT5 connection to Fiber Optics Internet. Experienced Slow Sluggishness on Larger Websites with More Web Components and Controls. Configured Browsers to run with Duck Duck Go Search Engine for Privacy concerns.
  - **Filezilla**: Quick Transfer of Files from PCs within the Network for Small Sized Files; Slower for Large File Sizes
  - **ooRexx**: Fast Response for Shell Based Programs; Did not test Windows environment as my preference is to use BSF4ooRexx with Java Swing
  - **Regina Rexx**: Fast Response for Shell Based Programs; Did Not Test GUIs, RexxXML or Rexx/SQL additions.
  - **Rexx/CURL**: Good Response pulling Smaller Web Pages from Internet; Larger Web Page content was slower
  - **Net Rexx**: Fast Reponse Loading and Fetching Data from SQLite3 Databases using JDBC on Shell programs
  - **BSF4ooRexx**: Program Installation was understandably slower; BSF4ooRexx Shell and limited GUI Programs ran well; Slower Response for BSF GUI Program I tested. SQLite3 DB Add and Load Programs Ran Quickly

Findings and Recommendations

- **Observation Limitations for Extended Desktop Use**:
  - **Bare Minimum Hardware** configuration for **Attended Desktop Use**
  - **No Additional USB Ports** for Thumb Drive and Other Peripherals
  - **Good I/O** for **A1** and **A2** Rated SD Cards; Tested: **San Disk Ultra** and **Amazon Basics**
  - These types of SBCs are more frequently used as Single or Restricted Task Servers
  - **Fluttering of Graphics** when Window is Moved or Resized using the Mouse
  - **CPU Temperature** is much hotter when **Multiple processes** are running concurrently. Code builds spiked the Temperature of the SBC
  - **Orange Pi SBCs** are notorious for running hot; CPU Case with **Cooling Fan** and **Heat-sinks** highly recommended to increase board life and extend session use in hot environments

List of Resources – HW Reviews

THE RexX LANGUAGE ASSOCIATION

Orange Pi Zero 2 Website Reviews:

Description	URL	Details
Orange Pi Zero 2 – Review / Benchmark / Tips – ~$35 Price	https://jamesachambers.com/orange-pi-zero-2-review-tips/	Info on Orange Pi Zero 2 tips on use of Heatsinks and Performance Benchmarks
Orange Pi Zero2: Review the Specs	https://all3dp.com/2/orange-pi-zero-2-review-specs/	Source of March 2021 Price Info; Lists Alternative Pi SBCs
Orange Pi Zero2: Small, Powerful, Cost Effective	https://www.tomshardware.com/news/orange-pi-zero2-small-powerful-cost-effective	November 2020 Review of SBC with Specs Summary
Orange Pi Zero 2 Review	https://blog.jmdawson.co.uk/orangepi-zero-2-review/	February 2021 Blog Review with 3D Printer Case; $24 Amazon Price

List of Resources – Orange Pi Wiki

Orange Pi Zero 2 Wiki Info Pages:

Description	URL	Details
Orange Pi Zero 2 Wiki Home Page	http://www.orangepi.org/orangepiwiki/index.php/Orange_Pi_Zero_2	Contains Links for Products, FAQs, Support and Tools for the Orange Pi Zero 2
Hardware Features of the Orange Pi Zero 2	http://www.orangepi.org/orangepiwiki/index.php/Orange_Pi_Zero_2#Hardware_Features_of_Orange_Pi_Zero_2	Hardware Features and Top / Bottom Views of SBC with Port Details
Introduction to the Use of the Development Board	http://www.orangepi.org/orangepiwiki/index.php/Orange_Pi_Zero_2#Introduction_to_the_use_of_the_development_board	Covers Neccessary Accessories, Download Images and Tools for Use of SBC
Orange Pi Zero 2 Overview	http://www.orangepi.org/html/hardWare/computerAndMicrocontrollers/details/Orange-Pi-Zero-2.html	Orangepi.org – Product Information and Hardware Specification Page

List of Resources – WM Config Info

WMs Requiring Extensive Configuration Info Pages:

Description	URL	Config Details
i3	https://i3wm.org/docs/	Contains Links for User's Guide, i3status Configuration and Reference Card plus More
Awesome WM	https://awesomewm.org	**rc.lua** and **theme.lua** Lua Code files are Used to Setup Themes, Task Bar Widgets and Wallpaper Background
bspwm	https://github.com/baskerville/bspwm	Shell Scripts: **bspwmrc** (X Event & Msg handler) and **sxhkdrc** (Socket Keyboard & Pointer Events) Used to Configure WM and Desktop
JWM	https://joewing.net/projects/jwm/config.html	Initial Menus are Limited. XML **.jwmrc** File can be modified to Add Menus Items , Menu Icons and Change Wallpaper , etc.

Acknowledgements – Rexx LA

- **Acknowledgements**
  - **Howard Fosdick** – Suggestions for lightweight Linux Window Managers (JWM in particular)
  - **Till Winkler** – 2022 Symposium Presentation: Linux Tiling Window Managers with ooRexx (i3 WM reference & status bar customization)
  - **Per Olov Jonsson** – Work and Support of Building the ooRexx 5.0 Raspberry Pi OS Debian Packages
  - **Mark Hessling** – Information on the Build of Regina Rexx Debian Packages and Support of Regina Rexx and Rexx/CURL

End of Presentation

- **Questions?**
- **Comments?**
- **Thanks for Your Time and Interest**