Rexx LA Virtual Symposium 2020
A Survey of Linux Distros for the RPi4

Documentation of Installation Experiences, System Use Findings and Recommendations for Implementing a Rexx Desktop Development Environment on the Raspberry Pi 4 Model B Single Board PC.

by Tony Dycks
Last Revised: September 30, 2020
Overview of Presentation

- Objectives for R Pi4 Desktop Environment
- Hardware Utilized with Findings and Recommendations
- Linux Distros Selected with Installation Details, Findings, References and Recommendations
- Linux Packages Installed as Rexxx Pre-Requisites
- Open Object Rexxx Installation Details for Distros
- Net Rexxx Installation Details & Findings for Distros
- BSF4ooRexxx Installation Details for Distros
- Checking the R Pi’s Temperature
- Backing Up the R Pi’s SD Card Image on Another Linux PC
Linux Distro Selection Criteria

Easily Implemented from a Linux or Windows Base Workstation

No Additional Hardware Required Other Than The Raspberry Pi 4 Board, Keyboard, Mouse, Display, Power Supply, microSD Card, Cat 5 Internet Connection and a Base Linux Workstation for setup and backup storage

A Distro that has a good base of Installation Software Packages (Debian, Ubuntu, Arch Linux, Mint, Manjaro, CentOS, Fedora and openSuSE to name the possible candidates)

Stability in the Distro

Linux Based with a reliable GUI Desktop and stable File Manager
Linux Distros Considered and Implemented

Desktop Linux Distros Implemented

Debian Family

- **Raspberry Pi OS**
- **Sparky Linux** (Stripped down Debian implementation for reduced Resource demands)

Ubuntu Family

- **Xubuntu** based on Ubuntu Server v18.04 LTS (Xfce Desktop)
- **Ubuntu Mate** based on Ubuntu Server v20.04 (Mate Desktop)

Arch Linux Family

- **Manjaro Xfce Updated Desktop**
- **Manjaro KDE Plasma Desktop**
- **Arch Linux Xfce Legacy Desktop** (Similar to Debian Buster v10 Xfce Desktop)
Objectives for Rpi4 Desktop Environment

Implement a GUI Based Desktop Workstation to Develop ooRexx, NetRexx and BSF4ooRexx code

Create a Workstation that is faster than a Windows 10 Implementation

Workstation Image will be Easier and Faster to Backup than my Windows 10 Workstation

Complete Backup of System Image not Just The Files

Workstation will have enough Storage Space to Implement a Good Number of Development Software Products (Web Servers, Libre Office Suite, Editors, IDEs, Several Programming Languages in addition to REXX)
Hardware Utilized with Findings and Recommendation - I

Raspberry Pi Board
Version 4 Model B with 4GB RAM Memory

Keyboard and Mouse
Official Raspberry Pi Keyboard and Hub
Official Raspberry Pi Mouse

Cases with Cooling Fans
Canakit Acrylic Premium Case – Available in Black, White or Clear (Fits together without use of any Screws)
Vilros Aluminum Case (4 Screws Used To Put Together Halves of Case Shell) Available Colors: Black and Silver
I Uniker Pi Enclosure for Pi 4 (Colors: White, Black and Clear; 4 Screws used to Fit R Pi Board to bottom half of Case)
Fan Installation in Case

All of the 3 Cases provided Documentation for the GPIO pins to use for Connecting the Fan Wires.

I Uniker Pi Enclosure Case had options for Faster or Slower Fan Speed Installation

Canakit Kit Case Fan Snaps in to the Top of The Case without need for Screws

I Uniker Pi Enclosure and Vilros Aluminum Allow Cases provided 4 Screws for Fan Installation

The Vilros Case and I Uniker cases provided a Screwdriver for Installing the Very Small Screws
Heat Sinks for the Raspberry Pi 4 Board

The I Uniker Pi Enclosure Case had 4 Aluminum Heat Sinks
The Canakit Premium Case had 3 Heat Sinks
The Vilros Case had 2 Heat Sinks (CPU and RAM Chips)

Heat Dissipation

All of the 3 Cases had either 4 installed or installable Rubber Feet for the bottom of the case
The Vilros Aluminum Case was coolest to the touch after extended use
All R Pi Cases performed well in a 86 degree Fahrenheit room
Hardware Utilized with Findings and Recommendation - IV

Canakit Premium Acrylic Case
Canakit Fan and Heat Sinks
Hardware Utilized with Findings and Recommendation - VI

Vilros Heavy Duty Aluminum Case
I Uniker Pi Enclosure Acrylic Case

- Easy Access to All Ports
- Gigabit Ethernet
- USB-C Power
- HDMI
- Audio
- USB 3.0
- USB 2.0
Web Site References for Case Screenshots

Canakit Premium Acrylic Case
https://www.canakit.com/raspberry-pi-4-case-clear.html

Vilros Heavy Duty Aluminum Alloy Case

I Uniker Pi Enclosure Acrylic Case
Basic Starter Kit Recommendation

Vilros Aluminum Alloy Case Basic Starter Kit ($84.99 USD on Amazon)

Pros:
- Case has better heat dissipation over the Acrylic Cases
- Very Good Strong Fan that is fairly quiet compared to my Intel CPU PCs
- Getting Started Documentation is well done
- Screwdriver Provided was Great for Fan and Case Installation
- Power Supply Has On/Off Switch; Canakit Power Supply did not
- A lot of other Aluminum Alloy cases do not provide Heat Syncs or Fans

Cons:
- Very Small Screws; use the Screwdriver Provided with the Kit if you don’t have a good quality small Phillips head screwdriver
- You have to Install the Fan and the Heat Syncs; not that Big of a Challenge
- Exercise caution when Installing the SD Card; it can slip into the Case
- Only 2 Heat Sinks for CPU and RAM Storage Chips
Other Recommendations - 1

SD Card Storage

If you are planning to store a great deal of info on the Card; consider getting a 64GB or larger card. Most R Pi 4 kits currently have 32 or 64 GB cards.

After installing nearly 2500 Debian Packages several of most SDXC Cards have utilized nearly 40% of the Storage space on a 64 GB Card.

Opt for a high quality micro SDXC UHS-I card for improved storage, durability and performance. R Pi 4 may not boot if a poor quality micro-SD card is used.

Personally I used the Samsung EVO Plus or Select 64Gb cards for my storage.

Maker.Pro – What Micro SD Card is Best for a Raspberry Pi 4?
Raspberry Pi 4 Board

Use the 4 GB or 8 GB Versions of the R Pi Board for an effective Desktop PC so that your memory intensive applications run well

Software Examples that require Memory

- Libre Office
- Apache Web Server with Web Apps
- Web Browsers such as Firefox and Chromium
- MongoDB Server

Raspberry Pi 4 8 GB Board Does Generate a bit more heat

Fan cooling Recommended
Other Recommendations - III

Monitor

Personal taste and budget truly influence your choice here.

I decided to go with the Eviciv Monitor as it was the right size (7 Inches Diagonal) and configuration for my limited desktop space (Currently about $77 USD on Amazon)

Amazon Link:

https://www.amazon.com/dp/B07L6WT77H?tag=duckduckgo-d-20&linkCode=os&th=1&psc=1

What may influence your choice is your need for the size of your displayed visual information.
Other Recommendations - IV

Monitor Recommendation Screenshot
Other Recommendations - V

Monitors to Evaluate:

Top 10 Best Raspberry Pi Monitors 2020 Review

Cabling:

Use the leftmost smaller HDMI port immediate to the right of the Power Supply port to connect the Display HDMI cable.

The rightmost smaller port did not yield any video output when I attempted to use that HDMI port for the EVICIV 7 Display.
Raspberry Pi 4 Model B Board

Screenshot Source (raspberrypi.org)


Criteria for Distro Selection

Stable Distro with a large Package Base; Easy to Install and Configure

Candidates Evaluated

**Recommended Choice for Distro Family Group** ...
- Raspberry Pi OS (formerly Raspbian) - *Implemented*
- Sparky Linux - Implemented
- Xubuntu for Raspberry Pi 4 - Implemented
- Ubuntu Mate for Raspberry Pi 4 - *Implemented*
- Manjaro Xfce Desktop - *Implemented*
- Manjaro KDE Plasma Desktop - Implemented
- Arch Linux Xfce Desktop - Implemented
- Balena OS - **Rejected**
- CentOS - **Rejected**
- Alpine Linux - **Rejected**
Reasons for Linux Distros Rejected

**Balena OS**

Concept for OS is based upon Docker Containers; currently my knowledge of Docker is too limited to consider a Docker container based OS solution. I do love the Balena Etcher Card Flash utility. More later.

**Alpine Linux**

Difficult to implement a GUI Desktop Manager solution on the R Pi 4.

After efforts to create both a writeable /usr and /home directory, I could never accomplish both; just one or the other.

**CentOS**

Their development of their existing Raspberry Pi 2/3 Distros has not evolved enough for a easy to install Raspberry Pi 4 solution. In the case of CentOS, only version 7 is available for the R Pi 4 with a limited base of outdated GPG signed packages. Their development repository does have a fair number of unsigned packages for installation.
Linux Distros Selected - II

**Debian Family**
Raspberry Pi OS (formerly Raspbian) – based on Debian Buster Distro
Sparky Linux – Debian based distro with Openbox Desktop Manager

**Ubuntu Family**
Xubuntu – Updated Xfce Desktop based on Ubuntu Server 18.04 LTS
Ubuntu Mate – Mate Desktop based on Ubuntu Server 20.04 LTS
Linux Distros Selected - III

Arch Linux Family

Manjaro Linux Xfce Desktop – Based on Arch Linux v 20.05 – Updated Xfce Desktop

Manjaro KDE Plasma Desktop – Based on Arch Linux v 20.05 – KDE Plasma Desktop (a bit slow on a 4 GB Raspberry Pi 4 board; more later)

Arch Linux – Xfce Legacy Desktop – Similar to Debian Buster v10.4 Xfce Desktop
Raspberry Pi OS (Raspbian)

If you purchased a Raspberry Pi 4 Kit chances are you received a NOOBS SD Card (likely 32GB; go $Bigger or go $HOME)

NOOBS can also be downloaded using the Raspberry Pi Imager from the following link:


This page also contains links for copying images to an SD card

Currently, Raspberry Pi OS is armv71 32 bit architecture

Work is underway for a 64 bit architecture (Beta available for download)

Desktop is one of the more stable implementations and response time on this distro is quite good

This is the easiest Linux distro to implement; good GUI response
Sparky Linux

V5.12 is the latest implementation based upon Debian Buster armv71 architecture (32 Bit)
Openbox Desktop GUI is less polished than the Raspberry OS distro Desktop
Very fast and quite stable; good response on a 4 GB Raspberry Pi 4 board
As of this writing, the older Java OpenJDK v8 is still available for installation from the Sparky/Debian package repository
The Raspbian Version of the ooRexx .deb Package can be used to install ooRexx
This version requires a bit more work to implement vs. Raspberry Pi OS
Vast Library of Installable Packages for the Debian based distros
Fastest response time of all the implementations surveyed
Manjaro Linux Xfce Desktop

Manjaro Installs are 64 bit aarch Architecture
Manjaro Images are the easiest to Install Images

Download the image file
Use Balena Etcher to burn the downloaded image to the SD card

Link to Download Manjaro Xfce

https://www.manjaro.org/downloads/arm/raspberry-pi-4/arm8-raspberry-pi-4-xfce/

Balena Etcher can be used to transfer a downloaded image to a SD card
Website link for Balena Etcher (Downloads for Linux, Windows and Mac OS)

https://www.balena.io/etcher/

Current Version: 20.06 (July 2020)

Xfce Desktop works well on a 4GB Raspberry Pi 4B Board
Manjaro Linux KDE Plasma Desktop

Manjaro Installs are 64 bit aarch Architecture
KDE Plasma is the Slickest Desktop IMHO; it is slower than the Xfce Version of Manjaro
Recommend getting the 8 GB R Pi4 for this distro
Manjaro Images are the easiest to Install Images

**Download the image file**

**Use Balena Etcher to burn the downloaded image to the SD card**

Link to Download Manjaro KDE Plasma

https://www.manjaro.org/downloads/arm/raspberry-pi-4/arm8-raspberry-pi-4-kde-plasma/

Balena Etcher can be used to transfer a downloaded image to a SD card
Website link for Balena Etcher

https://www.balena.io/etcher/

Current Version: 20.06 (July 2020)

KDE Desktop is sluggish on a 4GB Raspberry Pi 4B Board; Dolphin file Manager is buggy
Arch Linux Xfce Desktop

Arch Linux Install chosen was 32 bit armv71 Architecture
Arch Linux armv8 Architecture images are Available for Download
Most difficult distro to install; a great deal of additional customization is required to implement a GUI Desktop and Start the GUI
Still haven’t figured out how to autostart the Xfce Window Manager, Use `startx` to start the X Window Manager after logging in with your User Id and password.
Customization required to Implement the GUI Display Manager
Arch Linux Images are the toughest to Install Images
File and Web Link for Download of ARMv7 Raspberry Pi 4 Image:

   **File:** ArchLinuxARM-rpi-4-latest.tar.gz
   [https://archlinuxarm.org/about/downloads](https://archlinuxarm.org/about/downloads)

Link to Website for Arch Linux Install; Select the **Installation** Tab:
[https://archlinuxarm.org/platforms/armv8/broadcom/raspberry-pi-4#installation](https://archlinuxarm.org/platforms/armv8/broadcom/raspberry-pi-4#installation)
Xubuntu Server for R Pi 4 with Mate Desktop

Download and Etch Ubuntu Server R Pi4 20.04 Image
Install the Ubuntu Server First
Then Install the Mate Desktop (this takes a while)
Setup requires a bit more work than a Raspbian or Manjaro Install
Great Detailed Web Blog Article for Complete A-Z Setup of Ubuntu Mate
Coverage includes audio and firewall setup considerations ( | more)

Home Network Guy Web Link:

How to Install Ubuntu MATE 20.04 LTS (64-bit) on the Raspberry Pi 4
Xubuntu Server for R Pi 4 with Xfce Desktop

Downloaded and Etched Ubuntu Server R Pi4 18.04 LTS Image
Install the Ubuntu Server First
Then Install the Xfce Desktop (this takes a while)
Setup requires a bit more work than the Raspbian or Manjaro Installs, but not as much work as an Arch Linux install
Web Source for Details of Ubuntu Xfce Setup

Ubuntu Web Link for Installation of Ubuntu on the R Pi:
Ubuntu.com -- Tutorials -- How to Install Ubuntu on Your Raspberry Pi
Debian Family Distros (Raspberry Pi OS & Sparky Linux)

**ooRexx**

Given that most Linux Distros have libc installed, you can download the Debian Raspbian package for ooRexx and install it. Recommend ooRexx v4.2 for an easier installation using the Raspbian Dev package. If installing ooRexx 5.0 from a build source, g++, cmake and subversion Linux Development packages are required for code checkout with subversion and build using cmake.

**NetRexx and BSF4ooRexx Pre-requisite**

If your Debian Distro no longer offers the openjdk-8-jdk:armhf package, you will need to install a Oracle Java SE 8 Package; most Debian repositories currently offer Open JDK version 11 installs, but I would recommend installing the Open JDK or Java SE Version 8, which still allows the use of Jar Files vs. Modules (Account Registration required to download from the Oracle Website).

Website link for Linux Oracle Java SE Development Kit 8 Downloads:

[Oracle Java JDK v8 Downloads](#)
Arch Linux Family Distros (Arch Linux & Manjaro Linux)

ooRexx

Although there is an ooRexx Pacman package available in the AUR (Auxiliary Package Repo), I would recommend building ooRexx from a Subversion Release checkout. Use the gcc Pacman package as there is no g++ Pacman package available for installation.

NetRexx and BSF4ooRexx Pre-requisite

If your Arch Linux Distro no longer offers the jdk-openjdk8 (Currently still available as of July 2020) Pacman package, you will need to install a Oracle Java SE JDK 8 Package. Most Pacman repositories currently offer Open JDK version 8 Package installs

Website link for Linux Oracle Java SE Development Kit 8 Downloads::

Oracle Java JDK v8 Downloads
Ubuntu Linux Family Distros (Ubuntu Mate & XUbuntu)

ooRexx

I would recommend building ooRexx from a Subversion Release checkout.

NetRexx and BSF4ooRexx Pre-requisite

If your Arch Linux Distro no longer offers the jdk-openjdk8 (Currently still available as of July 2020) Pacman package, you will need to install a Oracle Java SE JDK 8 Package. Most Pacman repositories currently offer Open JDK version 8 Package installs.

Website link for Linux Oracle Java SE Development Kit 8 Downloads:

Oracle Java JDK v8 Downloads
Debian Family Distros

Install the ooRexx Raspbian Debian Package Available on Source Forge

Alpine Linux & Ubuntu Linux Family Distros

Check Out the Subversion Release and Build ooRexx from Source with the following Linux Commands

1. Install `gcc`, `subversion`, `ncurses` and `cmake` Library Packages with their dependencies using "pacman"

   1. Example: `sudo pacman -S subversion`

2. From a Linux Shell Checkout the subversion ooRexx build from Source Forge:

   1. `svn checkout svn://svn.code.sf.net/p/oorexx/code-0/main/trunk oorexx-code-0`
   2. `cd oorexx-code-0`
   3. `cmake .` (use `sudo` if in a root protected directory such as `/usr` or `/opt`)
   4. `sudo make install`

3. Test the results of your build with the command: `rexx -V`
Recommendation

I prefer to run the nrxInstall Jar setup file and install the Net Rexx files to the ‘/opt/netrexx/’ directory of my workstation using **sudo** (Net Rexx Version 3.03GA). The .zip files can be downloaded and used if a newer version of Net Rexx is desired. **I have implemented v 3.08 GA on a few of the Distros.**

These details apply to all Linux Distros; the only pre-requisite is an install of a java jre or jdk (in my case I used Open JDK 8)

**Location of NetRexx Jar Install File**

[http://netrexx.org/downloads.nsp](http://netrexx.org/downloads.nsp)

**File:** nrxInstall-3.03GA.jar

**Install Net Rexx v3.03 with the Following Command:**

```
sudo java -jar nrxInstall-3.03GA.jar
```

Select ‘/opt/netrexx’ for the installation directories; accept all default options
Copy Net Rexx Files to JRE Library Extensions Directory

I am lazy about setting a Java $CLASSPATH Environment ...

So I create a $JAVA_HOME Environment Variable in my .bashrc file

```bash
export JAVA_HOME=/usr/lib/jvm/<jdk-base-dir>
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk # Arch & Manjaro Linux
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-armhf
    # Sparky Linux & Raspbian (32 Bit)
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-arm64
    # Ubuntu Linux Server (64 Bit)
```

Copy the Net Rexx ‘/opt/netrexx/lib/*.jar’ and ‘/opt/netrexx/runlib/*.jar’ files to the $JAVA_HOME/jre/lib/ext Directory

This allows the JDK javac compiler and the JRE java runtime the ability to find the Jar files without defining a $CLASSPATH
BSF4ooRexx Installation Details for Distros - I

**BSF4ooRexx Version Selected**

Same Installation .Zip file Used for All Linux Distros

**Initially Filename**: BSF4ooRexx_install_v641-20200130-beta.zip

**Revised Filename**: x-deprecated-BSF4ooRexx_install_v641-20200130-beta.zip

**Debian Family Distros (Raspbian and Sparky 32 Bit)**

From a Bash Shell ...

Copy and unzip the downloaded BSF4ooRexx Zip archive

`cd` to the `./install/linux` Directory

From a su logion or via sudo run:

```
sh ./install.sh
```

Copy file: `bsf4ooRexx-v641-20200130-bin.jar` to

`$JAVA_HOME/jre/lib/ext` directory

Copy file: `BSF.CLS` to your Source code directory
Arch Linux Distro (32 Bit)

From a Bash CommandShell ...
Copy and unzip the downloaded BSF4ooRexx Zip archive
`cd` to the `./install/linux` Directory
From a su logion or via sudo run:

```
sh ./install.sh
```

Copy file: `bsf4ooRexx-v641-20200130-bin.jar` to
`$JAVA_HOME/jre/lib/ext` directory
Copy file: `BSF.CLS` to your Source code directory
Ubuntu and Manjaro Linux Distros (64 Bit)

From a Bash Shell
Unzip the downloaded BSF4ooRexx Zip archive

**Recommendation:** use a sub-directory under your $HOME directory

Cd to the ./install/linux Directory

From a **su** logion or via **sudo** run:

```
sh ./install.sh
```

Copy file: `bsf4ooRexx-v641-20200130-bin.jar` to

```
$JAVA_HOME/jre/lib/ext directory
```

Copy the file: `BSF.CLS` to your Source Code directory

Plus More Additional Steps to Build a 64 bit Version of the `libBSF4ooRexx.so` Library ...
Ubuntu and Manjaro Linux Distros (64 Bit)

Build a 64 bit Version of the libBSF4ooRexx.so Library …

Create a build sub-folder name of your choosing on your home directory (I used the sub-folder **build** from my $HOME/bsf4oorexx directory)

Install the Manjaro Linux Package: **subversion** and any dependencies for this package using the command line utility **pacman**:

```
sudo pacman -S subversion
```

Checkout the latest BSF4ooRexx Source Code

URL: https://sourceforge.net/p/bsf4oorexx/code/HEAD/tree/

Use **svn** to Checkout the Current BSF4ooRexx Source Package

```
   cd $HOME/bsf4oorexx/build
   svn checkout https://svn.code.sf.net/p/bsf4oorexx/code/trunk bsf4oorexx-code
```

You should have a directory path similar to what follows:

```
$HOME/bsf4oorexx/build/bsf4oorexx-code/bsf4oorexx.dev/source_cc
```
BSF4ooRexx Installation Details for Distros - V

**Ubuntu and Manjaro Linux Distros (64 Bit)**

**Build a 64 bit Version of the libBSF4ooRexx.so Library ...**

Change to that directory ...

    cd $HOME/bsf4oorexx/build/bsf4oorexx-code/bsf4oorexx.dev/source_cc

Copy the 32 Bit Linux Arm Make to a new File for 64 Bit Mods...

    cp Makefile-32-linux-arm Makefile-64-linux-arm

Modify the following information in the 64 Bit Makefile using a Text Editor:

    JDK BASE=/usr/lib/jvm/java-8-openjdk   # JDK v8 for Ubuntu, Manjaro and Alpine Linux
    BITNESS = 64  # Was BITNESS = 32

Run the following make command to build the 64 Bit Arm Shared Library File:

    make -f Makefile-64-linux-arm all {rebuild can be used as an alternative to all}

Copy the built Library file to the Base Library Directory:

    cp   $HOME/bsf4oorexx/build/bsf4oorexx-code/bsf4oorexx.dev/source_cc/lib/libBSF4ooRExx.so-64-arm  /usr/lib/libBSF4ooRexx.so  {OK to overwrite the existing file in this case}

Make Sure to chmod the destination file so that it is executable

    sudo chmod +x /usr/lib/libBSF4ooRexx.so

Run ldconfig to refresh the Linux Shared Library cache using sudo:

    sudo ldconfig
Possibly the Build of the 64 Bit Library May Not Be Required in the Future ...

A subsequent release of BSF4ooRexx after the v641-20200130 Beta Release is Likely to Include the 64 Bit Arm Library in the Standard Linux Install Setup

Then the build exercise in the preceding slides can be omitted

**Testing**: I used the `JavaVersion.rex` sample program in an older release of the BSF4ooRexx Samples to verify the version of Java that I intended to run as a simple test. There are numerous code samples available in the BSF4ooRexx package available for testing purposes.
Checking the R Pi’s CPU Temperature - I

CPU Temperature Can Be Measured on the R Pi with the Following Shell Command

```
cat /sys/class/thermal/thermal_zone0/temp
```

The resulting value divided by 1000 is the temperature in Celsius

Typically the R Pi 4 CPU will run around 39-49 degrees Celsius for a desktop use session of 2-3 hours

The Next Slide will provide a Sample ooRexx Program to Encapsulate this Linux OS Command

I had to have at least one Rexx Code Sample :-(
Checking the Raspberry Pi’s CPU Temperature - II

Sample Run Bash Shell Screenshot

```
File Edit View Terminal Tabs Help

rpicputemp.rex
Display the Raspberry Pi CPU Temperature in Both Celsius & Fahrenheit
Version 1.0
Written By: Tony Dycks
Revised By: Tony Dycks
Date Written: July 28, 2020
Last Revised: July 28, 2020

CPU Temperature:
41.868 C
107.3624 F

>>> End Of Program -- rpicputemp.rex <<<
[tonyd@ManoWar source]$  
```
Checking th R Pi’s CPU Temperature - III

Core ooRexx Code for Utility

```rexx
-- Mainline Routine
Main:
infnm = './rpitempval.txt'
rpitempcmd = 'cat /sys/class/thermal/thermal_zone0/temp > ' || infnm
address "bash" rpitempcmd

do while lines(infnm) > 0
   inln = linein(infnm)
   tmpC = inln / 1000
   tempF = (tempC * 1.8) + 32
   say 'CPU Temperature:
   say
   say tempC || ' C'
   say tempF || ' F'
end

return

-- Load The RexxUtil Library
LoadRexxUtil: PROCEDURE
   if RxFuncQuery('SysLoadFuncs') THEN
   do
      if RxFuncAdd('SysLoadFuncs', 'RexxUtil', 'SysLoadFuncs') THEN
         do
            say 'Error: Couldn’t Load RexxUtil Library'
         return
      end
   end
```

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The Linux `lsblk` Utility Can Be Used to Verify the SD Card Image Device Id Mounted on Another Linux PC

**Preparation:**

- Shutdown and Power Off the R Pi Workstation You Wish to Backup
- Remove the SD Micro Card from the R Pi’s slot (tweezers can help out here)
- If Your Destination PC has a miniSD slot ... Insert the microSD Card into the SD Adapter card and then insert the miniSD card in the miniSD Slot
- Otherwise you may need a USB microSD Card Adapter; Insert the Adapter in a USB Port of the PC You Wish to Hold the Backup Image
- Verify the microSD Card is mounted; You can use `lsblk` to List Mounted Volumes
  - Card is usually mounted on a secondary or tertiary device
    - `/dev/sdb` or `/dev/sdc` (`/dev/sda` is usually the Linux PC`s Main Hard Drive)

**Syntax:**

- `lsblk`
Back Up The R Pi’s SD Card Image - II

Sample Output of lsblk

In this example

`/dev/sda’ is my 250Gb Hard Drive of my Destination Linux PC
`/dev/sdb’ is my Auto Mounted 64Gb microSD Card from my Raspberry Pi 4 PC
The Linux `dd` Utility Can Be Used to Write the SD Card Image to a File on the Linux PC’s Hard Drive

**Preparation:**

From a Terminal Display; Create a Folder in the Home Directory of your Linux Destination PC to Hold Your R Pi 4 Backup Images Files

For Example:

```
  cd $HOME
  mkdir Rpi4
  cd Rpi4
  mkdir backups
  cd backups
```

**Syntax Example (Image File name of your choosing):**

```
  dd if=/dev/sdb of=$HOME/Rpi4/backups/rpi4-sdimage.img bs=1M status=progress
```
Sample Output of `dd`

In this example:

```
cd $HOME/RaspPi4/backups
sudo dd if=/dev/sdb of=./sparkylinux-2020-07-30.img bs=1M status=progress
```
Restoring the Backup Image

The Balena Etcher Utility can be used to Flash the Backup Image to a new SD Card from the Linux, Windows or Mac Workstation that holds the Backup .img File.

If Reusing a Previously Used Card that may have become Corrupted, it is Recommended that you Reformat and Possibly Repartition the Card based upon the Degree of Use and the Nature of the Corruption (For Example: A Card that is not Bootable).

Or Use the dd Utility to Write The Image File to a New Formatting Card (Linux Workstation)

```
dd if=$HOME/Rpi4/backups/rpi4-sdimage.img of=/dev/sdb bs=1M status=progress
```
Wrapping It Up ...

Acknowledgments ...
Special Thanks for Rene` Jansen and Rony Flatscher for getting me up to speed on the specifics for the ooRexxx and BSF4Rexxx source code Subversion Checkouts, Makefiles and Code Builds

Sample ooRexxx Program

**rpicputemp.rex** – Will be made available with the PDF of the Presentation Slides

Appendix A: Key Website References for This Presentation

Appendix B: List of Key Technologies Referenced

Questions? Thanks for Your Time & Interest
## Reference(s):

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<th>Article</th>
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<tr>
<td>Top 10 Best Raspberry Pi Monitors 2020 Review</td>
<td>by “Pansy”</td>
<td><a href="https://reviewbest1.com/best-raspberry-pi-monitors/">https://reviewbest1.com/best-raspberry-pi-monitors/</a></td>
<td>Cites Eviciv 7” Inch Touchscreen Monitor as Top Choice; Durability</td>
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<tr>
<td>Arch Linux Armhf Image Download</td>
<td>Not Applicable</td>
<td><a href="https://archlinuxarm.org/about/downloads">https://archlinuxarm.org/about/downloads</a></td>
<td>ArchLinuxARM-rpi-4-latest.tar.gz Image Used</td>
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</table>
## Reference(s):

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>URL</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry Pi 4 Arch Linux ARM Installation</td>
<td>Not Applicable</td>
<td><a href="https://archlinuxarm.org/platforms/armv8/broadcom/raspberry-pi-4#installation">https://archlinuxarm.org/platforms/armv8/broadcom/raspberry-pi-4#installation</a></td>
<td>How to Install Arch Linux ARM for R Pi4 on an SD Card</td>
</tr>
<tr>
<td>Home Network Guy – How to Install Ubuntu Mate 20.04 on The Raspberry Pi 4</td>
<td>Dustin Casto</td>
<td><a href="https://homenetworkguy.com/how-to/install-ubuntu-mate-20-04-lts-on-raspberry-pi-4/">https://homenetworkguy.com/how-to/install-ubuntu-mate-20-04-lts-on-raspberry-pi-4/</a></td>
<td>Complete A-Z Article on Setting Up Ubuntu Mate on the R Pi 4</td>
</tr>
<tr>
<td>Canonical Tutorial -- How to Install Ubuntu on Your Raspberry Pi 4</td>
<td>Not Applicable</td>
<td><a href="https://ubuntu.com/tutorials/how-to-install-ubuntu-on-your-raspberry-pi#1-overview">https://ubuntu.com/tutorials/how-to-install-ubuntu-on-your-raspberry-pi#1-overview</a></td>
<td>Paged Tutorial on Setting Up Ubuntu Server and a Desktop on the Raspberry Pi</td>
</tr>
<tr>
<td>Java SE Development Kit 8 Downloads</td>
<td>Not Applicable</td>
<td><a href="https://oracle.com/java/technologies/javase/javase-jdk8-downloads.html">https://oracle.com/java/technologies/javase/javase-jdk8-downloads.html</a></td>
<td>Oracle Java SE JDK 8 Development Kit Downloads</td>
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<tbody>
<tr>
<td>Maker.Pro – OS Options for the Raspberry Pi 4</td>
<td>Eduardo Pecina</td>
<td><a href="https://maker.pro/raspberry-pi/tutorial/os-options-for-raspberry-pi-4">https://maker.pro/raspberry-pi/tutorial/os-options-for-raspberry-pi-4</a></td>
<td>One of the few Web Articles that filters the coverage of OS choices specifically for the Raspberry Pi 4</td>
</tr>
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</table>
## Appendix B: List of Technologies

### Summary of Linux Distro Technologies Installed:

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
<th>Architecture</th>
<th>Notes / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspbian Linux</td>
<td>10 (Buster)</td>
<td>Armv71 32 Bit</td>
<td>Raspberry Pi OS Installed with Noobs (Xfce Like Desktop?)</td>
</tr>
<tr>
<td>Sparky Linux</td>
<td>5.12</td>
<td>Armv71 32 Bit</td>
<td>Based on Debian w. Openbox Desktop (Very Fast &amp; Lean)</td>
</tr>
<tr>
<td>Manjaro Linux Xfce</td>
<td>2020-06-11</td>
<td>Aarch 64 Bit</td>
<td>Rolling Distro 20.05 (New Xfce; Best Choice for Desktop)</td>
</tr>
<tr>
<td>Manjaro Linux KDE</td>
<td>2020-06-11</td>
<td>Aarch 64 Bit</td>
<td>Rolling Distro 20.05 (KDE Plasma; If Choice go 8Gb on your Rpi 4 Board)</td>
</tr>
<tr>
<td>Arch Linux Xfce</td>
<td>2020-07-15</td>
<td>Armv71 32 Bit</td>
<td>Rolling Distro Rpi4 Latest (Old Xfce)</td>
</tr>
<tr>
<td>Xubuntu Linux</td>
<td>18.04 LTS</td>
<td>Aarch 64 Bit</td>
<td>Xubuntu Install on Ubuntu Server (New Xfce)</td>
</tr>
</tbody>
</table>
## Appendix B: List of Technologies +

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
<th>Architecture</th>
<th>Notes / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ubuntu Mate</td>
<td>Server 20.04 LTS</td>
<td>Aarch 64</td>
<td>Mate Desktop Install on Ubuntu Server</td>
</tr>
<tr>
<td>Java Open JDK</td>
<td>8</td>
<td>To Match Distro Arch</td>
<td>Install Debian Package Otherwise Download &amp; Install From Oracle Site</td>
</tr>
<tr>
<td>ooRexx</td>
<td>4.2 or 5.0</td>
<td>To Match Distro Arch</td>
<td>For 32 Bit Distro the Raspbian .Deb File Works Well; For 64 Bit Distros Build From SVN Checkout</td>
</tr>
<tr>
<td>NetRexx</td>
<td>3.03 GA or Later</td>
<td>Pick a Jar or Zip Archive</td>
<td>I prefer the .Jar File Installation</td>
</tr>
<tr>
<td>BSF4ooRexx</td>
<td>641 Beta</td>
<td>Arm 32 and 64</td>
<td>Matches Well with 4.2 or 5.0 ooRexx</td>
</tr>
</tbody>
</table>