SBC Arm Linux Rexx Stack Build Environment

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SBC Arm Linux Rexx Stack Build Environment

Overview

Objective of Presentation

- Create a Headless Single Purpose Server Environment to Build Rexx Software for Both 32 and Possibly 64 Bit Arm Linux Environments
- Use SBC Hardware that will Restrict Cost to $100 or Less
- Use Existing Windows 10 Workstation for Remote SSH Access to SBC Server
- Document Headless Linux OS Setup
- Document Headless Server Access on Windows 10
- Document How to for Native 32 Bit (armv7l) Build Processes
- Test to See if Different Bitness Executables can be Built on the Nano Pi NEO

SBC Hardware for Build Server

FRIENDLY ELEC

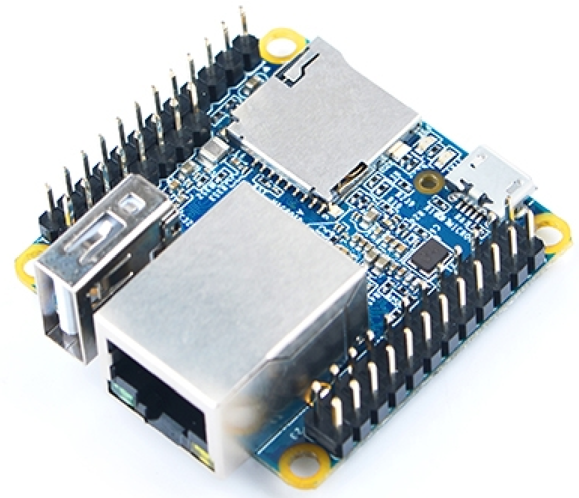
Friendly Nano Pi NEO

- **CPU**: Allwinner H3, Quad-core Cortex-A7 Up to 1.2GHz
- **DDR3 RAM**: 512MB
- **Connectivity**: 10/100M Ethernet
- **USB Host**: Type-A x 1, 2.54 mm pin x 2
- **MicroSD Slot** x 1
- **MicroUSB**: OTG, for power input
- **Debug Serial Port**: 4 Pin, 2.54 mm pitch pin header
- **Audio input/output Por**t: 5 Pin, 2.0mm pitch pin header
- **GPIO**: 2.54mm pitch 36pin. It includes UART, SPI, I2C, IO etc
- **Power Supply**: DC 5V/2A
- **PCB Dimension**: 40 x 40 mm
- **Working Temperatur**e: -20℃ to 70℃
- **Weight**: 14g (WITHOUT Pin-headers)

SBC Hardware for Build Server

Nano Pi NEO SBC

- **$32.99 USD Amazon** (Jan. 2024)



SBC Hardware for Build Server

Nano Pi NEO SBC Aluminum Case with Heatsink Base

- **$12.99 USD Amazon** (Jan. 2024)

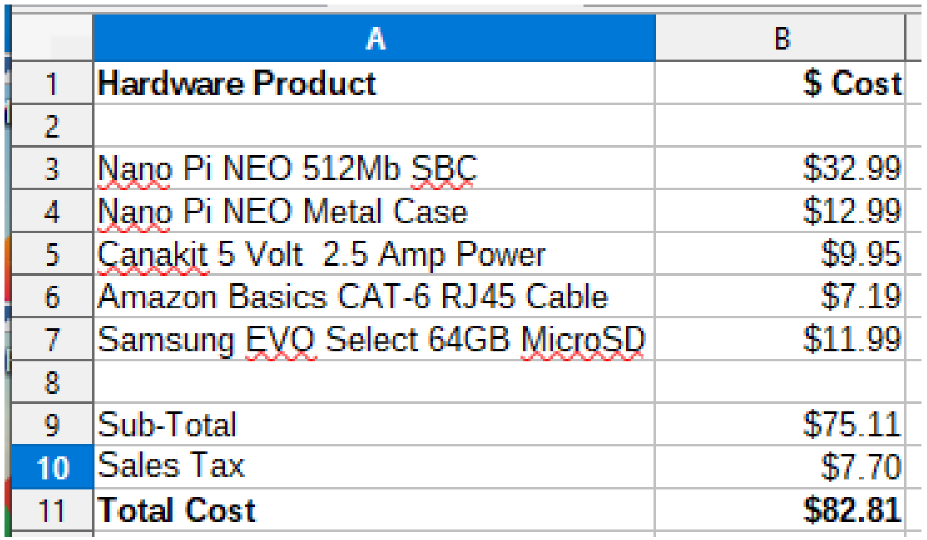
SBC Hardware for Build Server

Additional Hardware with Amazon Prices:

- **Power Supply**:
- CanaKit 5V 2.5A Raspberry Pi 3 B+ Power Supply/Adapter $9.95 USD
- **Ethernet 10/100 Mbps Connectivity**:
- 15 Foot Amazon Basics RJ45 CAT-6 LAN Cable $7.19 USD
- **Disk Storage**:
- Samsung EVO Select 64GB Micro SD Card $11.99 USD

SBC Hardware for Build Server

Amazon.com Total Cost (under $100 USD):



	A	B
1	**Hardware Product**	**$ Cost**
2		
3	Nano Pi NEO 512Mb SBC	$32.99
4	Nano Pi NEO Metal Case	$12.99
5	Canakit 5 Volt 2.5 Amp Power	$9.95
6	Amazon Basics CAT-6 RJ45 Cable	$7.19
7	Samsung EVO Select 64GB MicroSD	$11.99
8		
9	Sub-Total	$75.11
10	Sales Tax	$7.70
11	**Total Cost**	**$82.81**

Linux OS Selection and Installation

- **Armbian Linux for Nano Pi NEO**
- Jammy 23.02 (Ubuntu) CLI
- Older Release due to OS Boot Issues with Linux Kernel v6
- Community Build; Not Officially Supported
- Image File to Download:
  - Armbian_23.02.2_Nanopineo_jammy_current_5.15.93.img.xz
- Why Ubuntu? OpenJDK Version 8 Debian Install Package still Available

Linux OS Selection and Installation

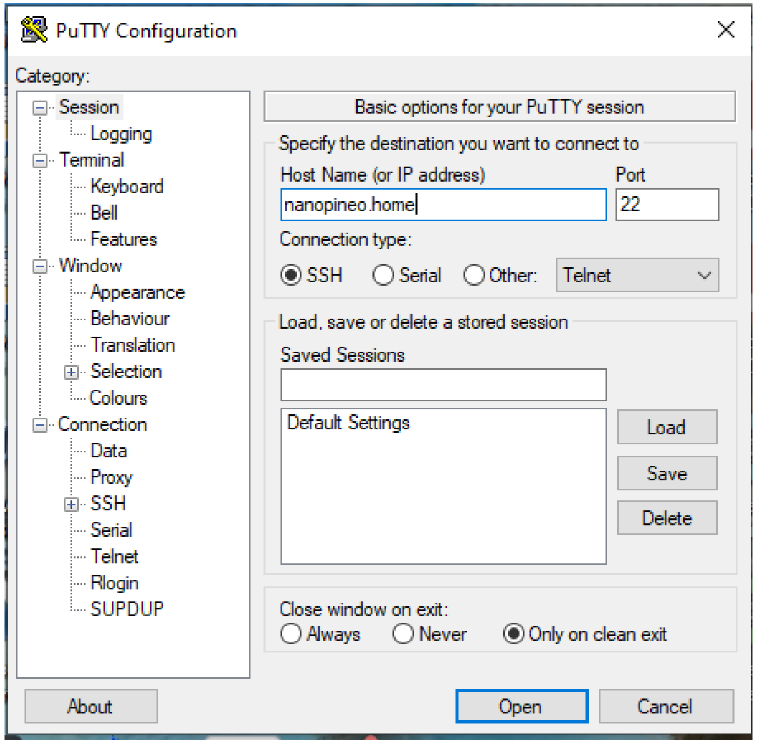
- **Burn Downloaded Image File to MicroSDXC**
- Use Bit Accurate Imaging Utility to Flash OS to MicroSD Card
- **Recommended Tool**: Balena Etcher for Windows or Linux Intel
- Armbian Image Contains Base SSH Image to facilitate **Remote Access**
- No Need to Mess with GPIO pin or USB Port to Connect Serial Display for Data Entry
- Use Remote Access Tools such as **PuTTY** or **Terra Term** on Windows

Setup of Basic Headless Environment on Win 10

- Local Area Network IP Connectivity Detection:
  - Use Tool such as Angry IP Scanner
  - Cross Platform Friendly: Java Based
  - https://angryip.org
- Remote SSH Access Tool for Windows 10-11:
  - PuTTY – https://putty.org
  - Debian Packages Also Available for Linux Distros
  - Download Link: https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
  - Latest Release: v0.80

Setup of Basic Headless Environment on Win 10

- **PuTTY Screenshot**


PuTTY Configuration

Category:
- Session
  - Logging
- Terminal
  - Keyboard
  - Bell
  - Features
- Window
  - Appearance
  - Behaviour
  - Translation
  - Selection
  - Colours
- Connection
  - Data
  - Proxy
  - SSH
  - Serial
  - Telnet
  - Rlogin
  - SUPDUP

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): nanopineo.home

Port: 22

Connection type: [✓ SSH] Serial Other: Telnet

Load, save or delete a stored session

Saved Sessions

Default Settings

Close window on exit: Always Never [✓ Only on clean exit]

Linux OS First Time Remote Access Configuration

- Initial Image **root** User Password: 1234
- System Will Prompt for The Following on First Login:
  - Change of **root** User Password
  - Creation of **New User Id** with **sudo** Privileges
  - Entry of Formal **Name** (Doesn’t need to be too formal)
  - Choice of use of **bash** or **zsh** Command Shell
  - Choice of System **Locale** and **Data Encoding**
  - Choice of Timezone

Linux OS First Time Remote Access Configuration

- Following the Initial Configuration Additional Desired Configuration:
  - Change and Verify the Computer Hostname:
    - # **hostnamectl set-hostname** MyHostName
    - # **hostnamectl**
  - Apply Any System Updates (Kernel Updates are Disabled for Stability):
    - # **apt update**
    - # **apt upgrade**
  - Install Security Related Debian Packages for Firewall and Anti-virus
    - # **apt install ufw clamav**
  - For CLI Environment apt installs Will Be Used to Install all .deb Packages

Rexx Implementations for Build Server

- **Rexx Software for Builds:**
  - **ooRexx v5.1 Beta from Subversion Checkout**
  - **BSF4ooRexx850 from Subversion Checkout**
  - **Regina Rexx v3.9.6 from Downloaded Source Tarball**
  - **Rexx/CURL v2.1.0 from Downloaded Source Tarball**
- **Linux Software Package Pre-Requisites for All The Products**
  - **buildessential** (Already installed for Ubuntu)
  - The **gcc** Compiler Suite will be used for Compilation of All Rexx Products

Rexx Implementations for Build Server

- **Linux Software Package Pre-Requisites for ooRexx**
  - **$ sudo apt install libncurses-dev**
  - **$ sudo apt install subversion**
  - **$ sudo apt install cmake**
- **Linux Software Package Pre-Requisites for BSF4ooRexx850**
  - A Java Runtime or JDK Version 8 or Later
    - Used for this Presentation: **java-8-openjdk** (still available in Ubuntu 22.*)
  - **subversion**
  - **32 Bit ARM ooRexx build or Debian package install**

Rexx Implementations for Build Server

- **Linux Software Package Pre-Requisites for Regina Rexx**
  - **$ sudo apt install pkgconfig**
  - **$ sudo apt install fakeroot** (If Building .deb files)
- **Linux Software Package Pre-Requisites for Rexx/CURL**
  - A Regina Installation or The following Debian Packages
    - **$ sudo apt install regina-rexx**
    - **$ sudo apt install libregina**
    - **$ sudo apt install libregina-dev**
  - **$ sudo apt install libcurl4-ssl-dev**
  - **$ sudo apt install pkgconfig**
  - **$ sudo apt install fakeroot** (If Building .deb files)
  - **$ sudo apt install debhelper** (If Building .deb files for Rexx / CURL)

Mixing ooRexx / BSF4ooRexx Install with Regina Install

- **Regina and ooRexx can co-exist on the same Linux Environment by Separating the Binary and Library Environments**
- **My Strategy for Sequence and Configuration Steps and Options:**

1) Build ooRexx 5.1 Beta Source to Reside in **/usr/local**
2) Install **Java OpenJDK 8 Debian Package**
3) Install **BSF4ooRexx850** (Defaults Install to Linux Base Directory: **/opt/BSF4ooRexx850**)
4) Configure and Build **Regina Source** to Reside in **--prefix=/usr**
5) Configure and Build Rexx/CURL Source to Reside in --**prefix=/usr**

Mixing ooRexx / BSF4ooRexx Install with Regina Install

- **Sample Regina Rexx Source Build How Tos**
  - **Download Regina Rexx v3.9.5 Source Gzipped Tarball**
    - **Extract tarball to /usr/local/ Directory**
    - **$ cd /usr/local/regina-rexx-3.9.5**
    - **$ ./configure --prefix=/usr**
    - **Check End Result of Configure to Confirm SW File Locations**
    - **$ make**
    - **$ make deb** (Optional: If Creating .deb Package)
    - **$ make install** (Or …)
    - **Install the libregina and regina-rexx Debian Binary Packages**

Mixing ooRexx / BSF4ooRexx Install with Regina Install

- **Sample Rexx / CURL Source Build How Tos**
  - **Download Rexx / CURL v2.1.0 Source Gzipped Tarball**
    - **Extract tarball to /usr/local/ Directory**
    - **$ cd /usr/local/rexxcurl-2.1.0**
    - **$ sudo ./configure –prefix=/usr --with-rexx=regina**
    - **Check End Result of Configure to Confirm SW File Locations**
    - **$ sudo make**
    - **$ sudo make deb** (Optional: If Creating .deb Package)
    - **$ sudo make install** (Or …)
    - **Install the 3 Debian Binary Packages**

Attempt to Create a Cross Architecture Rexx Build Environment

- **GCC Compiler Tools for Alternate ARM SBC CPU Bitness**
  - **For the Nano Pi NEO in this presentation the preceding slides have detailed the 32-Bit (armv7l) GCC and G++ Tools (The build-essential Debian Package)**
  - **For 64 Bit (aarch64) One Would Install the Following Debian Packages:**
    - **sudo apt update**
    - **sudo apt install gcc-arm-none-eabi** (bare metal binary)
    - **sudo apt install gcc-arm-linux-gnueabihf** (not available for the 32 Bit Nano Pi NEO Armbian Ubuntu distro)
    - **sudo apt install gcc-aarch64-linux-gnu** (not available for the 32 Bit Nano Pi NEO Armbian Ubuntu distro)

Attempt to Creatie a Cross Architecture Rexx Build Environment

- **Changes to gcc Compiler Steps – A Simple C Program Example**
  - **To Build a helloworld.c Program for the Same Architecture …**
    - **$ gcc -o helloworld helloworld.c**
  - **To Build helloworld.c for a 64-Bit ARM Architecture …**
    - **$ aarch64-linux-gnu-gcc -o helloworld helloworld.c**
  - **To Verify the Architecture Bitness use the Command …**
    - **$ file <executable-path>**
  - **Some Examples:**
    - **$ file ./helloworld**
    - **$ file /usr/bin/regina**
    - **$ file /usr/local/bin/rexx**

Attempt to Create a Cross Architecture Rexx Build Environment

- **64-Bit Natively Built Examples:**
  - **OoRexx 5.0.0 r12523 Native build for aarch64 Architecture:**
  - **tonyd@LedZeppelin:~$ file /usr/local/bin/rexx**
  - **/usr/local/bin/rexx: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, BuildID[sha1]=c7ee09c0ef3b72052a937d2ebfd066f8cd0d435b, for GNU/Linux 3.7.0, not stripped**
  - **Regina 3.9.5 Debian Binary Package Installation for aarch64 Architecture:**
  - **tonyd@LedZeppelin:~$ file /usr/bin/regina**
  - **/usr/bin/regina: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, BuildID[sha1]=78ad3abf8e247064d456f87e6de877617db2bba6, for GNU/Linux 3.7.0, stripped**

Attempt to Create a Cross Architecture Rexx Build Environment

- 32-Bit Natively Built Examples on Nano Pi NEO:
  - ooRexx Native build for armv7l Architecture:
  - tonyd@Easter:~/gcc/source$ file /usr/local/bin/rexx
  - /usr/local/bin/rexx: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, BuildID[sha1]=ea5ba2cf83b5fd3baa228a20107cacb66cafb354, for GNU/Linux 3.2.0, not stripped
  - Regina 3.9.5 Source Built Debian Binary Package Installation for armv7l Architecture:
  - tonyd@Easter:~/gcc/source$ file /usr/bin/regina
  - /usr/bin/regina: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, BuildID[sha1]=ebe6adf8f98d2713e4f293ba3501ee957f7d63ac, for GNU/Linux 3.2.0, stripped

Attempt to Create a Cross Architecture Rexx Build Environment

– Hello World Program Built Examples on Nano Pi NEO:

- Migrated Object from aarch64 Linux Environment will not run due to Architecture Differences:
- tonyd@Easter:~/gcc/source$ file ./helloworld
- ./helloworld: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, BuildID[sha1]=513e8c87c59c8051a8f9ef065c89af49ab1b759f, for GNU/Linux 3.7.0, not stripped
- tonyd@Easter:~/gcc/source$ ./helloworld
- -bash: ./helloworld: cannot execute binary file: Exec format error
- Native Compilation for armv7l Architecture runs Okay:
- tonyd@Easter:~/gcc/source$ file ./helloworld
- ./helloworld: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, BuildID[sha1]=b1cf4551a387171e0ff0a30ddb103d64d285e540, for GNU/Linux 3.2.0, not stripped

Attempt to Create a Cross Architecture Rexx Build Environment

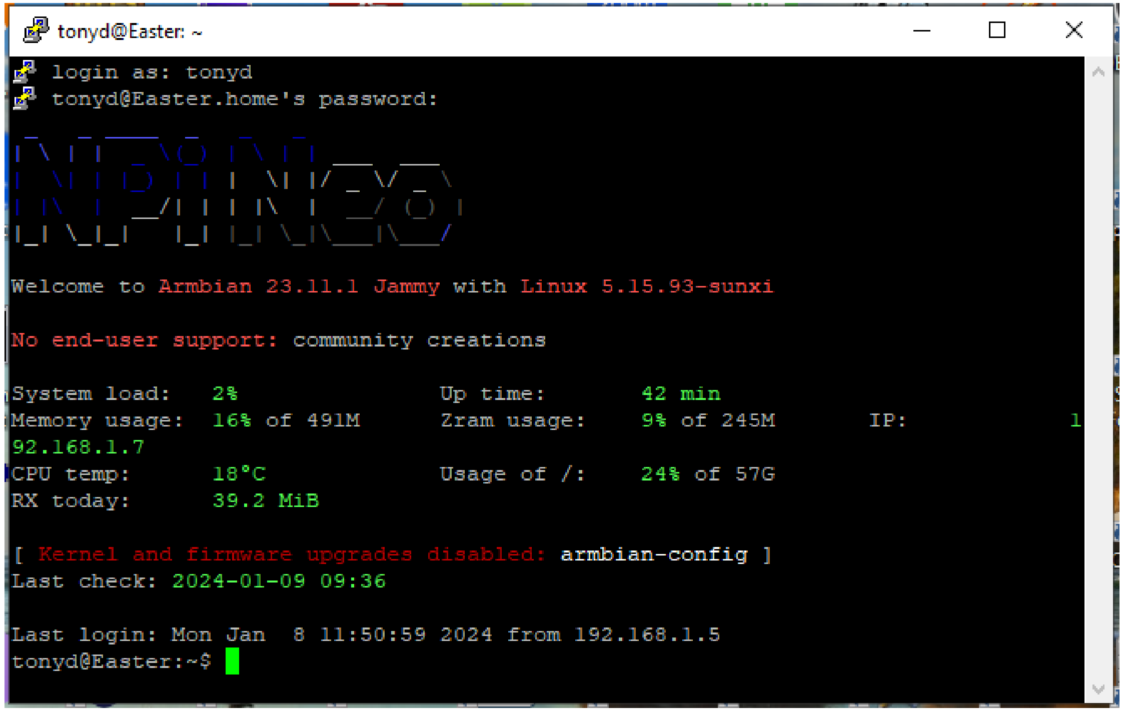
- **Hello World Program Built on Nano Pi NEO:**
  - **Executable Copied to USB Thumb Drive and Copied to Ubuntu 64 Bit Environment**
  - **Make Sure the Migrated Binary has Executable Privileges**
    - **$ chmod +x ./helloworld**
  - **Verify The Architecture is ELF 32-Bit:**
    - **$ file ./helloworld**
  - **Attempt to Run Binary Results:**
    - **No such file or directory** Error Message

Summary of Findings

- The **Nano Pi NEO Runs Exceptionally Cool** when Installed in the Metal Case with the Heatsink; No Need for a Fan
- If **Operating Temperature Reaches Over 70C** Then Additional Cooling will be Necessary
- Since the SBC **Does Not Have a Graphics Processing Unit** (GPU); No Windows Based Programs will Run Successfully
- As an Alternative Use a **Curses Based Progams** or Shell Based Programs can be Used
- **Examples:** Shell Dialogs, Ncurses Based Programs, Nano Text Editor, Midnight Commander, CLI Shell Programs
- Other Linux Distros that Will Run on the Nano Pi NEO:
  - **Armbian Linux Debian 11 Buster CLI** (Linux Kernel v5)
  - **Debian Bookworm 12 CLI**
  - **Diet Pi for Nano Pi NEO** (Debian Bookwork armv7l)
- Avoid the Red Hat Family of Linux Distros due to Boot Issues (Fedora, Oracle, Alma Linux)
- Migrated Natively Built aarch64 and armv7l Architecture Programs Will Not Run on the Other Bitness Linux Distros

Summary of Findings

Sample PuTTY Console Screenshot – Completed Login Message

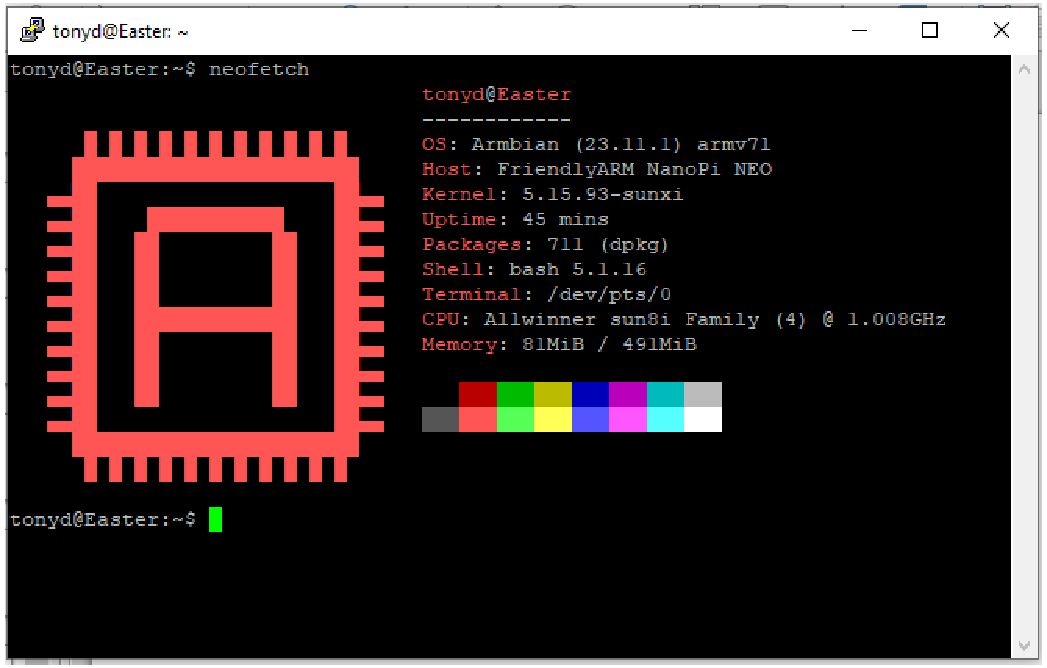


tonyd@Easter: ~

```
login as: tonyd
tonyd@Easter.home's password:
 _   _ ____  _ _   _
| \ | |  _ \(_) \ | | ___  ___
|  \| | |_) | |  \| |/ _ \/ _ \
| |\  |  __/| | |\  |  __/ (_) |
|_| \_|_|   |_|_| \_|\___|\___/

Welcome to Armbian 23.11.1 Jammy with Linux 5.15.93-sunxi

No end-user support: community creations

System load:   2%              Up time:       42 min
Memory usage:  16% of 491M     Zram usage:    9% of 245M      IP:            1
92.168.1.7
CPU temp:      18°C            Usage of /:    24% of 57G
RX today:      39.2 MiB

[ Kernel and firmware upgrades disabled: armbian-config ]
Last check: 2024-01-09 09:36

Last login: Mon Jan  8 11:50:59 2024 from 192.168.1.5
tonyd@Easter:~$
```

Summary of Findings

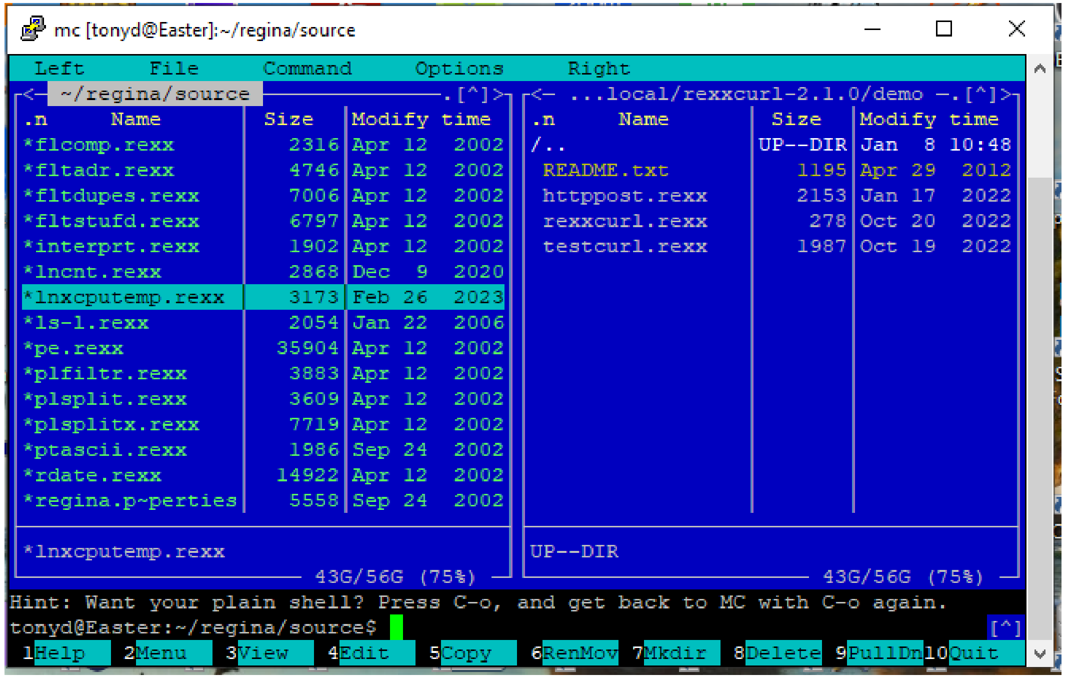
Sample PuTTY Console Screenshot – neofetch Utility Output



```
tonyd@Easter:~$ neofetch
                                  tonyd@Easter
                                  ------------
                                  OS: Armbian (23.11.1) armv7l
                                  Host: FriendlyARM NanoPi NEO
                                  Kernel: 5.15.93-sunxi
                                  Uptime: 45 mins
                                  Packages: 711 (dpkg)
                                  Shell: bash 5.1.16
                                  Terminal: /dev/pts/0
                                  CPU: Allwinner sun8i Family (4) @ 1.008GHz
                                  Memory: 81MiB / 491MiB

tonyd@Easter:~$
```

Summary of Findings

Sample PuTTY Console Screenshot – mc Utility Output



```
mc [tonyd@Easter]:~/regina/source
 Left       File       Command       Options       Right
┌<─ ~/regina/source ──────────────────.[^]>┐┌<─ ...local/rexxcurl-2.1.0/demo ─.[^]>┐
│.n       Name       │ Size │Modify time   ││.n       Name       │ Size │Modify time  │
│*flcomp.rexx        │  2316│Apr 12   2002 ││/..                 │UP--DIR│Jan  8 10:48│
│*fltadr.rexx        │  4746│Apr 12   2002 ││ README.txt         │  1195│Apr 29  2012 │
│*fltdupes.rexx      │  7006│Apr 12   2002 ││ httppost.rexx      │  2153│Jan 17  2022 │
│*fltstufd.rexx      │  6797│Apr 12   2002 ││ rexxcurl.rexx      │   278│Oct 20  2022 │
│*interprt.rexx      │  1902│Apr 12   2002 ││ testcurl.rexx      │  1987│Oct 19  2022 │
│*lncnt.rexx         │  2868│Dec  9   2020 ││                    │      │             │
│*lnxcputemp.rexx    │  3173│Feb 26   2023 ││                    │      │             │
│*ls-l.rexx          │  2054│Jan 22   2006 ││                    │      │             │
│*pe.rexx            │ 35904│Apr 12   2002 ││                    │      │             │
│*plfiltr.rexx       │  3883│Apr 12   2002 ││                    │      │             │
│*plsplit.rexx       │  3609│Apr 12   2002 ││                    │      │             │
│*plsplitx.rexx      │  7719│Apr 12   2002 ││                    │      │             │
│*ptascii.rexx       │  1986│Sep 24   2002 ││                    │      │             │
│*rdate.rexx         │ 14922│Apr 12   2002 ││                    │      │             │
│*regina.p~perties   │  5558│Sep 24   2002 ││                    │      │             │
├──────────────────────────────────────────┤├──────────────────────────────────────┤
│*lnxcputemp.rexx                          ││UP--DIR                               │
└─────────────────────── 43G/56G (75%) ───┘└─────────────────── 43G/56G (75%) ───┘
Hint: Want your plain shell? Press C-o, and get back to MC with C-o again.
tonyd@Easter:~/regina/source$                                                  [^]
 1Help   2Menu   3View   4Edit   5Copy   6RenMov 7Mkdir  8Delete 9PullDn10Quit
```

Summary of Findings

- For Transfer of Files from Other Storage:
  - Utilize a USB Thumb Storage Drive on the One USB Port
  - Setup Example from Command Prompt:
    - $ cd /mnt
    - $ sudo mkdir usb1
    - $ cd $HOME
    - $ sudo mount /dev/sda1 /mnt/usb1
    - $ cd /mnt/usb1
    - $ mc (Use Midnight Commander to Transfer Files from Left Pane to Right Pane)
  - Attempted to Use FileZilla to Transfer Files from Windows 10 PC; Unable to Connect via SFTP(Possibly due to Firewall Settings)

Future To Dos

- For Repeated Builds and File Transfers of Rexx Product Files to and from this SBC Server:
  - Implement a Secured FTP Server Connection to SBC
  - Implement an Automated Build Process with Linux SW Components such as:
    - Subversion
    - Pkgconfig
    - Make and CMake
    - GCC
    - Rexx / CURL
    - Bash Shell Scripting
    - Kron
  - Implement All Necessary Software to Cross Compile ARM 64 Bit Rexx Object Files
    - **Challenges**: Architecture Bitness of Dependent Binary Packages; Differences in USR Library Path Conventions
  - Implement Debian Packaging to Create Binary Installation Package

List of Web Based Resources

- Friendly Elec Nano Pi NEO Wiki:
  - https://wiki.friendlyelec.com/wiki/index.php/NanoPi_NEO
- Armbian OS CLI Alternative Image Download:
  - http://xogium.performanceservers.nl/archive/nanopineo/archive/
- Angry IP Scanner Download for Windows 10:
  - https://angryip.org/download/#windows
- PuTTY SSH Remote Access Software: https://putty.org
- Diet Pi Linux Distro for Nano Pi NEO (based on Debian 12 Bookworm):
  - https://dietpi.com/downloads/images/DietPi_NanoPiNEO-ARMv7-Bookworm.img.xz
- Uncomplicated Firewall Configuration:
  - https://www.digitalocean.com/community/tutorials/how-to-set-up-a-firewall-with-ufw-on-ubuntu-22-04

Acknowledgements of Rexx Language Association Members

- Dr. Rony Flatscher for his Continued Support of the ARM Library Maintenance for BSF4ooRexx
- Mark Hessling for his Continued Support and Maintenance of Regina Rexx and Rexx / CURL
- P.O. Jonsson for his Continued Support and Maintenance of the ooRexx ARM SBC Builds
- Rene` Jansen for his Instruction on How to Build ooRexx from Subversion Source
- Howard Fosdick for his Wrox Press Rexx Programmer’s Reference Book