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# Slackware ARM on a Honeycomb LX2K Workstation



Jan 2024 - Work in progress. HoneyComb LX2 support is complete - just instructions need to be finished.

	Target
Platform	AArch64/ARM64
Hardware Model	Solid-Run Honeycomb LX2K (lx2160Acex7) Workstation
Document Version	1.01, January 2024
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## Video Tutorial

TODO: add firmware video link here

Video tutorial is [here](#).

## Summary

The Honeycomb LX2K ARM Workstation is a mini ITX platform manufactured by [SolidRun](#). The Honeycomb is [ARM SystemReady](#) certified and it has great functionality right out of the packaging. Support is mature and was added in to the Linux kernel in version 5.14.y. This hardware is highly extensible, adaptable, and can be used for many roles. It is available as a Workstation or in a 1U server chassis form factor.

Most Aarch64 boards do not stay relevant for more than a few years due to advances in technology. This is not an issue with the Honeycomb LX2K. The SFP+ fiber ports, SATA 3.0, NVMe interface, PCIe slot, and power efficiency are exceptional. It excels at edge computing, is great as a development platform, and will function well as a network appliance. As a Workstation it is ideal for developers working on the Aarch64 architecture due to all these reasons. It is versatile in that it can be configured to match many hardware, network, and software profiles.

## Help and Support

Please post questions to the [Slackware ARM forum](#).



This document is a work in progress while support is finalized for Hardware Model



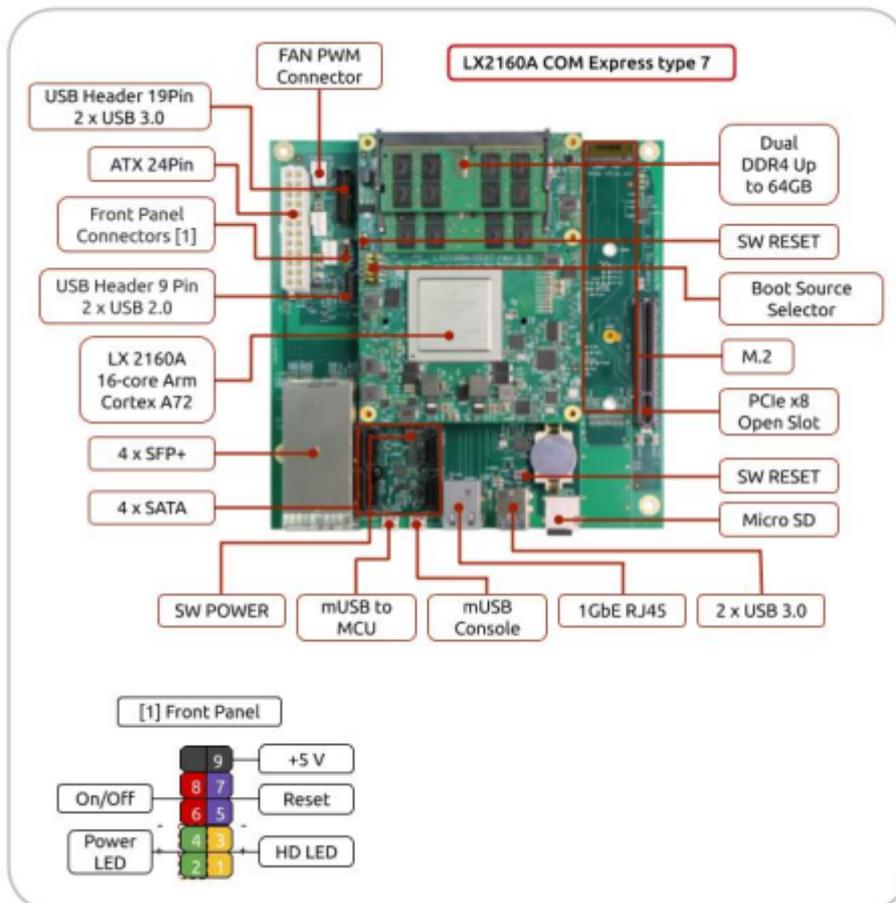
## Honeycomb LX2K Main Board Specifications

<b>Processor</b>	NXP Layerscape LX2160A 16-core Arm Cortex A72 up to 2GHz
<b>Memory</b>	Up to 64GB dual 64 bit SO-DIMM DDR4
<b>Storage</b>	64GB eMMC on board, MicroSD, SATA 3.0 x 4
<b>Expansion card I/Os</b>	1 PCIe x8 Gen 3.0, open slot (can support x16) and M.2 interface
<b>Networking</b>	4 x SFP+ ports (10GbE each) 1 x 1GbE copper (RJ45)
<b>Peripherals</b>	USB 3.0 x 3, USB 2.0 x 3, USB to STM32 for remote management
<b>Cooling</b>	Heatsink and Fan included
<b>Temperature</b>	Commercial: 0°C to 70°C
<b>Dimensions</b>	PCBA: 170 x 170mm

More specifics can be found [here](#).

## Board Layout

(Click to enlarge image.)



More details from the manufacturer [here](#).

## Hardware Recommendations

The list below is the hardware components the author of this document recommends. The case, power supply, Micro USB to Serial adapter, SSD Storage, Network components, and GPU, are a general, non-specific hardware configuration used during development. It is not a mandatory configuration. However, this list of hardware has been in use to develop Slackware ARM for about a year.

	<b>Tested Hardware during Development</b>	<b>Notes</b>
<b>Memory</b>	2x <a href="#">Kingston HyperX 16GB SO-DIMM DDR4 (up to 2x 32GB)</a> - Board supports ECC too.	Specifically tested by SolidRun
<b>NVME</b>	Not currently in use	Could be used as the Root Drive.
<b>Root Drive</b>	Kingston 120GB A400 SATA 2.5" SSD (SA400S37)	Could be added to the data RAID array
<b>Data Storage</b>	3x Kingston 500GB A400 SATA 2.5" SSD (SA400S37)	RAID data array
<b>SD Card</b>	Gigastone 32GB Micro SD Card (UHS-I U1 A1 Class 10)	Great performance and mostly reliable
<b>USB Memory</b>	SanDisk 16GB Cruzer USB 2.0 Flash Drive or similar	Stores installer image on first installation
<b>GPU (PCIe port)</b>	AMD RX550 4GB GPU	works out of the box with Slackware ARM and has 1 DVI and 1 HDMI port. Nvidia GPUs are not recommended. No driver for aarch64
<b>Monitor</b>	Modern LCD or LED	Any monitor that uses HDMI or DVI inputs
<b>Network</b>	Asix USB 3.0 to Ethernet adapter	It was reported some time ago that the On-board ethernet port does not work until kernel firmware is installed.
<b>Network</b>	Cat6 Ethernet cable	6 Feet in length recommended for the on board Realtek Ethernet port
<b>SFP+ / Fiber</b>	HiFiber 10Gb SFP+ RJ45 Module, 10Gbase-T Ethernet SFP+ Copper Transceiver (10G/5G/2.5G/1.25G)	Fiber connection untested without the RJ45 Module listed
<b>Case</b>	Rosewill FBM-X2 Micro ATX Mini Tower Computer Case	There is most definitely a better case. The USB ports on it are unreliable.
<b>Power Supply</b>	EVGA 100-BR-0450-K1 80+ Bronze 450W	May be a bit over kill. Reliable throughput.
<b>Serial</b>	Generic Micro USB to USB male cable for serial connection	Recommendations welcome for this guide
<b>Cooling</b>	A generic fan on the heatsink, above the CPU	Alternatives welcome. See Known Issue and Limitations at the end of this document

The HoneyComb can be purchased directly from Solid-Run, online at <https://shop.solid-run.com> . Shipping takes several weeks as it comes from abroad and goes through customs. It is recommended that the board, memory and SD card be purchased as a bundle. Solid-Run certifies that the Kingston

HyperX 32Gb RAM module has been thoroughly tested.



Headless hardware configurations can rely on the serial connection via the Micro USB port.

## Preliminary Tasks

### Boot Source Select Configuration

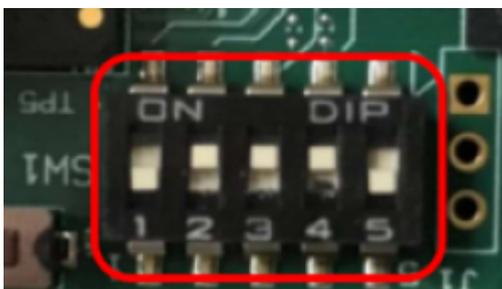
Also referred to as the DIP switch. It is found between the processor and the ATX input for the power supply. The image below describes in detail how the DIP switch can be configured. However, it is expected that the Slackware user to initially boot the installer with the SD image provided. Later on the firmware can be written to SPI Flash to free up the SD Card port.



While the eMMC boot media is present, it is not recommended that SlackwareAarch64-current be written to it. It has a limited number of reads and writes. As a result, it is far more reasonable to write only a stable release of Slackware ARM to the eMMC.

The boot media must be selected prior to turning on your Honeycomb for the first time. The following chart is a reference for the DIP switch configuration. Switch number 5 is disabled and unused.

Boot media	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5
SD	OFF	ON	ON	ON	X
eMMC	OFF	ON	ON	OFF	X
SPI	OFF	OFF	OFF	OFF	X



### UEFI Firmware and SPI Flash Memory

The Honeycomb LX2K does not use U-Boot as its boot loader for Slackware ARM. It requires that the UEFI firmware from the vendor be booted from a SD Card. The SD Card is the default boot method for the Honeycomb LX2K. The very first installation of Slackware ARM will need to be booted from a USB image. During the installation process the installer will prompt the user to install the UEFI firmware to

## SPI Flash.

Once the firmware is written to SPI flash, installation is successful, you need to completely power down the Honeycomb. The DIP switch needs to be adjusted to designate the SPI flash as the default boot method. From here on out, you will no longer need the USB image to boot the installer. You will be able to write the installer to a SD Card and boot the SD Card using the firmware in SPI Flash. The UEFI firmware functions much like a BIOS or UEFI interface from the x86 and x86\_64 architectures. It is menu driven with the keyboard and can do all the same functionality you would expect in a BIOS or UEFI interface.

The relevant and most recent UEFI firmware from Solid-Run is already included on the Slackware ARM installation media. During post installation you will also notice that the firmware is located in `/usr/share/hwm-bw-lx2160acex7/bootloader-firmware` within your new system. Found on all Slackware ARM mirrors too: [Slackware ARM mirror - Slackware.uk/slackwarearm](#)

An older or differently configured firmware can be found on the Solid-Run web site. These firmware images are not supported by Slackware ARM: Solid-Run - [images.solid-run.com](#).



Make sure you power the Honeycomb LX2K all the way down before adjusting the DIP switch. DIP switch discussed further in the vendor documentation [here](#).



Preliminary installation steps can be found on the Slackware ARM YouTube channel here: [S03E26 - R&D: First look at installing Slackware on the HoneyComb LX2K](#)

## Prepare Boot Media

TODO: create table explaining different UEFI firmware image naming conventions. TODO: remember to modify this section to reflect the steps taken with the bootloader flashing tool.

In order to prepare the Boot Media you must download the UEFI firmware that matches your RAM clock speed and desired SERDES configuration. It is important that the firmware you download matches your hardware specifications.

The UEFI firmware images are found [here](#).

On a second computer you can write the UEFI firmware to your SD Card. Be certain that `/dev/sdX` points to your SD Card and nowhere else.

```
xzcat lx2160acex7_2000_700_....img.xz | dd of=/dev/sdX bs=4k conv=fdatasync
```

The Slackware ARM All-In-One Installer is the preferred method to install Slackware ARM on your Honeycomb Workstation. The image can be found [here](#).

Once again, on your second computer write the Installer image to your USB thumb drive. Be certain you have selected the correct media.

```
xzcat lx2160acex7_....img.xz | dd status=progress bs=4M iflag=fullblock
```

```
of=/dev/XXX
```



For an installation image that only contains the kernel and the installer, [go here](#). These images are unsupported and left as an alternative option for the user to explore.

# Installation

## Boot Installation Media

To boot the system insert the SD Card into the Micro SD port located on the backside of the board. Plug in your USB thumb drive containing the Slackware ARM installer to any available USB port. Next connect the MicroUSB end of your serial cable to the board and plug the USB male connector ending into a second computer.

## Access the Serial Console

Configure GNU Screen to display and accept input from the serial cable within a terminal. Check the output of the `dmesg` command to identify the serial line connected to your second computer. The Honeycomb may be at `ttyUSB1` or `ttyUSB2`. Typically `/dev/ttyUSB0` is sufficient.

On your second computer you will need to be part of the **dialout** group to access the serial line as a **regular user**. Add your user to the **dialout** group:

```
# usermod -a -G dialout <username>
```

Log out of your user account and log back in so that your user has the permissions of the **dialout** group. Now the serial line can be accessed without the need to be root.

Now you can connect to the Honeycomb system serial console as a normal user:

```
$ screen /dev/ttyUSB0 115200
```



As an alternative to GNU Screen you can use the **minicom** application to access the serial connection. It is easier to navigate if you are unfamiliar with GNU Screen. Both applications are included in a full installation of Slackware. If you do not have Slackware installed on your second computer, please refer to the documentation of your chosen Operating System.

# Using the UEFI Firmware

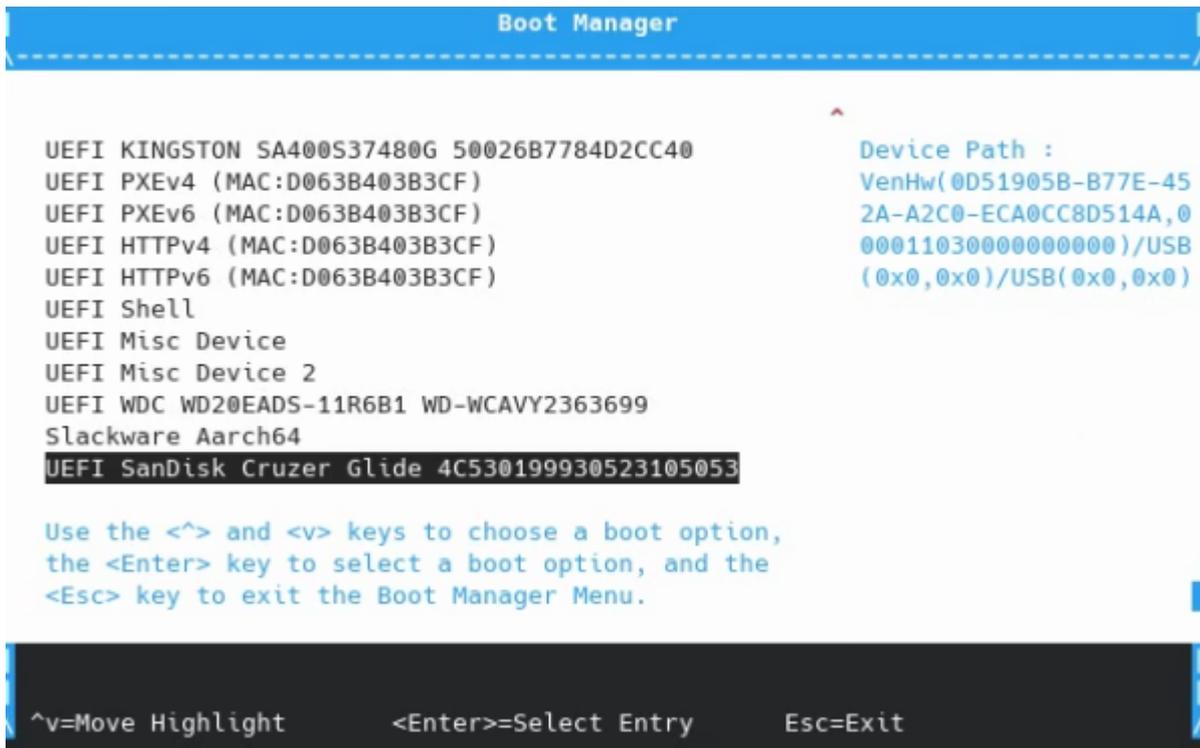
Turn on the Honeycomb and wait to be prompted to press the **Escape** key. This will open the UEFI firmware interface. It should be familiar if you have used a BIOS or UEFI interface on the x86 or x86\_64 architectures.

```
Tianocore/EDK2 firmware version 202105
Press ESCAPE for boot options
```

A screen containing the UEFI menu will be displayed. Select the **Boot Manager** menu option.



Select the USB thumb drive. In this case it is the **UEFI SanDisk Cruzer Glide** menu option. Press the **Enter** key.



## Grub Boot Loader

The next step is to make your selection in the GRUB menu. The boot options are as follows:

1. HDMI or DVI with a monitor
2. Serial console on a second computer display
3. Return to the UEFI Firmware interface to adjust settings





This guide assumes that the serial console is selected. The serial console is preferred as the Honeycomb LX2K does not ship with on-board video.

If you have a GPU available it is possible it will not function without the correct Linux firmware. The Slackware ARM kernel-firmware package will have whatever corrections available in the Linux ecosystem. It is important to note that NVIDIA does not provide a driver for the Aarch64 architecture. As a result, you will be better off with an AMD branded PCIe GPU. **See hardware recommendations above.**

## Disk Partitioning

An EFI partition is required for the UEFI firmware and GRUB boot loader to load Slackware ARM on the Honeycomb. It is required that the EFI partition be no less than 100 MB and recommended to be no greater than 300 MB. There are many partition layouts possible and many variations. In this guide it is assumed that one SATA 3.0 solid state drive (SSD) be partitioned with an EFI partition, a swap space, and the root partition. Finally, the partition table should be of type **gpt**.



The next steps require that the root disk will be wiped of the disk label, partition table, and all data backed up to another drive

Clear the disk label to assure the drive is empty:

```
gdisk /dev/sda
```

In the prompt, choose the “**x**” option and then the “**z**” option in gdisk. This will remove all disk labels.

Format the drive:

```
fdisk /dev/sda
```

Use the “**g**” option first to use a GPT disk label. The UEFI firmware provided by the vendor has difficulty with a msdos disklabel. Stick with GPT.



Partition types can be set textually with “**swap**”, “**uefi**”, “**linux**”. This saves time and effort in fdisk to avoid remembering the partition type codes.

### TODO: add screenshot

Basic partition table:

```
Welcome to fdisk (util-linux 2.39.2).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Command (m for help): p
Disk /dev/sdd: 111.79 GiB, 120034123776 bytes, 234441648 sectors
Disk model: KINGSTON SA400S3
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 3B295C75-01D6-4682-88BE-053AE793D23E

Device          Start      End      Sectors  Size Type
/dev/sdd1        2048     206847    204800   100M EFI System
/dev/sdd2       206848   8595455   8388608    4G Linux swap
/dev/sdd3       8595456 234440703 225845248 107.7G Linux filesystem

Command (m for help): g
```

## Installation

**TODO: more screen shots!**

The preferred installation method is the Slackware ARM All-In-One Installer.

## Date and Time

Before you begin the installation process make sure the time on your Honeycomb LX2K is correct.

Connect to the internet if an Ethernet connection is available.

```
# dhcpcd eth0
```

Synchronize with a time server to correct a possibly inaccurate system clock.

```
# ntpdate clock.akamai.com
# hwclock -w
```

## Launch the Installer



The Slackware ARM All-In-One installation media will be automatically detected, as will the Slackware ARM tree within the boot medium.

Launch the installer with the **setup** command.

```
# setup
```

The installer will...

1. Ask you to identify your swap space and activate it.
2. Mention the system EFI partition that will be automatically identified and formatted.
3. Ask you to assign your root partition and format it. Add any additional partitions you wish.
4. Require you to choose “Yes” when you are asked to use the Slackware ARM tree included within the All-In-One installer.

The next menu will ask you which Slackware package series you wish to install. A full installation is highly recommended. Below is an example of packages being installed.

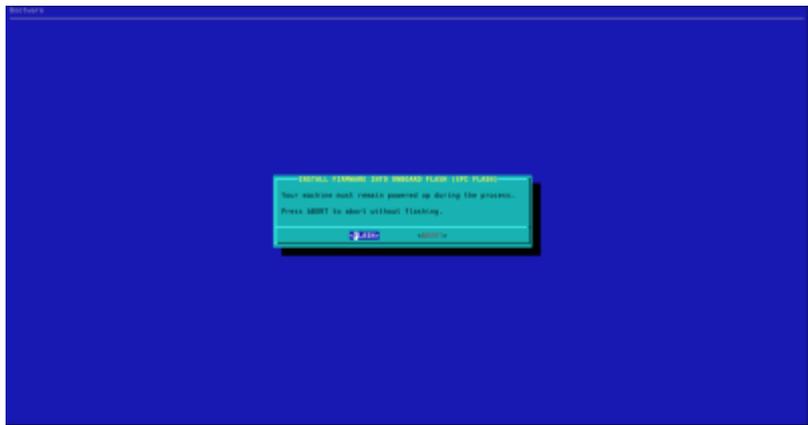
```
libassuan-2.5.6-aarch64-1: Interprocess Communication Library for GPG .. [ 360K]
libgcrypt-1.10.2-aarch64-1: General purpose crypto library ..... [ 1.6M]
libgpg-error-1.47-aarch64-1: GnuPG Error Definitions Library ..... [ 1.4M]
libksba-1.6.4-aarch64-1: X.509 & CMS library for S/MIME and TLS ..... [ 480K]
libmbim-1.28.4-aarch64-1: MBIM library and utils ..... [ 3.7M]
libmilter-8.17.2-aarch64-1: sendmail Mail Filter API ..... [ 410K]
libnml-1.0.5-aarch64-1: user-space library oriented to Netlink developer [ 100K]
libndp-1.0-aarch64-1: library for Neighbor Discovery Protocol ..... [ 100K]
libnetfilter_acct-1.0.3-aarch64-4: userspace library for netfilter accou [ 60K]
libnetfilter_conntrack-1.0.9-aarch64-1: netfilter conntrack library ... [ 210K]
libnetfilter_cthelper-1.0.1-aarch64-1: userspace infrastructure for conn [ 50K]
libnetfilter_cttimeout-1.0.1-aarch64-1: connection tracking timeout libr [ 60K]
libnetfilter_log-1.0.2-aarch64-1: userspace packet logging library .... [ 70K]
libnetfilter_queue-1.0.5-aarch64-2: userspace API for netfilter packet q [ 80K]
libnftnl-1.0.2-aarch64-1: library for netfilter kernel/userspace com [ 80K]
libnftnl-1.2.6-aarch64-1: user-space interface to the kernel nf_tables s [ 290K]
libqmi-1.32.4-aarch64-1: QMI library and utils ..... [ 19M]
libtirpc-1.3.3-aarch64-1: Transport-Independent RPC library ..... [ 510K]
links-2.29-aarch64-1: WWW browser for the console ..... [ 4.7M]
lynx-2.9.0dev.12-aarch64-1: text mode browser ..... [ 5.5M]
mcabber-1.1.2-aarch64-2: Jabber console client ..... [ 1.1M]
metamail-2.7-aarch64-6: MIME extensions for mail ..... [ 380K]
mobile-broadband-provider-info-20230416-aarch64-1: service provider sett [ 530K]
```

## Write Boot Loader Firmware to SPI Flash

Following further into the installation process you will be asked to upgrade or install the UEFI firmware. It is a requirement of this guide that the firmware be installed into flash memory. If you choose to forego this option, you are in marginally unsupported territory. Below, the screen shots are fairly self explanatory.

1. Select “Yes” to start the flashing process.

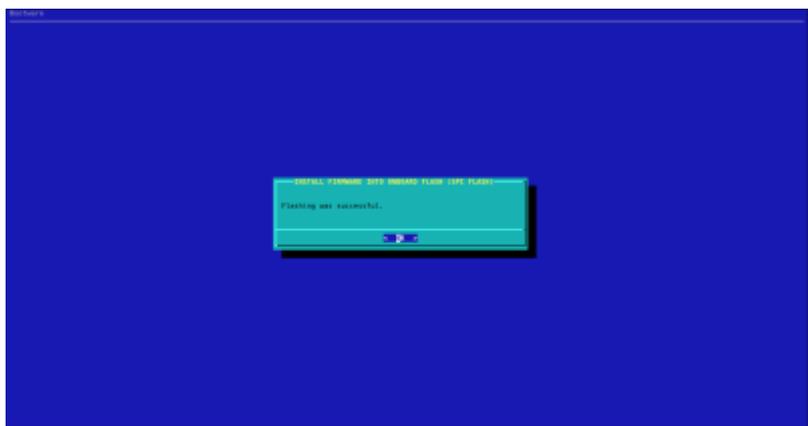




5. Following that, the firmware will be written to SPI flash. Do not cancel it, shut down your machine, or interrupt this process. The SPI flash chip will be erased first. After that the firmware will be written to memory.



6. Finally, you will be notified of the success or failure of this process.



Skipping this process will leave your system in a state that is unsupported. While the UEFI firmware is present on a SD Card it will not reboot successfully. Attempting to reboot after the installation process completes causes a boot failure. The work around is to use the "poweroff" command at that stage. There is no issue rebooting while the UEFI firmware exists in SPI flash.

## Finishing Up the Installation

The remaining installation steps initiated by the **setup** command are left up to the reader to answer. You will be asked to pick the services you want to activate, amongst other custom options.

It is highly recommended to enable the Network Time Protocol service by editing `/etc/ntp.conf` and choosing a server. Many inconsistencies surface when a computer system has the wrong time.

```
server 0.pool.ntp.org iburst
#server 1.pool.ntp.org iburst
#server 2.pool.ntp.org iburst
#server 3.pool.ntp.org iburst
```

Power the Honeycomb LX2K completely down when you are finished. This is required due to a known issue mentioned in the previous section about flashing firmware.

```
# poweroff
```

Remember to reconfigure the DIP switch so that the SPI flash has priority prior to booting up the Honeycomb LX2K.



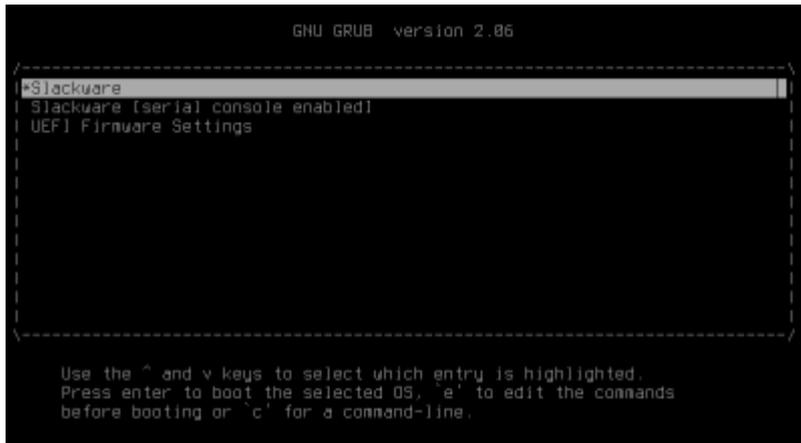
All DIP switches should be adjusted to “**off**”.



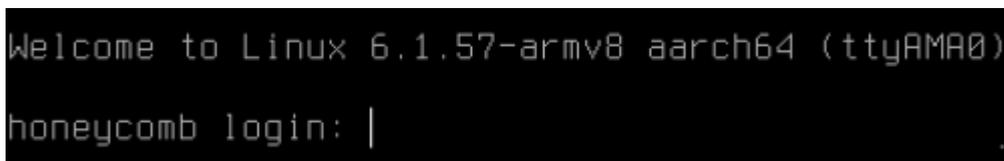
### TODO: screen shot

Remove the USB thumb drive and power on the Honeycomb. When you are prompted to hit the **Escape** key, do so. Enter the **Boot Maintenance Manager**.





Installation is now complete. Slack on!



## Useful Guides and Resources

- [Slackware ARM Support Forum](#)
- [Slackware ARM/Aarch64 Disk Encryption](#)
- [Zram in Slackware ARM and ARM64 Architectures](#)

## Known Issues and Feature Gaps

### NVMe Suggestions

- Recommendations for supported NVMe M.2 storage are welcome.

More details on the development Road Map [here](#).

## External References

- [SolidRun Honeycomb LX2K Quick Start Guide](#)
- [SolidRun Honeycomb Product Page](#)
- [SolidRun Developer Center](#)
- [UEFI firmware source code on GitHub](#)
- [Guide for beginners.](#) (references other distributions)

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Last update: **2024/05/01 08:42 (UTC)**

