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PJAI-100-ON/OX Jetpack 5 BSP User Manual

Revision 1.1.1

Dec. 19, 2024

Portwell Inc.



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Revision History

Rev.	Date	Author	Draft/Changes
V1.0.0	2024/06/17	Brian Wu	<ul style="list-style-type: none">● First revision to support following Portwell systems:<ul style="list-style-type: none">■ PJA1-100-ON4G■ PJA1-100-ON8G■ PJA1-100-NX8G■ PJA1-100-NX16G
V1.1.0	2024/11/05	Brian Wu	<ul style="list-style-type: none">● Page 7: The picture for the location of recovery button is not correct, so replace it with the correct one.● Upgrade JP5.1.3 (L4T 35.5.0) to JP5.1.4 (L4T 35.6.0).
V1.1.1	2024/12/19	Brian Wu	<ul style="list-style-type: none">● Page 4, 5: Modify the name of BSP tarball.



A. Setup Develop Environment

You need to prepare a host PC with Ubuntu. We highly recommend using **Ubuntu 20.04** to avoid unexpected issues such as failed burning or compilation.

We have introduced two scripts to help user to create their own working directory for Portwell BSP:

- **prepare_nv_l4t_bsp.sh**

This script is used to install the specified Jetson Linux (L4T) version into the working directory. It will first download the **L4T BSP Tarball**, **Sample Rootfs Tarball**, **Driver Package Source Tarball** and **Toolchain Tarball** from Nvidia website and then unpack them into the user specified working directory.

NOTE: This script only support installs the L4T version supported by the Portwell BSP. See [Appendix A](#) for a list of all supported L4T versions.

- **install_pw_bsp.sh**

This script will copy Portwell BSP source into the target L4T root directory, install Nvidia packages into the rootfs and disable USB auto-suspend on the host PC (to prevent burning failures).

The commands below show the steps to set up the working directory for Portwell BSP:

```
# Untar the BSP tarball in Portwell's SDK
$ tar xzf pjai-100onox_bsp.tar.gz
$ cd pjai-100onox_bsp
$ find . -type f -name "*.sh" -exec chmod a+x {} \;

# Download and setup Jetson Linux (L4T) source
# -w <work_dir> - Specify the working directory to store L4T source
# -v <l4t_ver> - Specify the L4T version such as '35.6.0'
$ sudo ./prepare_nv_l4t_bsp.sh -w <work_dir> -v <l4t_ver>

# The L4T root directory will be '<work_dir>/Linux_for_Tegra/'

# Install Portwell BSP source into L4T root directory
$ sudo ./install_pw_bsp.sh -d <work_dir>/Linux_for_Tegra/
```



Example

Make sure CURRENT USER has permission to create the work directory

```
$ export L4T_WORK="${HOME}/L4T_100ONOX"
```

```
$ export L4T_VERSION="35.6.0"
```

```
$ tar xzf pjai-100onox_bsp.tar.gz
```

```
$ cd pjai-100onox_bsp
```

```
$ sudo find . -type f -name "*.sh" -exec chmod a+x {} \;
```

Will take some minutes while untar rootfs

```
$ sudo ./prepare_nv_l4t_bsp.sh -w ${L4T_WORK} -v ${L4T_VERSION}
```

```
$ sudo ./install_pw_bsp.sh -d ${L4T_WORK}/Linux_for_Tegra/
```



B. Flashing Jetson Linux OS to NVMe

1. Put the system into the force recovery mode (RCM):

- (1) Disconnect the power supply of the system for safety purposes.
- (2) Remove the screws on the small side cover.

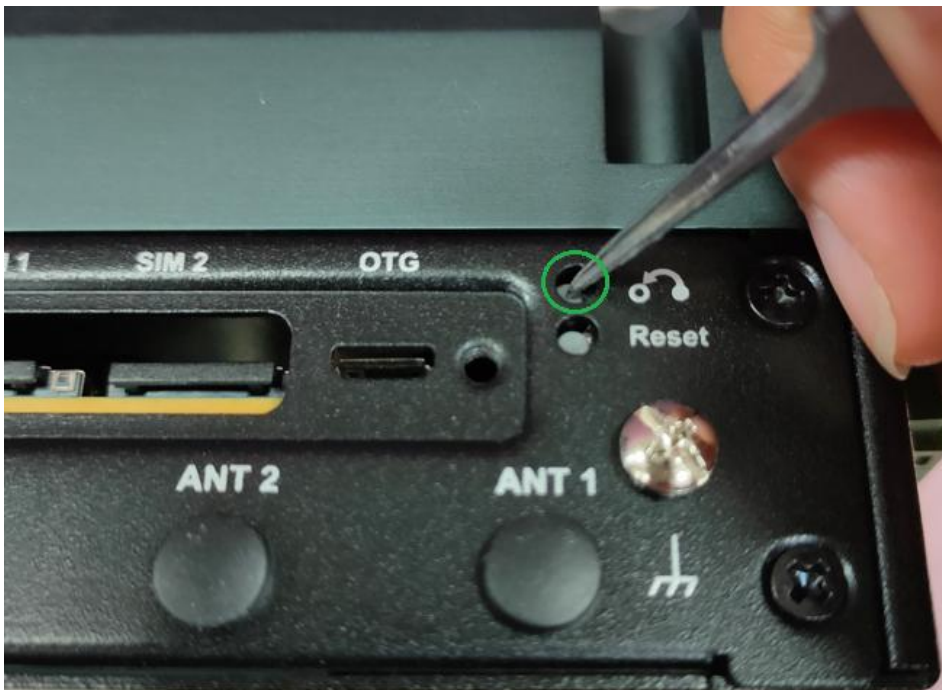




(3) Use an **USB Type-C to Type-A Cable** to connect the system and host PC with BSP installed.



(4) Push and hold (don't release) the force recovery button using a pin.





- (5) Power on the system. Wait for approximately 2 seconds after the power LED turns on, and then release the force recovery button.



- (6) Use the **lsusb** command on the host PC to verify whether the system has entered force recovery mode. If you find the string **ID 0955:7XXX Nvidia Corp** in the output, the system is in force recovery mode.

NOTE: See [Appendix B](#) to know the USB ID for each model.

```
test@test-System: ~  
File Edit Tabs Help  
test@test-System:~$ lsusb  
Bus 002 Device 003: ID 174c:3074 ASMedia Technology Inc. ASM1074 SuperSpeed hub  
Bus 002 Device 002: ID 0bc2:231a Seagate RSS LLC Expansion Portable  
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub  
Bus 001 Device 003: ID 0b05:19af ASUSTek Computer, Inc. AURA LED Controller  
Bus 001 Device 002: ID 0b05:1996 ASUSTek Computer, Inc. USB Audio  
Bus 001 Device 007: ID 8087:0033 Intel Corp.  
Bus 001 Device 006: ID 058f:6254 Alcor Micro Corp. USB Hub  
Bus 001 Device 005: ID 24ae:2015 RAP00 Rapoo 2.4G Wireless Device  
Bus 001 Device 002: ID 0955:7523 NVIDIA Corp. USB Audio  
Bus 001 Device 004: ID 174c:2074 ASMedia Technology Inc. ASM1074 High-Speed hub  
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub  
test@test-System:~$
```

2. Install required packages on host PC.

```
# Go to L4T root directory  
$ cd <work_dir>/Linux_for_Tegra/  
# Install required packages for flashing (only need run once)  
$ sudo ./tools/l4t_flash_prerequisites.sh
```



3. Disable USB auto-suspend on host PC.

WARN: Run this command once after each power cycle of your host PC

```
# Disable USB auto suspend to prevent USB timeout
# NOTE: Run this command once after each power cycle of your host PC
$ echo -1 | sudo tee /sys/module/usbcore/parameters/autosuspend
```

4. Flash OS

The following provides some examples for different flashing scenarios.

(1) Re-create all images and flash both QSPI flash on module and NVMe on carrier board.

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Build images and then flash all (QSPI flash on module and NVMe)
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh \
--external-device nvme0n1p1 \
-c tools/kernel_flash/flash_l4t_external.xml \
-p "-c bootloader/t186ref/cfg/flash_t234_qspi.xml" \
--showlogs --network usb0 pjai-100onox internal
```

(2) Flash both QSPI flash on module and NVMe on carrier board using exist images.

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Flash QSPI flash on module and NVMe using exist images
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh \
--flash-only --showlogs --network usb0
```



- (3) Re-create all images and then flash both QSPI flash on module and NVMe on carrier board using exist images

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Build images but no flash
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh \
--external-device nvme0n1p1 \
-c tools/kernel_flash/flash_l4t_external.xml \
-p "-c bootloader/t186ref/cfg/flash_t234_qspi.xml" \
--showlogs --network usb0 --no-flash pjai-100onox internal

# Flash QSPI flash on module and NVMe using exist images
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh --flash-only \
--showlogs --network usb0
```

- (4) Flash only QSPI flash on module.

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Flash only QSPI flash on module
$ sudo ./flash.sh -c bootloader/t186ref/cfg/flash_t234_qspi.xml \
pjai-100onox nvme0n1p1
```



(5) Flash only NVMe on carrier board.

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Flash only NVMe on carrier board using exist files
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh --flash-only \
--external-only --external-device nvme0n1p1 \
--showlogs --network usb0
```

(6) Flash to multiple systems

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Create a flashing environment that can concurrently flash five devices
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh \
--external-device nvme0n1p1 \
-c tools/kernel_flash/flash_l4t_external.xml \
-p "-c bootloader/t186ref/cfg/flash_t234_qspi.xml" \
--massflash 5 --no-flash \
--showlogs --network usb0 pjai-100onox internal

# Previous command will create a tarball 'mfi_<target-board>.tar.gz'
# It can be used on other machine to flash the boards.

# The following line only required on other PC
$ sudo tar xpfv mfi_pjai-100onox.tar.gz

# Flash the system in the flashing environment
$ cd mfi_pjai-100onox
$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh \
--flash-only --massflash 5
```



C. Customize Rootfs

To create default user:

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Create default user, enable auto login
$ sudo tools/l4t_create_default_user.sh -u <user> -p <password> \
--autologin --accept-license
```

To install other packages via apt commands:

```
# Go to L4T root directory
$ cd <work_dir>/Linux_for_Tegra/

# Chroot the sample rootfs
$ sudo ./chroot_rootfs.sh

# After chroot, you can use apt command to install required packages
$ apt update
$ apt install <packages>

# Exit chroot
$ exit
```



D. Customize Kernel

The table below lists the variables that will be used in this section:

Variable	Description
<work_dir>	The working directory created by prepare_nv_14t_bsp.sh script
<l4t_dir>	Point to <work_dir>/Linux_for_Tegra
<src_dir>	Point to <work_dir>/Linux_for_Tegra/source/public
<kernel_dir>	Point to <work_dir>/Linux_for_Tegra/source/public/kernel

The table below lists the L4T kernel source directories:

Directory	Description
<kernel_dir>/kernel-5.10	The 5.10 kernel source code. For L4T 35.6.0, the kernel version is 5.10.216.
<kernel_dir>/Portwell	Include a default configuration file and some required drivers for Portwell system.
<kernel_dir>/nv*	Include some Nvidia drivers. DO NOT modify it.

Install required packages to build kernel:

```
# Required for building kernel
$ sudo apt-get install build-essential flex bison libssl-dev
# Required for menuconfig
$ sudo apt-get install libncurses-dev
```

There is a help script **nvbuild_pw.sh** in directory <src_dir>. User can use the script to customize kernel configuration and rebuild the kernel easily. The following show some example usages:

To customize kernel configuration:

```
$ cd <src_dir>
$ ./nvbuild_pw.sh -t menuconfig
# It runs "menuconfig" to create a configuration window
```



To rebuild kernel image:

```
$ cd <src_dir>
$ ./nvbuild_pw.sh -t image
# Output image is in "<src_dir>/kernel_out/arch/arm64/boot/"
```

To rebuild kernel modules:

```
$ cd <src_dir>
$ ./nvbuild_pw.sh -t modules
# Build but no install
```

To rebuild kernel device tree:

```
$ cd <src_dir>
$ ./nvbuild_pw.sh -t dtb
# Output dtb files are in "<src_dir>/kernel_out/arch/arm64/boot/dts/nvidia/"
```

To install kernel modules in `<src_dir>/kernel_module` directory:

```
$ cd <src_dir>
$ ./nvbuild_pw.sh -t modules_install
# Install path is "<src_dir>/kernel_module"
```



To update kernel image, kernel device tree and kernel modules in BSP:

```
# NOTE: You have to build kernel image, modules and device trees, also install
modules before using the following commands.
# $ cd <src_dir>
# ### build kernel image, modules and device trees
# $ ./nvbuild_pw.sh -t all
# ### install modules
# $ ./nvbuild_pw.sh -t modules_install

$ cd <src_dir>
# Update kernel image in <l4t_dir>/kernel
# Update kernel device tree in <l4t_dir>/kernel/dtb
$ ./nvbuild_pw.sh -t bsp_install

$ cd <l4t_dir>
# Create kernel BUP. It is required for kernel debs
$ sudo ./l4t_generate_soc_bup.sh -f pjai-100onox_board_spec.cfg \
-e t23x_kernel_spec t23x

# Repack kernel debs
# New kernel debs will be saved in <l4t_dir>/kernel
$ sudo ./repack_nv_kernel_debs.sh -n "your_name <your_email>" \
-v pjai100onox0
# EX: sudo ./repack_nv_kernel_debs.sh "brian wu <brian.wu@portwell.com.tw>"
# -v pjai100onox0

# Apply new kernel debs in rootfs
$ sudo ./apply_binaries_pw.sh --kernel
```



Appendix A. Supported Jetpack Version & L4T Version

Jetpack Version	Jetson Linux (L4T) Version
5.1.4	35.6.0

Appendix B. USB ID Mapping in RCM

Portwell System	USB ID (VID:PID)
PJAI-100-ON4G	0955:7623
PJAI-100-ON8G	0955:7523
PJAI-100-OX8G	0955:7423
PJAI-100-OX16G	0955:7323

Appendix C. Supported Jetpack Orin Module

Jetson Module	Portwell System
Nvidia Jetson Orin Nano 4GB	PJAI-100-ON4G
Nvidia Jetson Orin Nano 8GB	PJAI-100-ON8G
Nvidia Jetson Orin NX 8GB	PJAI-100-OX8G
Nvidia Jetson Orin NX 16GB	PJAI-100-OX16G