



Android and BP3|PAK

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abp3 - Android and BP3|PAK considerations

BP3 and PAK licensing are orthogonal features. Devices (parts) which are BP3 aware do not need PAK licensing and vice-versa PAK licensing is targeting functionalities which are not licensed through BP3 because the part is not BP3 capable.

The term "legacy" in this document refers to parts that are not BP3 aware and thus may be affected by PAK licensing. PAK licensing applies to audio features of the device, in particular Dolby audio support (AC4, MS12).

When moving to a BP3 enable part of a particular device, or when moving to PAK aware firmware support of a legacy device, it is important to understand what changes need to happen at the android integration level.

The changes necessary are discussed below.


Devices Affected

The devices potentially affected by BP3 support are those running the following chipsets:

- 7271: cypress
- 7268: dawson
- 72604A0: elfin
- 7278: fundy - defaults to BP3 enabled
- 72604B0: grouse - defaults to BP3 enabled

The devices potentially affected by PAK support are those running the following chipsets:

- 7439: avko and banff
- 7271 (non BP3): cypress
- 7268 (non BP3): dawson

- 72604A0 (non BP3): elfin
 Broadcom AndroidTV

BP3 integration

Device Configuration

The following device configuration needs to be enabled when the device is meant to be targeted for a BP3 provisioning part|flow.

On a given device profile, this usually would be set in the device/broadcom/<device>/<device>.mk module configuration.

```
export ANDROID_DEVICE_SUPPORTS_BP3 := y
```

Hwcfg mode change

When migrating a device from non BP3 to BP3 aware part, the bulk of the device integration is not changed. However one aspect of the device is to be dealt with carefully, the hwcfg content.

hwcfg is the partition which contains the device keybox in particular. prior to BP3 provisioning, the keybox was always a one time read only programmable entity since it was not intended to be changed during the lifetime of the device. For that, we used a cramfs file system to store the device keybox.

When the device is built to target BP3 aware parts, this needs to change since we now need to allow the keybox to be updated by the provisioning mechanism. In this case, we change the hwcfg to be vfat file system (ext4 was considered as well, but it has too much overhead for the purpose). The new vfat based hwcfg needs to fit exactly in the hwcfg partition where the cramfs content used to be.

On a given device profile, this usually means the fstab for the device needs to change the entry for hwcfg from cramfs to vfat in the device/broadcom/<device>/fstab/<device-fstab>.


Migrating cramfs hwcfg to vfat hwcfg

If migrating a device from non-BP3 provisioning to BP3 aware provisioning, the following steps can be taken to produce a hwcfg that is compliant with the new expectations.

- dd if=/dev/zero of=hwcfg.vfat bs=1k count=1024
 - creates a 1MB size vfat file system to match the hwcfg 1MB partition on the device (default layout size).
- mkfs.vfat hwcfg.vfat
 - create a vfat file system associated with the hwcfg.vfat.
- mkdir vfat && sudo mount -o loop hwcfg.vfat vfat
 - loop mount hwcfg.vfat to populate its content.
- mkdir cramfs && sudo mount -o loop hwcfg.img cramfs
 - loop mount the existing hwcfg.img (cramfs) file system to copy its content into the hwcfg vfat one

copy its content into the hwcfg.vfat one.

e)  do cp cramfs/* vfat/*

f)  sudo umount vfat && sudo umount cramfs

g) fastboot flash hwcfg hwcfg.vfat

- flash the new vfat partition to override the cramfs one.

Example configuration

To illustrate the changes necessary on a device profile to make a device BP3 aware from a device that is not, we look at the "elfin" device profile located in "device/broadcom/elfin". By default, "elfin" is not a BP3 device, the following changeset is however the minimum necessary to turn the basic profile into a "elfin bp3" aware device.

The change below implements the two aspects mentioned above.

```
diff --git a/elfin.mk b/elfin.mk
index fb08207..e3422a7 100644
--- a/elfin.mk
+++ b/elfin.mk
@@ -1,5 +1,6 @@
 export LOCAL_PRODUCT_OUT      := elfin
 export LOCAL_DEVICE_FULL_TREBLE := y
+export ANDROID_DEVICE_SUPPORTS_BP3 := y

 ifeq ($(LOCAL_DEVICE_FORCED_NAB),y)
 export LOCAL_DEVICE_GPT      := device/broadcom/common/gpts/nab.o.conf
diff --git a/fstab/fstab.verity.ab-update.early b/fstab/fstab.verity.ab-update.early
index 227b8e8..f9bbe0a 100644
--- a/fstab/fstab.verity.ab-update.early
+++ b/fstab/fstab.verity.ab-update.early
@@ -2,7 +2,7 @@
 */block/sd*                auto          auto          defaults
voldmanaged=usb:auto,encryptable=userdata
 /dev/block/by-name/system    /                  ext4          ro,barrier=1
wait,verify=/dev/block/platform/rdb/f0200200.sdhci/by-name/metadata,slotselect
 /dev/block/by-name/userdata  /data              ext4
noatime,nosuid,nodev,nomblk_io_submit,errors=panic wait,check,quota
-/dev/block/by-name/hwcfg     /dev/hwcfg         cramfs        ro,relatime,barrier=1 wait
+/dev/block/by-name/hwcfg     /dev/hwcfg         vfat          rw wait
 /dev/block/by-name/misc      /misc              emmc          defaults defaults
 /dev/block/by-name/eio       /eio               emmc          defaults defaults
 /dev/block/by-name/cache     /cache             ext4
noatime,nosuid,nodev,barrier=1,data=ordered,nomblk_io_submit,noauto_da_alloc,errors=p
anic wait,check
```

PAK integration is a more straightforward task since the PAK license is generic to a device class and not a per chip unique identifier. This means the PAK license can be shared by all devices of the same (android) family, that is defined by the "device/broadcom/<device-name>" class.

As such, the PAK license does not need to be part of the device's specific hwcfg and instead can be packaged into the vendor image from which it will be retrieved by the audio firmware process. The only task to be done is to make sure the PAK license for a device is setup properly and copied into the image.

The following local device configuration are defined:

```
export LOCAL_DEVICE_PAK_BINARY_DEV    := <zdev-pak-license>
export LOCAL_DEVICE_PAK_BINARY_PROD    := <zdev-pak-license>
```

The two settings can be used to provide a ZD (development) and ZB (production) license within a single image for mixed mode environments. In practice, we typically assume only one mode is necessary for a production device.

Configuring BP3|PAK licenses

This section describes how one can configure BP3|PAK licenses on a device under android using the license portal. This assumes the user has access to the license portal, whether the portal is a production or development portal is out of the scope of this discussion, here we simply focus on explaining the steps required to allow proper device configuration and setup.

PAK license can be requested from the same license portal as the BP3 licenses.

BP3 parts:

- At the present time, you are still required to request license via drm binary for hdcp, widevine, playready, keymaster ... which means, you still are required to provide a "drm.bin" and a "drm_hdcp1x.bin" for a device.
- Follow the steps below to enable proper decoder support as well as additional feature such as Dolby licensed audio|video support.

PAK aware:

- Devices (i.e. non BP3 parts) are required to support an additional PAK license which is created per device family, i.e. the license includes information on the tuple [chip family, oem identifier, bond option] but this license is not a per device otp'd unique chip identifier one.
- For those reasons the PAK license is made part of the vendor image and not the hwcfg image.

Register and/or log into the license portal

The official portal for bp3 is located (<https://bp3.broadcom.com/>).



Broadcom AndroidTV

- For Broadcom users, a development portal is [located here](#); use the development portal for setting up test devices.

If you are a new user, scroll to the end of the page displayed on the portal and "register" as a new user to gain access. You will receive an email confirming your registration before you can log into the portal.

- for Broadcom users, use your okta credentials.
- follow the instructions to register proper okta user identifier.

Identify which license you need for a given part

The next step is really to know which part you are using and which licenses are available for the part. The part is typically located on a sticker on the device, in case you are not sure of which exact part number you are using.

Find the part of interest

In the portal, follow "View -> Parts", then search for your part of interest.

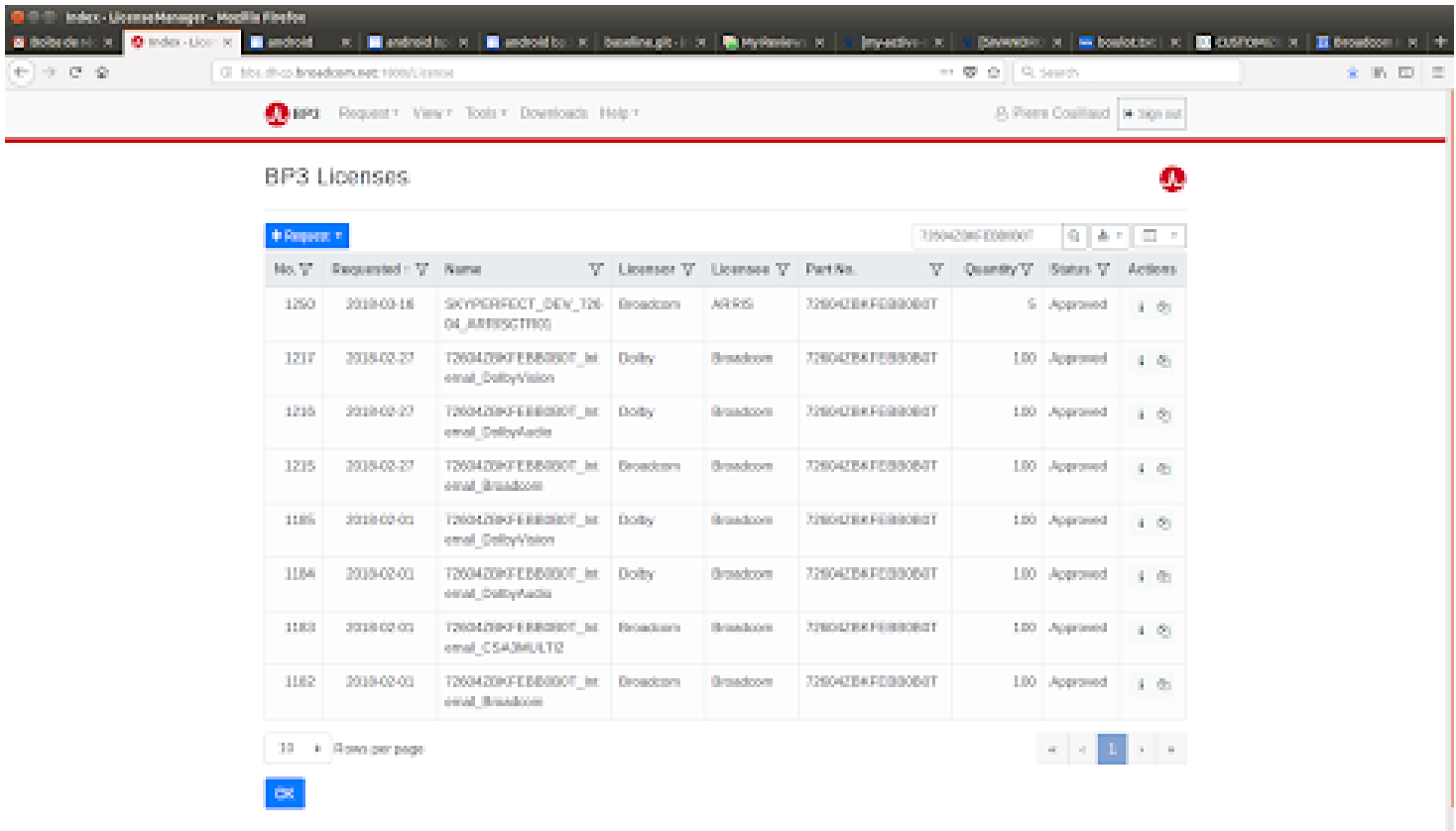
The screenshot shows a web browser window with the URL "https://bp3.broadcom.com/PartSearch?P=1159428". The page title is "BP3 Parts". There is a search bar with the value "1159428" and a "Search" button. Below the search bar is a table with the following columns: Part Number, Date Requested, Product ID, Security Code, Status, and Actions. The table contains one row with the following data: Part Number: 73684280F0000007, Date Requested: 2023-01-09, Product ID: 00366480, Security Code: 20, Status: Approved, and Actions: a dropdown menu. Below the table is a pagination bar showing "15" items per page and a "Next" button. At the bottom of the page, there is a copyright notice: "Copyright © 2018 Broadcom Limited. All Rights Reserved." and links for "Cookies and Your Privacy" and "Terms of Use".

Part Number	Date Requested	Product ID	Security Code	Status	Actions
73684280F0000007	2023-01-09	00366480	20	Approved	

... in this example, we searched for 72604ZB device and we see that one part exists on the portal:
72604ZBKFE8B0B0T

Find the license(s) associated with the part

Next, follow "View -> Licenses", then search for the part you selected in the step above, it will display all the available licenses for the part.



The screenshot shows the 'BP3 Licenses' page in the Broadcom License Manager. A search bar at the top right contains the part number '72604ZBKFE8B0B0T'. Below the search bar is a table listing licenses. The table has columns: No., Requested, Name, Licensee, Licenses, Part No., Quantity, Status, and Actions. There are 8 rows of license data. At the bottom of the table, there is a 'Rows per page' dropdown set to 10 and a 'OK' button.

No.	Requested	Name	Licensee	Licenses	Part No.	Quantity	Status	Actions
1260	2018-03-18	SKYPERFECT_DEV_12604_AMTSC1100	Broadcom	ARM	72604ZBKFE8B0B0T	5	Approved	i d
1217	2018-02-27	72604ZBKFE8B0B0T_in_email_DolbyVision	Dolby	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1216	2018-02-27	72604ZBKFE8B0B0T_in_email_DolbyAudio	Dolby	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1215	2018-02-27	72604ZBKFE8B0B0T_in_email_Broadcom	Broadcom	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1186	2018-02-03	72604ZBKFE8B0B0T_in_email_DolbyVision	Dolby	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1184	2018-02-03	72604ZBKFE8B0B0T_in_email_DolbyAudio	Dolby	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1183	2018-02-03	72604ZBKFE8B0B0T_in_email_CS43MULTE	Broadcom	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d
1182	2018-02-03	72604ZBKFE8B0B0T_in_email_Broadcom	Broadcom	Broadcom	72604ZBKFE8B0B0T	100	Approved	i d


... in this example, we see there are 8 licenses associated with the part. you may go through all of them to see what exactly they contain, the classic one we would need for android baseline integration are (in this example): **1182 (default bcm)** and **1184 (dolby audio)**.

Copy the PAK license in the code tree

PAK licenses do not need to be per device, therefore they are integrated in the vendor.img using the configuration settings mentioned in the prior section. They are however copied into the code tree in a single location under: "device/broadcom/common/pak", from which they are then pulled by the build process into the specific image.

PAK license compatibility

Although PAK licenses are not per device specific, they still are required some level of compatibility to work with a specific family of devices, as such the devices targeting usage of PAK need to be aware of the following:

-  for broadcom reference devices used internally
 - **Broadcom AndroidTV**
 - if the drm binary for the device was generated prior to 16.07.2018, then it is very likely the PAK license embedded in the default image will not match the drm binary identifier.
 - PAK bound features will consequently not work for that device use cases.
 - to address this problem, simply request a new drm license from the drm license portal and update the device hwcfg with it.
 - by default, the reference code is providing a PAK license suitable for matching a drm license produced for broadcom oem identifier (broadcom identifier is 0x1111).
- for broadcom reference devices used outside of broadcom, in particular devices used as part of the ATV reference program (elfin, cypress)
 - those devices are production devices (ZB).
 - those devices are using a specific identifier which is embedded in the drm license and the drm license cannot be easily changed for the devices.
 - by default, the reference code is providing a PAK license suitable for matching a drm license produced for a specific oem identifier which is not the broadcom one.
 - should you see any problems with a particular combination of PAK and drm license (such as PAK features are not able to work), it is very likely the drm and PAK licenses are not using the same oem identifier, in which case, one of them will have to change.

Program the BP3 license on the device


For the time being, the programming of licenses on android device happens from command line interface, using the "bp3" binary. For devices which are enabled for BP3 support in their device profile, the BP3 executable is automatically packaged with the image.

Step 1: check the status of the device licenses

Simply see what the device is currently configured to enable, running the "**bp3 status**" command.

In the example below, we highlight the licenses we are going to enable, which are the one we looked up in the prior step of this tutorial.

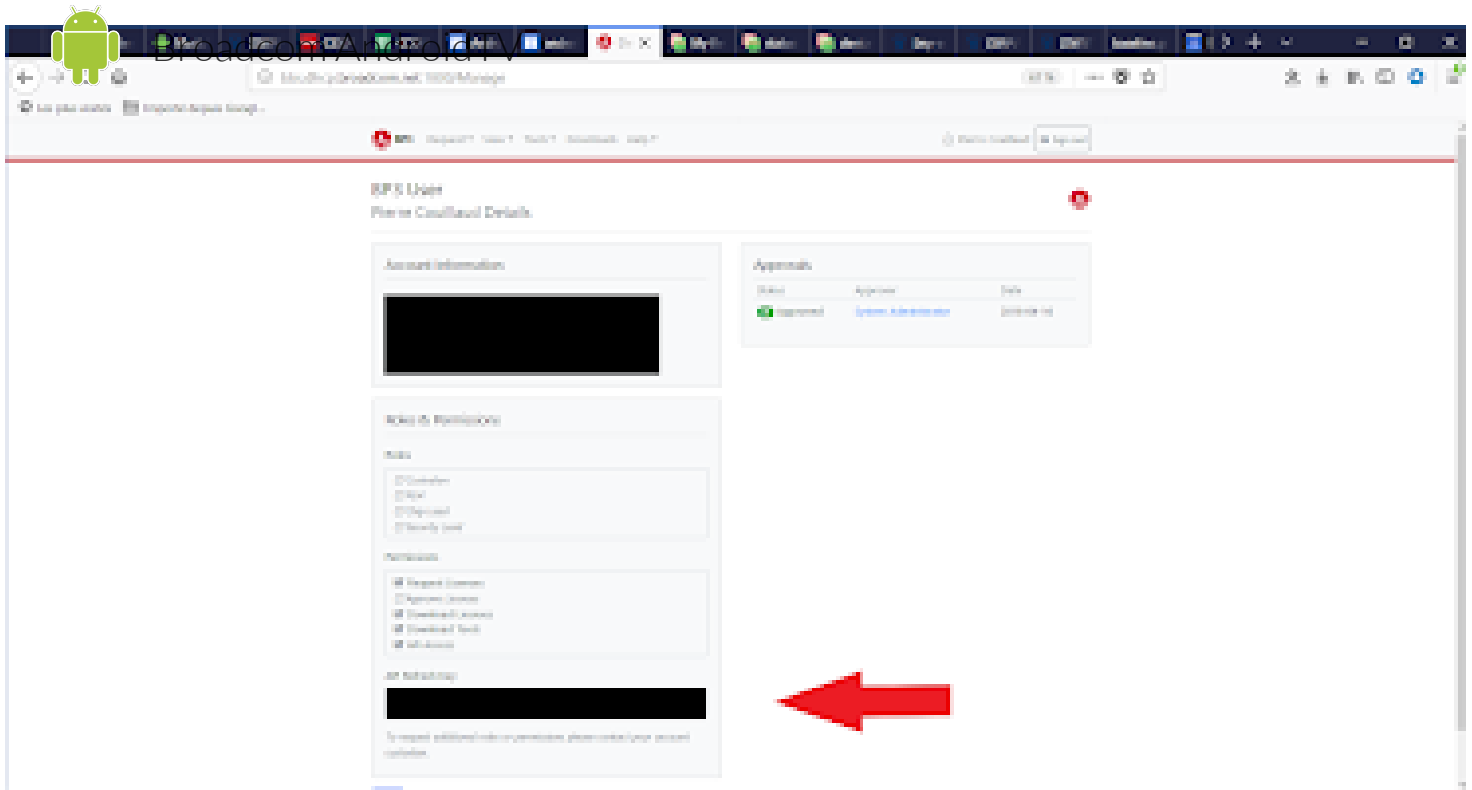
```
grouse:/ # bp3 status
UId = 0xd78e7ea54885c189
Broadcom - H265 (HEVC) [Disabled]
Broadcom - Dolby Vision HDR Activation ($) [Disabled]
Broadcom - Technicolor HDR Activation ($) [Disabled]
Broadcom - Technicolor ITM Activation ($) [Disabled]
Broadcom - QAM Activation ($) [Disabled]
Broadcom - CA Multi2 [Disabled]
Broadcom - CA DVB-CSA3 [Disabled]
```

 - Post Proc: DAP [Disabled]
Dolby - Decode Dolby Digital [Disabled]
Dolby - Decode Dolby Digital Plus [Disabled]
Dolby - Decode AC4 [Disabled]
Dolby - Decode TrueHD [Disabled]
Dolby - MS10/11 [Disabled]
Dolby - MS12 v1 [Disabled]
Dolby - MS12 v2 [Disabled]
Dolby - Decode Dolby Vision [Disabled]
Rovi - (ACP) Macrovision [Disabled]
Technicolor - Prime [Disabled]
Technicolor - ITM [Disabled]
DTS - DTS TruVolume [Disabled]
DTS - DTS Digital Surround [Disabled]
DTS - DTS-HD (M6) [Disabled]
DTS - DTS-HDMA (M8) [Disabled]
DTS - DTS Headphone:X [Disabled]
DTS - DTS Virtual:X [Disabled]
DTS - DTS:X [Disabled]

Step 2: Apply provisioning

Using the "**bp3 provision**" command, apply provisioning of the license of interest. The option to pass to the command are:

- portal: the portal to reach for provisioning, which is the same portal mentioned in the prior steps you would be looking up licenses on.
- key: this is the user key identifier, this information is found on the portal and is uniquely associated with your user identifier, you will find the key by selecting your user name on the top right corner of the portal main page which will bring up the information associated with the user on the portal. example below.



- license: this a comma separated list of license(s) to enable.
 - note: at least one of the license(s) must be a bcm license initially.
 - note: in this example, we use the licenses identified in the prior step.

```
bp3 provision -portal http://bbs.dhcp.broadcom.net:1800 -key <user-key-identifier> -
license 1182,1184
UIId = 0xd78e7ea54885c189
Provision succeeded
```


Upon successful provisioning, a "bp3.bin" module will appear (if first time), or may be updated in your "hwcfg" partition on the device.

Step 3: Verify the licensing configuration

Finally, verify the status of the provisioning, this assumes the command in the above step returned successfully.

In our example, we can verify the licenses state associated with the decoder firmware and the dolby audio have changed and those are now enabled for the device.

```
grouse:/ # bp3 status
UIId = 0xd78e7ea54885c189
Broadcom - H265 (HEVC) [Enabled]
Broadcom - Dolby Vision HDR Activation ($) [Disabled]
Broadcom - Technicolor HDR Activation ($) [Disabled]
```

Broadcom - Technicolor ITM Activation (\$) [Disabled]
 Broadcom Android TV [Disabled]
Broadcom - CA Multi2 [Disabled]
Broadcom - CA DVB-CSA3 [Disabled]
Dolby - Post Proc: DAP [Enabled]
Dolby - Decode Dolby Digital [Enabled]
Dolby - Decode Dolby Digital Plus [Enabled]
Dolby - Decode AC4 [Enabled]
Dolby - Decode TrueHD [Enabled]
Dolby - MS10/11 [Enabled]
Dolby - MS12 v1 [Enabled]
Dolby - MS12 v2 [Enabled]
Dolby - Decode Dolby Vision [Disabled]
Rovi - (ACP) Macrovision [Disabled]
Technicolor - Prime [Disabled]
Technicolor - ITM [Disabled]
DTS - DTS TruVolume [Disabled]
DTS - DTS Digital Surround [Disabled]
DTS - DTS-HD (M6) [Disabled]
DTS - DTS-HDMA (M8) [Disabled]
DTS - DTS Headphone:X [Disabled]
DTS - DTS Virtual:X [Disabled]
DTS - DTS:X [Disabled]