The story of a bug

Background

When the Compute Module 3 was launched in January 2017, it was available in two forms, with and without eMMc storage. Both had the same revision code.

The HAL (Hardware Abstraction Layer) uses the revision code (which is available via a mailbox property tag) to distinguish the different models of Pi, which, for example, may have memory arranged in different ways.

Allocating drive numbers to SDFS drives (and enabling or disabling the necessary checks for removal of media, especially for micro SD cards which have no 'present/absent' switch) is done by the HAP, using 0..3 for removable drives and 4..7 for fixed drives.

Philosophical problem

This presented a philosphical problem as the HAL was unable to make the distinction between CM3 Lite and CM3 with eMMc. A bug was therefore identified on 20 Jan that the CM3 identified both Lite and eMMc models as SDFS::4.

This was important as FileCore needs to know which discs are truly removable because it does extra checking that you've not ejected it behind its back. The hardware difference on the CM3 between the two variants cannot be detected in software.

It is also possible that the eMMc on the CM3 would only operate at 25MHz whereas a micro SD card would operate at 50MHz.

A hardware solution was pursued that would utilise an unused GPIO line on the IO expander that happened to run close to a ground line. In the longer term an 'eMMc fitted' pull down resistor might be fitted in manufacture (this was not pursued).

As a 'proof of concept' I was asked to send a CM3 to Rob Sprowson for a microscopic blob of solder to be applied in the right place. The solution worked and it was identified as SDFS::4 with CM3 otherwise being SDFS::0. It seemed that the philosophical problem was solved.

Compute Module 4

In October 2020 the CM4 was launched. A bug was raised (#512) in May 2021 that the eMMc on the CM4 could not be read by RISC OS. By January 2023 the on-board eMMc was working but was identifying as SDFS::0 and the Lite version as SDFS::4.

The HAL cannot use more complicated methods to interrogate the hardware. The revision code itself can be determined through the mailbox property interface, which the HAL can use.

```
 10 : DIM block 64
 20 : block!0=64
 30 : block!4=0
 40 : block!8=&10002:REM GetBoardRevision
 50 : block!12=4
 60 : block!16=0
 70 : block!20=0
 80 : block!24=0:REM End
100 : cmd$="BCMSupport_SendTempPropertyBuffer"
110 : SYS cmd$,block,block,0
120 : IF block!4=&80000000 THEN
130 :   PRINT"Message failed "
140 : ELSE
150 :   PRINT "Revision=";~block!20
160 : ENDIF
```

The HAL uses the mailbox property interface to work out which model of Pi it is on.

By June 2023 it was possible in software to discover whether the CM4 had WiFi and/or eMMc fitted.

The command `vcgencmd otp_dump` will show both revision code (at word 30) and extended revision code (at word 33). For the CM4 bits 31 and 30 of word 33

indicate whether WiFi (bit 31) or eMMc (bit 30) are fitted (zero = fitted). This can be used to decide whether the SDFS drive should be 0 or 4.

In August 2023 a bug (#611) was raised that some larger (32GB and above) SD cards on the CM4 could not be read reliably whereas prior to January 2023 they could.

Pursuing a fix

This started with a query to the raspberry pi forum in June 2023 about the extended revision code (flagging eMMc/SD card and WiFi/NoWiFi on CM4). I was encouraged to submit a firmware change request in October 2023 to add this to the mailbox interface so that RISC OS could see it from the HAL. Sprow helped this along by personal contact and the firmware was updated on 29 Feb 2024.

This was a pre-requisite for fixing bugs 512 and 611.

```
 10 : DIM block 64
 20 : block!0=64
 30 : block!4=0
 40 : block!8=&10002:REM GetBoardRevision
 50 : block!12=8
 60 : block!16=0
 70 : block!20=&DEADDEAD
 80 : block!24=&DEADDEAD
 90 : block!28=0:REM End
100 : cmd$="BCMSupport_SendTempPropertyBuffer"
110 : SYS cmd$,block,block,0
120 : IF block!4=&80000000 THEN
130 :   PRINT"Message failed "
140 : ELSE
150 :   PRINT "Revision=";~block!20
151 :   CASE block!24 OF
152 :   WHEN &DEADDEAD:PRINT "eMMc/SD card"
153 :   OTHERWISE
154 :   emm$="SD card"
154 :   IF block!24 AND 1<<30 THEN emm$="eMMc"
155 :   PRINT emm$
160 : ENDCASE:ENDIF
```

A small change to the earlier programme which now returns whether eMMc is fitted, not fitted or, if the firmware (start4.elf and fixup4.dat) is prior to 29 Feb 2024, unknown.

Further investigation

GPIO extender IO4, which was comandeered as the signal (when pulled low) to detect eMMc fitted (and therefore set to be pulled up by default) is used on the CM4 to signal whether the SDIO bus should use 1.8V (high) or 3.3V (low) signalling.

It is surprising how many SD cards designed for 3.3V logic will work at 1.8V. The new method of discovering eMMc fitment means this can be rectified. If the firmware is too old for the new method to work then removable media will be assumed.

The relevant bug fixes are these:
[611][512] Detect CM4 Lite variant using a mailbox tag : *https://gitlab.riscosopen.org/RiscOS/Sources/HAL/HAL_BCM2835/-/merge_requests/27*
Support for controllers that misbehave when they see CMD23 : *https://gitlab.riscosopen.org/RiscOS/Sources/FileSys/SDFS/SDFS/commit/e6d25ce01a604ec606202ff93070001bc96a7d4b*
Suppress use of CMD23 for multi-block SD transfers on SDHOST : *https://gitlab.riscosopen.org/RiscOS/Sources/HAL/HAL_BCM2835/commit/79a0d83467ab2ec6ad8b3bcecb8afb9c8aed195c*
Support for controllers that misbehave when they see CMD23 : *https://gitlab.riscosopen.org/RiscOS/Sources/HWSupport/SD/SDIODriver/commit/fecd9b0976f6a3b2514779d7a9cce1033775d93c*

So what?

Applying the first listed fix (which has not yet been merged) I have prepared a rom that includes these fixes which can be downloaded here *www.svrsig.org/rom.zip*.

Once merged, the readiness of the Pi for RISC OS 5.30 should transition from red to amber, meaning that a release candidate can be produced.

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