External storage of a partition table representing an unreliable storage device

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ABSTRACT

This disclosure describes techniques to store a partition table that represents an unreliable storage device such as NAND flash external to the storage device. The partition table is stored in a storage device with greater reliability, such as NOR flash. The reliable and unreliable storage devices are mounted on the same circuit board. The techniques enable simple firmware to be used to access the storage device. The technique can be utilized in embedded systems and other computing devices to provide reliable storage at a relatively low cost.

KEYWORDS

- NAND flash
- NOR flash
- Partition table
- Storage reliability

BACKGROUND

NAND flash storage is unreliable and frequently has bad blocks. The bad blocks are discovered upon performing an operation on the NAND flash, e.g., a read, write, or erase. The unreliability is greater than that of disks. GUID Partition Table (GPT) is a standard for the layout of the partition table on a physical storage device, such as a hard disk drive or solid-state drive, using globally unique identifiers (GUID). The GPT mechanism includes redundancy and checksumming features for reliability on disks. Partition tables that describe a device are typically stored on the same device. NAND flash requires greater reliability mechanisms due to the higher unreliability. Other storage technologies that are under development are also likely to present their own forms of reliability problems. By contrast,
NOR flash storage is very reliable. The failures in NOR flash storage are expected to be only of the catastrophic kind, not specific bad blocks.

DESCRIPTION

This disclosure describes techniques to provide greater reliability when using NAND flash storage in a computing device, e.g., desktop, laptop, or server computers, mobile devices, wearable devices, etc. Fig. 1 illustrates a circuit board (100), e.g., a motherboard in a computing device implementing the techniques described herein.

![Circuit Board 100](image)

**Fig. 1: Storing NAND partition table on a separate NOR storage**

As illustrated in Fig. 1, the circuit board includes a NAND flash storage device (102) and a NOR flash storage device (104). Other components (106) such as a processor, a graphics processing unit, memory, etc. can also be mounted on the circuit board, or can be included on a different board. The storage devices and other components are electrically coupled.

The partition table (110) that refers to NAND storage (102) is stored in the separate NOR storage (104). While traditionally partition tables are usually stored on the same device as what they represent, this disclosure makes advantageous use of the circuit board layout where the NAND and NOR flash are both mounted, e.g., soldered onto, the same circuit board. Due to this physical layout, keeping the devices paired is not a challenge. In addition
to the GUID partition table, other data may be stored on the NOR storage, e.g., metadata that is relevant to the integrity of the data on the NAND storage, cryptographic metadata, etc.

The described technique to store on a different device the partition table, cryptographic metadata, metadata relevant to data integrity, etc. is applicable for any combination of devices where one type of device has lower reliability and lower cost, while the other type has greater reliability but higher cost. Alternatives such as applying a complex block remapping strategy to the NAND partition table can provide higher reliability while storing the partition table on NAND are possible. However, the technique described in this disclosure is advantageous since it reduces the complexity of the firmware code that reads the partition table. The lower complexity of firmware lowers the possibility of bugs and enables a faster time to market. Further, reduced code size for the firmware lowers the requirements for the storage that the firmware is placed. These advantages are particularly valuable for embedded systems.

CONCLUSION

This disclosure describes techniques to store a partition table that represents an unreliable storage device such as NAND flash external to the storage device. The partition table and other relevant metadata are stored in a storage device with greater reliability, such as NOR flash. The reliable and unreliable storage devices are mounted, e.g., soldered onto, on the same circuit board. The techniques enable simple firmware to be used to access the storage device. The simple firmware has lower requirements and reduces the possibility of bugs in the firmware. The technique can be utilized in embedded systems and other computing devices to provide reliable storage at a relatively low cost.