Protective Avionics Flash File System
PAFFS

Pascal Pieper

26. April 2017

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Overview

Computer guided spaceflight

- Consisting of many subparts
  - Focus of this work is mass storage
- Experiment data (payload)
- Instructions
- Program images

  → Many applications for long term memory

Overview

Negative influences on memory

- Vibrations
- Radiation
- Rapid temperature changes
- Hard heat dissipation

Overview

Solution

- Radiation tolerant and robust memories
  - High cost

Cheap memories

- Compensate error rate with filesystem
- Its logic optimizes lifetime and reliability

Use

Cheap memory in space

NAND Flash

- Can write a page only once (512-4096 Bytes)
- Can delete only a whole block (16-512 Pages)
- Deletions can only happen rarely (100.000-100 Erases)

Requirements

- Take care of NAND specialities
  - → Especially the low lifetime
- Manage multiple redundant chips
- Tolerate bit errors as well as total loss of single chips
- Show minimal RAM footprint while being able to scale with increasing size memories
- Offer POSIX related file interface
- Minimize loss of data after unexpected power failure

Requirements

Tradeoff

- Read-/Writespeed $\longleftrightarrow$ RAM usage
- Wear $\longleftrightarrow$ RAM usage, fail safety
- Efficiency of data storage $\longleftrightarrow$ RAM usage, fail safety

Übersicht

Inodes

- Represent an Object
  - → File, directory or softlink
- Point to data chunks containing each objects contents
- ... and some other metadata such as an unique ID and size

Tree Index

Structure

- Contains all Inodes
- Is ordered by Inode ID in a B+Tree
- Branches contain pointers to branches or leaves
- Leaves contain Inodes

Difficulties

Change in a file

- → changes location of files data
- → changes location of Inode
- → changes location of corresponding leave
- → changes location of every parent branch including root node

How to approach

- Reduce wear by caching a subset of tree index
- But still: how to find a ever changing root node?

Superblock

- a

Areas

- a

Fehlerkorrektur

- a