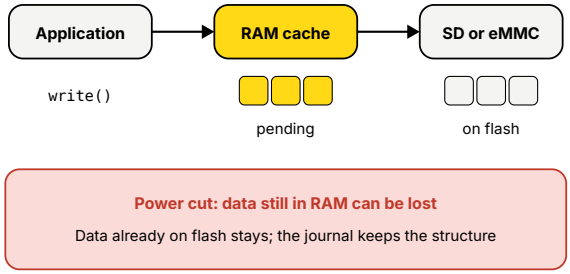
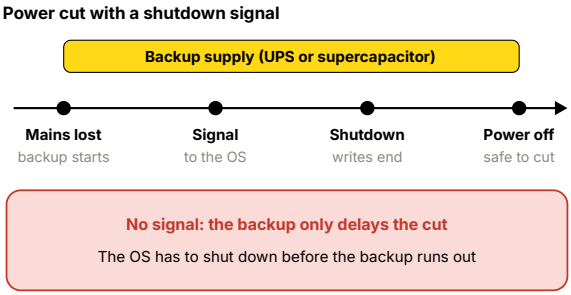
SD card corrupted? 6 habits for Linux in the field

A Linux device that boots from an SD card or eMMC loses power without a shutdown, and then does not start, or starts with files missing. Before you replace the card, check these six habits. Valid for Raspberry Pi based PLCs and panel PCs, gateways and other Linux devices in the field.

Where the data is when the power goes



Write path: data waits in the RAM cache before it reaches the flash. What is still in RAM when the power goes can be lost.



Outage with a signal: the backup supply holds the system long enough to shut down before the power is cut.

The card may not be faulty

Corruption can come from a write interrupted by a power cut. Cards also fail from wear or poor quality: look at both before you replace it.

Journaling is not a backup

ext4 journaling keeps the structure of the file system consistent. The file that was being written can still be lost or incomplete.

Six habits, in this order

Habit	What to do	Good result
1. Writes	Data waits in the RAM cache before it reaches the flash (ext4 commits every 5 s by default). Applications that must not lose data call fsync after each critical write.	Critical data on the flash before the next step.
2. File system	Keep ext4 with its journal and the default data=ordered mode. Journaling keeps the structure consistent; it does not protect the file being written.	The file system mounts after a cut.
3. Shutdown	Shut down with `sudo poweroff` before you remove power. A button wired to an input that triggers the shutdown is fine; a switch that cuts the supply is not.	The system is off before the supply is cut.
4. Outages	UPS or supercapacitor with a power-fail signal that starts the shutdown in time (for example NUT upsmon or a GPIO input).	Every outage ends in a clean shutdown.
5. Write less	journald in RAM (Storage=volatile), temporary files on tmpfs, no debug logging to the card. Logs you need for diagnosis go off the device.	Fewer writes, less flash wear.
6. Protect	Read-only or overlay root. Card from a reliable brand, industrial grade or eMMC if the site needs it. A tested backup image.	Recovery is a reflash, not a rebuild.

What the symptom tells you

Symptom	Possible causes	Next step
Does not boot after a power cut	Write interrupted on the boot or root partition, or a worn card.	Reflash the backup image; habits 3, 4 and 6.
Boots, but a file is empty or incomplete	File open when the power went, data still in the cache.	Habits 1 and 2.
File system check runs at every boot	Shutdowns that are not clean.	Habits 3 and 4.
Read-only file system errors while running	The kernel may remount it read-only after errors (errors=remount-ro), or the card is failing.	Check dmesg, copy the data, replace the card.
Card fails again after months, with no power cuts	Flash wear from constant writes: logs, databases, swap.	Habits 5 and 6.
Logs gone after a reboot	Expected with journald in RAM or an overlay root.	Send the logs off the device if you need them.
Configuration changes lost after a reboot	Overlay file system active: changes stay in RAM.	Disable the overlay, or use a data partition.

From the sources

- Raspberry Pi: corruption can occur when a writing process is interrupted before it completes.
- Journaling protects the structural consistency of the file system, not the content of the file being written.
- The flash in SD cards has a limited write cycle lifetime: writing less helps.

What protects what

- Journaling: the file system structure.
- Software shutdown: pending writes.
- Backup with a signal: outages.
- Fewer writes: flash wear.
- Read-only or overlay: the root.
- Backup image: recovery.

Reference commands

- `sudo poweroff` before you remove power.
- `Storage=volatile` in /etc/systemd/journald.conf.
- A tmpfs line for /tmp in /etc/fstab.
- raspi-config > Performance Options > Overlay File System.

Know the trade-offs

Logs in RAM and changes on an overlay root are lost at reboot. Keep the data you need on a separate partition or send it off the device.

tmpfs uses RAM; with swap on the card, it can still reach the flash.

References: Raspberry Pi Ltd, Making a more resilient file system (RP-003610-WP); Raspberry Pi documentation: Getting started (Shutdown options) and Configuration (raspi-config); Linux kernel documentation: ext4 and tmpfs; systemd journald.conf(5); fsync(2); Network UPS Tools upsmon(8). Device manuals take precedence over this general guide.