EDGE·FS

Protecting mission-critical data in resource-constrained environments

Tuxera EdgeFS ensures data integrity with resiliency to corruption in resource-constrained, mission-critical environments. EdgeFS is a transactional file system created specifically for real-time operating systems (RTOS). It protects critical system and user data in systems prone to unexpected power losses. It works with a broad array of storage media including e•MMC, UFS, NVRAM, mass storage (SD/MMC, USB), and special, custom flash memory types.

EdgeFS integrates with any RTOS: FreeRTOS, GreenHills INTEGRITY, SafeRTOS, ThreadX/AWS, Micirum OS, ARM mbed. Additionally, EdgeFS CERT edition ships with a full set of documents and artifacts. CERT provides a certifiable file system designed for safety-critical applications in regulated industries – such as automotive, avionics, industrial devices, and medical equipment – that require certification evidence to ISO26262, DO-178C, and other functional-safety standards. EdgeFS ships in millions of devices and is trusted by top OEMs and Tier-1 suppliers worldwide.

Figure 1. EdgeFS random read/write performance superior to alternative

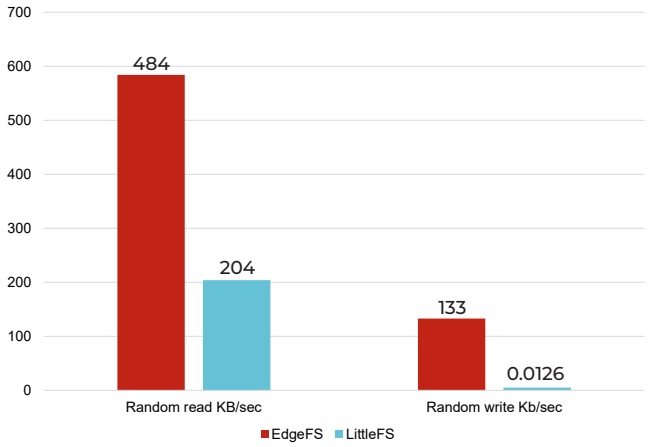
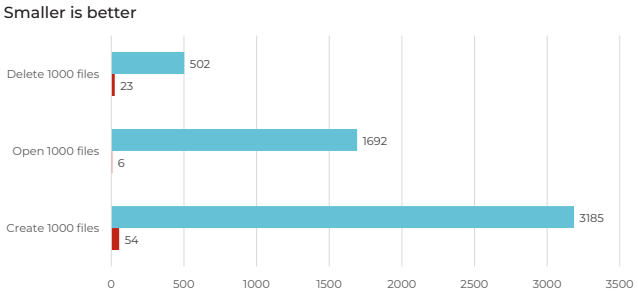


Figure 2. EdgeFS random file creation, access, and deletion superior to alternative



	Create 1000 files/sec	Open 1000 files/sec	Delete 1000 files/sec
LittleFS	3185	1692	502
EdgeFS	54	6	23

EdgeFS editions

Tuxera EdgeFS

Tuxera EdgeFS is the ideal choice when you need to manage and store mission-critical data without straining CPU and memory usage. It supports larger files and volumes than standard FAT file systems and offer consistent perfomance and reliability when compared to other alternatives like LittleFS

Tuxera EdgeFS CERT

Tuxera EdgeFS CERT works best for safety-critical applications with the highest reliability requirements. It follows strict coding standars like MISRA-C and includes comprehensive documentation. For project certification, a complete set of artifacts is available.

Tuxera EdgeFS NAND

EdgeFS NAND is designed specifically for SPI NAND flash, with a built-in flash translation layer. It handles everything you need to make NAND flash work properly—from wear leveling to bad block management and error handling. EdgeFS NAND keeps your data safe without any extra batteries or capacitors, saving you storage space and money.

EDGEFS EDITIONS	EdgeFS	EdgeFS NAND	EdgeFS CERT
Dynamic Transaction Points	•	•	•
Fault-tolerant during unexpected shutdown	•	•	•
Metadata CRC	•	•	•
RAM requirements*	3.9 kb – 8.4 kb	7.4 kb – 12.0 kb	4.0 kb – 8.7 kb
Code size (ROM)*	10.6 kb – 17.6 kb	35.2 kb – 42.1 kb	13.3 kb – 20.3 kb
Integrated NAND flash memory controller		•	
Coding standards	Tuxera coding style	Tuxera coding style	MISRA-C
Certification evidence	–	–	•
Effective Lines of code (ELOC)*	–	–	4148 – 7029
Cyclomatic complexity (avg)*	–	–	6.57 – 6.21
Maximum stack depth (bytes)*	–	–	440 – 704

*Depending on configuration options: FSEssentials, Small POSIX, Full POSIX

Fast, consistent mount times

In cases where power failure may occur, EdgeFS has a definite mount time advantage. There is no need to replay a journal or perform any other file system checks—Tuxera EdgeFS always keeps the disk in a known good state.

Better reliability for a better user experience

Device reliability means different things to different people. Lack of reliability can have consequences ranging from a failed mission due to lost or corrupted data, warranty returns due to program corruption, or a frustrating user experience – the enemy of customer loyalty. Because EdgeFS is a copy-on-write transactional file system, live data is never overwritten. This makes the system extremely fault tolerant even after an unexpected system shutdown caused by power loss or component failure. True transactional architecture designed into EdgeFS ensures rock-solid data reliability as EdgeFS maintains complete metadata and file data integrity, while providing the performance needed to create an optimal user experience. Dynamic Transaction Point™ technology gives developers complete compile-time and run-time control.

Our Software Test team uses multiple tools to verify basic functionality via API tests, along with reliability via power fail simulation. Designed for maximum portability, Reliance Edge is also tested on FreeRTOS and Microsoft Windows using various implementations of GCC, including Atmel Studio 6.2.

Uncompromising performance

EdgeFS has strong read and write performance, compared to other file system alternatives. In benchmark tests, EdgeFS achieved over 2.3x faster random read performance and over 10,000x faster random write performance. EdgeFS also excels in random file operations: when tasked with creating, opening, and deleting 1000 files, EdgeFS dramatically outperformed its alternative; file operations were performed from 20x - 280x times faster. The test setup simulates typical real-world embedded workloads, particularly in IoT devices, where I/O sizes are small. The performance advantage offered by EdgeFS is particularly

meaningful when the write sizes are smaller than the block size. This comparative advantage exists even when EdgeFS prevents data loss from power interruption while other file systems do not. The test used on page 1 benchmarked EdgeFS NAND and LittleFS in FreeRTOS using Tuxera's general purpose file system I/O test (FSIOTest). This test suite measures a variety of file operations and I/O types and works with virtually any file system. Tuxera's FSIOTest it is included with EdgeFS and its variants.

Integrity checking guards against data corruption due to media failure

Advanced instrumentation enables fast, precise diagnosis of errors within the storage subsystem. Finding the source of these storage media failures is normally a time-consuming part of the development process, which can delay market availability for many weeks. At the heart of Tuxera's file system diagnostics are full metadata CRCs (Cyclic Redundancy Checks), which enable developers to continuously monitor reliability in any embedded system. Unlike basic file systems such as FAT, Reliance Edge is capable of monitoring metadata to detect and provide early warning of imminent media failure and data inconsistencies.

Smart transaction model guarantees integrity

The design of Tuxera EdgeFS provides both system and data integrity with or without atomic sector writes. Most modern media support this feature, which guarantees the sector being written will contain either completely written new data or the original values. EdgeFS provides stronger error checks at mount time if atomic sector writes are available. In cases where this feature is not available, data integrity is also guaranteed thanks to proprietary transaction technology.

Discards

In the commercially-licensed version, discards provide significant performance benefits and create less flash wear, which extends flash lifetime. This is achieved by enabling the disk to perform compactions more efficiently. File systems using the flash memory driver, FlashFX Tera, experience even greater performance improvements, making it the perfect complement to EdgeFS.

Simple architecture enables faster implementation

The Tuxera EdgeFS RTOS services API is designed to be easy to implement for any RTOS, even a simple scheduler loop.

FEATURES OF TUXERA EDGEFS

- **Fault tolerance to unexpected shutdowns**
- **Never overwrites live data**
- **Transaction point settings can be set at runtime**
- **Fast power loss recovery**
- **Discards**
- **Encryption support**
- **Secure erase**
- **Metadata CRC**
- **Deterministic operations**
- **Multiple configuration modes (FSEssentials, small POSIX, Full POSIX)**

KEY APPLICATIONS

- **ADAS systems, cluster systems, and telematics units**
- **Engine diagnostics**
- **Avionic systems**
- **Satellite on-board computers**
- **Smart meters**
- **Industrial IoT devices, PLCs, and motion controllers**
- **Handsets and radios**

Our comprehensive developer documentation provides a searchable reference to every library function and configuration, leaving the developer free to concentrate on a superior application for the customers. It is far quicker to utilize the fully tested EdgeFS file system than to write a custom data storage that is both power fail safe and well tested.

Data exchangeability

If the media used with EdgeFS is removable, such as a USB drive or a SD card, data on that media can be copied to and from a Windows-based computer using the Reliance Edge Image Copier/Image Builder command line utilities. A FUSE version of EdgeFS is also available on Linux.

Software integration and licensing

Distribution licensing models can be structured to fit your project budget. Commercially-licensed projects include a comprehensive Developer's Guide, API reference, and validation utilities. Tuxera also provides Integration and Optimization Services to create a custom module tuned for your platform and specific requirements. Consult your Tuxera representative for options that apply to your project.

Professional technical support

Tuxera's award-winning technical support has a strong commitment to making your devices work reliably, from testing to implementation. Tuxera regularly goes above and beyond to make sure your project performs flawlessly.

Annual support subscriptions are available with a choice of service level options that provide reliable access to responsive Tuxera file system experts ensuring your project stays on schedule.

Interested? Get in touch: sales@tuxera.com

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