UFS and UFS Card on Windows

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Agenda

- UFS and the Windows inbox driver
- UFS and the exFAT file system

Windows UFS Driver

Windows UFS Support (1/2)

- Inbox UFS driver (storufs.sys) added in Anniversary Update (RS1)
  - Support for Gear 2
- Gear 3 support added in Creators Update (RS2)
  - Added support for RPMB

Windows UFS Support (2/2)

- More features coming in Fall Update (RS3)
  - Firmware Update
  - Secure Erase
  - Inline Crypto Engine
- Futures
  - UFS Card support
  - UFS 3.0

exFAT for UFS Cards

exFAT Is FAT32's Successor (1/6)

- exFAT shares may aspects of file system design with FAT32
  - exFAT shares may of FAT32's concepts such as volume layout, mounting process, and clusters
  - Developers should be able to take existing FAT32 implementations and adapt them to exFAT
  - exFAT is truly designed to be FAT32's successor (and retains its valuable simplicity – our exFAT implementation is actually smaller than our FAT12/16/32 implementation)

exFAT Is FAT32's Successor (2/6)

- FAT32 has two critical limitations:
  - FAT32 can only describe files up to $2^{32} – 1$ bytes (4GB) in size; this is a hard file system limitation, changing it essentially means creating a new file system
  - FAT32 can, in theory, work on storage volumes up to $2^{32} – 1$ sectors (2TB) in size; experience shows volumes in just the 100s of GB are at the fringe of practical maximum volume size

exFAT Is FAT32's Successor (3/6)

- exFAT overcomes FAT32's critical limitations:
  - exFAT can describe files up to $2^{64} – 1$ bytes in size; this is well in excess of all existing needs and all foreseeable future needs
  - exFAT can describe volumes up to $2^{64} – 1$ sectors in size; to manage such large volumes, exFAT supports:
    - Clusters up to 32MB in size
    - An Allocation Bitmap, which is authoritative over the FAT, to manage the allocation state of clusters

exFAT Is FAT32's Successor (4/6)

- exFAT provides significant improvements to ensure longevity:
  - exFAT directory entries are extensible, enabling exFAT to meet future needs, likely without requiring yet another painful switch (the FAT16 -> FAT32 and FAT32->exFAT switches are painful due to no backward compatibility)
    - Extensions can direct legacy exFAT implementations they can safely read the file data, despite the presence of an extension (i.e. alternate streams)
    - Or extensions can direct legacy exFAT implementations they cannot read the file data due to the presence of an extension (i.e. access controls)

exFAT Is FAT32's Successor (5/6)

- exFAT is broadly supported
  - exFAT first shipped with Windows Vista
    - Backported to Windows XP ☺
  - Supported on Mac OS X since 10.6
  - Implementations available for Linux/Android

exFAT Is FAT32's Successor (6/6)

- exFAT is broadly adopted
  - Official file system for SDXC cards
  - A preferred file system for UFS cards