

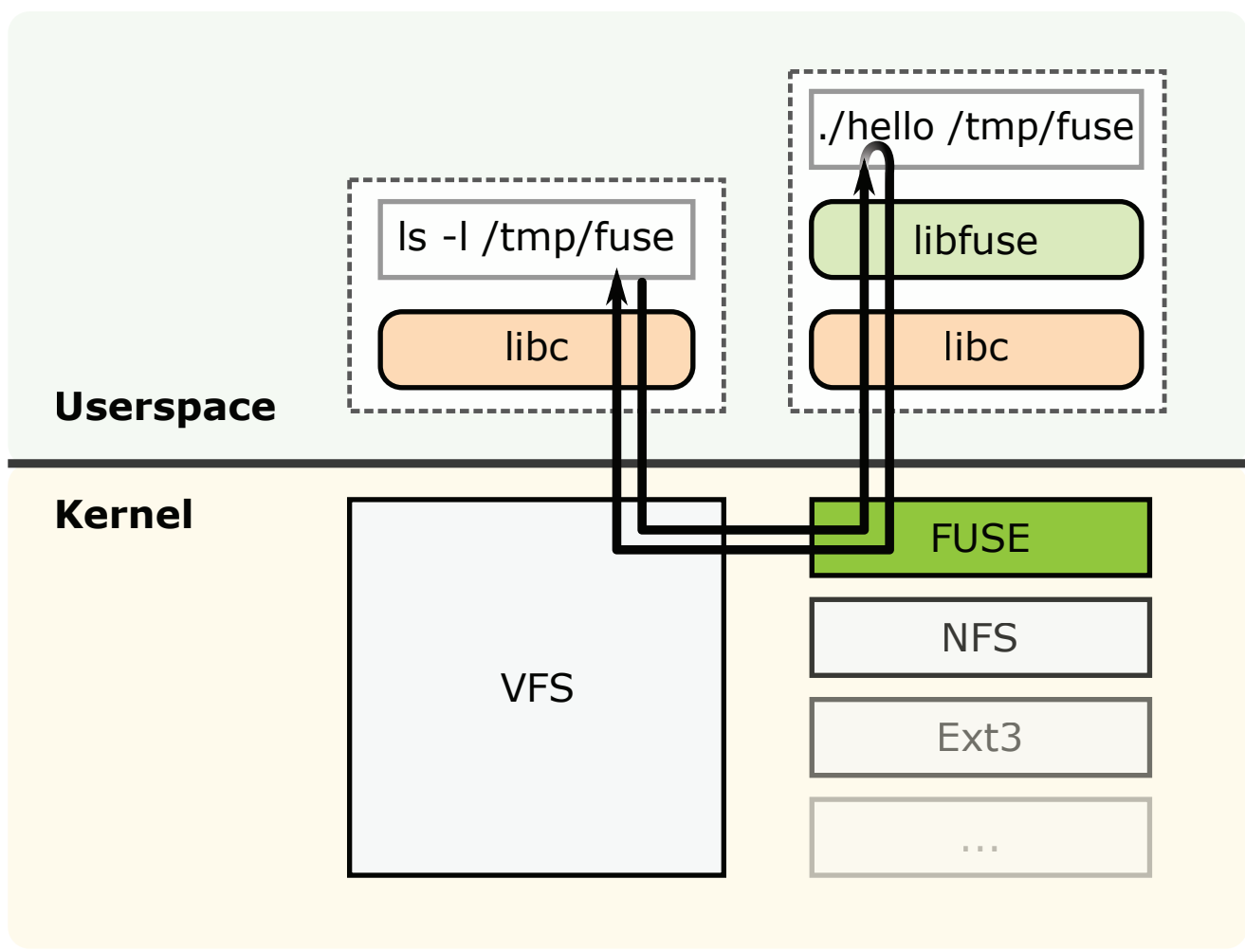


Finesse: Kernel Bypass for FUSE File Systems

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File Systems In User Space



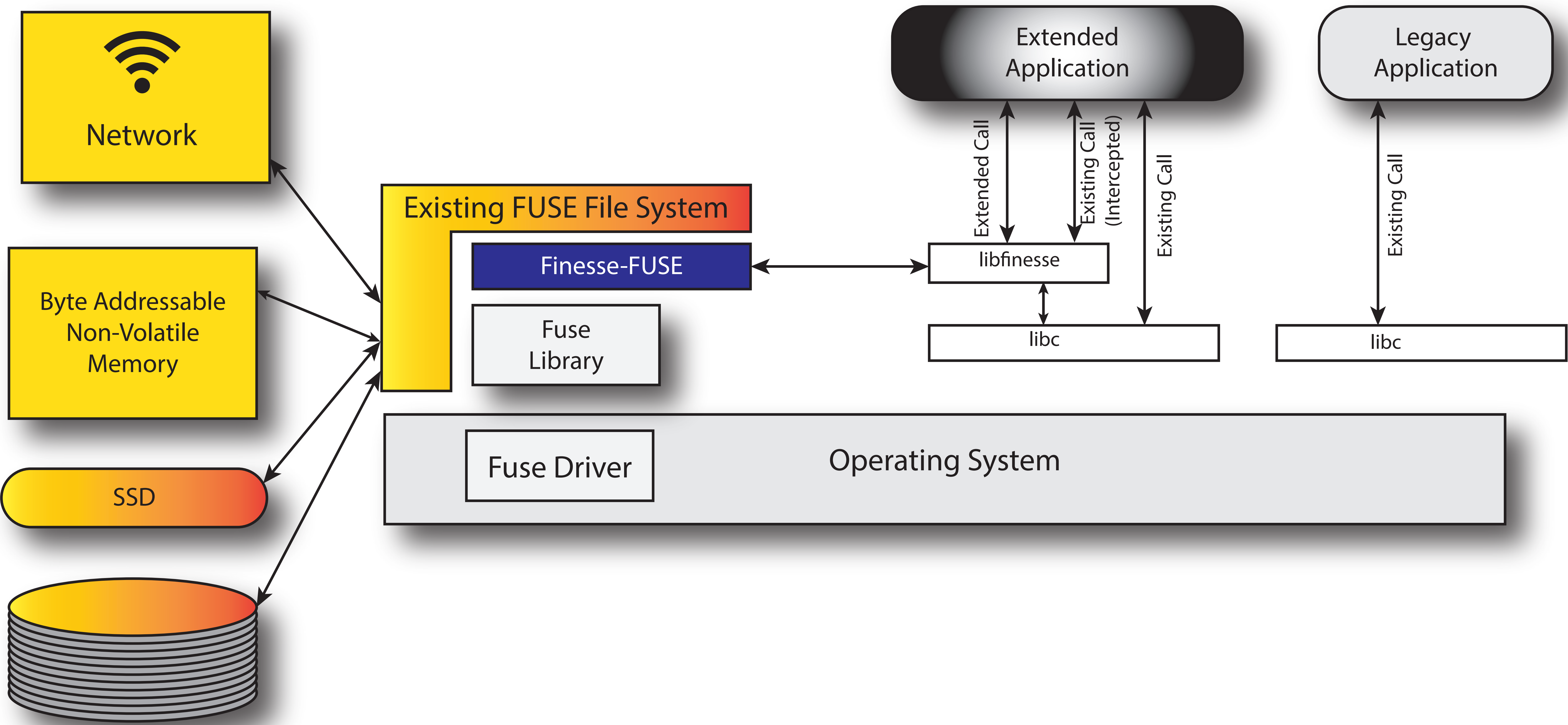
Source: <https://commons.wikimedia.org/w/index.php?curid=3009564>

Challenges:

- Large body of existing applications
- Rigid interfaces
- Implicit state information
- Performance
- Existing semantics

Advantages:

- Large body of existing applications
- Cross-platform support
- User mode development (easier)
- Easy to prototype/build
- Well understood semantics



Preliminary Results

| Workload | I/O Size (KB) | Ext4 HDD (ops/sec) | StackfsBase HDD (%Diff) | StackfsOpt HDD (%Diff) | Finesse HDD (%Diff) | EXT4 SSD (ops/sec) | StackfsBase SSD (%Diff) | StackfsOpt SSD (%Diff) | Finesse SSD (%Diff) |
|----------------|---------------|--------------------|-------------------------|------------------------|---------------------|--------------------|-------------------------|------------------------|---------------------|
| files-cr-1th | 4 | 16406 | -155.16 | -247.01 | -151.36 | 25622 | -21.04 | -13.79 | -268.01 |
| files-cr-32th | 4 | 20186 | -1122.04 | -169.25 | -1654.03 | 46183 | -17.00 | -32.26 | -3816.01 |
| files-rd-1th | 4 | 164 | -22.17 | -107.40 | -1.03 | 5803 | -25.87 | -25.66 | -480.56 |
| files-rd-32th | 4 | 432 | -174.39 | -86.68 | -375.78 | 65779 | -18.99 | -18.73 | -6218.78 |
| files-del-1th | - | 685 | -164.54 | -255.32 | +97.77 | 21465 | -11.38 | -14.94 | +29.21 |
| files-del-32th | - | 301 | +80.28 | -18.00 | +98.36 | 20000 | -14.93 | -20.12 | -13.34 |

Green class (marked with +) indicates that the performance either degraded by less than 5% or actually improved; Yellow class includes results with the performance degradation in the 5–25% range; Orange class indicates that the performance degradation is between 25–50%; And finally, the Red class is for when performance decreased by more than 50%

| Workload Name | Description |
|---------------|--|
| files-cr-Nth | Nthreads (1,32) create 4 million 4KB files over many directories |
| files-rd-Nth | Nthreads (1,32) read from 1 million preallocated 4KB files over many directories |
| files-del-Nth | Nthreads (1,32) delete 4 million preallocated 4KB files over many directories |

Project Goals

- Optimize meta-data paths
- Extend support for more calls
- Enhance message passing performance
- Integrate with other FUSE extensions (e.g., ext-FUSE)
- More kernel bypass



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