SDC

STORAGE DEVELOPER CONFERENCE

SNIA ■ SANTA CLARA, 2017

Recent Developments in the Linux I/O Stack

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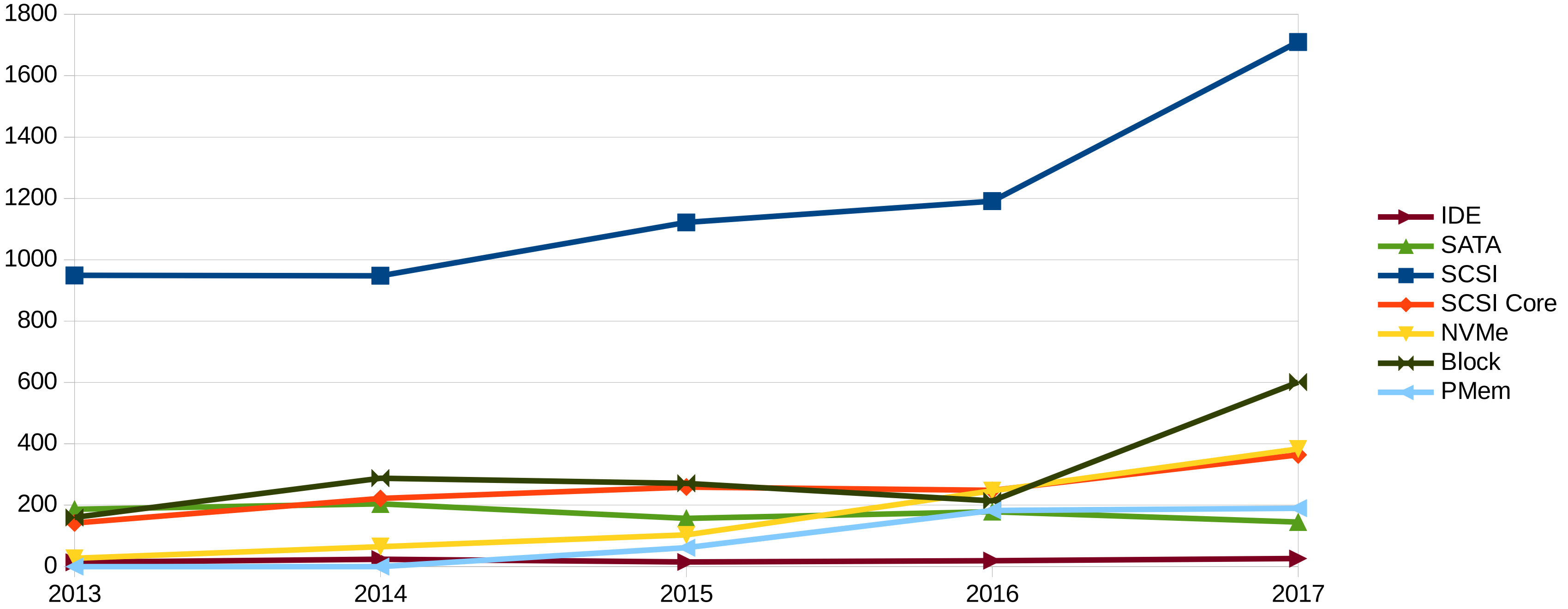
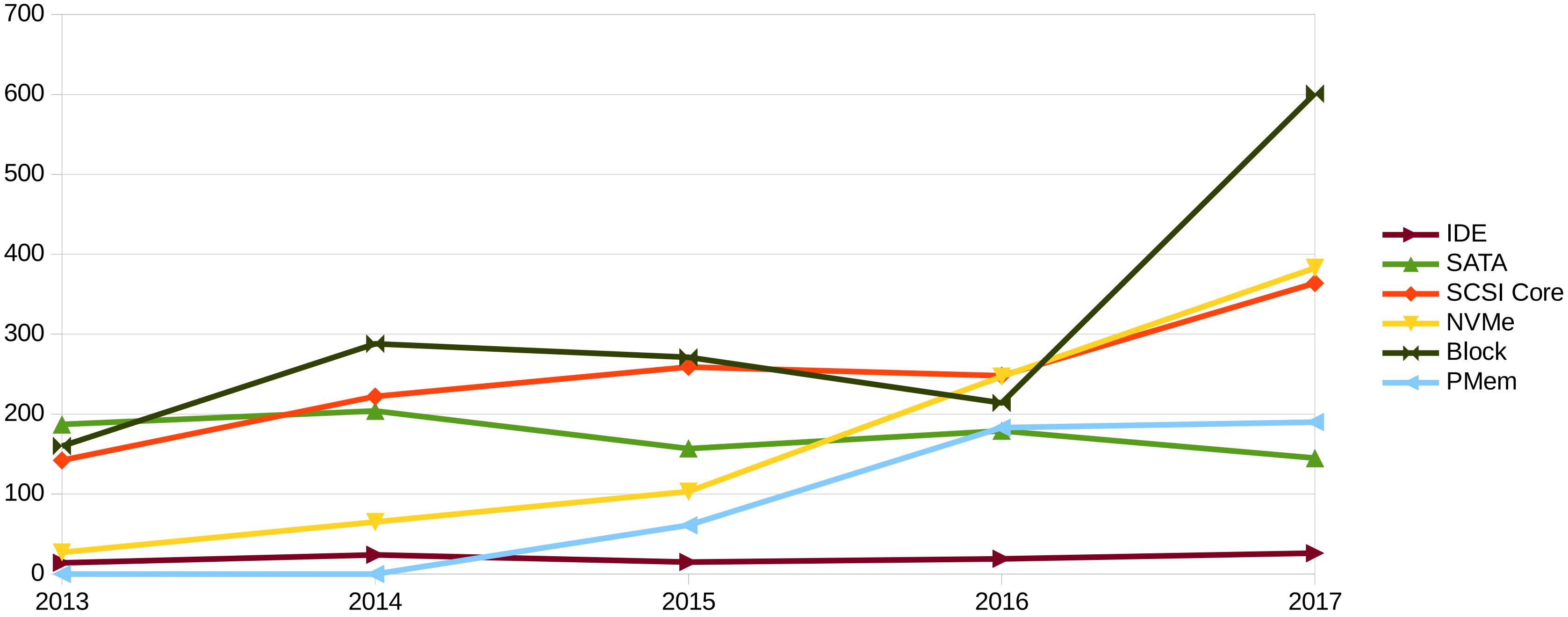
Oracle

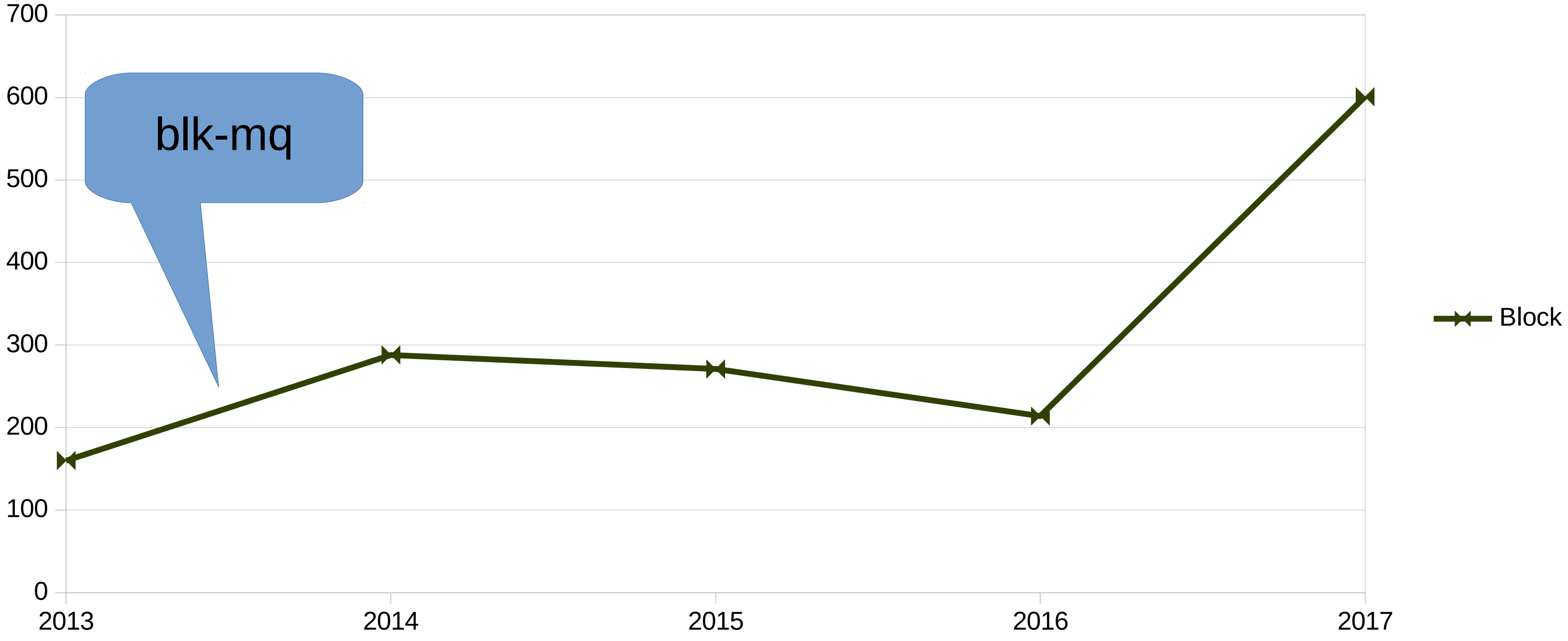
Linux I/O Development Activity



Linux I/O Development Activity



Linux I/O Development Activity



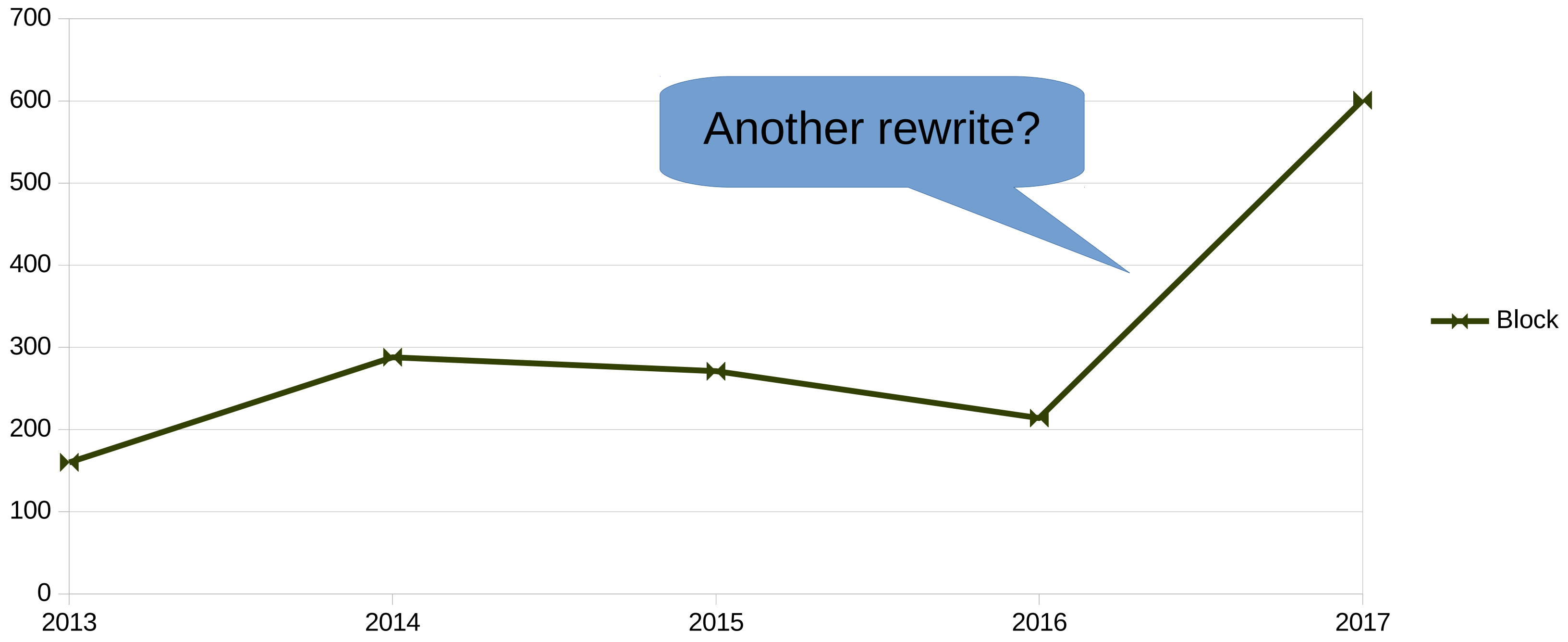
Multiqueue Block Layer

- Legacy I/O submission path is single-threaded
- Major rework of the block I/O infrastructure to accommodate devices with multiple submission queues such as NVMe
- Lockless submission path and better scalability
- NVMe and SCSI are the two main users

Multiqueue Block Layer

- Legacy I/O path developed for spinning media
- I/O schedulers for fairness and coaslescing
- High latency due to seek reduction
- blk-mq aims at low-latency devices
- However, some mq devices and workloads benefit from I/O scheduling

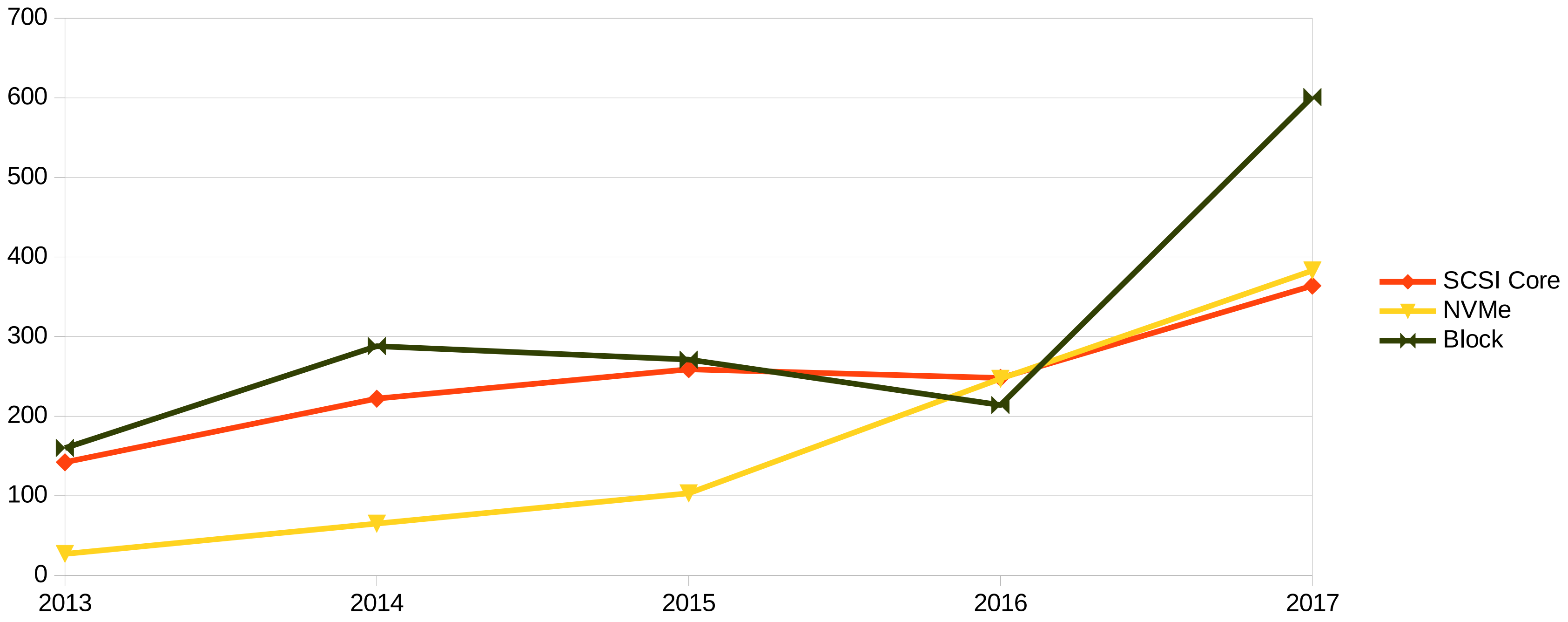
Linux I/O Development Activity



Multiqueue Block Layer Enhancements

- ❒ Preparation to remove legacy I/O path
- ❒ blk-mq now has I/O scheduling capability:
  - Kyber
  - Budget Fair Queueing
- ❒ Polling
- ❒ Opal/SED

Linux I/O Development Activity



Block Layer I/O Abstractions

- Not just reads, writes, and passthrough
- *Flush* operation for consistency
- *Discard* for deprovisioning block ranges
- *Write Zeroes* for clearing block ranges
- Persistent Reservations
- *Copy In* and *Copy Out* in pipeline

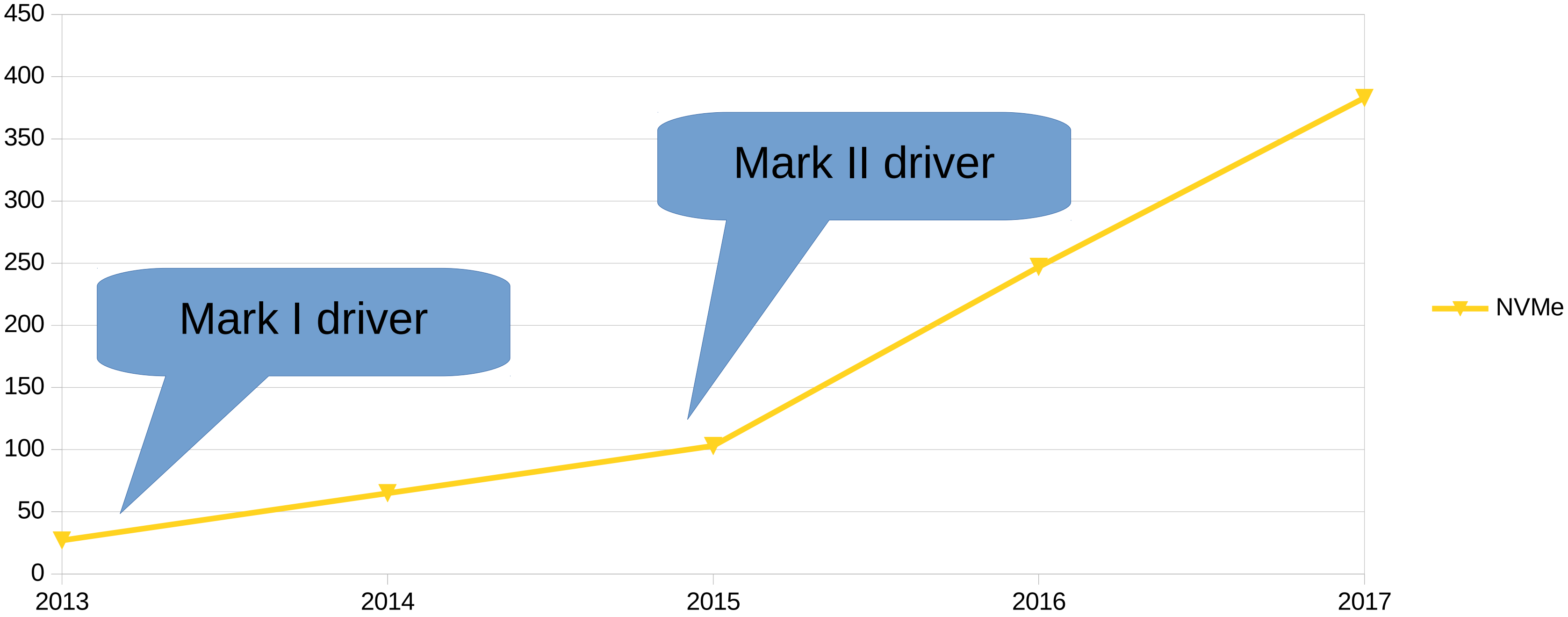
Block Layer I/O Abstractions

- ❐ Hinting
  - Data lifetime
  - Realtime and Background operations
- ❐ Streams & File IDs
  - Data Affinity
- ❐ Key-Value vs. General Purpose

Zoned Block Devices

- SMR drives, zones are append only
- Challenging for existing applications and file systems
- dm-zoned
- Legacy I/O path only, MQ support in pipeline
- Key-Value vs. General Purpose

Linux I/O Development Activity



Mark I driver

Mark II driver

NVM Express

- 3rd iteration of the Linux NVMe driver
- Mainly done to facilitate NVMe over Fabrics RDMA transport binding
- Fibre Channel transport binding merged
- TCP transport binding in the pipeline

NVM Express

- 1.2/1.3 features
- Power Management
- Device Quirks
- Persistent Reservations
- Fabrics NVMe target support
- Multipathing support in the pipeline

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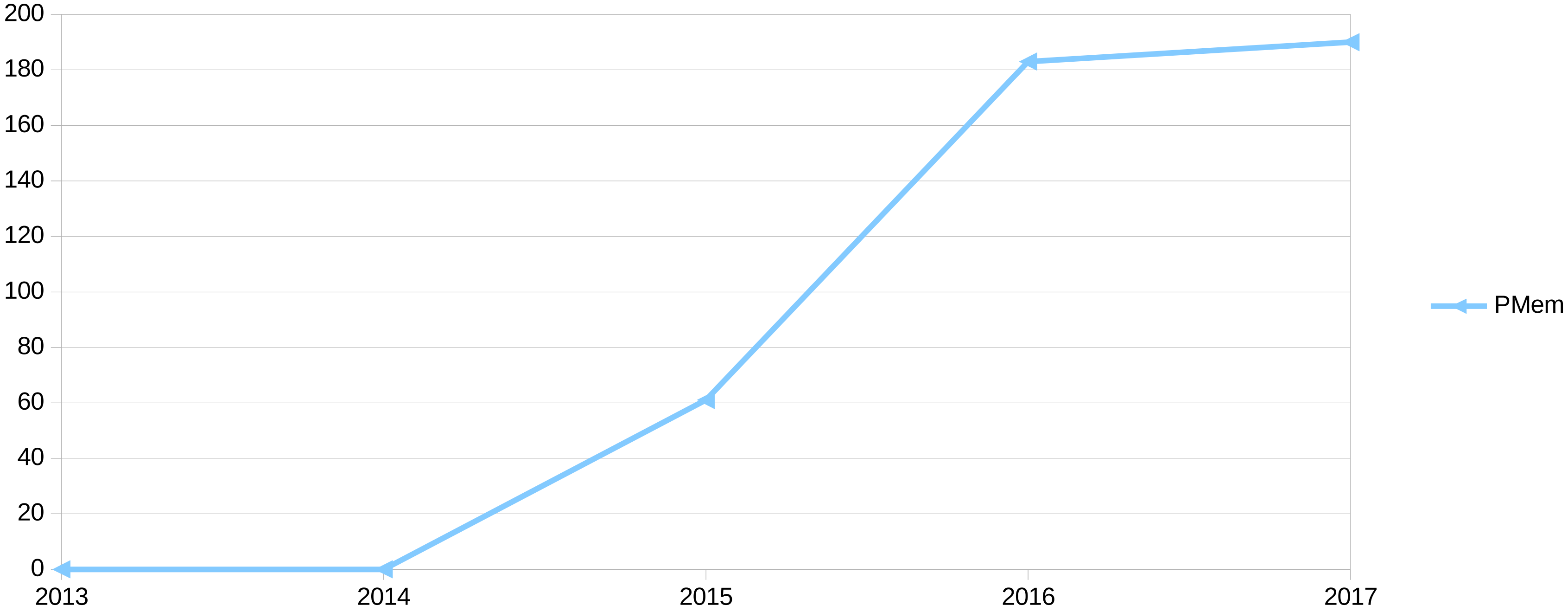
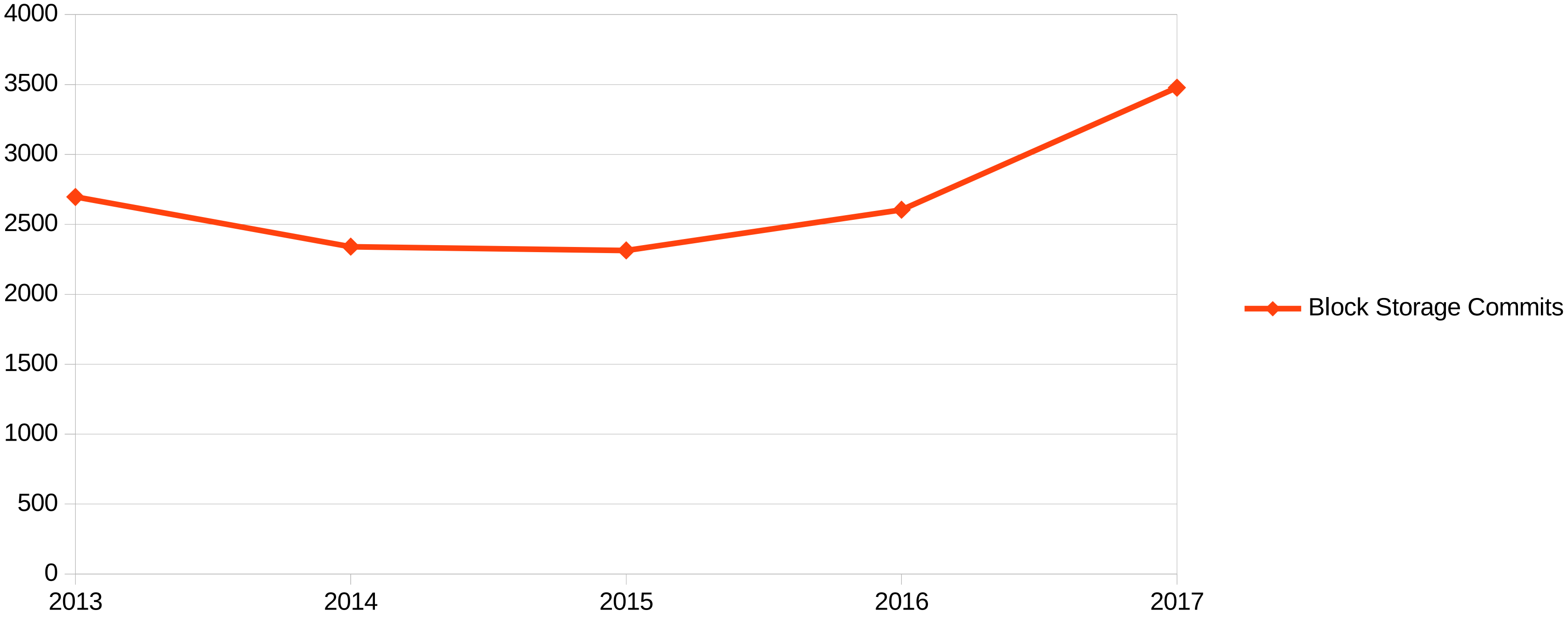


Persistent Memory

- ❒ Persistent Memory
- ❒ Block accesses vs. byte-addressable memory
- ❒ Device DAX vs. Filesystem DAX
- ❒ Combining fast flushes with benefits of file management

Linux I/O Development Activity



Thank You!