

# 2021-2021 Co-Op Summary (Sanitized)

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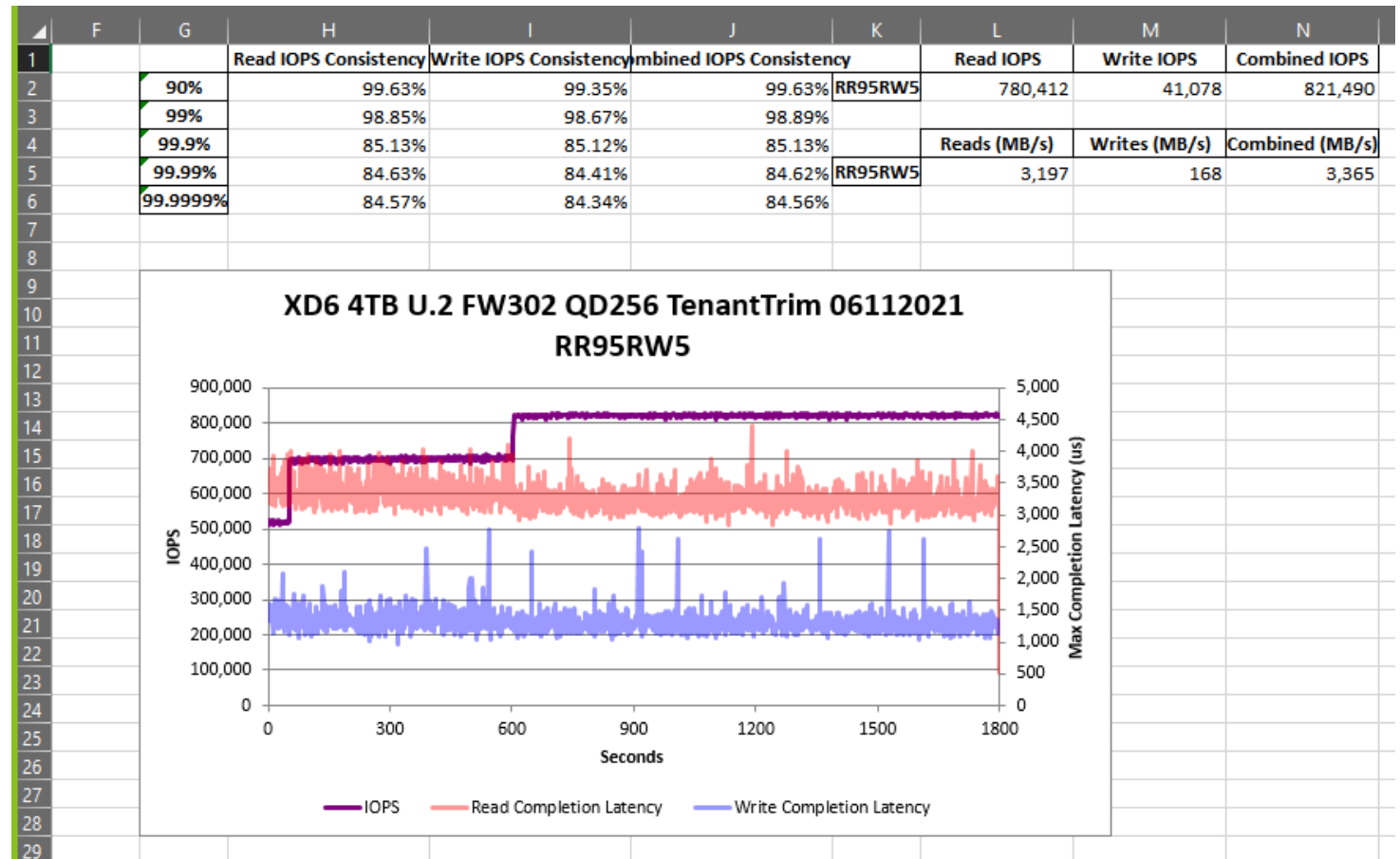
KIOXIA

# Agenda

- **Projects**
  - Performance Automation
    - Sweep tests
    - Pressure tests
  - Characteristics Automation
- **Skills and Knowledge**
- **Work from Home challenges**
- **My Takeaways**

# Performance Automation – performance-analyzer

- Hands-off, set-and-forget auto-tester
- Repeatable runs with consistent reporting spreadsheets, including second-by-second IOPS and worst-case latency data
  - IOPS sweep workloads jump from write heavy to read heavy until a 50/50 mix
- Integrates second-by-second IOPS, completion latencies by I/O type, IOPS consistency automatically



RR95RW5 sample from Tenant Trim workload

# Performance Automation – Time Savings

## Previous Routine:

- Setup/Execution: ~15 minutes (usually EOD)
- Performance Run: overnight, ~10.5 hours
- Idle time: data sits until next day
- Processing: fully manual, ~8hr process

Start a run **Monday**, data ready for viewing and analysis **Wednesday**.

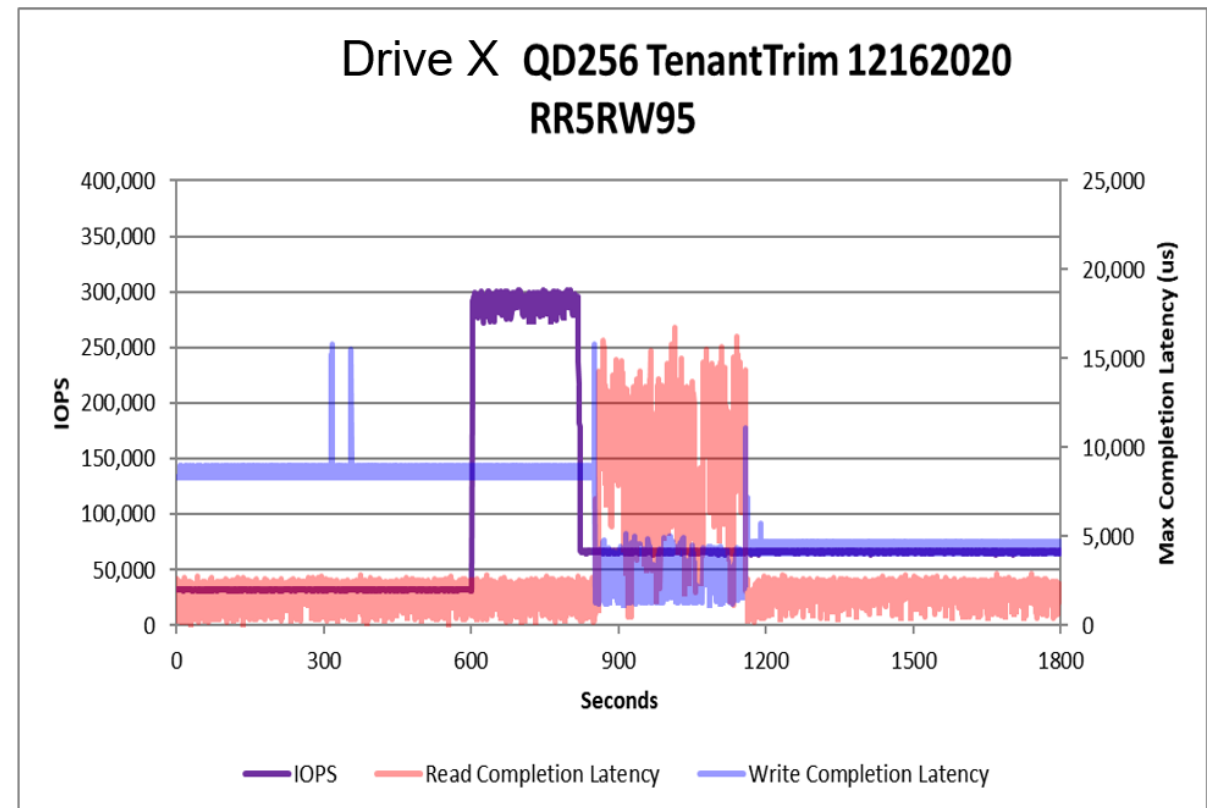
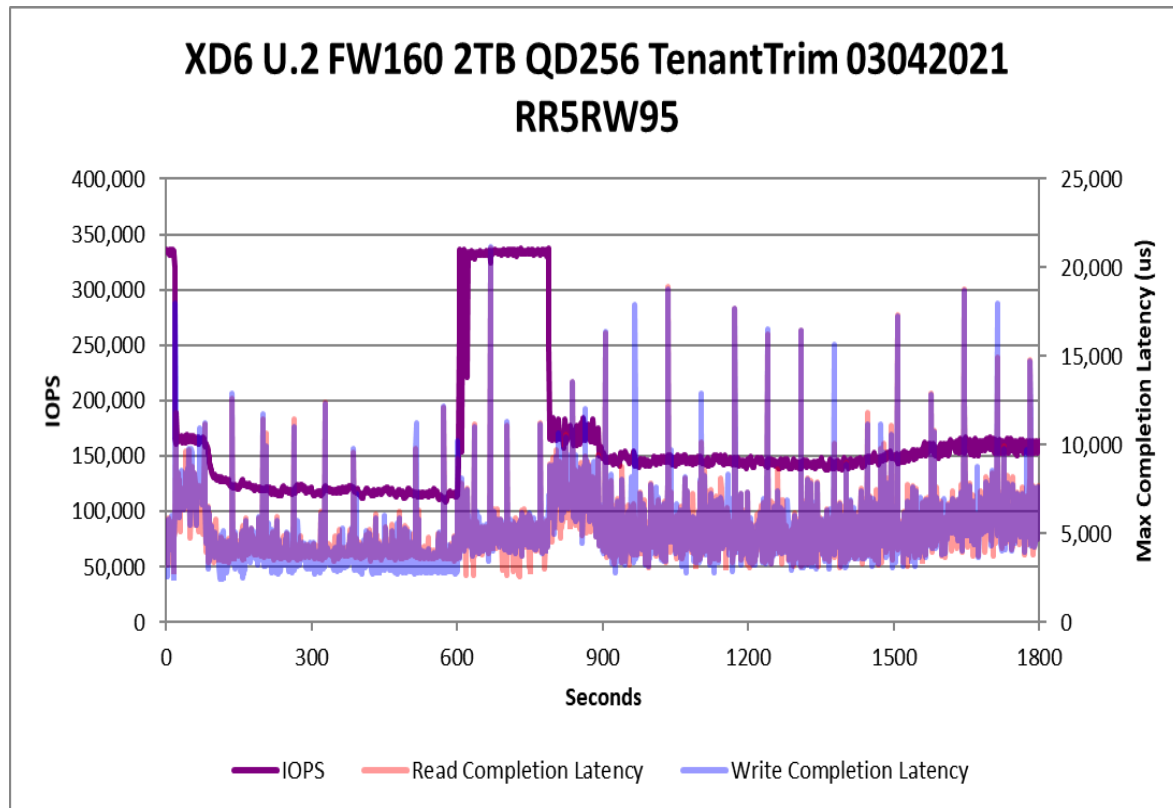
## Routine with Performance-analyzer:

- Setup/Execution: ~3 minutes (usually EOD)
- Performance Run: overnight, ~10.5 hours
- Processing: automatic following run, ~2 minutes

Start a run **Monday**, data ready for viewing and analysis **Tuesday**

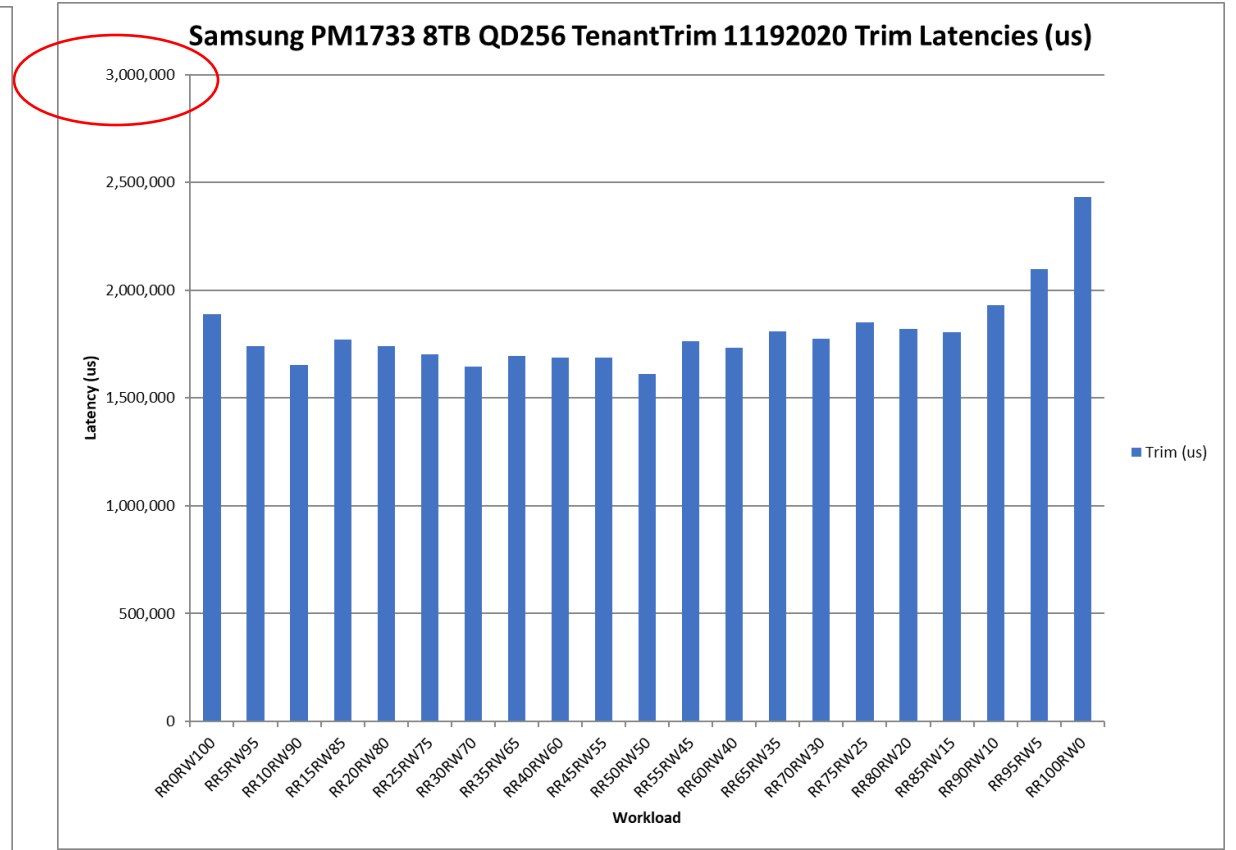
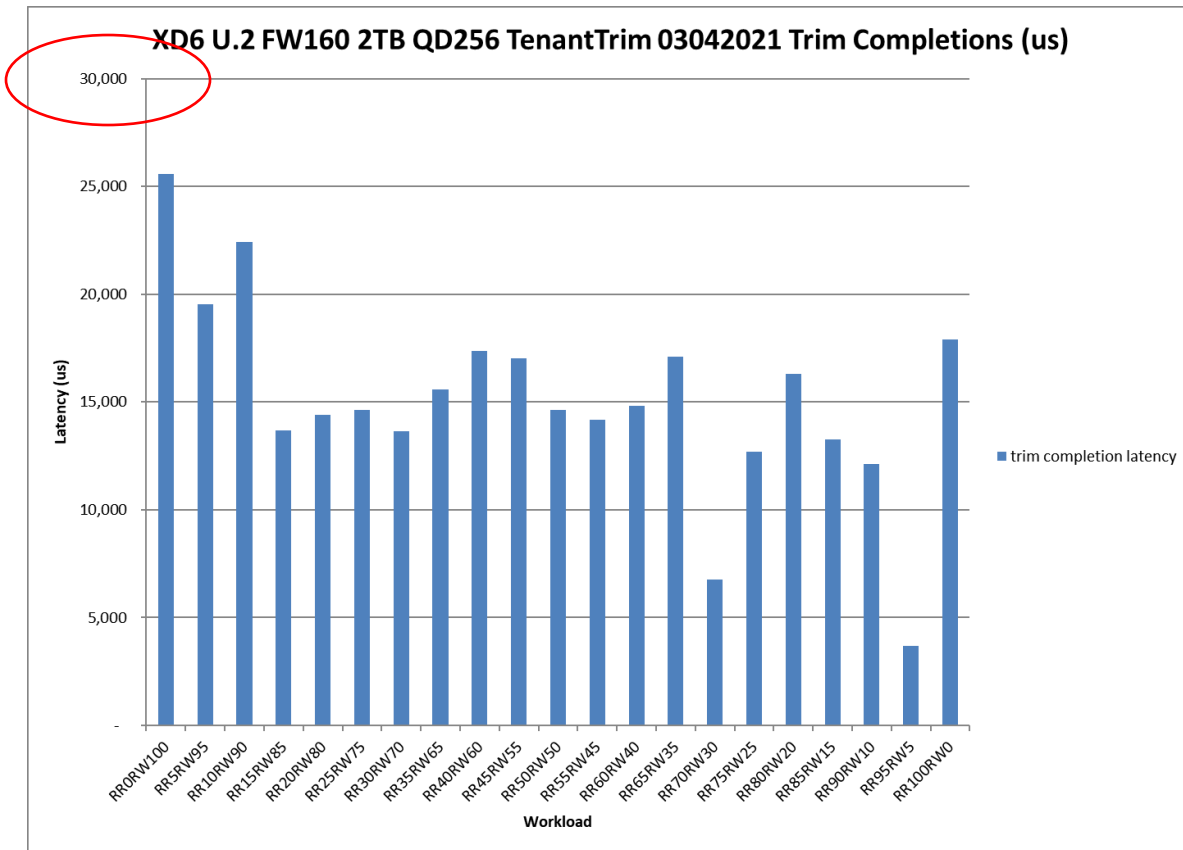
Auto-tester saves ~8 hours of work time and enables next-day reporting

# Performance Automation – performance-analyzer



- Aggregate of 8 workers (QD32/8threads)
- Reporting of worst-case completion latencies in time with IOPS
- No “warm-up” – all data was recorded and reported
  - Spotting of transient behaviors like background GC

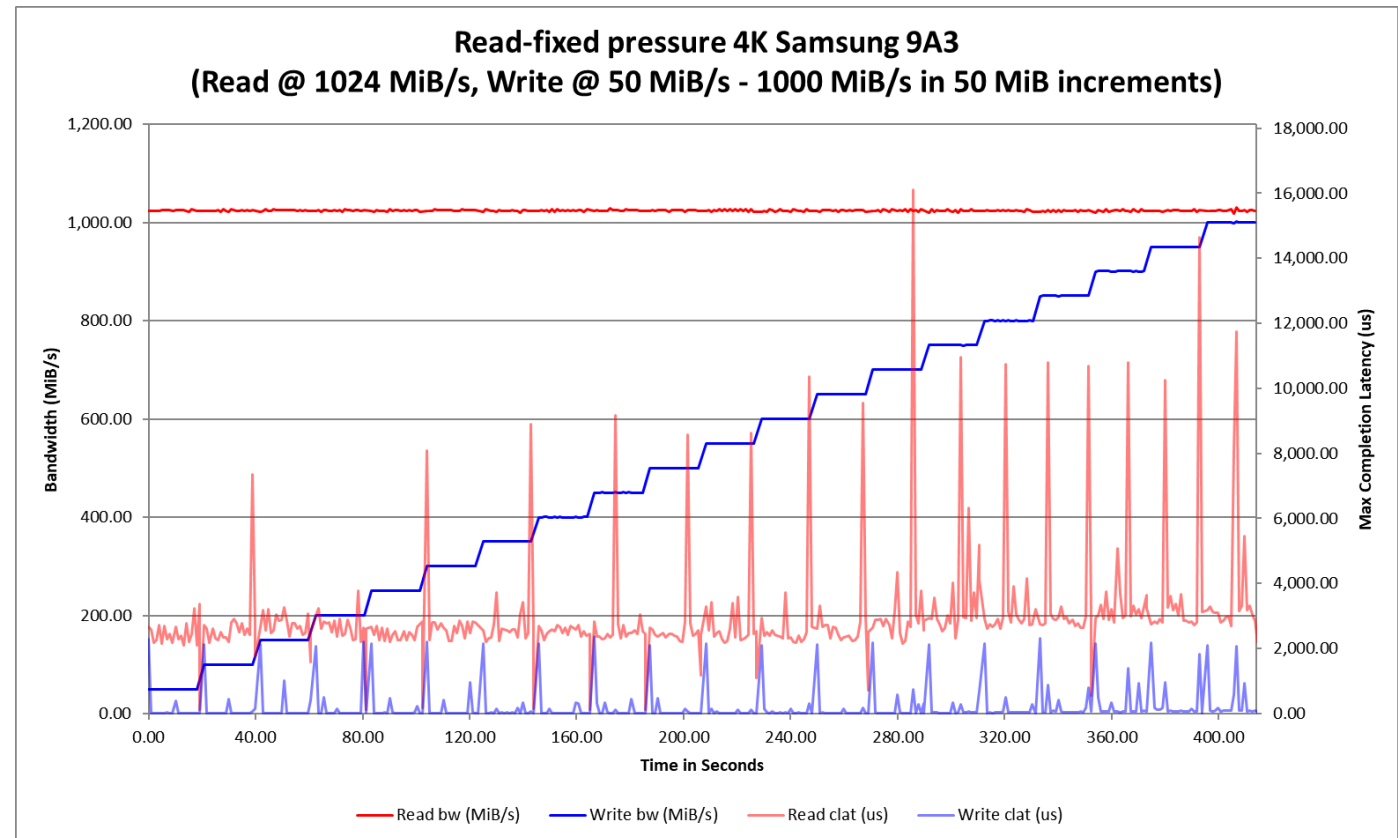
# Performance Automation – performance-analyzer



- Trim command latencies included – visually demonstrates **XD6 advantage in trim commands**

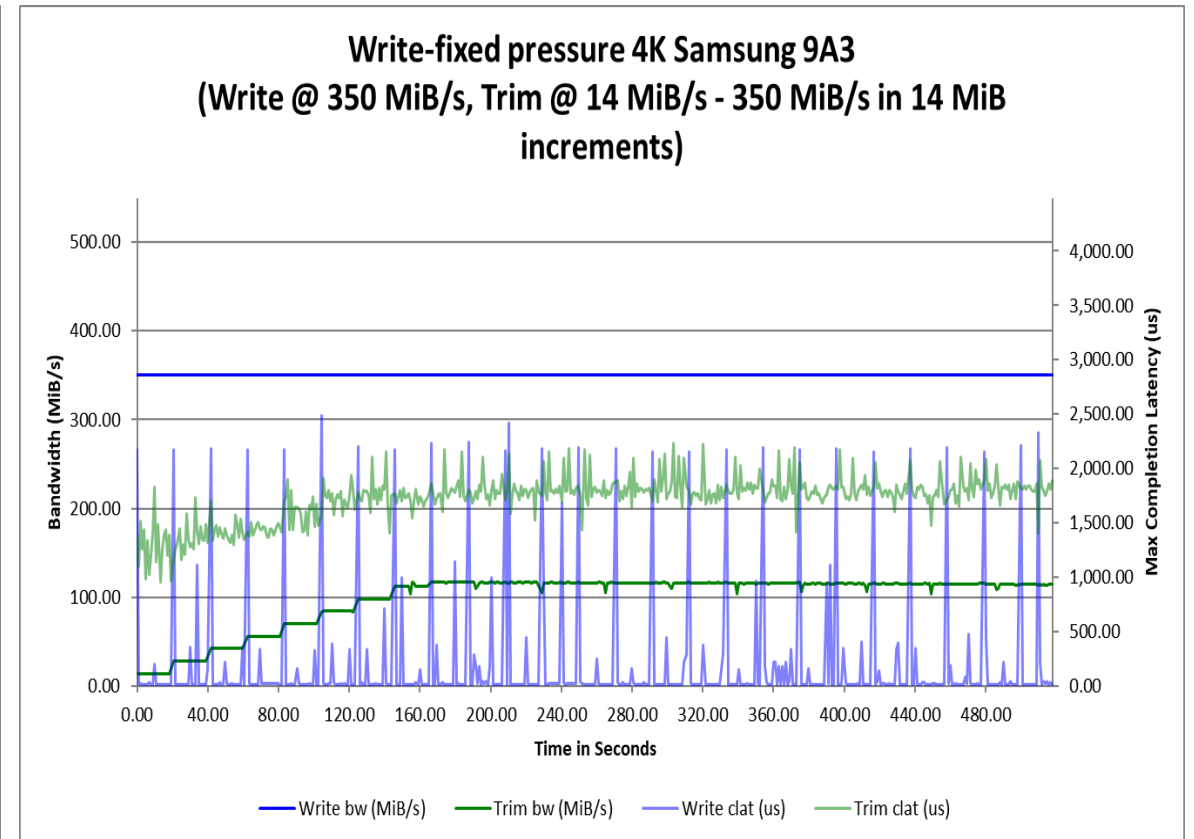
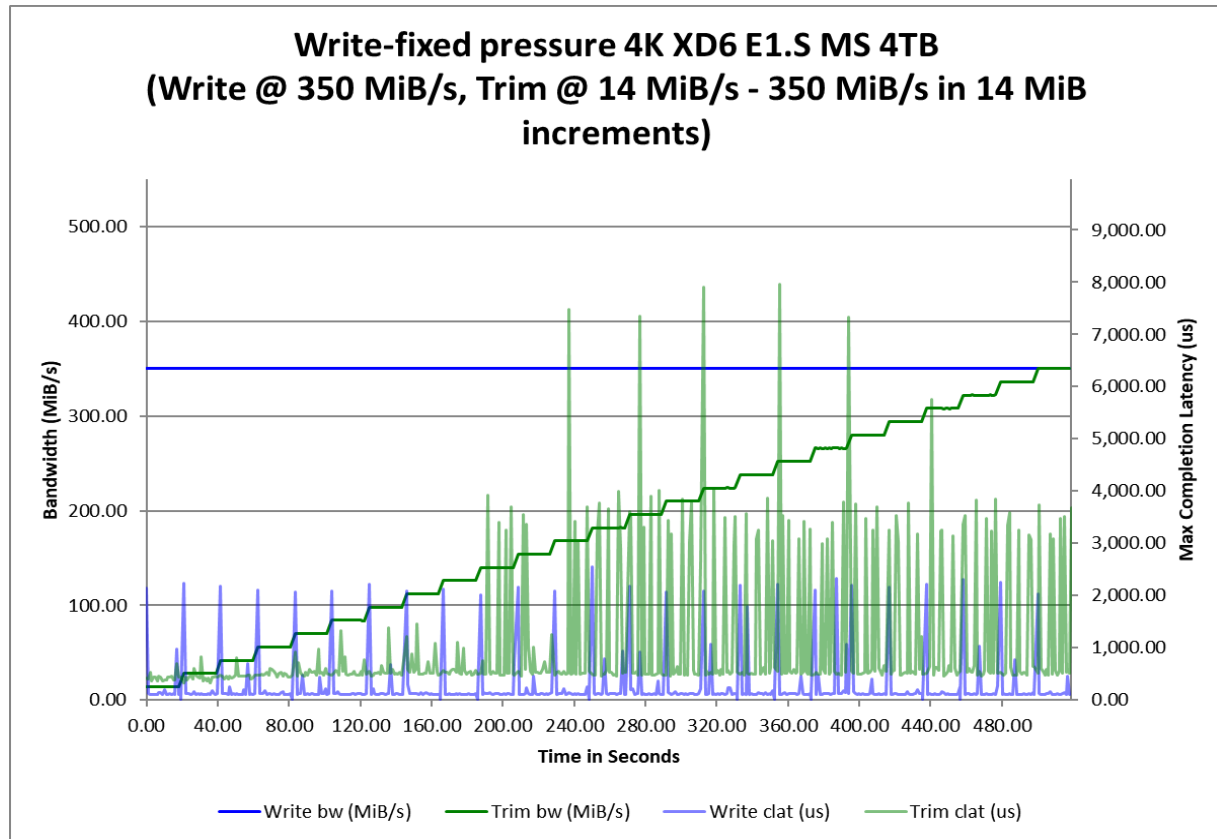
# Performance Automation – Block Device I/O Capabilities Analyzer Tool (io-cat)

- Experimental workloads.
- Reads and writes on separate queues – no reads blocking writes or vice versa
- Made into separate tool, io-cat



Example of second-by-second plotting with Samsung 9A3

# Performance Automation – io-cat and pressure testing



- Exploratory trim benchmark based on rising 64K random trims against a constant random write workload
- A visual, thorough way to compare Kioxia drives to competition



## Characteristics Automation

- Part of our CI process is tracking NVMe and PCIe identify info in our database
  - Previously a fully manual, error-prone process (1-2 work day process per drive):
    - Nvme-cat is the automation suite for this process
      - Pulls each identify file, decodes the information, appends it to the spreadsheet automatically
      - 1-2 day, error prone process turned into a ~2 minute automated and accurate task
- Valuable data on competitors and a sanity check for our internal drives available at a glance
- Updates for NVMe 2.0 conformity and latest XD6 FW are underway

[illegible]

### Snippet of the database highlighting OACS data from the Intel 660p, Hynix PE8010, Samsung 9A3, XD6 MSFT, and CM6

# Skills and Knowledge

- Python
  - I didn't know Python well before, now I would consider myself generally competent
  - Experience with Pandas, Excel APIs, and the Python standard library broadly
- Flash storage in general
  - How storage devices are characterized for performance
  - NVMe spec and drivers
- General soft skills
  - Time management
  - Accountability
  - Communication

# Work from Home Challenges

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- Internship was near 100% remote!
  - Grand total of ~8 days in the office.
- Honestly, not that difficult...
  - Separation of work and home was the major issue
  - Certain tasks, like drive swaps, were more difficult than they really needed to be

# My Takeaways

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- A yearlong internship offered me the chance to actually learn as opposed to just observing
- Developed confidence that I'm on the right educational path
- I traded a year of rigid classes for a year of work – I won out!
- I extend a thanks to:
  - Steven Wells, for being an excellent manager and helping me push my work farther than I thought I could
  - Nicole Ross, for being an amazing mentor and guide, both with technical skills and the more emotional side
  - The company broadly, for allowing me the chance to come on for the time I did
- Next steps
  - Two more semesters of university left...