OakGate Technology

The *Gold* Standard for System Validation Tools & Services

Role of Advanced Test & Validation in Storage Development Ecosystem

Presented By

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Formula For Success !!

In God, We Trust
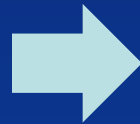
Trust, But Verify

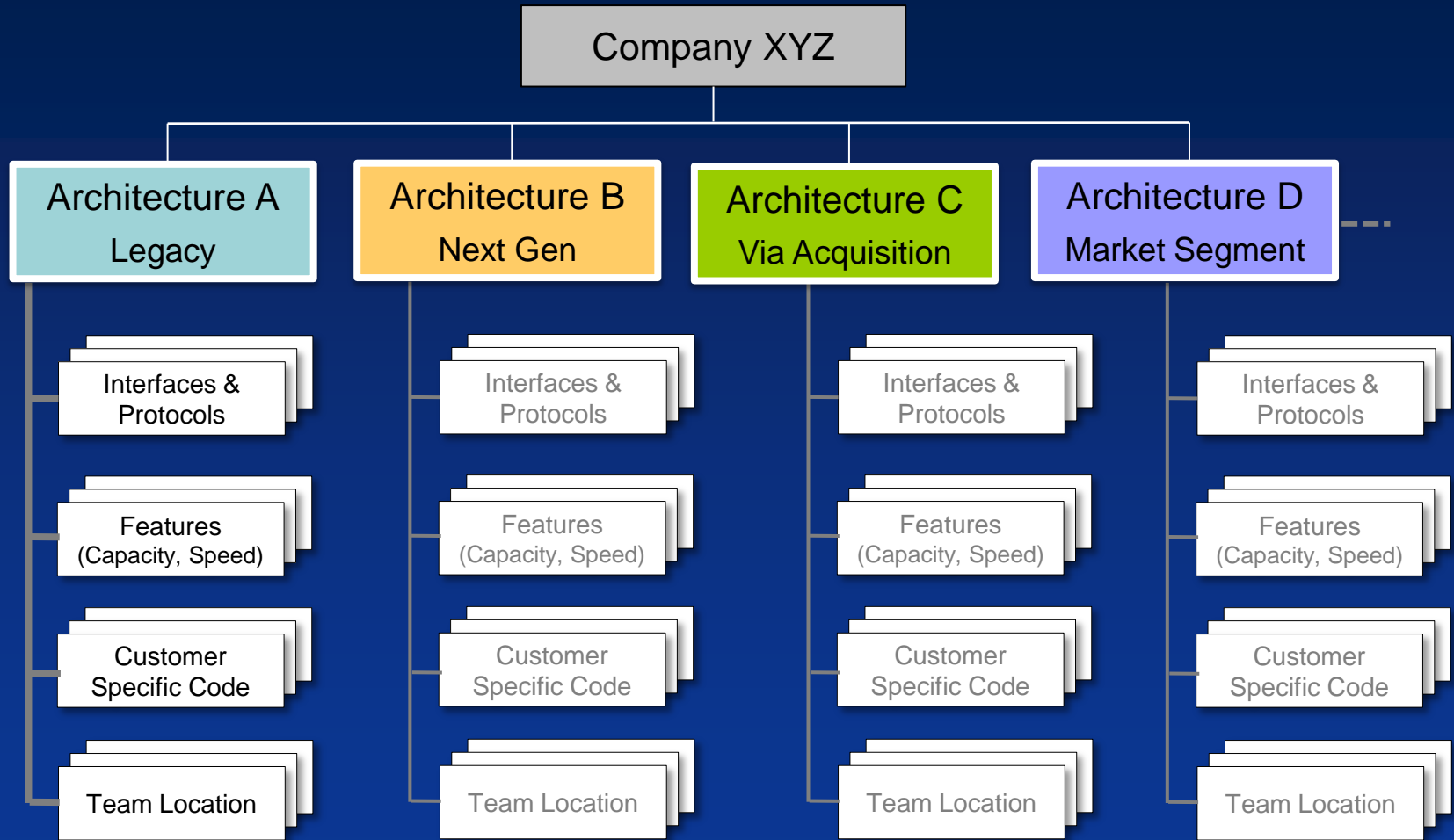## Why Take A Chance? Test & Validate !!

Investing In Test: Necessary Evil or Life Saver?

- ▣ Companies typically spend 25-30% of development dollars on Test & Validation, yet it is often underrated
  - Tools are often a combination of organically developed, supplied by multiple third parties and acquired; making it difficult to quickly isolate, correlate and fix issues
  - Schedules are squeezed and short cuts are taken to meet market timing

- ▣ Defects not discovered prior to product shipment can be costly

  - Service calls
  - Field repair
  - Product replacement
  - Loss of reputation
  - Liability

Test Challenges Have Multiplied

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                        Company XYZ

   Architecture A    Architecture B    Architecture C    Architecture D
      Legacy            Next Gen       Via Acquisition   Market Segment      ...

   Interfaces &      Interfaces &      Interfaces &      Interfaces &
    Protocols         Protocols         Protocols         Protocols

    Features          Features          Features          Features
 (Capacity, Speed) (Capacity, Speed) (Capacity, Speed) (Capacity, Speed)

    Customer          Customer          Customer          Customer
  Specific Code     Specific Code     Specific Code     Specific Code

  Team Location     Team Location     Team Location     Team Location
```

And Now You Have To Worry About Flash

◻ Advent of Flash storage requires a fresh look at test tools

- Simply duplicating the strategy and infrastructure developed for HDDs is not enough and could be risky

◻ Key differences

- Endurance
- Raw Performance
- Performance variance with usage
- Flash management
- Data always in motion
  - Power management complications
- Different failure modes
- Lack of historical experience

Not To Mention PCIe

- ☑ Departure from SCSI based protocols, but a significant "upgrade"
  - Faster interface that is closer to the CPU (i.e. better performance)
  - Consistency, especially latency

- ☑ Multiple emerging protocols and form factors
  - NVMe, SATA Express/AHCI, SCSI Express/ SOP, Vendor proprietary
  - Cards with different dimensions, SFF 8639, NGFF

- ☑ Test tool challenges
  - Ability to generate and measure MIOPS
  - Ability to measure short latency
  - Support for multiple (thousands) of queues
  - Need to provide new error injection methods
  - Accommodate emerging, less mature ecosystem
    - New cables, enclosures, dual-port SFF
    - x4, x8, x16 configurations
    - Bridges, switches

Desired Attributes of An Advanced Test System
Broad Functional Coverage
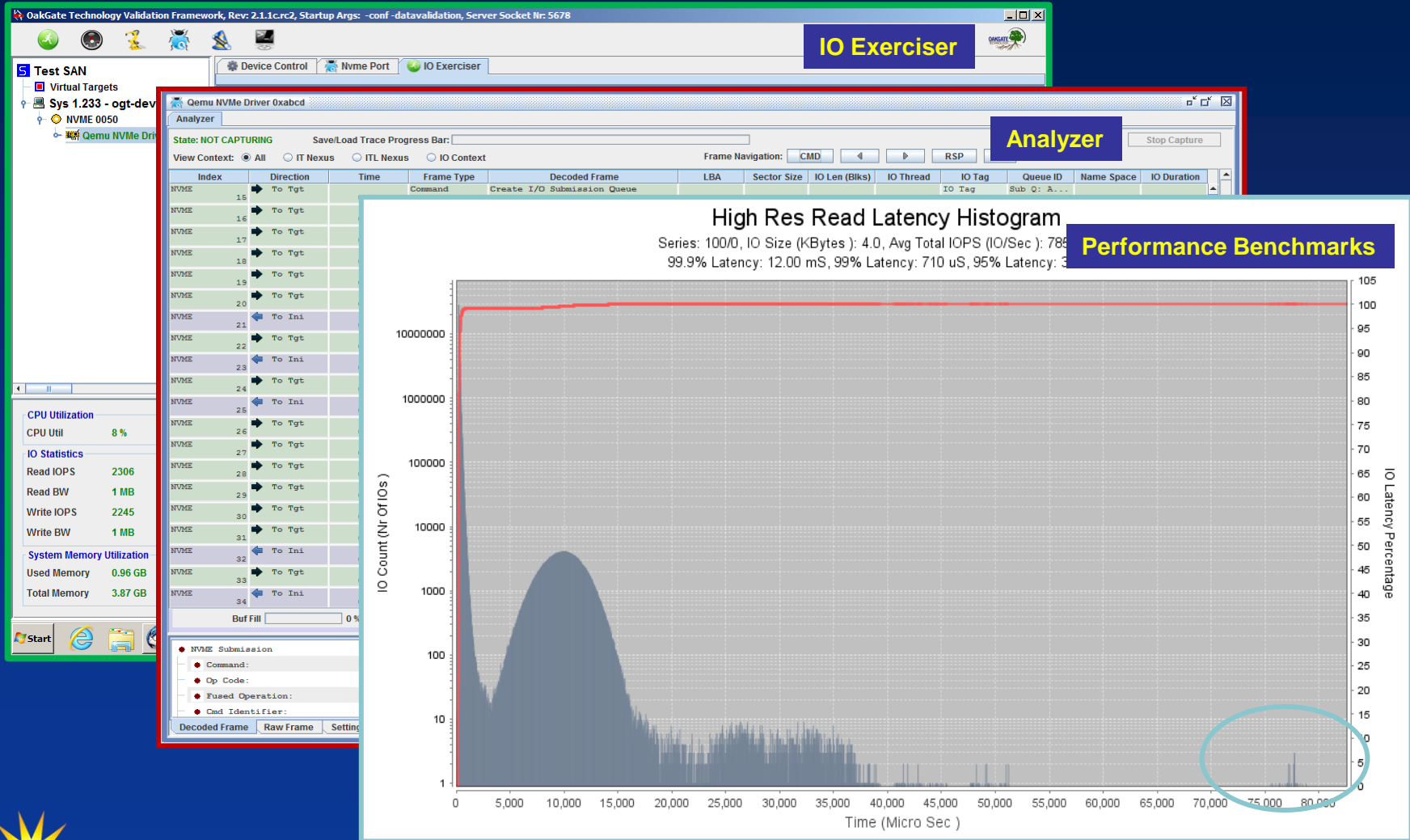
- Flexibility to generate complex traffic patterns
  - Maximum control of workloads
  - Fixed and random IO sizes
  - Small to large Q-Depths
- Extensive error injection capabilities
  - From link level through SCSI/SATA level
- Performance benchmarking
  - Average IOPS, Bandwidth, Latency under various workloads
  - Entropy Data Patterns
  - Consistent, reproducible results
- Protocol conformance verification
- Analyzer
- Data integrity/validation
- Power control and measurement

Desired Attributes of An Advanced Test System
Flexibility, Scalability, Customization, End-to-End Coverage

- ▣ Automation and ability to support custom test scripts

- ▣ Scaling of DUTs
  - Connectivity to external enclosures, switches, arrays, power modules

- ▣ Support/mimic industry models for endurance and performance
  - JEDEC, SNIA, SPC, ANSI

- ▣ Common architecture across the board
  - End-to-end coverage throughout the development cycle - from FPGA/ASIC bring-up to preproduction
  - Common platform for all popular protocols – SATA, SATA, FC, Various flavors of PCIe
  - Key goals
    - Correlation and faster fixing of defects
    - Prevention of defect leakage
    - Minimization of training curve and costs
    - Cost leverage

Advanced Test System - Examples

Common Tools – From Design To Production

Design	Firmware Development	Validation, QA	DVT	Qualification, RDT	Production

Customer Desire → Common Platform & Tools

	Design	Firmware Development	Validation, QA	DVT	Qualification, RDT	Production
Environment	Individual Developer	Individual Developer	Lab	Lab	Lab	Factory
Key Characteristics	Architecture HW/SW Design Prototype	Engineering Development Unit Test Test Development	Frequent Firmware Rolls Daily Bug Fixes Functionality, Performance	Environmental Power Cycling Temp/Voltage Margin Shock/Vibe	Rel Demo Environ Chambers Temp Cycling Error Logging	Basic Functionality Go/No Go
Typical DUT Population	<12	<20	50-200	<50	100-1000	10,000's

Fault isolation, Debug using a Common Platform

Summary

- ☐ As volumes of SSDs rise and new connectivity/protocol options emerge, test & validation tools must be re-evaluated and/or re-architected to address the specific characteristics of flash storage

- ☐ An ideal test platform must provide rich functionality, high performance, flexibility, scalability and a common architecture across the development chain while delivering consistent results

- ☐ Working closely with leading suppliers and users in the rapidly growing solid state storage market, OakGate has created a strong portfolio of advanced, end-to-end, Test, Validation and Benchmarking platforms

Thank You!

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