Qualification Process for Enterprise SSDs

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Abstract

IBM has qualified several generations of SSDs across multiple products and form factors. The growth of the SSD Enterprise space will bring a wide variety of suppliers under consideration as candidates for qualification. This paper will discuss the process by which industry SSDs are qualified. Topics to be discussed include early joint qualification activity between IBM and the OEM, OEM qualification activity against an IBM supplied test plan, IBM Integration Test Cycle and IBM System Test cycles. These topics will include both industry standard qualification activities such as Safety and EMI/EMC Certifications as well as IBM specific activities. IBM specific test activities discussed would include Signal Integrity, Error Injection, Power, Thermal, and Performance testing. Recent qualification activities would now also include TCG/Encryption verification. A key factor for OEMs to consider is first-time data capture mechanisms to aid in quick resolution of problems. Discussion of the overall qualification process will provide a clear view of what is expected from OEM SSD suppliers looking to have their products qualified in an Enterprise product.

Agenda

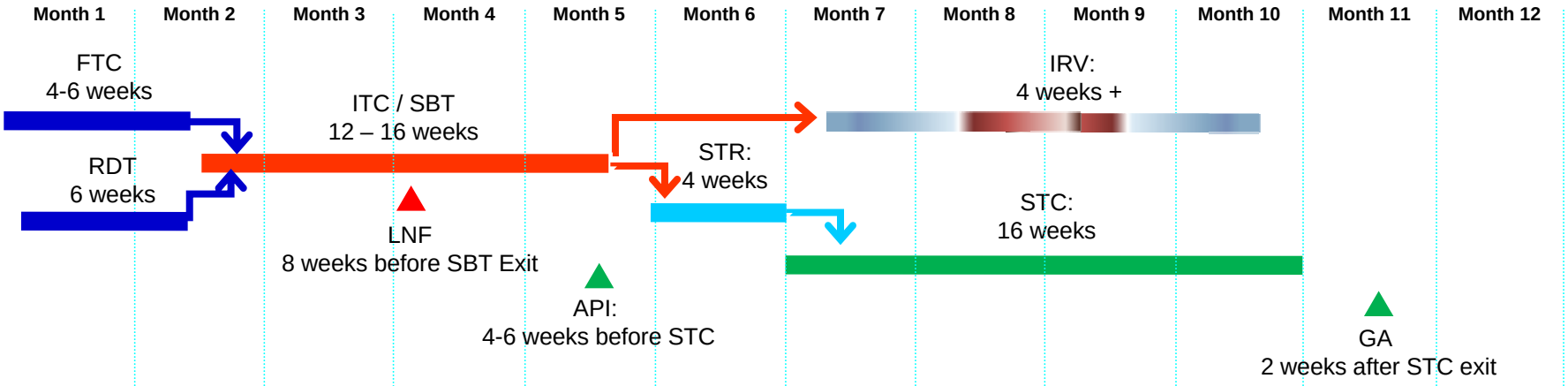
- IBM Power SSD Product Offerings
- Qualification Stages
  - OEM Reliability Demonstration Test (RDT)
  - OEM Functional Test Cycle (FTC)
  - IBM Integration Test Cycle (ITC)
  - IBM System Test Cycle (STC)
- Industry Standard Testing
- IBM Specific Testing
- IBM/OEM Problem Resolution

IBM Power SSD Product Offerings

MLC SSD 2.5” Form Factor	**Generation-1** 200GB 2.5” SAS 3Gb SAS	**Generation-2** 400GB 2.5” SAS 6Gb SAS
MLC SSD 1.8” Form Factor	**Generation-1** 200GB 1.8” SATA Bridge to 3Gb SAS	**Generation-2** 400GB 1.8” SATA Bridge to 6Gb SAS

Qualification Stages

Power Systems Qualification Process / Schedule



RDT – Reliability Demonstration Test – Performed at Supplier facility

FTC – Functional Test Cycle – Typically performed on Power Systems HW at Supplier facility

ITC – Integration Test Cycle – Performed by Power Systems Qualification Team

SBT – System Based Testing – Performed by Power Systems Qualification Team

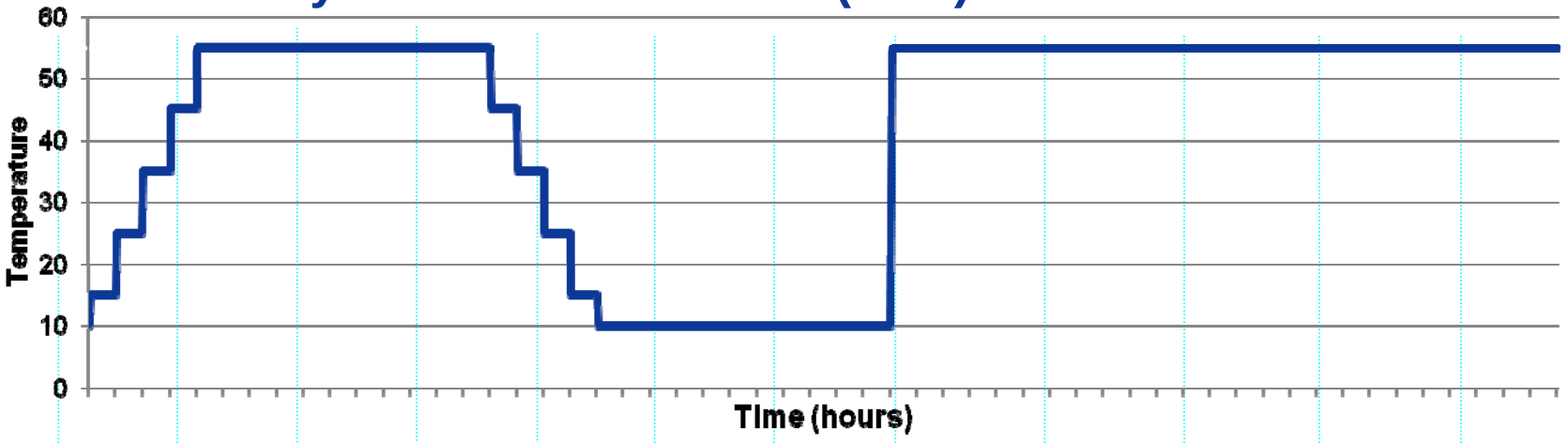
STR – System Test Readiness – Owned & Performed by System Test Group

STC – System Test Cycle – Owned & Performed by System Test Group

IRV – Integration Reliability Verification – Owned & Performed by Power Systems Qualification Team

Qualification Stages

OEM Reliability Demonstration Test (RDT)

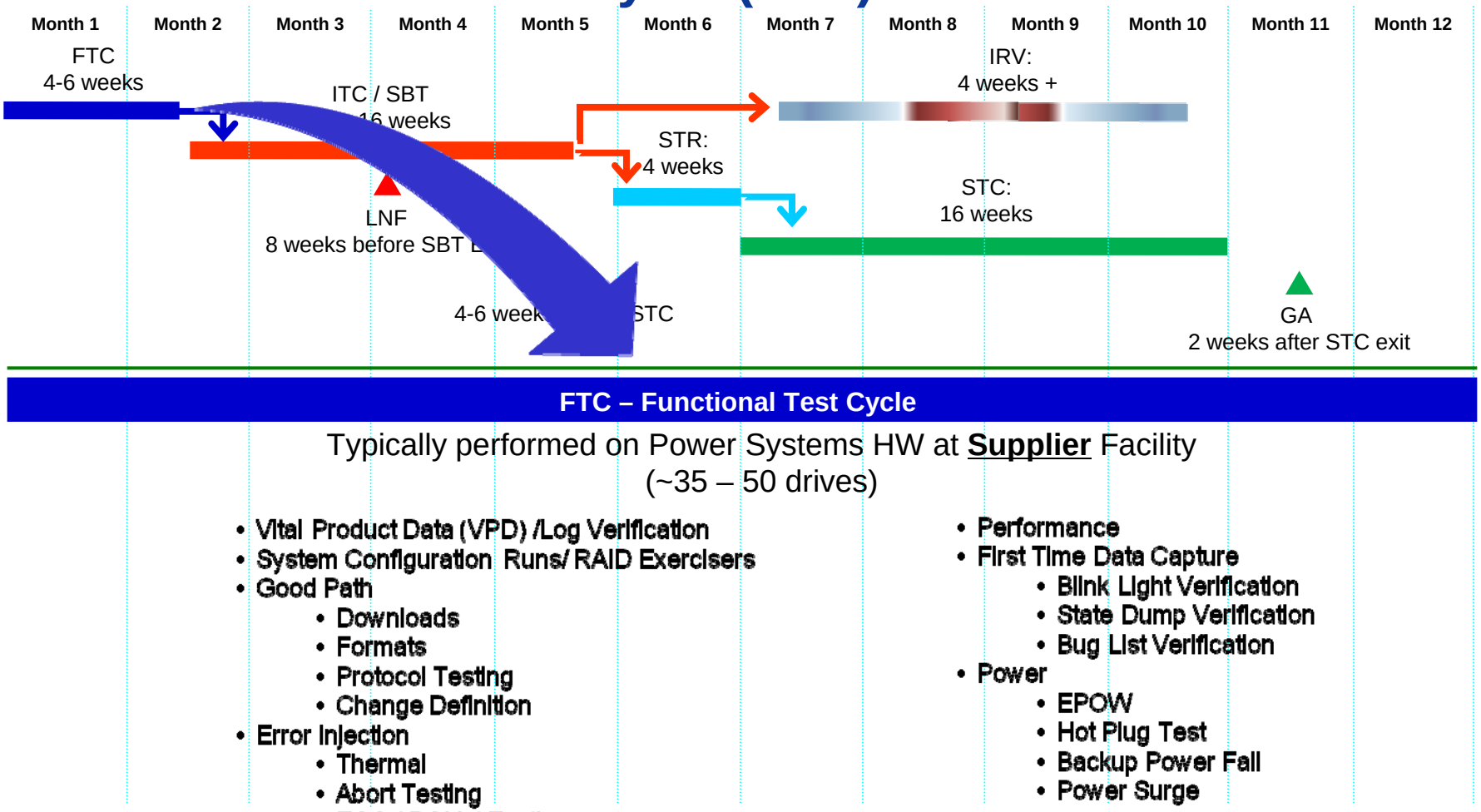


Reliability Demonstration Test – Sample Profile

- ~500 – 1,000 drives @ 1,000+ hrs
- Data Pattern
  - Randomly generated 4K compressed data pattern
- Work load
  - 80% - random
  - 20% - Sequential
- Read/Write Ratio
  - 50% Reads
  - 50% Writes
- Data Thru put
  - Total data throughput should be ~1Terabyte per day on each Drive in this RDT.
- Power Cycles
  - 6 power on/off cycles performed per day, one every 4 hours

Qualification Stages

OEM Functional Test Cycle (FTC)

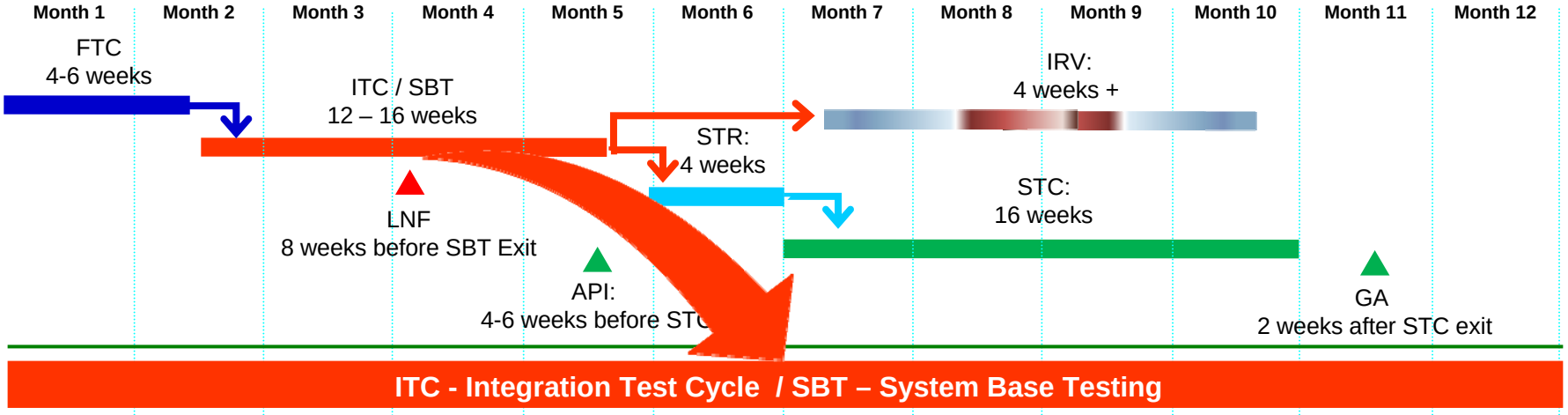


Typically performed on Power Systems HW at **Supplier** Facility
(~35 – 50 drives)

- Vital Product Data (VPD) /Log Verification
- System Configuration Runs/ RAID Exercisers
- Good Path
  - Downloads
  - Formats
  - Protocol Testing
  - Change Definition
- Error Injection
  - Thermal
  - Abort Testing
  - ECC / PGList Testing
- Performance
- First Time Data Capture
  - Blink Light Verification
  - State Dump Verification
  - Bug List Verification
- Power
  - EPOW
  - Hot Plug Test
  - Backup Power Fail
  - Power Surge

Qualification Stages

IBM Integration Test Cycle (ITC) / System Base Testing (SBT)



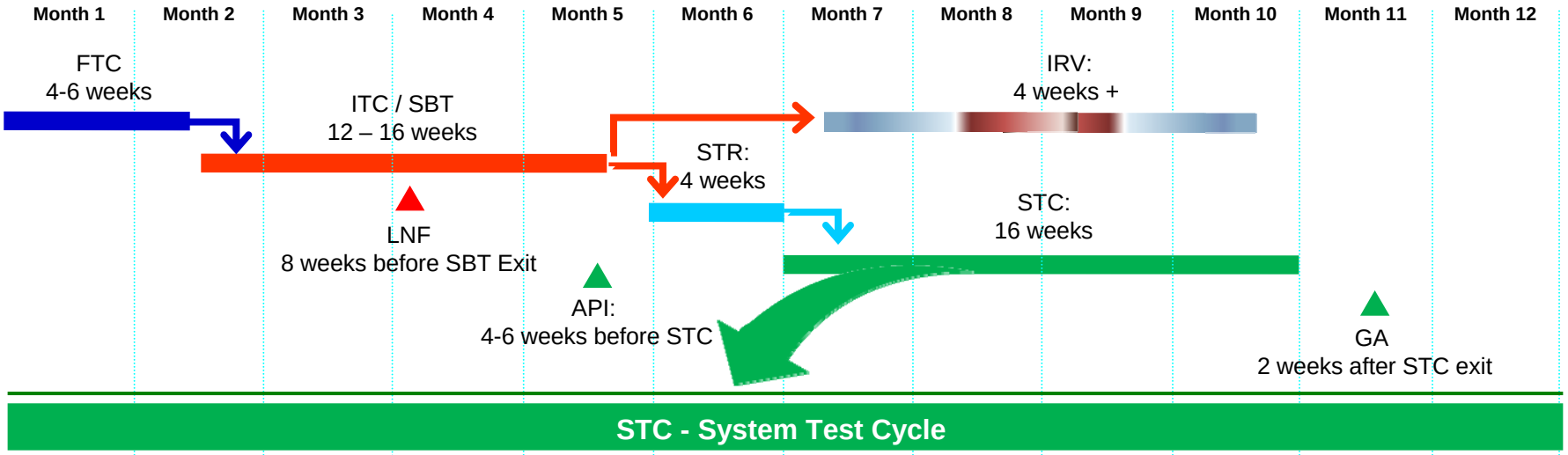
Performed on Power Systems HW by Power Systems Qualification Team
(~200 drives per capacity)

- Vital Product Data (VPD) /Log Verification
- System Configuration Runs/ RAID Exercisers
- Good Path
  - Downloads
  - Formats
  - Protocol Testing
  - Change Definition
- Bad Path RAID Testing
- Error Injection
  - Thermal
  - Abort Testing
  - ECC / PGList Testing

- Performance
- Simulated Customer Workloads
- First Time Data Capture
  - Blink Light Verification
  - State Dump Verification
  - Bug List Verification
- Power
  - EPOW
  - Hot Plug Test
  - Backup Power Fail
  - Power Surge
- Operating System Install / Boot / Compatibility

Qualification Stages

IBM System Test Cycle (STC)



Performed on New Power Systems by System Test
(~200 drives per capacity)
Exercisers and Operating Systems

Official Test Cycle for New Machines prior to Announce / General Availability

- Expanded Testing on new Machine Type / Models
- Testing under Operating System
  - IBM I
  - AIX
  - Linux
- Includes other IO (DVD, Tape, Optical)

Industry Standard Testing

- Safety Certification (OEM)
  - Confirm supplier met all required safety Certifications in IBM Purchase Specification
- System-Level EMI/EMC (IBM)
  - SSD is tested against EMI/EMC Industry Standard Specifications, in IBM Systems

IBM Specific Testing

- Signal Integrity
  - Jitter and Eye Measurements
- Error Injection
  - Bad site handling to stress SSD error recovery (ECC)
  - Interface Errors (abort tag testing)
- Power
  - Repeated power drop and confirm data
  - Measure power draw on power up
  - Hot Plug Testing
  - Break backup circuit (SuperCap), power cycle and confirm failure detected and no unknown data loss

IBM Specific Testing (Cont)

- Thermal
  - Heat drive, confirm:
    - Warning message
    - Proper functionality (throttling)
- Performance
  - Measure performance in single drive and multi drive arrays, in IBM Systems, against known workloads (vary qdepth, transfer size, r/w percentage and cache utilization).
- Guardband
  - Temperature & Voltage corners
- Classical Testing
  - Power Line Disturbance, Lightning Strike, etc.

IBM Specific Testing (Cont)

- Encryption Testing
  - Confirm drives meet TCG specification and IBM Purchase Specification
    - Create Bands
    - Verify functionality with exercisers
  - Futures Specs TBD

Typical OEM Problems Discovered

- System Incompatibility
  - IBMi and AIX OS incompatibility
  - IBM unique SAS controller incompatibility
  - IBM unique FW requirement (NACA, Skip, etc)
  - Dual Initiator Issues
  - Power Cycle and Power Loss issues

- VPD Mismatch
  - Inquiry and Mode pages do not match IBM spec

-> Most of these issues can be prevented if OEMs test their devices using IBM HW/SW/OS

IBM/OEM Problem Resolution

- First Time Data Capture
  - Target is to gather sufficient first time data to identify root cause of problem event
    - Review data available from drive (log pages), state dump data to ensure drive is capturing sufficient data to debug most problems.
    - IBM will force a state dump and then ask supplier to tell us what was going on at the time of dump to confirm supplier captures enough data.
  - Gather statistical data to assess performance of drive anomalies

For More Information

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