FabTest - NVMe-oF Compliance Test Suite

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Agenda

- NVMe-oF Goals and Trend
- Existing Tools
- FabTest Framework Design
- Key Features
- NVMe Base/Fabrics Command support
- Contributing to FabTest
- Future Work
- Summary

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NVMe-oF Goals and Trend

- NVMe-oF – Non-volatile memory express over fabrics
  - ✓ Propulsion of NVMe-oF in the market and replacement of iSCSI
  - ✓ Diversity of NVMe/NVMe-oF products deployed
  - ✓ Huge complexity in ensuring compatibility and performance across different implementations.
  - ✓ Robust testing especially with compliance is must.

- Existing Open Source Tools
  - ✓ nvmecompliance (tnvme + dnvme)
  - ✓ nvmetools
  - ✓ pynvme

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Our Goal

- ❑ NVMe-oF Compliance suites available in market are proprietary
  - ✓ Aim – To develop an open source compliance framework
- ❑ Our Solution: FabTest – NVMe-oF compliance Test framework
  - ✓ Easily pluggable to any other standard framework

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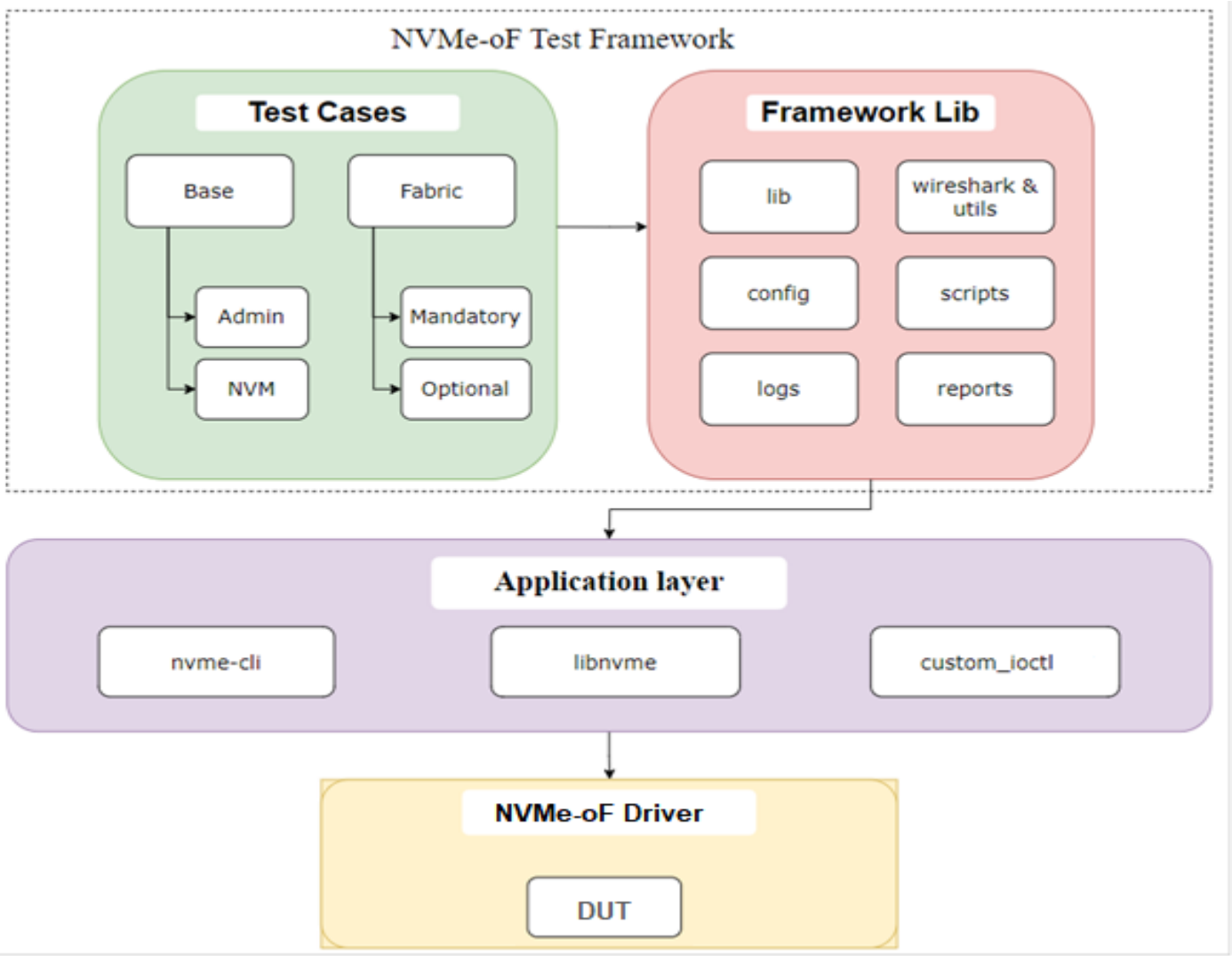
FabTest Framework



- ✓Python pytest based test framework
- ✓Simple CLI interface
- ✓ Application Lib layer - abstracted from TCs
- ✓Supports interfaces to use C based libnvme library
- ✓ Uses pass-through interface of nvme-cli/libnvme

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FabTest - Key Features

- ✓Support for NVMe Base(1.4), NVMe-oF(1.1a) Protocol
- ✓ Support for RDMA/TCP as the transport protocol
- ✓ Wireshark - Test analysis by packet capture and tracing
- ✓ Error Injection
- ✓ Performance tests

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NVMe Base/Fabrics Command Support

Commands	Fabtest Support
Connect (M)	✓
Disconnect (O)	✓
Property Get (M)	✓
Property Set (M)	✓
Authentication Send/Receive (O)	✓
Discovery Service (M)	✓

NVMe Fabrics

Commands	Fabtest Support
Identify (M)	✓
Get Log page (M)	✓
AER (M)	✓
Abort (M)	✓
Read (M)	✓
Write (M)	✓
Flush (M)	✓
Set Features (M)	✓
Get Features (M)	✓

NVMe Base

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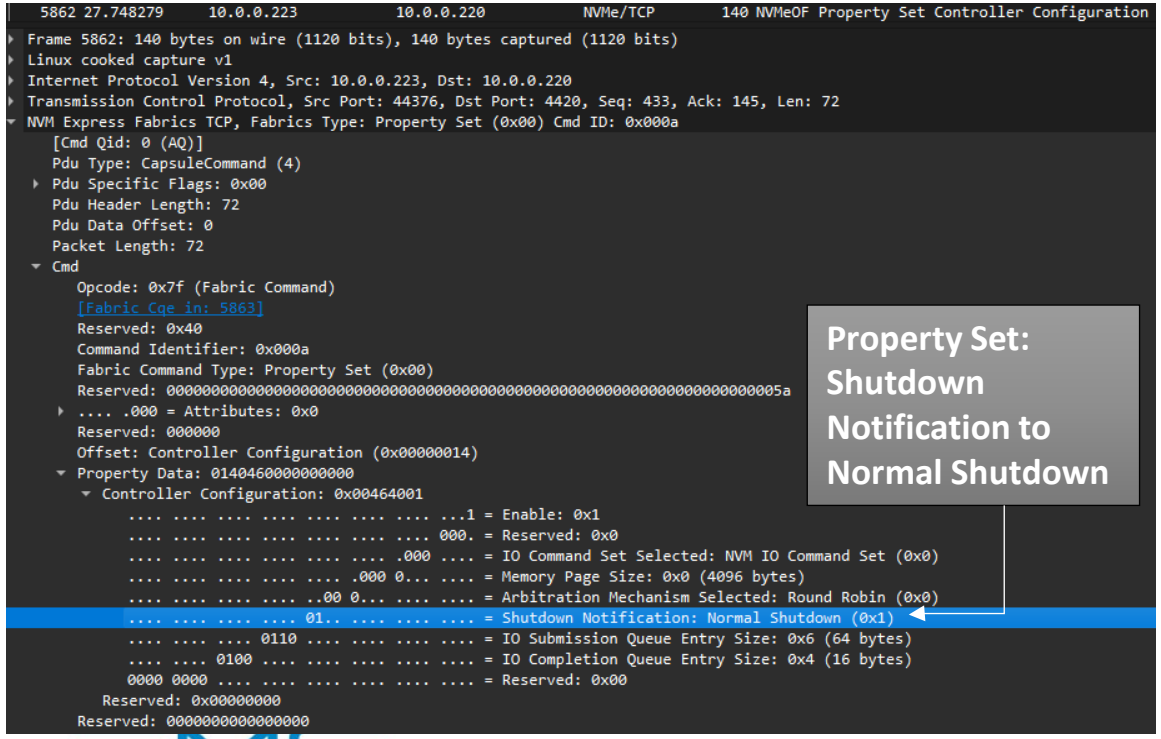
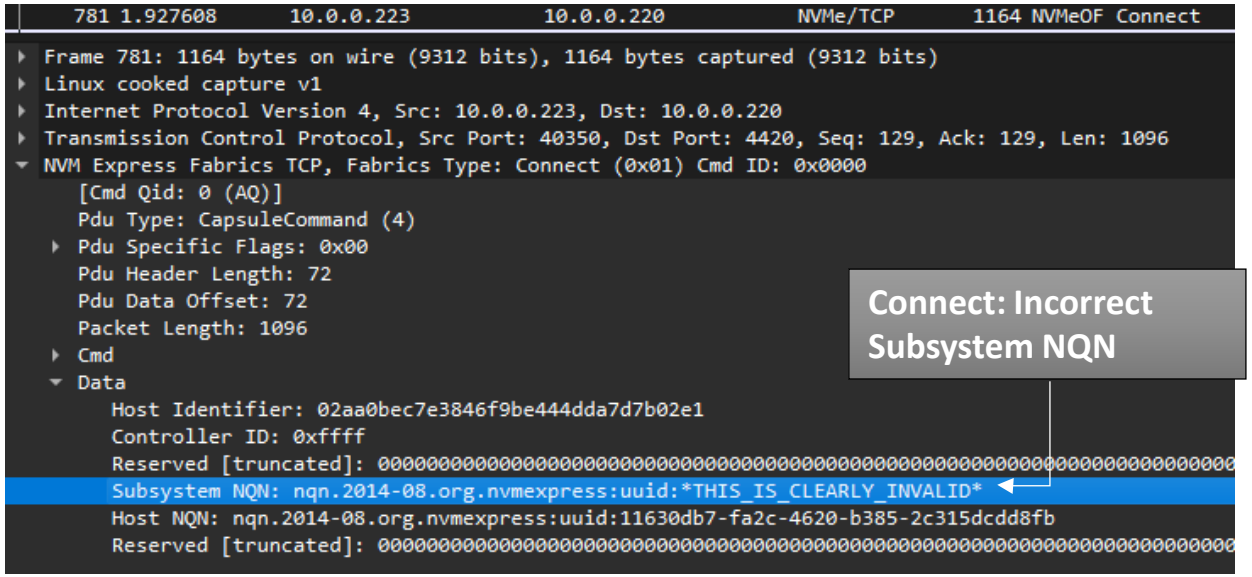
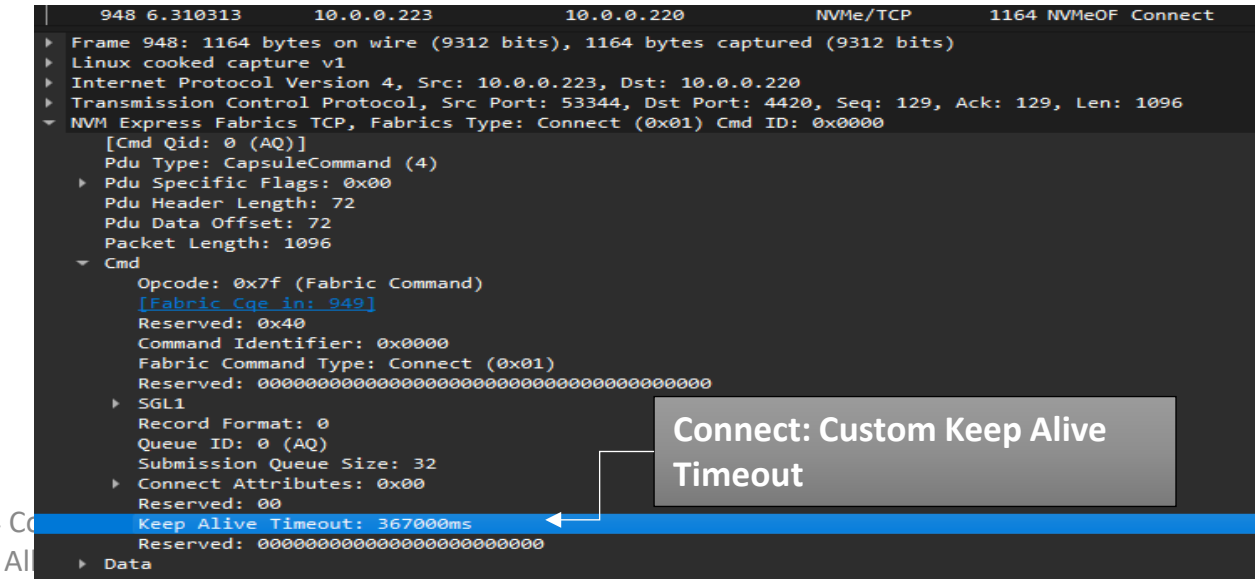
Wireshark packet capture and tracing

- Fabtest supports API's to start a packet capture using tcpdump tool
- Check test parameters sent on the wire







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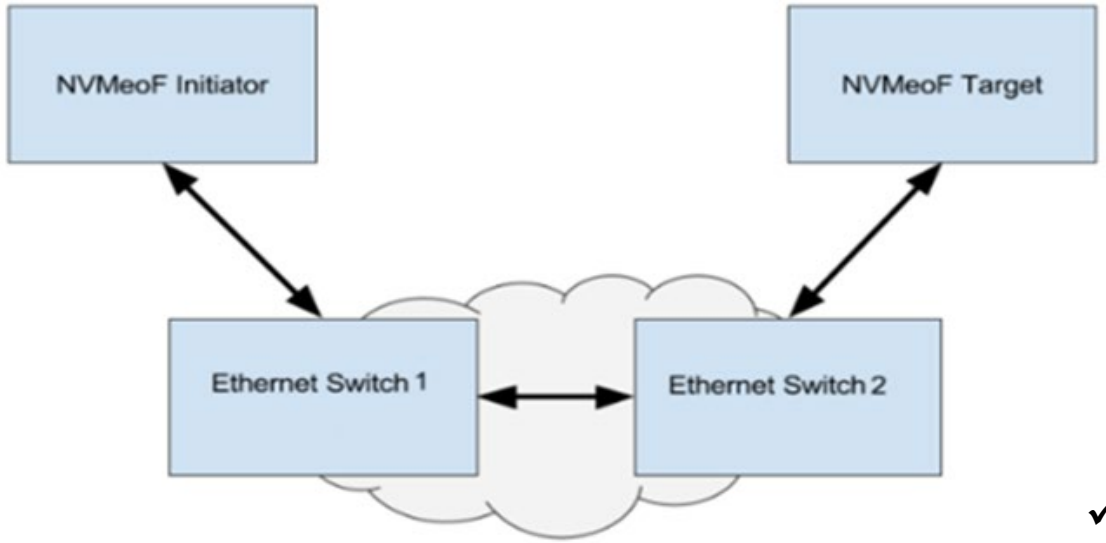
Error Injection & Performance Tests



Multiple Switch Fabric Topology

Error Injection

- ✓ Network Link/Port Down
- ✓ NVMe command/packet puncture
- ✓ CPU/Memory constraints
- ✓ NVMe hot plug and fault injection testing

Performance Tests

- ✓ Clean/Sustained State IO
- ✓ IO with known data patterns
- ✓ IO with varying data size
- ✓ IO workload generation for high performance and low latency

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FabTest Github

- Fabtest is Open source @ https://github.com/SamsungDS/nvmFabTest
- Getting Started - https://github.com/SamsungDS/nvmFabTest/blob/main/README.md#code-examples

Code examples

Sample Test Case:

```
class TestNVMeConnect:

    @pytest.fixture(scope='function', autouse=True)
    def setup_method(self, fabConfig):
        ''' Setup Test Case by initialization of controller object '''

        self.fabConfig = fabConfig
        device = self.fabConfig.device
        application = self.fabConfig.application
        self.controller = Controller(device, application)
```

```
    def teardown_method(self):
        '''Teardown test case'''

        # Any memory freeing or disconnections to be made
        # after test case completion
```

```
def test_sample(self):
    ''' Perform test '''

    # Get the required structure from self.controller.cmdlib
    nvme_cmd = self.controller.cmdlib.get_property_get_cmd()

    # Make required modifications as per the test scenario
    offset = 0x14
    nvme_cmd.cmd.generic_command.cdw11.raw = offset

    # Allocate memory for the expected response
    # according to the command and store in nvme_cmd.buff
    get_property_value = ctypes.c_uint64()
        nvme_cmd.buff = ctypes.addressof(get_property_value)

    # Send the command
    res_status = self.controller.app.submit_passthru(nvme_cmd, verify_rsp=True, async_run=False)

    # Make Testing assertions according to scenario
    # using the response data and response status
    if res_status!=0:
        assert False
    if get_property_value.value == 0:
            assert False, f"No value obtained"
        assert True
```

Future Work & Contributing to FabTest

- NVMe Optional commands
- NVMe Upcoming Commands/Features – FDP etc.
- Future NVMe protocol revisions
- NVMe Binding Spec Features
- Contributions can be made towards -
  - New Test cases
  - Add features to the framework
  - Bug fixes/Enhancements

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Summary

- ❑ Fabtest provides an end to end opensource ecosystem for compliance testing
- ❑ Could be used as a Whitebox test framework for NVMe-oF projects
- ❑ QA/Developers – can build own custom scripts with framework libraries

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Thank you!

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