



STORAGE DEVELOPER CONFERENCE

SNIA ■ SANTA CLARA, 2014

# iSCSI PCTS

## Protocol Conformance Test Suite

**Tejas Bhise**

**Arshad Hussain**

Calsoft Inc.

# Contents

- ❑ **Background**
- ❑ **Workings**
- ❑ **Test Case Coverage**
  - ❑ **Login Details**
  - ❑ **FFP Details**
  - ❑ **Errors Details**
- ❑ **RFC Sections Covered**
- ❑ **Architecture**
- ❑ **Setup**
- ❑ **Execution**
- ❑ **Data Flow - Sequence Diagram**
- ❑ **Data Flow and Output**
- ❑ **iSCSI PCTS Roadmap**
- ❑ **Summary**

# Terminology

- ❑ iSCSI PCTS – Calsoft iSCSI Protocol Conformance Test Suite
- ❑ CDB - Command Descriptor Block
- ❑ PDU - Protocol Data Unit
- ❑ FFP - Full Feature Phase
- ❑ ITT - Initiator Task Tag
- ❑ TTT - Target Transfer Tag
- ❑ R2T - Request to Transfer

# Background

## ❑ Problem Statement

- ❑ Automated iSCSI Protocol Conformance test suite

## ❑ Solution

- ❑ iSCSI PCTS

## ❑ Benefits

- ❑ Target Adhere To Industry Standard (RFC 3720)
  - ❑ Compatibility - Can work with iSCSI initiators on different platforms
  - ❑ Correct and Accurate Target implementation
  - ❑ Look good - Following standard adds to customer confidence

# Workings

- ❑ Each Test Case is a statically compiled binary.
- ❑ Mimics a minimal initiator/PDU generator designed for a special task only
- ❑ Whole test suite comes in a .tar format. Extract and use
- ❑ Comes with helper script to run test cases in batch or individually
- ❑ Comes with an extensive documentation

# Test Case Coverage

- ❑ Covering Login, FFP and Error Features.
  - ❑ Login - 79 Test Cases
  - ❑ FFP - 105 Test Cases
  - ❑ Errors - 20 Test Cases

# Login Conformance Details

- ❑ STATE TRANSITION DURING LOGIN
  - ❑ C BIT
  - ❑ T BIT
  - ❑ FFP
- ❑ KEY VALUE CHECK
  - ❑ TARGET ALIAS
  - ❑ X KEYS
  - ❑ INITIALR2T
  - ❑ IMMEDIATE DATA
  - ❑ MRDSL
  - ❑ MBL
  - ❑ FBL
  - ❑ DefaultTime2Wait

# Login Conformance Details

- ❑ KEY VALUE CHECK - CONTD
  - ❑ MaxOutstandingR2T
  - ❑ DataPDUInOrder
  - ❑ DataSequenceInOrder
  - ❑ ErrorRecoveryLevel
  - ❑ TargetPortalGroupTag
  - ❑ AuthMethod
  - ❑ HeaderDigest
  - ❑ DataDigest
  - ❑ TaskReporting
  - ❑ AuthMethod



# Login Conformance Details

- Incorrect Key Value Check
- Out of Range Check (FBL > MBL)
- Integer Key Negotiation
- Duplicate Key-Value Check
- Version Check
- Login Response Check
- CMDSN CHECK
- STATSN CHECK
- TISH
- SESSION ID CHECK
- STANDARD LOGIN
  - ITT AND VERSION
- INVALID PDU CHECK

# FFP Conformance Details

- ❑ SNACK-R2T CHECK

- ❑ R2T
- ❑ FLAGS
- ❑ ITT
- ❑ TTT
- ❑ STATSN
- ❑ CMDSN
- ❑ R2TSN
- ❑ LUN INFO
- ❑ LENGTH
- ❑ DESIRED DATA

- ❑ R2T CHECK

- ❑ R2TSN
- ❑ TTT
- ❑ ITT
- ❑ Transfer Length

# FFP Conformance Details

- ❑ CMDSN
  - ❑ DUPLICATE
  - ❑ OUT OF RANGE
  - ❑ SEQUENCE
  - ❑ ORDERING
- ❑ LOGOUT RESPONSE
- ❑ REJECT DATA OUT
- ❑ NOPIN (WITH / WITHOUT PAYLOAD)
  - ❑ IMMEDIATE RESPONSE
  - ❑ ITT
  - ❑ TTT
  - ❑ DSL
  - ❑ STATSN
  - ❑ EXPCMDSN
- ❑ NOPIN
  - ❑ NON-IMMEDIATE RESPONSE
  - ❑ ITT
  - ❑ TTT
  - ❑ DSL
  - ❑ STATSN
  - ❑ EXPCMDSN

# FFP Conformance Details

- ❑ STATS  
  - ❑ DUPLICATE
  - ❑ OUT OF RANGE
  - ❑ SEQUENCE
  - ❑ ORDERING
- ❑ MAXCMDSN
- ❑ EXPSTATSN
- ❑ DATA-IN
  - ❑ STATUS
  - ❑ F BIT SINGLE/MULTIPLE BURST
  - ❑ DATA SEGMENT LENGTH
- ❑ R2TSN
  - ❑ ORDERING
- ❑ SCSI RESPONSE
  - ❑ IMMEDIATE DATA
  - ❑ EXCESS IMMEDIATE DATA
  - ❑ SOLICITED DATA
  - ❑ UNEXPECTED SOLICITED DATA
  - ❑ NO DATA REQUEST

# FFP Conformance Details

- ❑ SCSI RESPONSE - CONTD
  - ❑ UNDERFLOW
  - ❑ OVERFLOW
  - ❑ RETRY BEFORE DATA TRANSMISSION
  - ❑ RETRY AFTER DATA TRANSMISSION
- ❑ SNACK-DATA
  - ❑ OPCODE
  - ❑ STATUS
  - ❑ LENGTH
  - ❑ STATSN
  - ❑ EXPCMDSN
  - ❑ MAXCMDSN
  - ❑ DATASN

# Errors Conformance Details

## ❑ SNACK

- ❑ SUPPORT FOR DATA REQUEST
  - ❑ SELECTED PDU
  - ❑ ENTIRE RUNS
  - ❑ SINGLE PDU REQUEST
- ❑ TYPE 0 R2T
- ❑ TYPE 1 SINGLE RESPONSE
- ❑ TYPE 1 COMPLET RUN

## ❑ SNACK

- ❑ SWAPPED DATASN CHECK
- ❑ SWITCHED DATASN CHECK
- ❑ DATASN OUT OF RANGE CHECK
- ❑ DROPPED COMMAND
  - ❑ IMMEDIATE
  - ❑ NON IMMEDIATE
- ❑ DATA IN

# RFC Sections Covered

- ❑ Overview

- ❑ 3.3, 3.2.2, 3.2.3, 3.2.2.1, 3.2.4.3, 3.2.2.2, 3.2.2.3 3.2.3, 3.2.4.1, 3.2.4.2, 3.2.4, 3.2.6, 3.3, 3.5, 3.5.1.1, 3.5.1.2, 3.5.1.5, 3.5.1.6, 3.5.2.3, 3.5.3.5, 3.6.2.6

- ❑ Login & FFP Negotiation

- ❑ 5.1, 5.2, 5.2.2, 5.3, 5.3.1, 5.9, 5.3.2, 5.3.3, 5.4, 5.2.1

- ❑ Error Handling

- ❑ 6.2.1, 6.3, 6.7, 6.8, 6.2, 6.1.4.2, 6.1.4.1

- ❑ Security

- ❑ 8.2.1

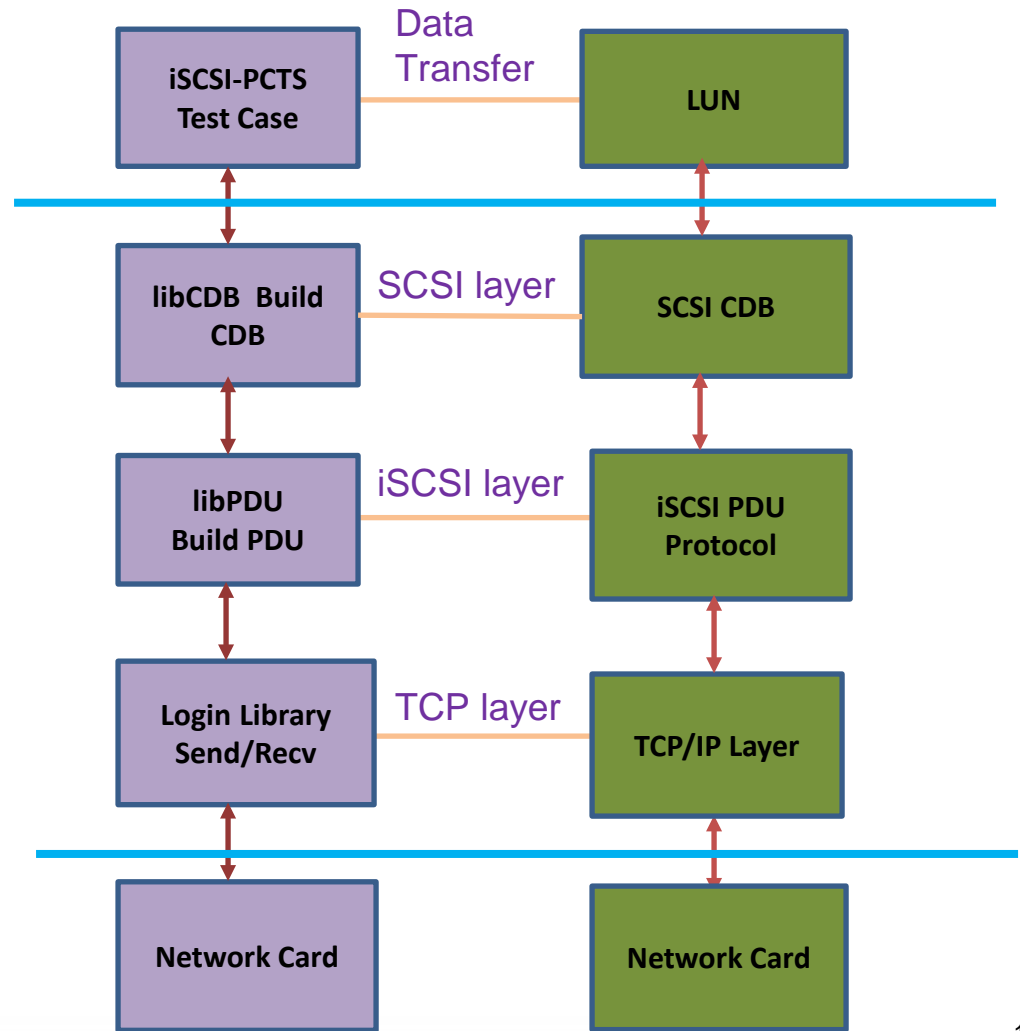
# RFC Sections Covered

- ❑ PDU Format
  - ❑ 10.3.4, 10.3.5, 10.4.2, 10.4.5, 10.4.7, 10.4.7.2, 10.4.9, 10.7.1,10.7.3, 10.7.4, 10.7.5, 10.7.6, 10.8.1, 10.8.2, 10.8.3, 10.8.4, 10.8.5,10.11.1, 10.11.13, 10.11.6, 10.12.2, 10.12.4, 10.12.7, 10.12.9, 10.13.1, 10.13.2, 10.13.3, 10.13.4, 10.13.4, 10.13.5, 10.13.8, 10.14, 10.15, 10.16, 10.17.1, 10.17.1, 10.18
  
- ❑ Security
  - ❑ 8.2.1
  
- ❑ Login Operational
  - ❑ 12.1, 12.2, 12.14, 12.9, 12.10, 12.11, 12.14, 12.21, 12.4, 12.5, 12.6, 12.12, 12.13, 12.15, 12.16, 12.22, 12.21, 12.20, 12.19, 12.18, 12.17, 6.2.1, 6.3, 6.7, 6.8, 6.2, 6.1.4.2, 6.1.4.1



# Architecture

- ❑ Each test case uses five building blocks or backend libraries
- ❑ Each test case leverages common functionality of these library only adding test case specifics on top



# Architecture – Contd.

- ❑ libSCSI: This library helps build and verify SCSI CDB
- ❑ libISCSI: This library helps build and verify iSCSI PDU
- ❑ libLOGIN: This library helps iscsi-pcts/binaries log into target (Target credentials are read from its.conf)
- ❑ TCP Library: This library helps in sending or receiving and verification of tcp data.
- ❑ libUTILS: This is a helper utility library to manipulate common task.

# Setup

- ❑ Setting up iSCSI-PCTS means populating a single conf file with target details
- ❑ Template Conf file comes with iSCSI-PCTS

```
# cat /usr/local/etc/its.conf
```

```
InitiatorName=iqn.1994-05.com.redhat:981fc286f48  
TargetName=iqn.2003-01.org.linux-iscsi.wfs.x8664:sn.a6fd093081c0  
DefaultTime2Retain=20  
DefaultTime2Wait=2  
IP=127.0.0.1  
AuthMethod=CHAP,None  
PassWord=password  
UserName=root
```

# Execution

- ❑ iscsi-pcts.sh is a bash script to execute the test cases Individually or in batches
- ❑ Creates three files
  - ❑ summary.txt: Test Summary
  - ❑ reports.txt: Description of each TC along with Pass/Fail Stat
  - ❑ logs.txt: Verbose logs from each test case.

```
$ ./iscsi_pcts.sh -t login
$ ./iscsi_pcts.sh -t login,ffp
$ ./iscsi_pcts.sh -i tc_ffp_1_1,tc_ffp_1_2
```

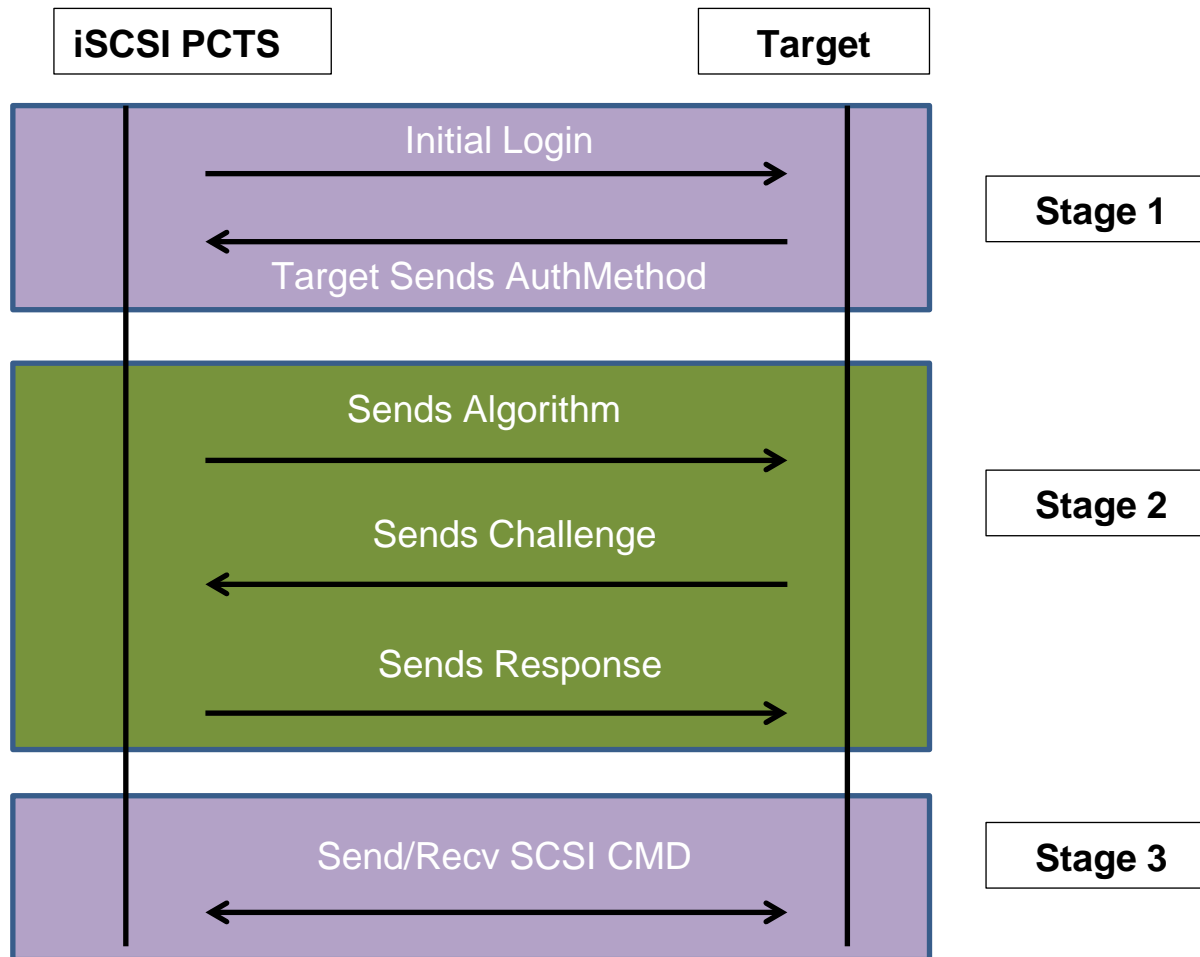
# Execution – Contd.

- ❑ iscsi-pcts.sh in action - Sample output of reports.txt

```
----- Executing Login Test Cases -----  
Running Test Case tc_login_1_1      : Passed  
Running Test Case tc_login_2_2      : Passed  
Running Test Case tc_login_2_4      : Passed  
Running Test Case tc_login_2_5      : Passed
```

```
[root@wfsc trunk]# cat report.txt | head  
tc_login_1_1      : Target Alias Check      : Passed  
tc_login_2_2      : X key Check(63 byte)      : Passed  
tc_login_2_4      : X key Check                : Passed  
tc_login_2_5      : Value Size check          : Passed
```

# Data Flow - Sequence Diagram



# Dataflow and Output – Step 1

- iSCSI-PCTS sends first login PDU to target and gets response back from target

```
----- Params Sending out to Target -----  
[InitiatorName=iqn.1994-05.com.redhat:981fc286f48]  
[TargetName=iqn.2003-01.org.linux-iscsi.wfs.x8664:sn.a6fd893081c0]  
[SessionType=Normal]  
[AuthMethod=CHAP,None]  
-----
```

```
----- Received following parameters From Target -----  
[ AuthMethod=CHAP ]  
[ TargetAlias=LIO Target ]  
[ TargetPortalGroupTag=1 ]  
-----
```

# Dataflow and Output – Step 2

- ❑ If Target responds back with “AuthMethod=CHAP”,
  - ❑ iSCSI-PCTS asks for the algorithm implemented in target.
  - ❑ Target then respond back with an Identifier and Challenge.
  - ❑ iSCSI-PCTS then takes this Challenge and respond back with a “Response”

```
----- Params Sending out to Target -----  
[CHAP_A=5]  
-----
```

```
----- Received following parameters From Target -----  
[ CHAP_A=5 ]  
[ CHAP_I=1 ]  
[ CHAP_C=0x3cd13cde069b423a5da08f5897efe991 ]  
-----
```

```
----- Params Sending out to Target -----  
[CHAP_N=root]  
[CHAP_R=0xcb5963dcaa8c6f68585f97939f1d269f]  
-----
```



# Dataflow and Output – Step 3

- At this point iSCSI-PCTS is logged into Target. It has entered FFP mode and can now send/recv SCSI commands

```
Sending out WRITE10 PDU....  
Size of the cmd cdb is [8] cmd value = [42].
```

```
Recieved opcode [0x31] from target  
----- Response PDU -----  
The opcode is [0x31]  
The flag field is [0x80]  
The Response is [0x0]  
The return status is [0x0]  
The Length is [0x0]  
The lun is [0x0]  
The init_task_tag is 0xa3a3a3a3  
The target_xfer_tag is [0x2]  
The stat_sn is [0x4aff2087]  
The exp_cmd_sn is [0x4]  
The max_cmd_sn is [0x42]  
The exp_data_sn is [0x0]  
The bidi_resid is [0x0]  
The resid is [0x200]  
-----
```

# Dataflow and Output – Step 4

- At the end of test case execution a status of pass/fail is displayed on the output.

```
-----  
tc_ffp_1_1: Passed  
-----
```

# iSCSI PCTS Roadmap

	<b>Module</b>	<b>Description</b>	<b>iSCSI PCTS</b>
1	FFP (RFC 3270)	Full Feature Phase	Phase1
2	Login (RFC 3270)	Login	Phase1
3	Errors (RFC 3270)	Errors	Phase1
4	CHAP (RFC 1994)	Handshake Authentication	Phase2
5	iSNS (RFC4171)	Name Service	Phase2
6	MC (RFC 3270)	Multi-Connection	Phase2
7	iSER (RFC 5046)	Extension for RDMA	Phase3
8	IPSec	Security	Phase3
9	SLPv2 (RFC2608)	Service Location Protocol	Phase3
10	DCB (RFC 6325)	Data Center Bridging	Phase3
11	Bootstrapping	Bootstrapping	Phase3
12	T11 (RFC 3980)	Network Address Authentication	Phase3

Phase1 – Delivered in March2014

Phase 2 – In progress. Will be delivered by September 2014

Phase3 – Based on customer requirements

# Summary

- ❑ Automated tool for RFC Verification and bug finding
- ❑ Very convenient trial license
- ❑ Easy to adopt and Deploy
- ❑ Easy to Integrate in an existing Test Suite
- ❑ We are expanding iSCSI-PCTS
  - ❑ CHAP, iSNS and MCS

# Speaker Biography

## Tejas Bhise



Tejas is Director of Engineering with Calsoft Inc.

He has about 20 years of experience working with companies like IBM, HP and Gluster where he specialized in development of enterprise products in the storage and virtualization domain.

# Co-speaker Biography

## Arshad Hussain



Arshad is Senior Technical Lead with Calsoft Inc.

- ❑ More than 10 years of experience in UNIX and system programming.
- ❑ Led iSCSI-PCTS Development

# Thank You.

## Calsoft Inc.



### ■ USA

4655 Old Ironsides Drive Suite 385  
Santa Clara CA 95054  
Phone: +1 (408) 834 7086

### ■ INDIA

SR Iriz, 4th Floor, Plot A, S.No. 134/2/1  
Pashan - Baner Link Road, Pune 411008  
Phone: +91 (20) 4079 2900