



# Generic On-Line Diagnostics

# What Is Generic On-Line Diagnostics? (GOLD)

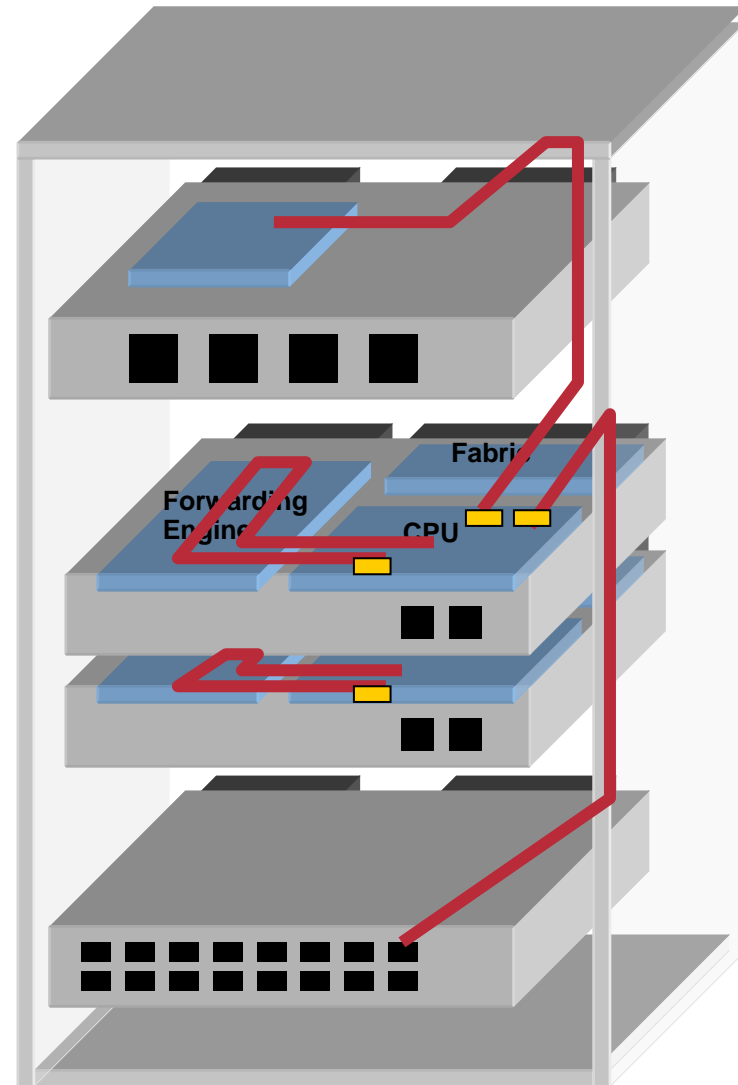


# What Is GOLD?

- **GOLD stands for “Generic OnLine Diagnostics”**
- **GOLD is a “platform independent” distributed framework that provides a common CLI and scheduling for runtime diagnostics**
- **GOLD is part of the Run-Time OS and consists of:**
  - ✓ **Boot Up Diagnostics - during boot up & Online Insertion & Removal (OIR)**
  - ✓ **Health Monitoring Diagnostics - while system is in operation**
  - ✓ **On Demand Diagnostics - using CLI**
  - ✓ **Schedule Diagnostics - using CLI**

# GOLD: How It Works?

- Is the supervisor control plane and forwarding plane functioning properly?
- Is the standby supervisor ready to take over?
- Are linecards forwarding packets properly?
- Are all ports working?
- Is the backplane connection working?



# GOLD: Fault Detection

- **Diagnostics capabilities built in hardware**
- **Depending on hardware, GOLD can catch:**

**Port Failure**

**Bent backplane connector**

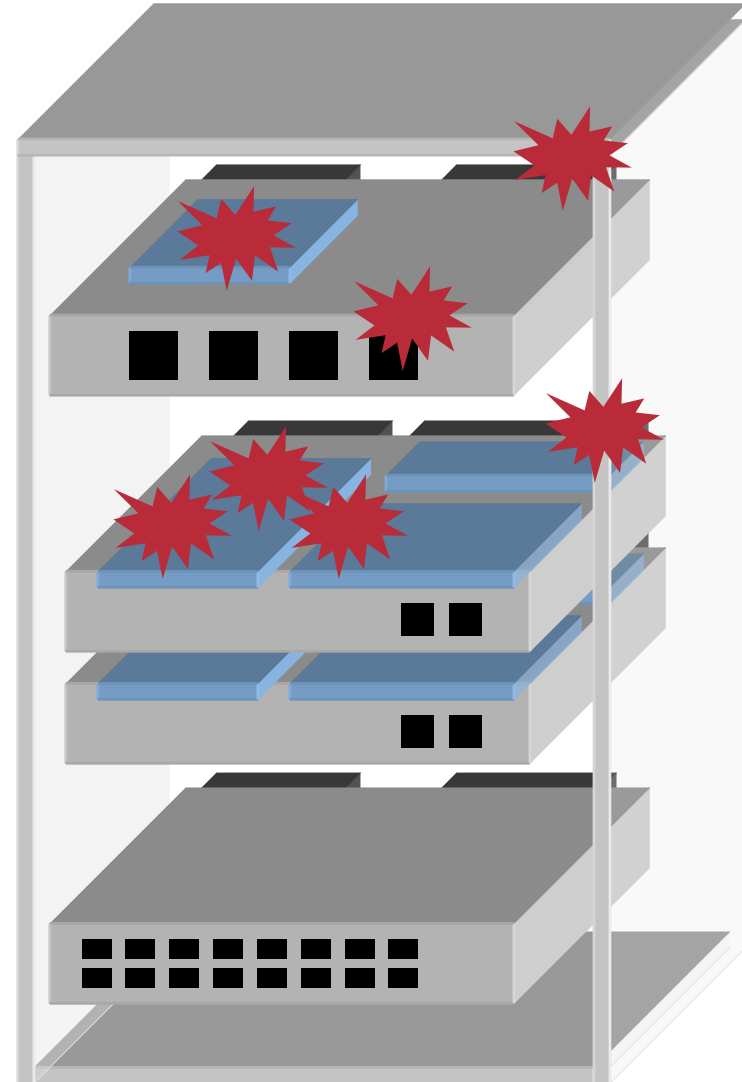
**Bad fabric connection**

**Malfunctioning Forwarding engines**

**Stuck Control Plane**

**Bad memory**

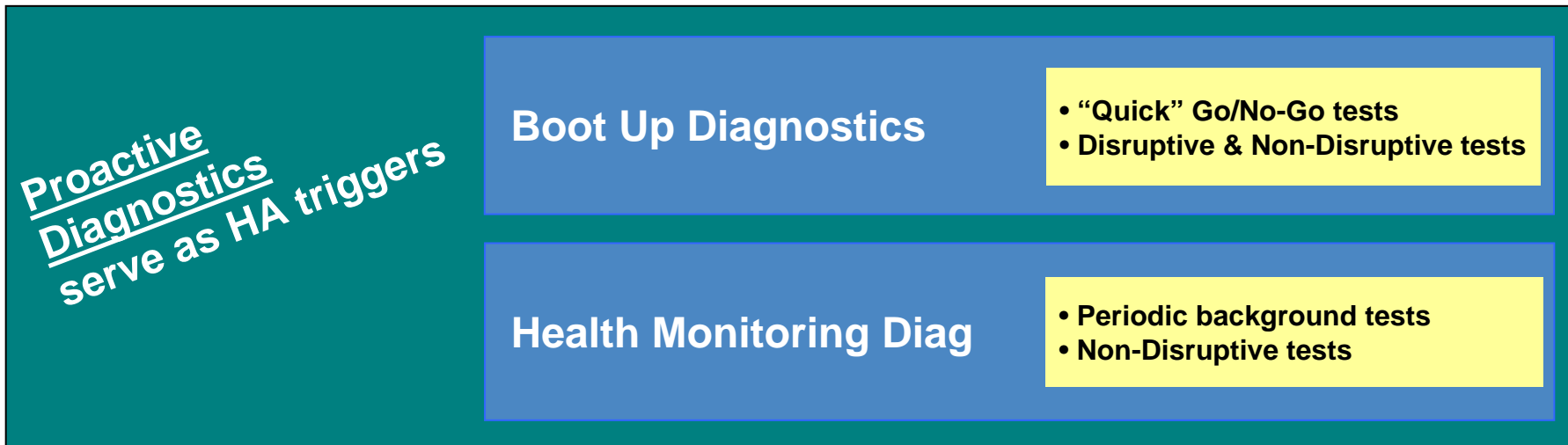
**...**



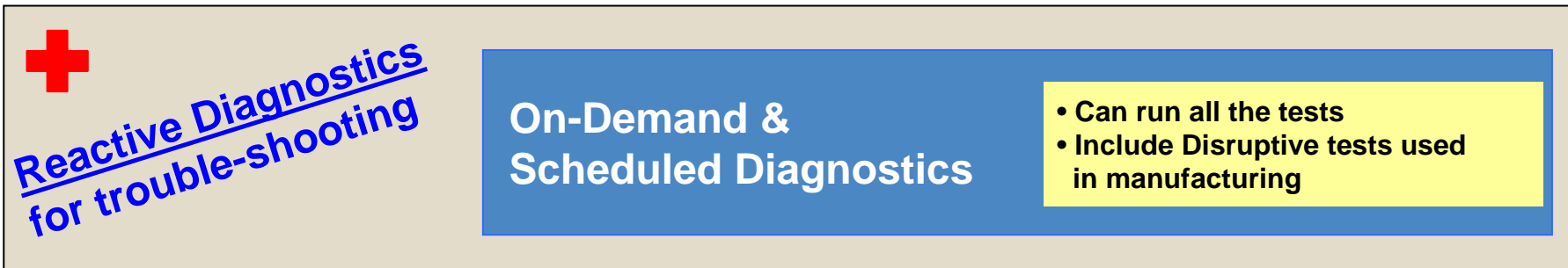
# What Does GOLD Address?

1/2

- Fault Detection framework for High Availability



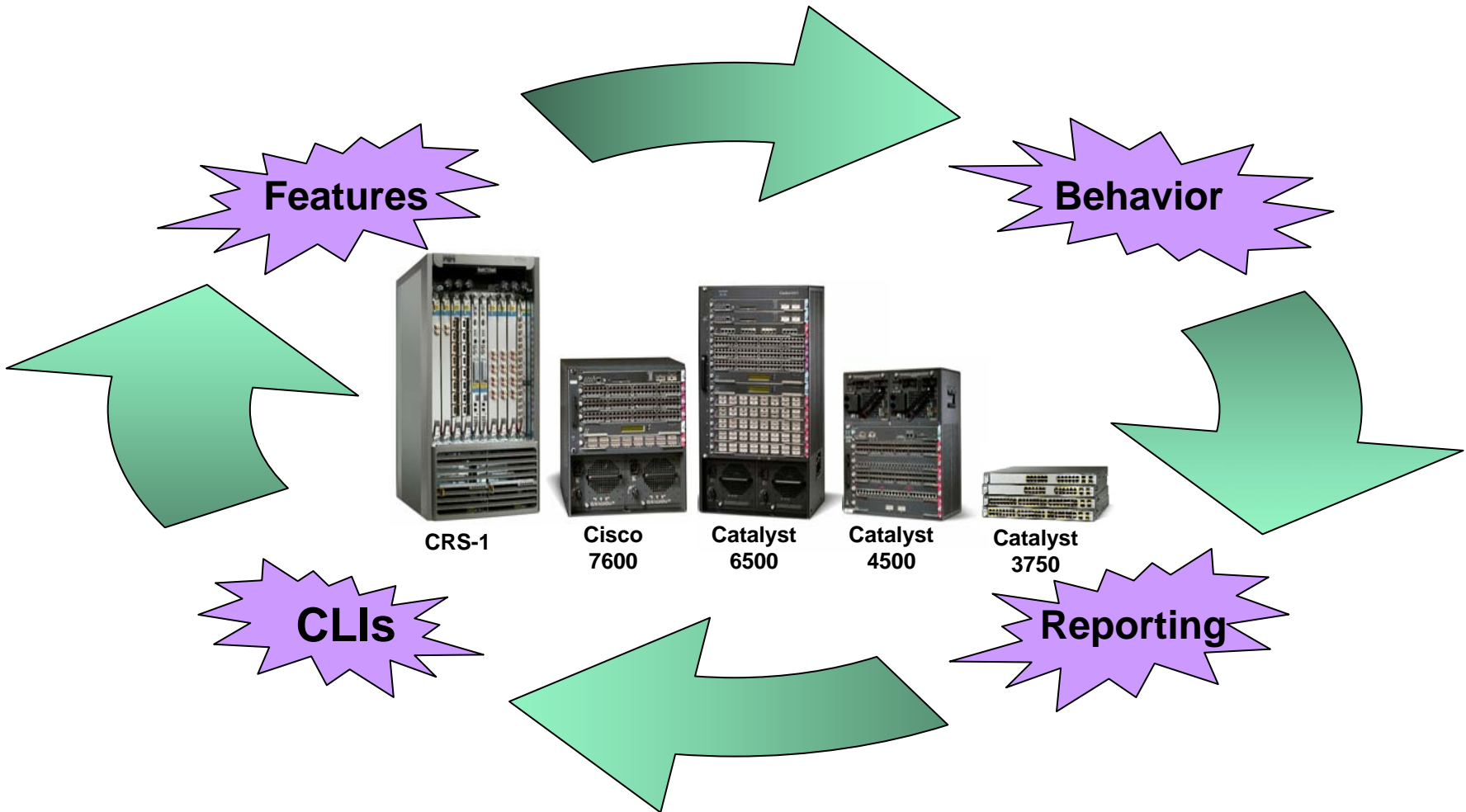
- Trouble Shooting Tool for TAC



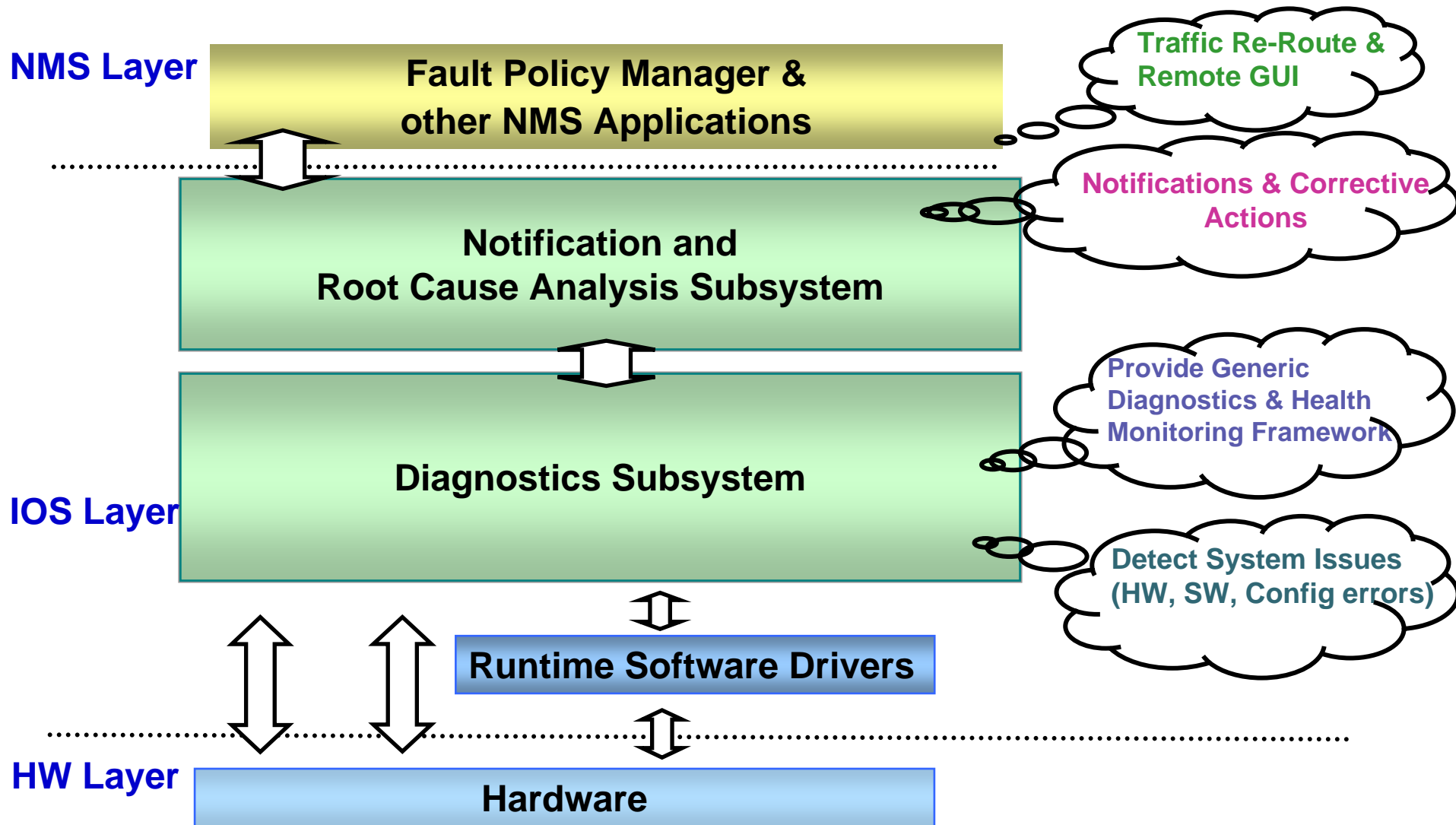
# What Does GOLD Address? (Cont.)

2/2

- Consistency across Cisco products



# High-Level Software Architecture





# GOLD Test Suite



# Catalyst 6K GOLD Test Suite

(1/2)

- **Boot up Diagnostics**
  - ✓ Forwarding Engine Learning Tests
  - ✓ L2 Tests (Channel, BPDU, Capture, etc.)
  - ✓ L3 Tests (IPv4, IPv6, MPLS, etc.)
  - ✓ Span and Multicast Tests
  - ✓ CAM lookup tests (FIB, NetFlow, QoS CAM, etc.)
  - ✓ Port loopback test
- **Health Monitoring Diagnostics**
  - ✓ SP-RP inband ping test (Sup's SP/RP, EARL(L2 & L3), RW engine)
  - ✓ Fabric Channel Health test (Fabric enabled line cards)
  - ✓ MacNotification test (DFC line cards)
  - ✓ Non Disruptive Loopback test (new line cards)
  - ✓ Scratch register test (PLD & ASICs)

# Catalyst 6K GOLD Test Suite

(2/2)

- **On-Demand Diagnostic**
  - ✓ Exhaustive memory test
  - ✓ Exhaustive TCAM test
  - ✓ Traffic Stress Testing
  - ✓ All boot up and health monitoring tests can be run on-demand using CLI

**On-Demand Exhaustive tests can be used during pre-production staging.**

- **Schedule Diagnostic**
  - ✓ All boot up and health monitoring tests can be scheduled
  - ✓ Schedule Switch-over

# POST vs. GOLD Boot Up Diagnostics

- **POST : Power On Self Test**

**Test CPU sub-system, system memory and peripheral during early stage of OS bring up**

cisco WS-C6503 (R7000) processor (revision 1.1) with 491520K/32768K bytes of memory.  
Processor board ID FOX073904WS  
R7000 CPU at 300Mhz, Implementation 39, Rev 3.3, 256KB L2, 1024KB L3 Cache

- **GOLD Boot Up Diagnostics**

**Perform functional packet switching test and ASIC memory test using runtime driver just before the module is declared “online”.**

```
*Mar 6 21:52:17.751: %DIAG-SP-6-RUN_COMPLETE: Module 1: Running Complete
Diagnostics...
*Mar 6 21:52:30.940: %DIAG-SP-6-DIAG_OK: Module 1: Passed Online Diagnostics
*Mar 6 21:52:36.805: %DIAG-SP-6-RUN_COMPLETE: Module 3: Running Complete
Diagnostics...
*Mar 6 21:52:45.300: %DIAG-SP-6-DIAG_OK: Module 3: Passed Online Diagnostics
```

# Cat6K Online Diagnostic Methodology

- **Boot-up diagnostics touch every single ASIC/memory device in the data path and control path.**
- **Perform Functional Testing combined with components monitoring to detect fault in passive components (connector, solder joint etc.) and active components (ASICs, PLDs etc.).**
- **Tests are written using run-time driver routines to catch SW defects.**
- **Non-disruptive tests are used as HA triggers.**
- **Both disruptive and non-disruptive tests are available on-demand as trouble shooting tools for CA/TAC.**
- **Root cause analysis and corrective actions are performed upon test failure.**
- **EEM will be used for configurable corrective action. (Tcl based)**

# Using Boot Up Tests

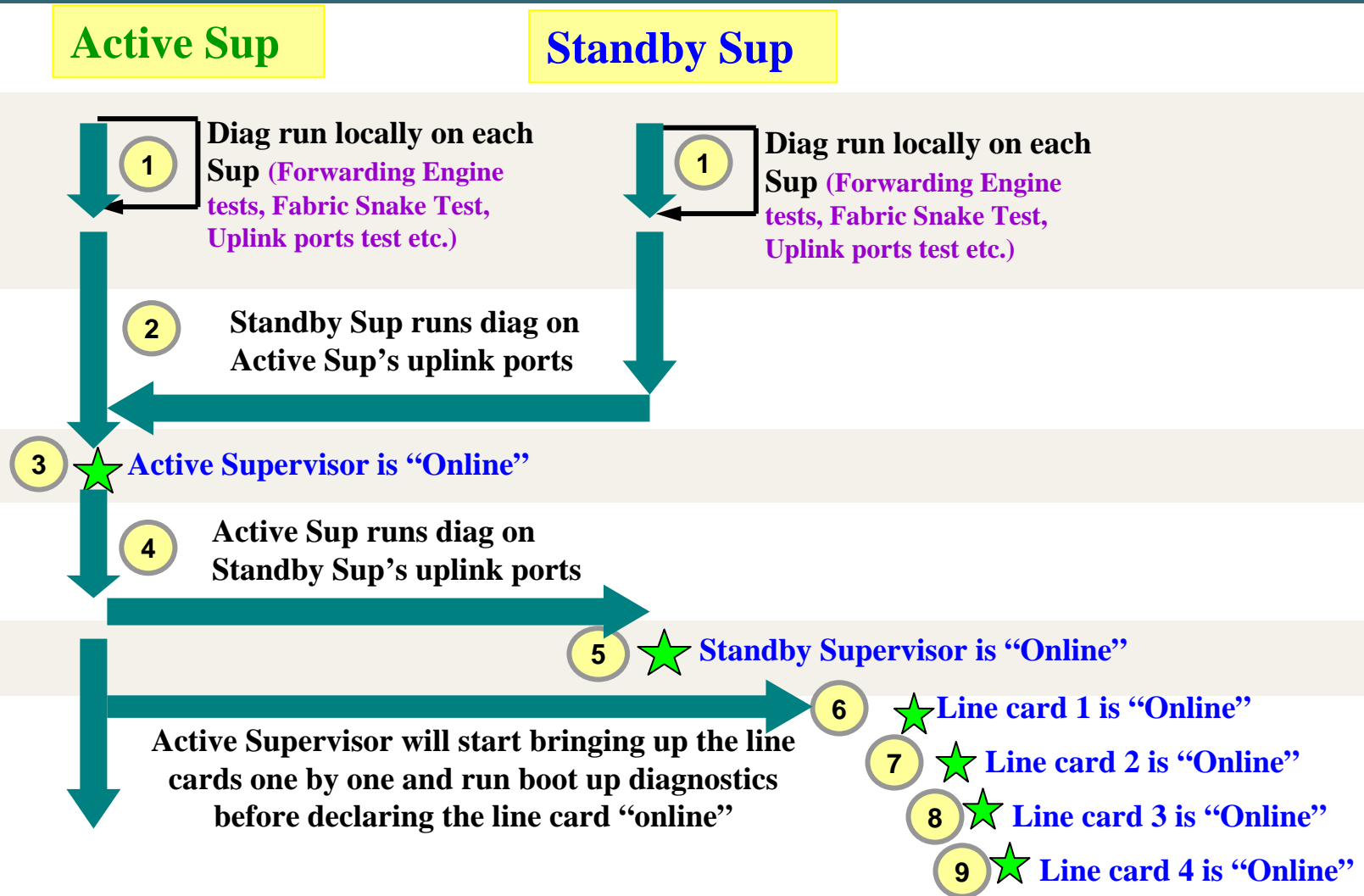


# Boot Up Tests

## Feature Definition and Benefits

- **Boot Up tests provide the ability to do quick “Go/No-Go” decisions on hardware**
- **Failing hardware is prevented from going into service**
- **Boot up diagnostics takes less than 10 seconds per module in ‘complete’ mode and in the ‘minimal’ mode it is about 5-7 seconds per module**
- **Boot up diagnostic level is stored as part of the switch configuration**

# Catalyst 6000 Boot Up Diagnostic Timing Diagram





# Using Health Monitoring Tests



# Health Monitoring Tests

## Feature Definition and Benefits

- **Non-disruptive tests running in the background while the system is switching packets**
- **Ability to disable/enable Health Monitoring tests**
  - Any non-disruptive diagnostic test could be configured to be run as HM test
- **Ability to change monitoring interval of each test (365 days down to 50 milliseconds granularity)**
- **Health-Monitoring info is stored in the switch configuration**
- **Health-Monitoring is SSO-compliant. Upon switchover, health-monitoring tests will run from new active seamlessly**

# Health Monitoring Tests

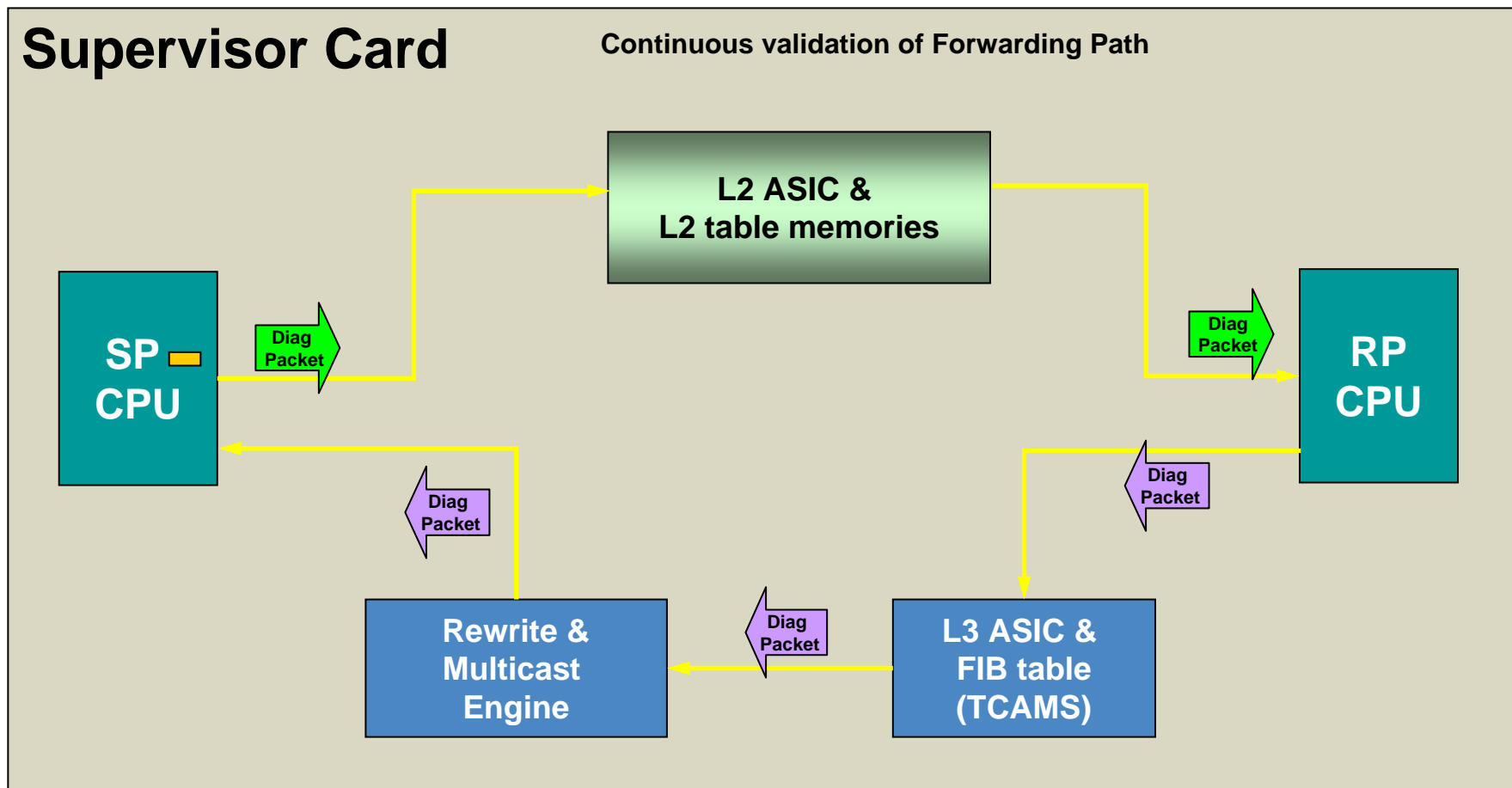
- **Test Name: TestSPRPinbandPing**
- **Test Description:**

**Detects most runtime software driver and hardware problems on supervisor engines**
- **Test Coverage:**

**Tests the Layer 2, Layer 3 and 4 forwarding engine, and the replication engine on the path from the switch processor to the route processor.**
- **Test Frequency:**

**Packets are sent at 15-second intervals. Ten consecutive failures results in failover or reload**
- **Attributes: Global, Non-disruptive, Default-On**
- **Corrective Action: Reset the active supervisor engine**

# SP-RP Ping Test (Supervisor Health Monitoring Test)



# Understanding Best Practices and Limitations for Health Monitoring

- There might be transient test failures due to bus stalls, or switching mode change. It will recover later. No action is taken until the failure threshold is crossed
- At high traffic or high CPU util, some HM tests are skipped to avoid false failures
- Supervisor module crash due to HM test failure is a **symptom** detected by proactive monitoring and **not the root cause**

# Using On Demand Tests



# On-Demand Diagnostics Feature

- **Ability to run tests from CLI**
- **Can be used by TAC to debug customer problems (field diagnostic), by engineers for internal debug**
- **User can run the test multiple times by configuring the iterations setting**
- **Allows user to configure what action to take upon failure – either continue or stop**
- **“Yes/No” Confirmation before running any disruptive test**

# On-Demand Online Diagnostics CLIs

- **diagnostic start module <module#> test {<test-id> | <test-id-string> | <test\_name> | minimal | per-port | non-disruptive} [port {<port#> | <port#-string> | all}]**

To run the specified Diagnostic test(s) at the specified slot.

For per-port tests, the user can also specify the port number range. Dynamic Help is also provided to the user.

Use “non-disruptive” flag to run all non-disruptive tests

Use “minimal” flag to run all tests that run in minimal diags mode

- **diagnostic stop module <module#>**

To stop the diagnostic running at the specified slot



# On-Demand Online Diagnostics CLIs (Cont...)

- **diagnostic ondemand iterations <iteration-count>**  
To set the ondemand testing iteration count
- **diagnostic ondemand action-on-failure {continue | stop} [<failure-count>]**  
To set the execution action when error is detected. The user can choose to continue or to stop when the test failure is detected.  
To stop the test after certain number of failures, use “failure-count” flag
- **show diagnostic ondemand settings**  
To display the settings for ondemand diagnostic

# Case Study

- **Situation:**

**Customer was running into a problem : packets ingress on a particular line card were getting dropped intermittently. All software/hardware entries etc were checked.**

- **Action:**

## TAC engineer requested customer to run line card memory test

- **Results:**

**Diagnostics results revealed that memory was failing. Line card was replaced and the switch functionality was restored in a very short time**

## Thanks to GOLD !!

**6500\_cust# diagnostic start module 1 test 28**

**Module 1: Running test(s) 28 may disrupt normal operation**

Do you want to run disruptive tests? [no] **yes**

**Mar 17 15:58:34: SP: \*\*\*\*\***

Mar 17 15:58:34: SP: \* WARNING:

**Mar 17 15:58:34: SP: \* ASIC Memory test on module 1 may take up to 1hr 30min.**

Mar 17 15:58:34: SP: \* During this time, please DO NOT perform any packet switching.

Mar 17 15:58:34: SP: \*\*\*\*\*

Mar 17 16:10:27: SP: diag\_scp\_asic\_mem\_test [1/1/RN\_PBIF]: LCP TEST FAILED. fail\_addr = 0xE923, test data | result data:

[illegible]

**Mar 17 16:10:27: SP: do\_mem\_test [1/1]: test RN\_PBIF memory failed**

Mar 17 16:10:27: SP: \*\*\*\*\*

Mar 17 16:10:27: SP: \* WARNING: Please RESET module 1 prior to normal use. Also, packet

**Mar 17 16:10:27: SP: \* switching tests will no longer work (i.e. test failure) because**

Mar 17 16:10:27: SP: \* its memories are filled with test patterns.

Mar 17 16:10:27: SP: \*\*\*\*\*

**MarchCMem: got data mismatch at addr: 0xE923, dev#: 1**

[illegible]

Mar 17 16:10:27: %DIAG-SP-3-TEST\_FAIL: Module 1: TestLinecardMemory{ID=28} has failed. Error code = 0x1

# Using Scheduled Tests



# Schedule Diagnostics Feature

- Ability to schedule tests to run at certain time or daily/weekly (i.e. one-time or periodically)
- Can create unlimited number of schedules

# Schedule Online Diagnostics CLIs

- [no] diagnostic schedule module <module#> test {<test-id> | <test-id-range> | all} [port {<port#> | <port#-range> | all}] **on** <month> <date> <year> <hh:mm>

To schedule diags to run on a specific day at a particular time  
(runs only once)

- [no] diagnostic schedule module <module#> test {<test-id> | <test-id-range> | all} [port {<port#> | <port#-range> | all}] **daily** <hh:mm>

To schedule diags to run daily at a particular time

- [no] diagnostic schedule module <module#> test {<test-id> | <test-id-range> | all} [port {<port#> | <port#-range> | all}] **weekly** <day-of-week> <hh:mm>

To schedule diags to run weekly on a particular day at a particular time

# Schedule Switchover

- **Schedule Switchover allows the customer to exercise standby Supervisor at pre-defined time**

- **Best Practice**

**Issue two schedule switchover config. The first command to switchover from active to standby**

**The second command is to schedule a switch over back from the new active supervisor to new standby supervisor about 5 minutes later**

# Other Information



# What Happens When A Test Fails?

- **Depending on the type of test failure, GOLD triggers**
  - Supervisor switch-over**
  - Fabric switch-over**
  - Port shut down**
  - Line card reset**
  - Line card power down**
  - Generates a syslog message**
  - Generates a call-home message**
  - Informs Embedded Event Manager (EEM) to invoke other actions configurable via EEM Tcl script**



# Typical Syslog Messages

- **GOLD related Syslog messages will start with the string “DIAG” or “CONST\_DIAG”**

- **Sample text of a syslog message:**

**%CONST\_DIAG-SP-3-BOOTUP\_TEST\_FAIL: Module 2: TestL3VlanMet failed**

**%CONST\_DIAG-SP-2-HM\_MOD\_RESET: Resetting Module 3 for software recovery, Reason: Failed TestMacNotification**

**DIAG-SP-3-TEST\_FAIL: Module 5: TestTrafficStress{ID=24} has failed. Error code = 0x1**

- **More detailed Syslog information:**

**<http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/122sx/msgguide/emsg.htm#wp1293376>**

# Items To Avoid/Remember

- **Do not run any packet switching tests following exhaustive memory tests.**

**The loop back tests will fail.**

- **Do not assume diagnostics failure is a confirmation that hardware is defective especially for boot up tests.**

**Run exhaustive tests to confirm since defect could be due to software failure in some cases.**

- **Non optimal network configurations that result in oversubscribing device capabilities will cause diagnostics to fail.**

# Other Tips To Remember & Further Reading

## When Interacting With Cisco TAC

- **Most common request from TAC engineers when working on a Cat 6K service request**

**show diagnostics event all**

**show diagnostics results module all detail**

- **Further Reading:**

**Cisco.com documentation link**

**<http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/122sx/swcg/diagtest.htm>**

# Conclusion

- **GOLD provides the generic diagnostics and health monitoring framework to detect hardware and some software issues**
- **GOLD can be used proactively to provide High Availability triggers in the event of a hardware failure**
- **GOLD can be used as part of the troubleshooting process to pin point a specific functional area of the hardware that is failing**

# CISCO SYSTEMS

