

Processing deliberate verification errors during regression

Alastair Lefley, ams AG, Kemble, UK (Alastair.Lefley@ams.com)

Roger Witlox, ams AG, Eindhoven, NL (Roger.Witlox@ams.com)

Clemens Süßmuth, ams AG, Premstätten, AT (Clemens.Suessmuth@ams.com)

Thomas Ziller, Cadence, München, DE (ThomasZ@cadence.com)

Kawe Fotouhi, Cadence, München, DE (Fotouhi@cadence.com)

Quis custodiet ipsos custodes / Who will check the checkers?

- VIPs have teams of bodyguards – but do they remain loyal?
- DV teams write many checkers – but do they remain functional?



The drive for automated regression

- As design complexity increases, so too do DV needs increase;
- The DV team will create a suite of testbenches and testcases.
 - Regression testing returns to, and reruns, the suite of testbenches and testcases;
 - Regression involves automatically producing coverage and pass/fail statistics;
 - We return in order to re-verify, as there will have been changes;
- While regressing, are all of our checks still functional, or are they compromised by the various changes?

While regressing, are all checks still functional, or are they compromised by the various changes?

- Why might a previous check cease to become active?
 - A qualifying condition is no longer met;
 - It gets disabled;
 - The sample clock is changed: deactivated, or masking duty-cycle;
 - 'define macros get redefined;
- Important that the DV regression proves all checks are still active;

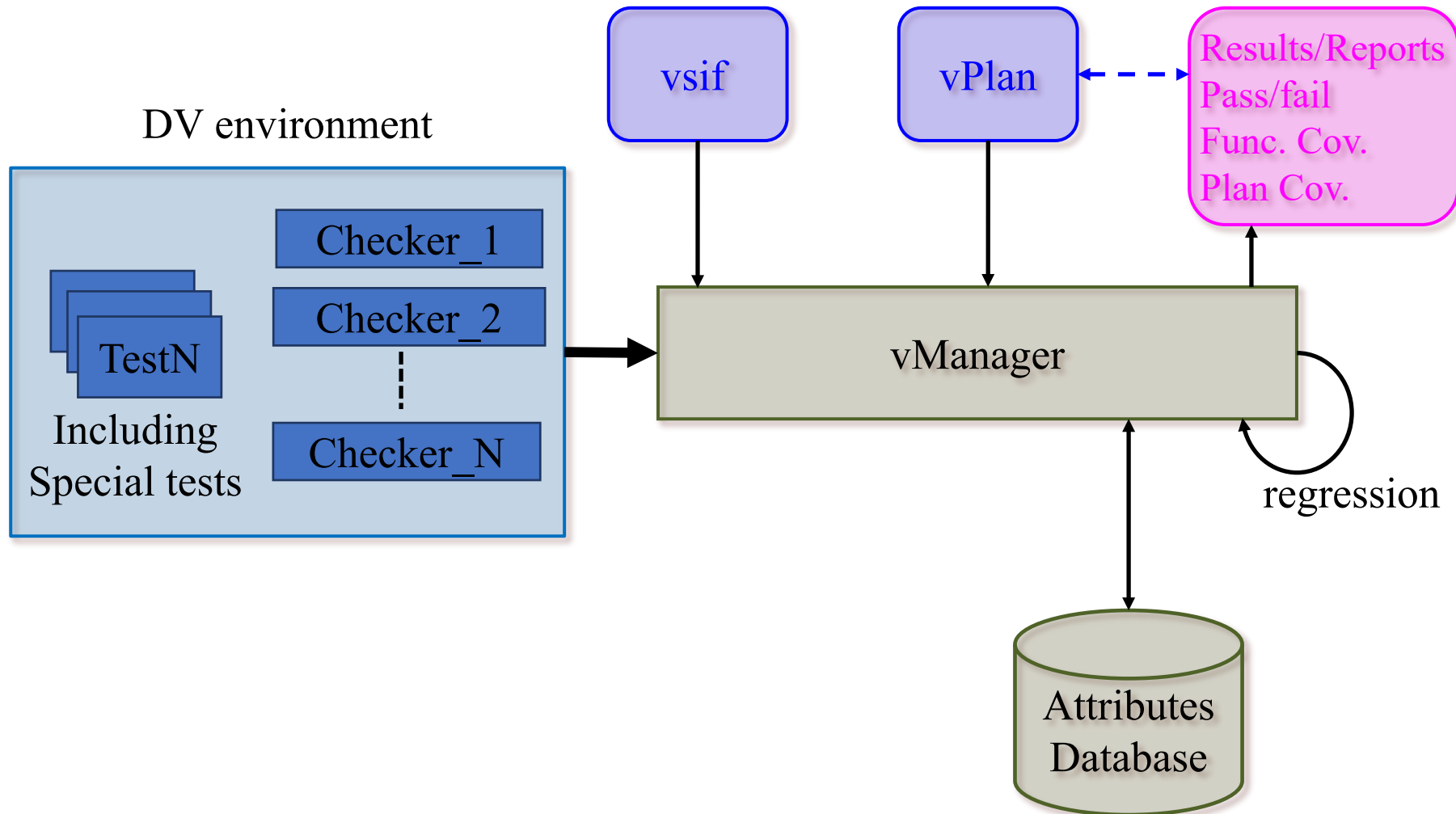
Methodology to check checkers during regression

- Need agnostic method to check all checkers remain functional;
- Problem:
 - Need to be deliberately producing errors;
 - Standard processing of regression results reports tests as:
 - FAIL – if they contain one or more errors;
 - PASS – if they have no errors;
- New methodology:
 - On selected tests, introduce predefined number of deliberate errors – provoke checkers;
 - Revised processing of regression results reports tests as:
 - FAIL – if they do not match the predefined deliberate errors or have others errors;
 - PASS – if they match the predefined number / style of deliberate errors and have no other errors;

Processing of regression results


- The regression setup will study two main aspects of the simulation data:
 1. The functional coverage data;
 2. The simulation log files containing error, warning and other information;
- The methodology proposed involves:
 - Using and adapting the Cadence® vManager™ flow;
 - Adding extra intelligence to the parsing of the simulation log files;

Simplified vManager use-case flow



Assert : source code → log file

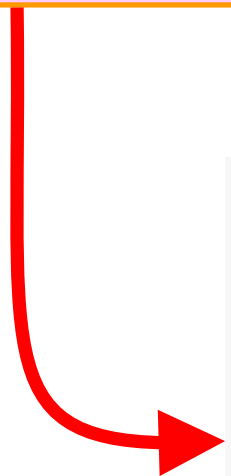
```
always @*  
begin  
  if (en == 1) begin  
    #1;  
    ibias_s1_ass : assert (correct_ibias_s1)  
      else $error (" ibias_0u5 out of range %f at time %tus",ibias_0u5, $time);  
  end //En==1  
end //always
```



```
Time:          30.138 us      Info: en = 1; ibias = 0. This deliberately  
provokes and proves a model-based assertion.  
ncsim: *E,ASRTST (/PATHNAME/PROJECTX/LDC_BIAS_V1/systemVerilog/verilog.sv,152)  
: (time 30139 NS) Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed  
  ibias_0u5 out of range 0.000000 at time          30.139 usus  
Time:          36.147 us      Info: en = 1; ibias = 0.5e-6.
```


Assert : log file → attributes in vManager DB

```
Time:          30.138 us          Info: en = 1; ibias = 0. This deliberately
provokes and proves a model-based assertion.
ncsim: *E,ASRTST (/PATHNAME/PROJECTX/LDC_BIAS_V1/systemVerilog/verilog.sv,152)
: (time 30139 NS) Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed
  ibias_0u5 out of range 0.000000 at time          30.139 usus
Time:          36.147 us          Info: en = 1; ibias = 0.5e-6.
```




List Tabs /model_configs/tb_LDC_BIAS		
Errors Warnings/Info		
Name	Description	Severity
ASRTST.ibias_s2_ass	Assertion tb_LDC_BIAS.DUT.ibias_s2_ass has failed	error
ASRTST.ibias_s1_ass	Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed	error
ASRTST.AVDD_ass	Assertion tb_LDC_BIAS.DUT.AVDD_ass has failed	error
Showing 3 items		

All Attributes	
Col # ▲	Name
	(no filter)
	Category
	Comment
	Context
	Editing
	ID
	Log File
	Log Line
	Module
	Number Of Entities
	Original Description
	Owner
	Time
	Tool
0	Name
1	Description
2	Severity

uvm_error : source code → log file

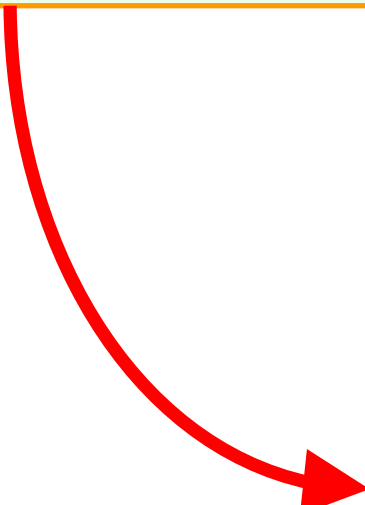
```
class ctc_sb extends uvm_scoreboard;
...
task ctc_compare_values();
    if (act_val != exp_val)
        `uvm_error("CTC_SB", $sformatf("ctc_compare_values: act_val != exp_val\n"))
    endtask
...
```



```
reporter [RNTST] Running test ctc_single_error_test...
...
UVM_ERROR /PATHNAME/ctc_uvm.sv(28) @ 100: uvm_test_top.m_ctc_env.m_ctc_sb
[CTC_SB] ctc_compare_values: act_val != exp_val
...
```

uvm_error : log file → attributes in vManager DB

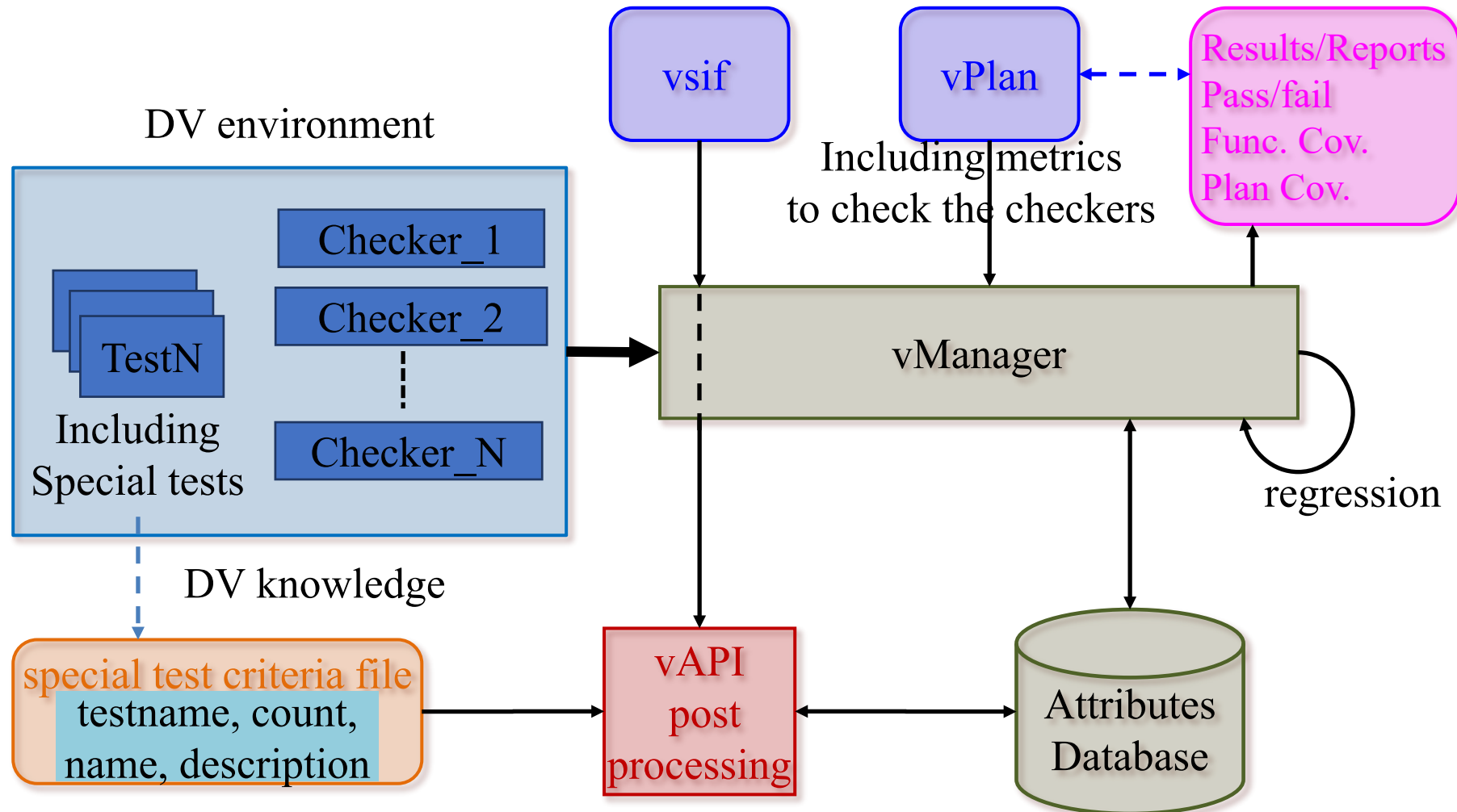
```
reporter [RNTST] Running test ctc_single_error_test...  
...  
UVM_ERROR /PATHNAME/ctc_uvm.sv(28) @ 100: uvm_test_top.m_ctc_env.m_ctc_sb  
[CTC_SB] ctc_compare_values: act_val != exp_val  
...
```



List Tabs		Test-Case Model	
Errors			
Name	Description	Severity	
(no filter)	(no filter)		
CTC_SB	ctc_compare_values: a != b	10 != 11	error
Showing 4 items			

All Attributes	
Col #	Name
	(no filter)
	Category
	Comment
	Context
	Editing
	ID
	Log File
	Log Line
	Module
	Number Of Entities
	Original Description
	Owner
	Time
	Tool
0	Name
1	Description
2	Severity

Adapted vAPI vManager use-case flow



Down-grading of attributes in vManager DB

The image shows two screenshots of the vManager DB interface. The top screenshot shows the 'Errors' tab with three items: ASRTST.ibias_s2_ass, ASRTST.ibias_s1_ass, and ASRTST.AVDD_ass, all with a severity of 'error'. The bottom screenshot shows the 'Warnings/Info' tab with the same three items, but their severity has been downgraded to 'warning'. A red arrow points from the 'Errors' tab to the 'Warnings/Info' tab, indicating the down-grading process.

Top Screenshot (Errors Tab):

Name	Description	Severity
ASRTST.ibias_s2_ass	Assertion tb_LDC_BIAS.DUT.ibias_s2_ass has failed	error
ASRTST.ibias_s1_ass	Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed	error
ASRTST.AVDD_ass	Assertion tb_LDC_BIAS.DUT.AVDD_ass has failed	error

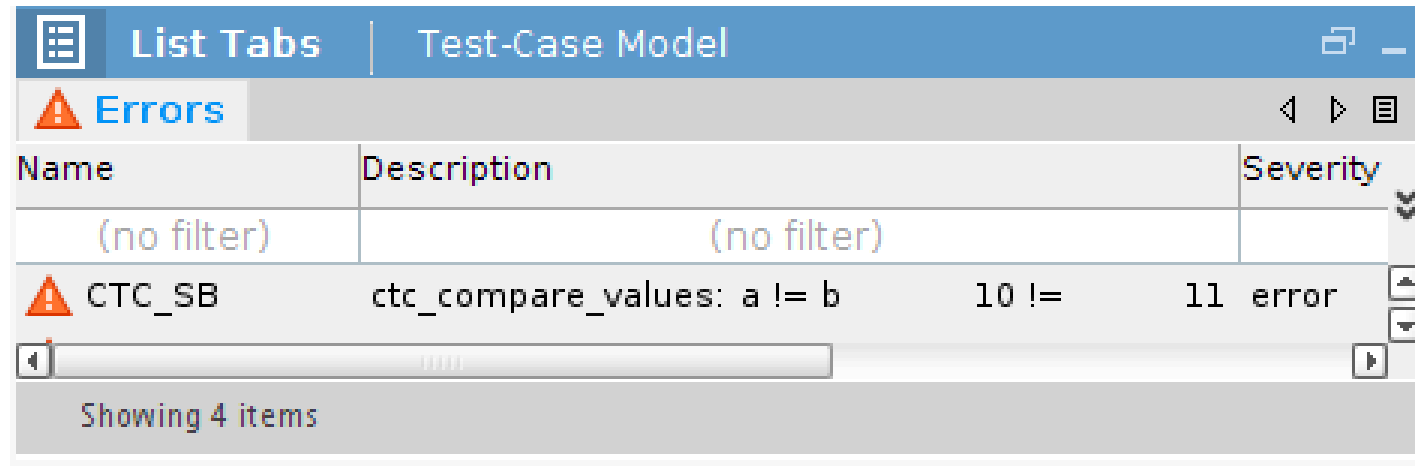
Showing 3 items

Bottom Screenshot (Warnings/Info Tab):

Name	Description	Severity
(no filter)	(no filter)	(no filter)
ASRTST.AVDD_ass	Assertion tb_LDC_BIAS.DUT.AVDD_ass has failed	warning
ASRTST.ibias_s1_ass	Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed	warning
ASRTST.ibias_s2_ass	Assertion tb_LDC_BIAS.DUT.ibias_s2_ass has failed	warning

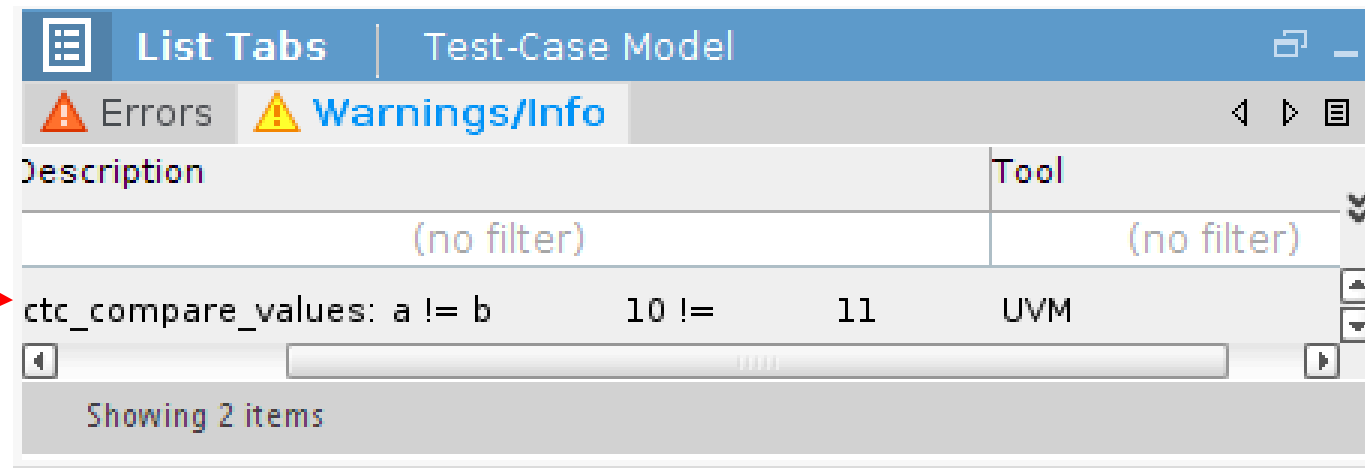
Showing 19 items

Down-grading of attributes in vManager DB



Name	Description	Severity
(no filter)	(no filter)	
CTC_SB	ctc_compare_values: a != b 10 != 11	error

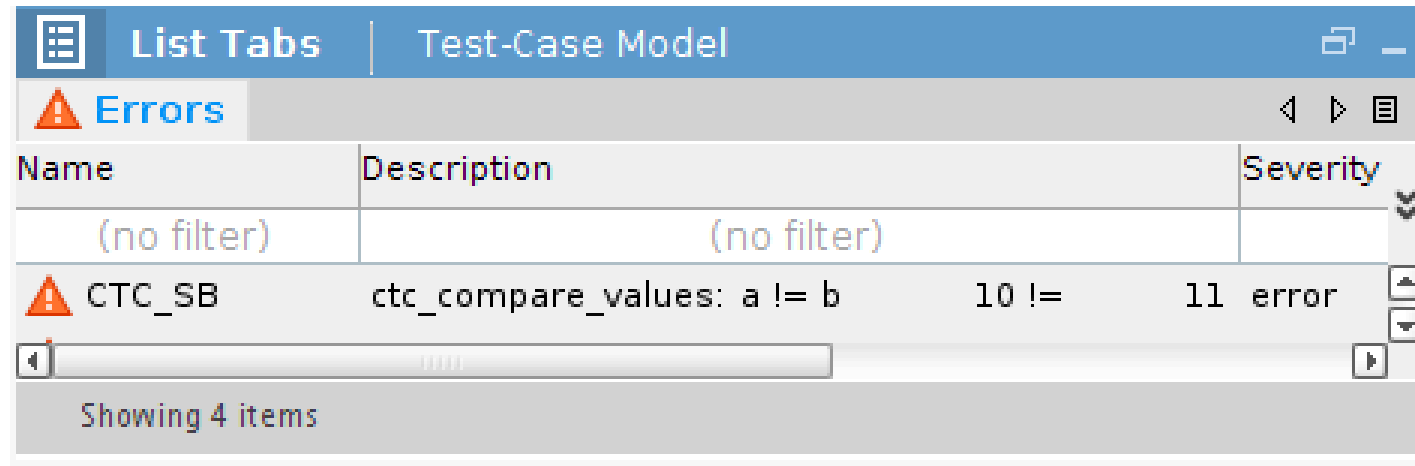
Showing 4 items



Description	Tool
(no filter)	(no filter)
ctc_compare_values: a != b 10 != 11	UVM

Showing 2 items

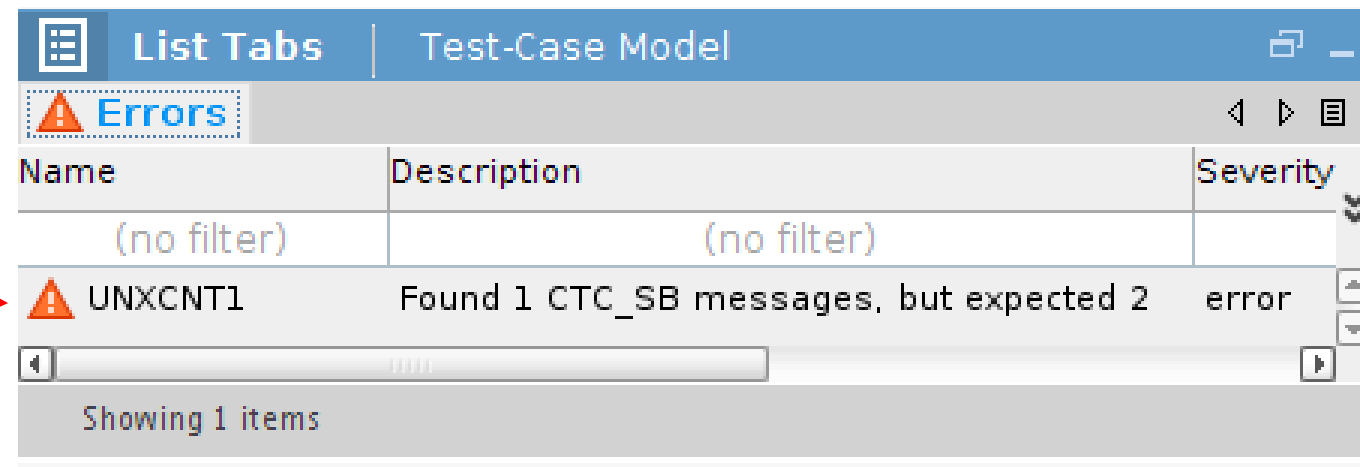
New attributes in vManager DB – count mismatch



The screenshot shows a window titled 'List Tabs' with a sub-tab 'Test-Case Model'. Below the title bar is a tab labeled 'Errors' with a warning icon. The main area contains a table with three columns: 'Name', 'Description', and 'Severity'. The table has a header row and one data row. The data row shows an error named 'CTC_SB' with a description 'ctc_compare_values: a != b' and a severity of 'error'. The table is filtered to show 4 items, as indicated by the text 'Showing 4 items' at the bottom.

Name	Description	Severity
(no filter)	(no filter)	
CTC_SB	ctc_compare_values: a != b	error

Showing 4 items

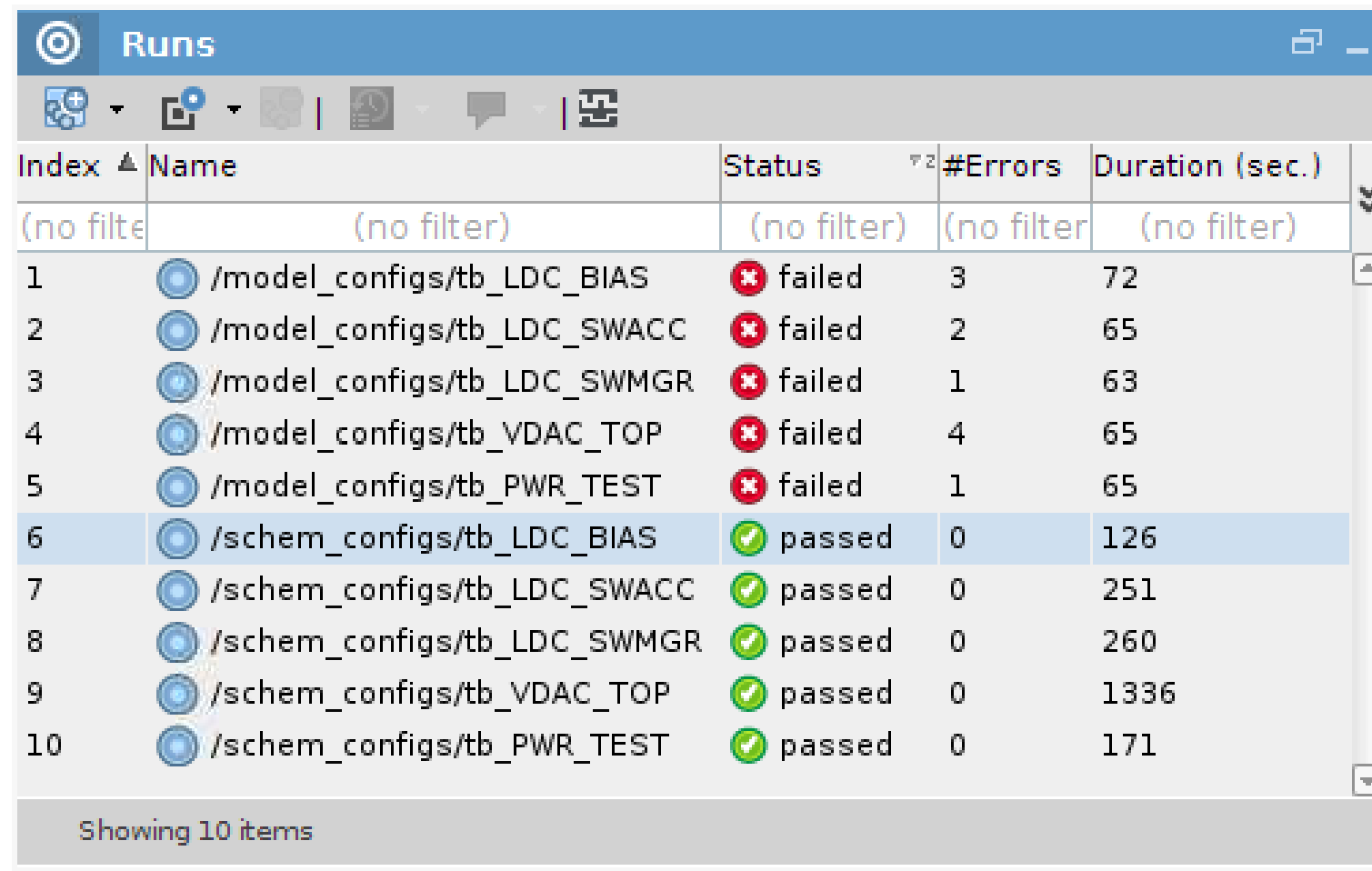


The screenshot shows the same 'List Tabs' window, but now the 'Errors' tab is selected and the table shows only one item. The data row shows an error named 'UNXCNT1' with a description 'Found 1 CTC_SB messages, but expected 2' and a severity of 'error'. The table is filtered to show 1 item, as indicated by the text 'Showing 1 items' at the bottom. A red arrow points from the 'CTC_SB' error in the first screenshot to the 'UNXCNT1' error in this screenshot.

Name	Description	Severity
(no filter)	(no filter)	
UNXCNT1	Found 1 CTC_SB messages, but expected 2	error

Showing 1 items

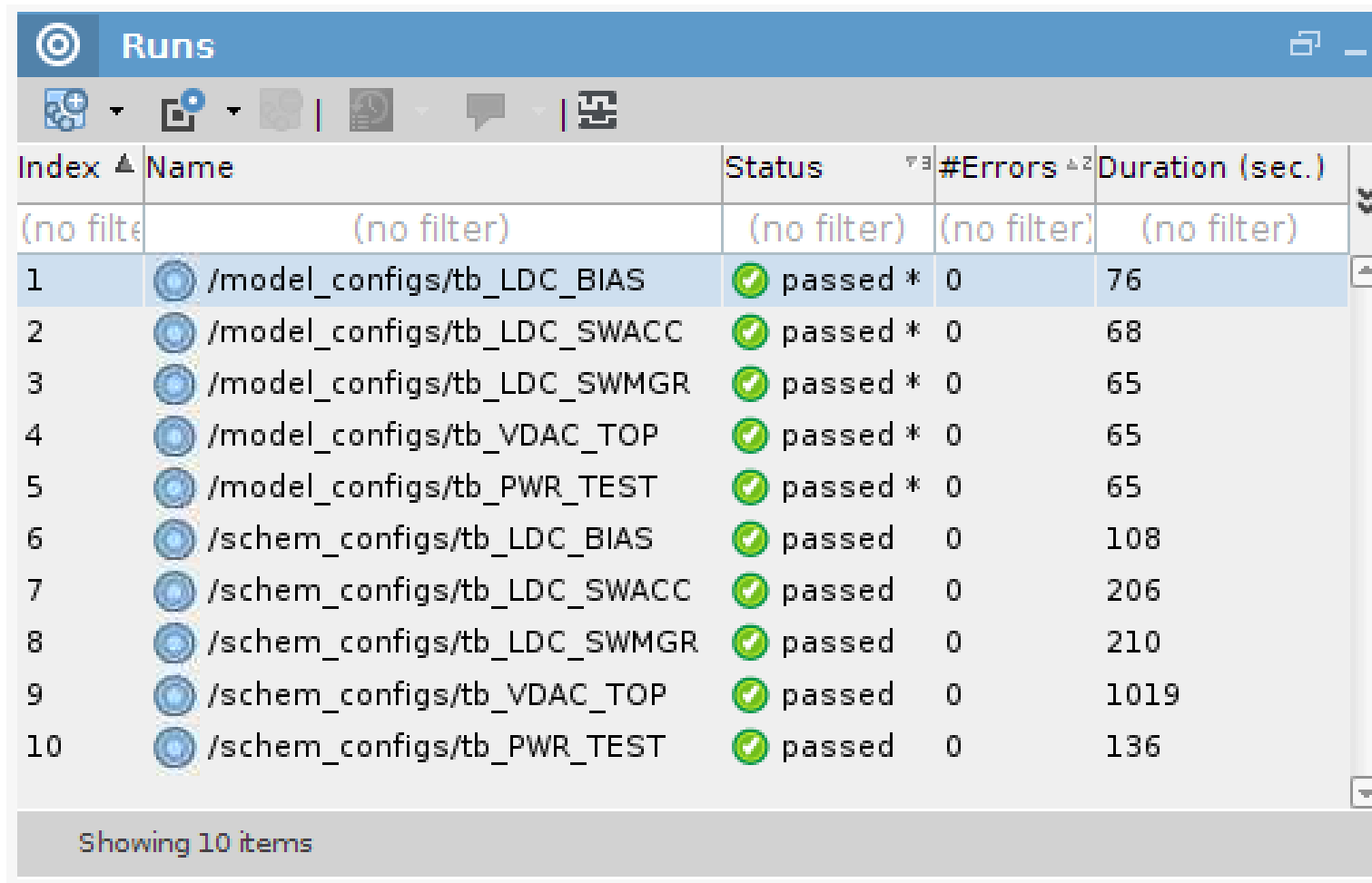
vManager DB – regression analysis, prior to vAPI



Index ▲	Name	Status	#Errors	Duration (sec.)
(no filter)	(no filter)	(no filter)	(no filter)	(no filter)
1	/model_configs/tb_LDC_BIAS	failed	3	72
2	/model_configs/tb_LDC_SWACC	failed	2	65
3	/model_configs/tb_LDC_SWMGR	failed	1	63
4	/model_configs/tb_VDAC_TOP	failed	4	65
5	/model_configs/tb_PWR_TEST	failed	1	65
6	/schem_configs/tb_LDC_BIAS	passed	0	126
7	/schem_configs/tb_LDC_SWACC	passed	0	251
8	/schem_configs/tb_LDC_SWMGR	passed	0	260
9	/schem_configs/tb_VDAC_TOP	passed	0	1336
10	/schem_configs/tb_PWR_TEST	passed	0	171

Showing 10 items

vManager DB – regression analysis, after vAPI



Index ▲	Name	Status ▴ ▾	#Errors ▲ ▾	Duration (sec.)
(no filter)	(no filter)	(no filter)	(no filter)	(no filter)
1	/model_configs/tb_LDC_BIAS	passed *	0	76
2	/model_configs/tb_LDC_SWACC	passed *	0	68
3	/model_configs/tb_LDC_SWMGR	passed *	0	65
4	/model_configs/tb_VDAC_TOP	passed *	0	65
5	/model_configs/tb_PWR_TEST	passed *	0	65
6	/schem_configs/tb_LDC_BIAS	passed	0	108
7	/schem_configs/tb_LDC_SWACC	passed	0	206
8	/schem_configs/tb_LDC_SWMGR	passed	0	210
9	/schem_configs/tb_VDAC_TOP	passed	0	1019
10	/schem_configs/tb_PWR_TEST	passed	0	136

Showing 10 items

vManager – vPlan metrics for special tests

The screenshot displays two windows from the vManager application. The 'vPlan Hierarchy' window on the left shows a tree structure under 'ctc_uvm'. The '2 Tests' folder is selected, revealing sub-items: '2.1 Normal operation' (containing '2.1.1 no_errors') and '2.2 Force checker error' (containing '2.2.1 single_error_expected' and '2.2.2 dual_error_dual_expected'). The 'Metrics Mapping' window on the right shows a mapping interface with 'Basic' and 'Advanced' tabs. The 'Basic' tab is active, displaying a grid of mapping buttons. The right pane of the 'Metrics Mapping' window shows a list of metrics under 'Verification Metrics', including 'default', 'Tests', and 'ctc_uvm_post_processing'. The 'ctc_uvm_post_processing' folder is expanded, showing four metrics: 'no_errors', 'single_error_expected', 'single_error_dual_expected', and 'dual_error_dual_expected'. Each metric has a corresponding icon and a 'Map' button.

vPlan Hierarchy

Show All Create Perspective

Name

- ctc_uvm
 - 1 Checks
 - 1.1 Data model and design equivalent
 - 1.1.1 values_compared
 - 2 Tests
 - 2.1 Normal operation
 - 2.1.1 no_errors
 - 2.2 Force checker error
 - 2.2.1 single_error_expected
 - 2.2.2 dual_error_dual_expected

Metrics Mapping











Basic Advanced

Name

(no filter)

 - Verification Metrics
 - default
 - Tests
 - ctc_uvm_post_processing
 - no_errors
 - single_error_expected
 - single_error_dual_expected
 - dual_error_dual_expected
 - Types

vManager – vPlan coverage for special tests

vPlan Hierarchy				
ctc_uvm				
Ex	UNR	Name	Overall Average Grade	Overall Covered
		(no filter)	(no filter)	(no filter)
		▲ ▼ ctc_uvm	 100%	4 / 4 (100%)
		▲ 1 Checks	 100%	1 / 1 (100%)
		▲ 1.1 Data model and design equivalent	 100%	1 / 1 (100%)
		▶ 1.1.1 values_compared	 100%	1 / 1 (100%)
		▲ 2 Tests	 100%	3 / 3 (100%)
		▲ 2.1 Normal operation	 100%	1 / 1 (100%)
		▶ 2.1.1 no_errors	 100%	1 / 1 (100%)
		▲ 2.2 Force checker error	 100%	2 / 2 (100%)
		▶ 2.2.1 single_error_expected	 100%	1 / 1 (100%)
		▶ 2.2.2 dual_error_dual_expected	 100%	1 / 1 (100%)

vAPI post-processing

- Controlled invocation from the vsif flow – “post session”;
- A python script is used – but other formats, Perl, are alternatives;
 1. Read and parse the special test criteria file;
 2. Using REST / JSON: traverse the attributes database – loop through all runs and all errors;
 3. Down-grade error attributes which match special test criteria; keep tally;
 4. If tally mismatches, introduce new error;
 5. Write back down-grades and new errors to the attributes database;

Special test criteria file – *.csv format – Ex. #1

test_name	count	name	description
tb_LDC_BIAS	1	ASRTST.AVDD_ass	Assertion tb_LDC_BIAS.DUT.AVDD_ass has failed
tb_LDC_BIAS	1	ASRTST.ibias_s1_ass	Assertion tb_LDC_BIAS.DUT.ibias_s1_ass has failed
tb_LDC_BIAS	1	ASRTST.ibias_s2_ass	Assertion tb_LDC_BIAS.DUT.ibias_s2_ass has failed
tb_LDC_SWACC	2	ASRTST.vdd_ass	Assertion tb_LDC_SWACC.DUT.vdd_ass has failed
tb_LDC_SWMGR	1	ASRTST.vdd_ass	Assertion tb_LDC_SWMGR.DUT.vdd_ass has failed
tb_VDAC_TOP	1	ASRTST.ibdacen_ass	Assertion tb_VDAC_TOP.DUT.ICORE.ibdacen_ass has failed
tb_VDAC_TOP	1	ASRTST.dacref_ass	Assertion tb_VDAC_TOP.DUT.ICORE.dacref_ass has failed
tb_VDAC_TOP	1	ASRTST.vref_ass	Assertion tb_VDAC_TOP.DUT.ICORE.vref_ass has failed
tb_VDAC_TOP	1	ASRTST.vdd_ass	Assertion tb_VDAC_TOP.DUT.ICORE.vdd_ass has failed
tb_PWR_TEST	1	ASRTST.vdd_ass	Assertion tb_PWR_TEST.DUT.vdd_ass has failed

Special test criteria file – *.csv format – Ex. #2

test_name	count	name	description
single_error_expected	1	CTC_SB	ctc_compare_values
single_error_dual_expected	2	CTC_SB	ctc_compare_values
dual_error_dual_expected	2	CTC_SB	ctc_compare_values

Conclusions

- We started explaining the need to check the checkers;
- We showed that introducing deliberate errors will explicitly demonstrate that the checkers are active;
- We showed that a cleverer PASS/FAIL definition can understand real- and deliberate-errors;
- This flow is now being actively used on a live project at ams;

Questions

Miscellaneous supplementary slides

- vsif flow – script excerpt;
- vAPI python – several script excerpts;

Miscellaneous – vsif script excerpt

```
session MINI__Projectx_model_vs_schem {
  top_dir : $ENV(SIM_DIR)/../vmgr_sessions;
  ...
  post_session_script: "check_the_checker.py";

  group model_configs {
    run_script: "runams -cell $ATTR(test_name) -view model_config -simulate batch ..."
    special_test_criteria_file : "$ENV(DV_DIR)/bin/vsifs/MINI__model_vs_schem__special-test-criteria-file.csv";
    ...

    test tb_LDC_BIAS;
    ...
  };

  group schem_configs {
    run_script: "runams -cell $ATTR(test_name) -view schem_config -simulate batch ...";
    ...

    test tb_LDC_BIAS;
    ...
  };
};
```


Miscellaneous – vAPI.py – REST definitions

```
set_server(vmgr_project="vmgr",server='https://' + vmgr_server,user=vmgr_username,passwd=vmgr_password)
headers = {
    'content-type':'application/json',
    'X-VMGR-Routing-Finalize' : 'true'
}
request={
    "filter" : { "@c"      : ".AttValueFilter",
                  "attName" : "parent_session_name",
                  "operand"  : "EQUALS",
                  "attValue" : session_name
                },
    "projection" : {
        "selection" : ["id", "test_name", "special_test_criteria_file", "index",
"failures_count", "failed_runs_count", "errors_count", "sv_seed", "log_file"]
    }
}
runs_response = post(url='/runs/list',request=request,headers=headers)
runs_response_list = runs_response.json()
```

Miscellaneous – vAPI.py – loop through runs

```
# Loop over all the runs of the current session
for run_resp in runs_response_list :
    if (run_resp.has_key('special_test_criteria_file')) :
        print "      =          P O S T   P R O C E S S I N G          ="
        print "      Run: special_test_criteria_file = " + run_resp['special_test_criteria_file']

        exists = os.path.isfile(run_resp['special_test_criteria_file'])
        if exists :
            with open(run_resp['special_test_criteria_file'], 'rb') as csvfile:
                spamreader = csv.reader(csvfile, delimiter=',', quotechar='/')
                for row in spamreader:
                    if (HDR_found & HDR_real_data) :
                        expected_test_name      = row[0]
                        expected_count          = int(row[1])
                        expected_name           = row[2]
                        expected_description     = row[3]
                    else :
                        print "      = N O       P O S T   P R O C E S S I N G          ="
```

Miscellaneous – vAPI.py – loop thru error attributes

```
# Read severe message for this run
severe_msg_response = post(url='/severe-messages/list',request=request,headers=headers)
severe_msg_response_list = severe_msg_response.json()

# Loop over all severe messages of this run.
for severe_msg_resp in severe_msg_response_list :
    ...
```

Miscellaneous – vAPI.py – matching algorithm

```
if (re.match(expected_name, severe_msg_resp['name'])) :  
    if (re.match('(.*?)'+expected_description+'(.*?)' , severe_msg_resp['description'])) :  
        if (re.match('(.*?)'+expected_test_name+'(.*?)' , run_resp['test_name'])) :  
            sim_log_count += 1  
            if (sim_log_count == 1) :  
                print "\n    match for " + expected_name + " - downgraded error to warning"  
            ...
```

Miscellaneous – vAPI.py – write-back attributes DV

```
request={  
    "update": {"severity": "warning",  
               "comment": "downgraded error to warning"},  
    },  
    "rs": {"filter": {"@c": ".AttValueFilter",  
                     "attName": "id",  
                     "operand": "EQUALS",  
                     "attValue": severe_msg_resp['id']},  
    }  
}  
  
severe_msg_update = post(url='/severe-messages/update', request=request, headers=headers)
```

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- Please keep the default font size for main lines at 28pt (or 26pt)
 - And use 24pt (or 22pt) font size for the sub bullets
- Use the default bullet style and color scheme supplied by this template
- Limited the number of bullets per page.
- Use keywords, not full sentences
- Please do not overlay Accellera or DVCon logo's
- Check the page numbering

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- Use clip-art only if it helps to state the point more effectively (no generic clip-art)
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- Embed pictures in vector format (e.g. Enhanced or Window Metafile format)