Utility Overview | pmm_pt_generate_slack_report

Description:

The "pmm_pt_generate_slack_report" utility is a tool used for analyzing the timing QoR for a specific functional endpoint and its association with a Path Monitor Unit (PMU). Associated steps are broken down below:

- **Identifying the Slowest Path:** The utility starts by identifying the critical timing path for the functional endpoint. This path typically has the longest delay within the design.
- **Monitoring via the Shadow Register:** The utility observes the performance of the monitored timing path as it passes through the shadow register of the PMU. During this observation, it records the timing slack of the monitored path. Additionally, it calculates the difference between the slack at this shadow register stage and the slack at the functional endpoint. This difference, referred to as "delta (shadow~ep)," helps in understanding the relative performance of the monitored path.
- **Monitoring via the Capture Register:** The utility then examines the monitored timing path again, capturing its timing data in the capture register of the PMU. This captured data serves as a reference point for further analysis during the delay chain association. Similar to the previous step, the utility calculates the difference between the slack at the capture register and the slack at the functional endpoint, denoted as "delta (capture~ep)." This comparison also aids in understanding the relative performance of the monitored path.
- **Evaluating Delay Chain Impact:** The utility proceeds to evaluate the observed data as it traverses through each delay chain element to reach the capture register. A delay chain is a component that intentionally introduces a specific amount of delay into the signal path. This process is carried out iteratively, allowing the assessment of how the performance of the functional timing path degrades as it encounters each delay element. It provides valuable insights into the influence of these elements on the timing Quality of Results (QoR).

In summary, the purpose of this utility is to comprehensively analyze the monitored functional timing path at various stages and through different processes. This analysis assists in identifying potential bottlenecks and areas where optimization can be applied to ensure that the timing requirements are met effectively.

Steps to Run:

This utility is focused on running in PrimeTime single scenario STA sessions. It needs to make sure that the STA scenario should be based on functional mode. Below template contains the necessary variables, scripts, and proc commands to facilitate this utility. After opening a STA session, this template needs to be sourced. Example steps:

- module load pt
- pt_shell
- restore_session <STA_session>
- source slm_pt_timing_slack_generation.tcl

The items mentioned below should be checked before running the template.

- **Variables:**
  - **pmm_var_script_dir:** The scripts area from where the root utility scripts will be sourced.
  - **pmu_ref_name:** Reference name of the PMU. Usually, it is "PATH_MONITOR_UNIT"
  - **pmm_var_user_pmu_name_pattern:** Instance pattern of the PMU in the design.
  - **pmm_var_monitored_clock:** Functional clock
  - name of the design.
- **Template script:** slm_pt_timing_slack_generation.tcl

Template Script Example:

```
set pmm_var_script_dir "<scripts dir>"
source ${pmm_var_script_dir}/pmm_util.tcl.e
source ${pmm_var_script_dir}/pmm_init_vars.tcl.e
source ${pmm_var_script_dir}/misc/timing_slack_generation.tcl.e
pmm_init_vars
set pmu_ref_name "PATH_MONITOR_UNIT"
set pmm_var_user_pmu_name_pattern {u_vcpu/path_monitor_unit*_loop1}
set pmm_var_pmm_module_name_pattern {u_vcpu/path_monitor}
set pmm_var_monitored_clock        {coreclk}
pmm_report_var
pmm_pt_generate_slack_report
```

Generated Reports:

After running this utility, a directory will be created named "PMM_reports" in the working directory. Below files and directories should be present after the successful run of this utility. Note that this utility will run for both setup & hold checks and the reports will contain data for both setup & hold checks.

- PMM_reports
  - timing_slack_reports.csv
  - delta_violation_setup.log
  - delta_violation_hold.log
  - timing_slack_reports.csv_old
  - timing_slack_rpt_dir

Here, if the utility is run for the first time, then “timing_slack_reports.csv_old” file won’t be there. This file is basically a copy of the previously generated report.
Here, “timing_slack_rpt_dir” directory contains detailed timing reports for each PMU (All timing paths from functional startpoint to endpoint, functional startpoint to shadow, functional startpoint to capture, functional startpoint to capture through each delay chain).

timing_slack_reports.csv demo:
Report for setup in the left of the CSV file.

	A	B	C	D	E	F	G	H	I	J	K
1	PMU_PATH	START	END	SLACK	DELTA(shadow~ep)	START - SHADOW	DELTA(capture~ep)	START - CAPTURE	0 - 1	0 - 2	0 - 3
2	0_0	u_vcpu/u	u_vcpu/	-0.014883	-0.005215	-0.020098	0.003503	-0.01138	-0.021265	-0.031167	-0.041052
3	0_1	u_vcpu/u	u_vcpu/	-0.019428	-0.004203	-0.023631	0.004518	-0.01491	-0.024794	-0.034695	-0.044579
4	0_2	u_vcpu/u	u_vcpu/	-0.014693	0.002681	-0.012012	0.011388	-0.003305	-0.013193	-0.023099	-0.032987
5	0_3	u_vcpu/u	u_vcpu/	-0.004775	-0.006391	-0.011166	0.002321	-0.002454	-0.012341	-0.022245	-0.032132
6	0_4	u_vcpu/u	u_vcpu/	-0.003133	-0.014843	-0.017976	-0.009488	-0.012621	-0.022686	-0.032642	-0.042683
7	0_5	u_vcpu/u	u_vcpu/	-0.015217	0.005548	-0.009669	0.014269	-0.000948	-0.010831	-0.020732	-0.030616
8	0_6	u_vcpu/u	u_vcpu/	-1.4E-05	-0.008061	-0.008075	0.000655	0.000641	-0.009244	-0.019146	-0.029031
9	1_0	u_vcpu/u	u_vcpu/	-0.019578	-0.00352	-0.023098	0.005152	-0.014426	-0.024315	-0.034151	-0.044039
10	1_1	u_vcpu/u	u_vcpu/	-0.000934	0.001287	0.000353	0.009954	0.00902	-0.000869	-0.010707	-0.020596
11	1_2	u_vcpu/u	u_vcpu/	-0.017287	-0.005292	-0.022579	0.003401	-0.013886	-0.023767	-0.033596	-0.043477
12	1_3	u_vcpu/u	u_vcpu/	-0.010011	-0.000317	-0.010328	0.008356	-0.001655	-0.011542	-0.021378	-0.031266
13	1_4	u_vcpu/u	u_vcpu/	-0.012727	0.006508	-0.006219	0.016901	0.004174	-0.005892	-0.015783	-0.025825
14	1_5	u_vcpu/u	u_vcpu/	-0.015237	0.00679	-0.008447	0.015473	0.000236	-0.009648	-0.01948	-0.029364
15	1_6	u_vcpu/u	u_vcpu/	-0.014013	0.003044	-0.010969	0.011729	-0.002284	-0.012168	-0.021999	-0.031883
16	2_0	u_vcpu/u	u_vcpu/	-0.027544	0.004886	-0.022658	0.013559	-0.013985	-0.023873	-0.033709	-0.043596
17	2_1	u_vcpu/u	u_vcpu/	-0.002839	-0.004601	-0.00744	0.004066	0.001227	-0.008662	-0.0185	-0.02839
18	2_2	u_vcpu/u	u_vcpu/	-0.014983	-0.0118	-0.026783	-0.003111	-0.018094	-0.027978	-0.03781	-0.047694
19	2_3	u_vcpu/u	u_vcpu/	-0.012672	-0.006785	-0.019457	0.0019	-0.010772	-0.020656	-0.030488	-0.040372
20	2_4	u_vcpu/u	u_vcpu/	-0.018916	0.004132	-0.014784	0.012819	-0.006097	-0.015982	-0.025815	-0.0357
21	2_5	u_vcpu/u	u_vcpu/	-0.005012	-0.00608	-0.011092	0.001777	-0.003235	-0.013305	-0.023193	-0.033237
22	2_6	u_vcpu/u	u_vcpu/	-0.009091	-0.013877	-0.022968	-0.005217	-0.014308	-0.0242	-0.034039	-0.043931

Report for hold in the right of the CSV file. The hold section will not contain the slacks through the delay chain.

	AN	AO	AP	AQ	AR	AS	AT
1	START (hold)	END	SLACK (hold)	DELTA(shadow~ep)	START - SHADOW (hold)	DELTA(capture~ep)	START - CAPTURE (hold)
2	u_vcpu/u_cpt	u_vcpu/	0.092821	-0.005886	0.086935	-0.014296	0.078525
3	u_vcpu/u_cpt	u_vcpu/	0.109206	-0.0139	0.095306	-0.029039	0.080167
4	u_vcpu/u_cpt	u_vcpu/	0.111464	-0.022471	0.088993	-0.030893	0.080571
5	u_vcpu/u_cpt	u_vcpu/	0.066311	-0.016704	0.049607	-0.025158	0.041153
6	u_vcpu/u_cpt	u_vcpu/	0.059737	-0.007357	0.05238	-0.015882	0.043855
7	u_vcpu/u_cpt	u_vcpu/	0.115486	-0.029518	0.085968	-0.037903	0.077583
8	u_vcpu/u_cpt	u_vcpu/	0.100596	-0.008581	0.092015	-0.016977	0.083619
9	u_vcpu/u_cpt	u_vcpu/	0.102479	-0.007245	0.095234	-0.015514	0.086965
10	u_vcpu/u_cpt	u_vcpu/	0.13792	-0.014281	0.123639	-0.02263	0.11529
11	u_vcpu/u_cpt	u_vcpu/	0.10371	-0.007129	0.096581	-0.015384	0.088326
12	u_vcpu/u_cpt	u_vcpu/	0.10942	-0.012555	0.096865	-0.020811	0.088609
13	u_vcpu/u_cpt	u_vcpu/	0.054191	-0.022477	0.031714	-0.034245	0.019946
14	u_vcpu/u_cpt	u_vcpu/	0.135842	-0.017882	0.11796	-0.029455	0.106387
15	u_vcpu/u_cpt	u_vcpu/	0.065466	-0.014188	0.051278	-0.02111	0.044356
16	u_vcpu/u_cpt	u_vcpu/	0.122182	-0.024984	0.097198	-0.036626	0.085556
17	u_vcpu/u_cpt	u_vcpu/	0.127521	-0.009628	0.117893	-0.018002	0.109519
18	u_vcpu/u_cpt	u_vcpu/	0.121149	-0.001006	0.120143	-0.009274	0.111875
19	u_vcpu/u_cpt	u_vcpu/	0.122332	-0.006234	0.116098	-0.014472	0.10786
20	u_vcpu/u_cpt	u_vcpu/	0.119221	-0.021056	0.098165	-0.029381	0.08984
21	u_vcpu/u_cpt	u_vcpu/	0.125114	-0.00498	0.120134	-0.013295	0.111819
22	u_vcpu/u_cpt	u_vcpu/	0.132916	-0.001366	0.13155	-0.00964	0.123276

delta_violation_setup.log demo:
This report has the delta value data with respect to setup check.

```
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[0] Check- SETUP slack_delta_shadow is less than avg_granularity_delay (expected less than 0.009249 actual: -0.005215)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[0] Check- SETUP slack_delta_capture is less than avg_granularity_delay (expected less than 0.009249 actual: 0.003503)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[1] Check- SETUP slack_delta_shadow is less than avg_granularity_delay (expected less than 0.009249 actual: -0.004203)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[1] Check- SETUP slack_delta_capture is less than avg_granularity_delay (expected less than 0.009249 actual: 0.004518)
```

For the above report, first the average delay of the delay chain is measured and compared against the delta values. The utility will check if the delta is below the average delay chain delay (PASSED) or not (FAILED).

```
PMM-INFO: ================= HISTOGRAM : DELTA FOR SHADOW | SETUP =======================
PMM-INFO: NUM = 569 MIN = -0.069627 MAX = 0.041031 AVG = 0.0030 STDDEV = 0.0143
        -0.070   to   -0.061  (2)         =
        -0.060   to   -0.051  (1)         =
        -0.050   to   -0.041  (3)         ==
        -0.040   to   -0.031  (6)         ===
        -0.030   to   -0.021  (18)        =========
        -0.020   to   -0.011  (35)        ==================
        -0.010   to   -0.001  (149)       ================================================================================
         0.000   to    0.009  (188)       ========================================================================================================
         0.010   to    0.019  (105)       ======================================================
         0.020   to    0.029  (43)        ======================
         0.030   to    0.039  (16)        ========
         0.040   to    0.049  (3)         ==

PMM-INFO: ================= HISTOGRAM : DELTA FOR CAPTURE | SETUP =======================
PMM-INFO: NUM = 569 MIN = -0.060891 MAX = 0.051338 AVG = 0.0110 STDDEV = 0.0145
        -0.070   to   -0.061  (1)         =
        -0.060   to   -0.051  (1)         =
        -0.050   to   -0.041  (1)         =
        -0.040   to   -0.031  (4)         ==
        -0.030   to   -0.021  (9)         =====
        -0.020   to   -0.011  (19)        ==========
        -0.010   to   -0.001  (56)        ============================
         0.000   to    0.009  (156)       ================================================================================
         0.010   to    0.019  (187)       ================================================================================================
         0.020   to    0.029  (88)        ============================================
         0.030   to    0.039  (30)        ===============
         0.040   to    0.049  (15)        ========
         0.050   to    0.059  (2)         =
```

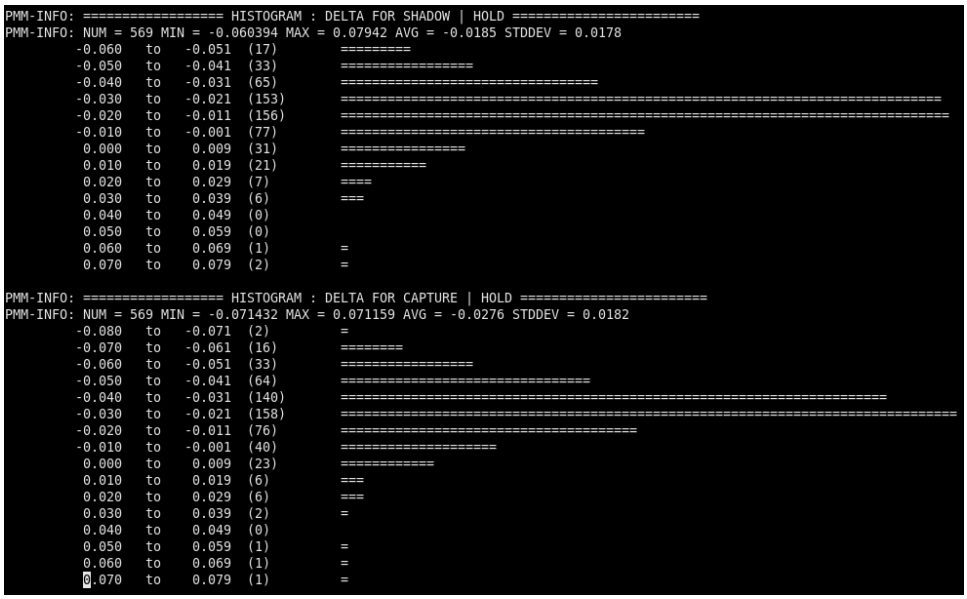
In the above portion, the histograms of the delta values are printed.

delta_violation_hold.log demo:

This report has the delta value data with respect to hold check.

```
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[0] Check- HOLD slack_delta_shadow is less than avg_granularity_delay (expected less than 0.009249 actual: -0.005215)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[0] Check- HOLD slack_delta_capture_h is less than avg_granularity_delay (expected less than 0.009249 actual: -0.014296)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[1] Check- HOLD slack_delta_shadow is less than avg_granularity_delay (expected less than 0.009249 actual: -0.004203)
PASSED, PMM-INFO: For Path-u_vcpu/path_monitor_unit0_loop1/i_pmu_func_paths[1] Check- HOLD slack_delta_capture_h is less than avg_granularity_delay (expected less than 0.009249 actual: -0.029039)
```

For the above report, first the average delay of the delay chain is measured and compared against the delta values. The utility will check if the delta is below the average delay chain delay (PASSED) or not (FAILED).



In the above portion, the histograms of the delta values are printed.