PLUNIFY

Auto Placement

AN:PIN002

Introduction

Auto Placement is a recipe that performs automatic placement adjustments on timing critical paths to improve timing of a FPGA design. It utilizes LogicLock feature in Quartus to re-locate the timing critical paths based on what InTime learns about the design's characteristics, without changing any source code.

Figure 1 below shows the chip view of an FPGA design before and after **Auto Placement.**

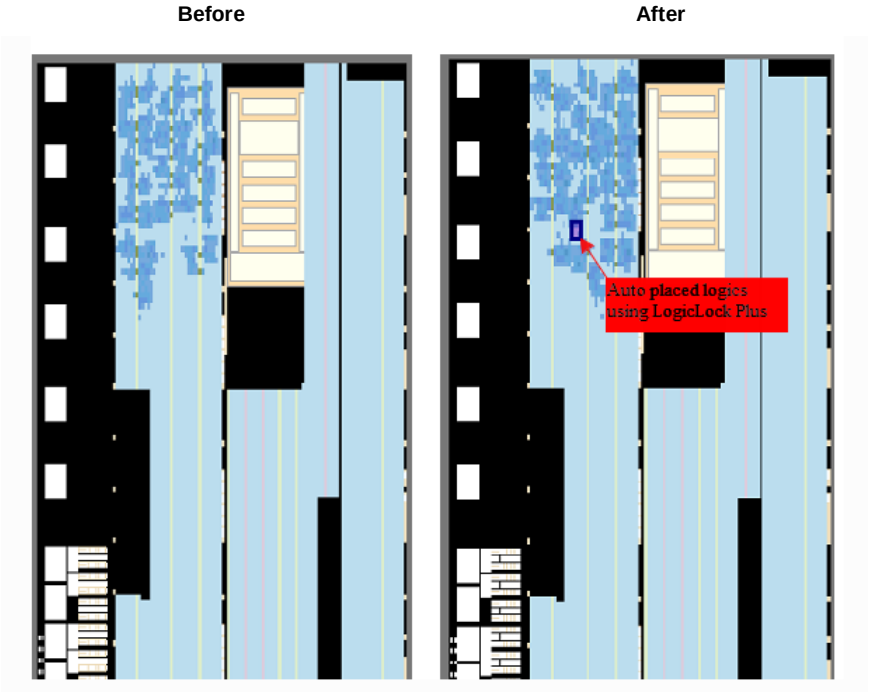


Figure 1: Chip View of FPGA design in Quartus Pro Edition before and after Auto Placement

Support

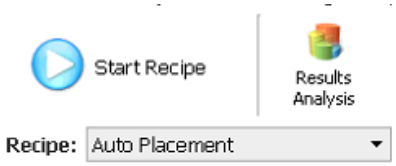
Intime:	v1.6.0 and newer version
FPGA tools:	Quartus-II, Quartus Prime Standard Edition and Quartus Prime Pro Edition (version 13.0 to 16.1)[(1)]

To know Quartus versions supported by Intime, please refer to
http://support.plunify.com/en/knowledgebase/what-are-the-supported-fpga-tool-versions/

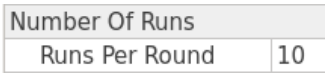
Quick start

To quick start **Auto Placement** for your project. Please kindly follow the below steps :

1. Open your project in InTime.
2. From the Recipe dropdown, click and select the **Auto Placement**.

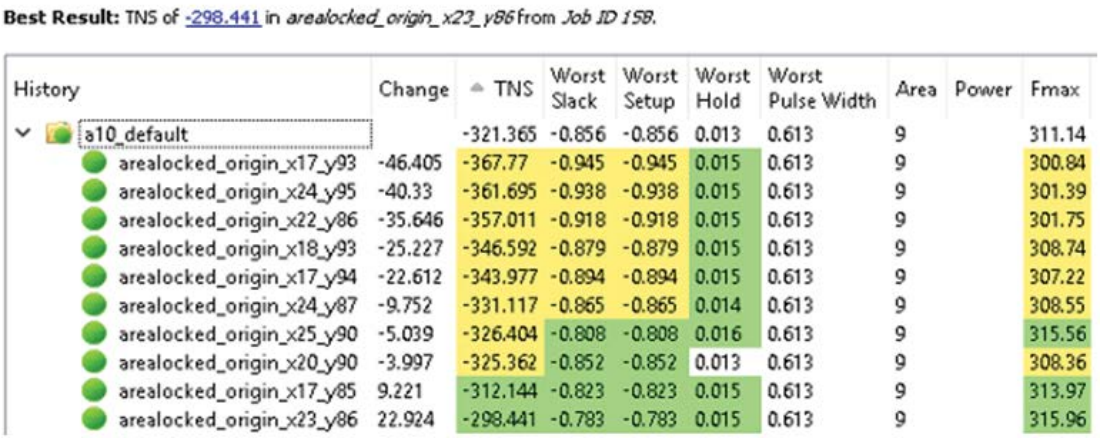


3. Specify the number of different results you want in the 'Runs per Round' flow property (10 in this example) .



4. Click 'Start Recipe' to start running. Figure 2 shows the example results of Intime after run **Auto Placement**.

(**Note :** You may also combine **Auto Placement** recipe with other recipes to further optimize timing closure on your design. Please check out section "**Auto Placement with other recipes**" for details.)



History	Change	TNS	Worst Slack	Worst Setup	Worst Hold	Worst Pulse Width	Area	Power	Fmax
a10_default		-321.365	-0.856	-0.856	0.013	0.613	9		311.14
arealocked_origin_x17_y93	-46.405	-367.77	-0.945	-0.945	0.015	0.613	9		300.84
arealocked_origin_x24_y95	-40.33	-361.695	-0.938	-0.938	0.015	0.613	9		301.39
arealocked_origin_x22_y86	-35.646	-357.011	-0.918	-0.918	0.015	0.613	9		301.75
arealocked_origin_x18_y93	-25.227	-346.592	-0.879	-0.879	0.015	0.613	9		308.74
arealocked_origin_x17_y94	-22.612	-343.977	-0.894	-0.894	0.015	0.613	9		307.22
arealocked_origin_x24_y87	-9.752	-331.117	-0.865	-0.865	0.014	0.613	9		308.55
arealocked_origin_x25_y90	-5.039	-326.404	-0.808	-0.808	0.016	0.613	9		315.56
arealocked_origin_x20_y90	-3.997	-325.362	-0.852	-0.852	0.013	0.613	9		308.36
arealocked_origin_x17_y85	9.221	-312.144	-0.823	-0.823	0.015	0.613	9		313.97
arealocked_origin_x23_y86	22.924	-298.441	-0.783	-0.783	0.015	0.613	9		315.96

Figure 2: Example of Intime results after run Auto Placement

Auto Placement with other recipes

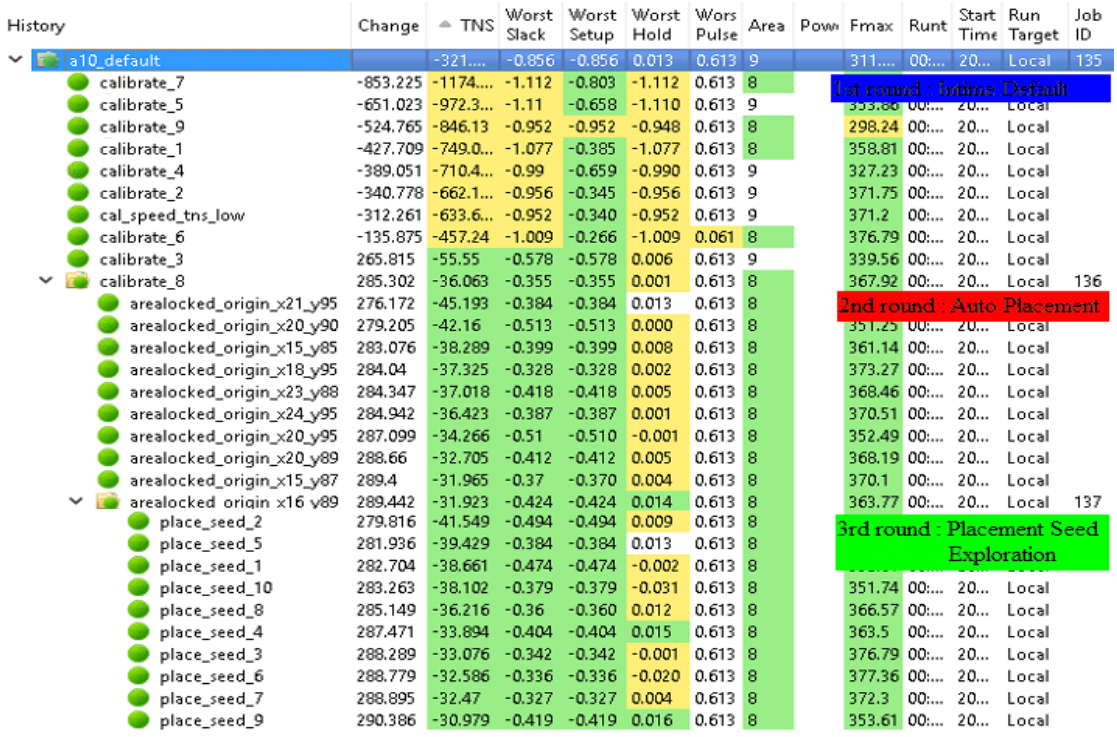
Auto Placement is able to work with other recipes such as **Intime Default**, **Placement Seed Exploration** and etc. This means the placement assignments created by **Auto Placement** is inheritable by its child revisions and it also able to learn compiler settings from its parent revision. Refer to Blog: Inheritance of Auto Placement for details.

The example below illustrates a possible combinations that how you may use Auto Placement together with other recipes. (You may also try other possible combinations of recipes or in difference sequence that suit for your design)

The a10_default design below is compiled in Intime for 3 rounds in the following sequence

1st round : Intime Default
2nd round : Auto Placement
3rd round : Seed Placement Exploration

At the end of each round, the revision that has the best timing results is set as parent revision for the next round. Figure 3 below shows the Intime results after completed all 3 rounds. Notice the Total Negative Slack (TNS) improve from -321.365ns to -30.979ns at the end of the runs.



History	Change	TNS	Worst Slack	Worst Setup	Worst Hold	Wors Pulse	Area	Pow	Fmax	Runt	Start Time	Run Target	Job ID
a10_default		-321....	-0.856	-0.856	0.013	0.613	9		311....	00:...	20...	Local	135
calibrate_7	-853.225	-1174....	-1.112	-0.803	-1.112	0.613	8						
calibrate_5	-651.023	-972.3...	-1.11	-0.658	-1.110	0.613	9						
calibrate_9	-524.765	-846.13	-0.952	-0.952	-0.948	0.613	8		298.24	00:...	20...	Local	
calibrate_1	-427.709	-749.0...	-1.077	-0.385	-1.077	0.613	8		358.81	00:...	20...	Local	
calibrate_4	-389.051	-710.4...	-0.99	-0.659	-0.990	0.613	9		327.23	00:...	20...	Local	
calibrate_2	-340.778	-662.1...	-0.956	-0.345	-0.956	0.613	9		371.75	00:...	20...	Local	
cal_speed_tns_low	-312.261	-633.6...	-0.952	-0.340	-0.952	0.613	9		371.2	00:...	20...	Local	
calibrate_6	-135.875	-457.24	-1.009	-0.266	-1.009	0.061	8		376.79	00:...	20...	Local	
calibrate_3	265.815	-55.55	-0.578	-0.578	0.006	0.613	9		339.56	00:...	20...	Local	
calibrate_8	285.302	-36.063	-0.355	-0.355	0.001	0.613	8		367.92	00:...	20...	Local	136
arealocked_origin_x21_y95	276.172	-45.193	-0.384	-0.384	0.013	0.613	8						
arealocked_origin_x20_y90	279.205	-42.16	-0.513	-0.513	0.000	0.613	8						
arealocked_origin_x15_y85	283.076	-38.289	-0.399	-0.399	0.008	0.613	8		361.14	00:...	20...	Local	
arealocked_origin_x18_y95	284.04	-37.325	-0.328	-0.328	0.002	0.613	8		373.27	00:...	20...	Local	
arealocked_origin_x23_y88	284.347	-37.018	-0.418	-0.418	0.005	0.613	8		368.46	00:...	20...	Local	
arealocked_origin_x24_y95	284.942	-36.423	-0.387	-0.387	0.001	0.613	8		370.51	00:...	20...	Local	
arealocked_origin_x20_y95	287.099	-34.266	-0.51	-0.510	-0.001	0.613	8		352.49	00:...	20...	Local	
arealocked_origin_x20_y89	288.66	-32.705	-0.412	-0.412	0.005	0.613	8		368.19	00:...	20...	Local	
arealocked_origin_x15_y87	289.4	-31.965	-0.37	-0.370	0.004	0.613	8		370.1	00:...	20...	Local	
arealocked_origin_x16_y89	289.442	-31.923	-0.424	-0.424	0.014	0.613	8		363.77	00:...	20...	Local	137
place_seed_2	279.816	-41.549	-0.494	-0.494	0.009	0.613	8						
place_seed_5	281.936	-39.429	-0.384	-0.384	0.013	0.613	8						
place_seed_1	282.704	-38.661	-0.474	-0.474	-0.002	0.613	8						
place_seed_10	283.263	-38.102	-0.379	-0.379	-0.031	0.613	8		351.74	00:...	20...	Local	
place_seed_8	285.149	-36.216	-0.36	-0.360	0.012	0.613	8		366.57	00:...	20...	Local	
place_seed_4	287.471	-33.894	-0.404	-0.404	0.015	0.613	8		363.5	00:...	20...	Local	
place_seed_3	288.289	-33.076	-0.342	-0.342	-0.001	0.613	8		376.79	00:...	20...	Local	
place_seed_6	288.779	-32.586	-0.336	-0.336	-0.020	0.613	8		377.36	00:...	20...	Local	
place_seed_7	288.895	-32.47	-0.327	-0.327	0.004	0.613	8		372.3	00:...	20...	Local	
place_seed_9	290.386	-30.979	-0.419	-0.419	0.016	0.613	8		353.61	00:...	20...	Local	

Figure 3: Example results after run Intime Default, Auto Placement, Placement Seed Exploration

Here is the steps to reproduce the above example

1. Open QuartusPP example project under File>Open Example Project>QuartusPP
2. Change the Recipe to **Intime Default.**
3. Set value of 'Runs per Round' to 10 under *Number of Runs* properties.
4. Untick 'Stop When Goal Met' under *Flow Control* properties
5. Click 'Start Recipe' to start running **Intime Default** recipe.

6. Once **Intime Default** run is completed, right click the revision that has the best timing result and set 'Set as Parent Revision' as shown in Figure 4 below.

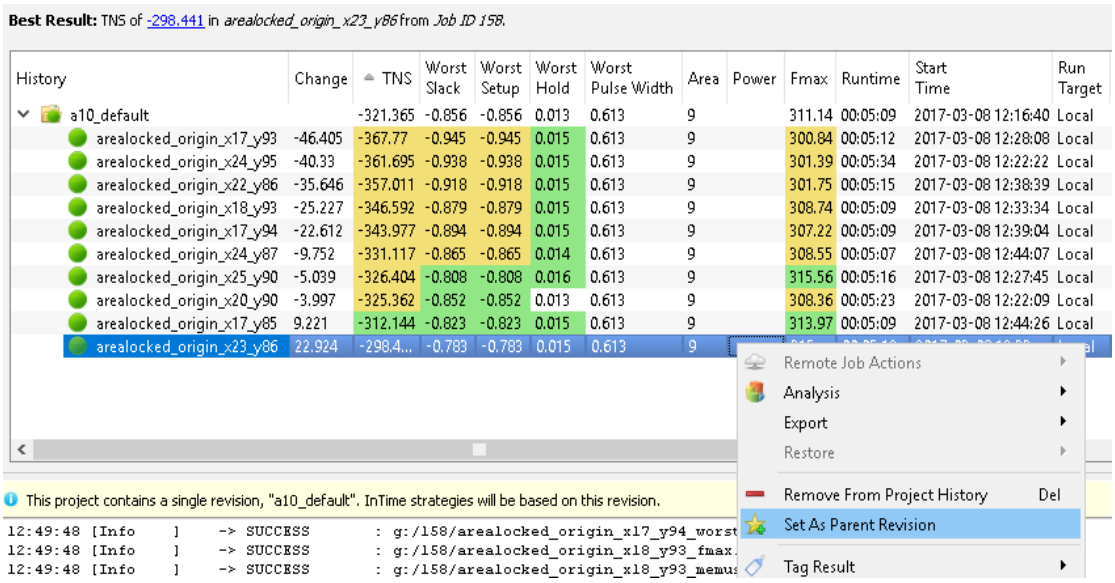


Figure 4: Setting revision that has best timing result as Parent Revision

7. Change the Recipe to **Auto Placement.**
8. Click 'Start Recipe' to start running **Auto Placement** recipe.
9. Once **Auto Placement** run is completed, right click the revision that has the best timing result and Set as Parent Revision.
10. Change the Recipe to **Placement Seed Exploration.**
11. Click 'Start Recipe' to start running **Placement Seed Exploration** recipe. Once completed, you should able to get back similar results as shown in Figure 3.[1]

Conclusion

Auto Placement is a recipe that utilizes LogicLock feature in Quartus to performs placement adjustments on timing critical paths to improve timing of a FPGA design. It supports Quartus II, Quartus Prime Standard Edition and Quartus Prime Pro (from version 13.0 to 16.1).

Note

1. Different version of Quartus may yield different timing results.