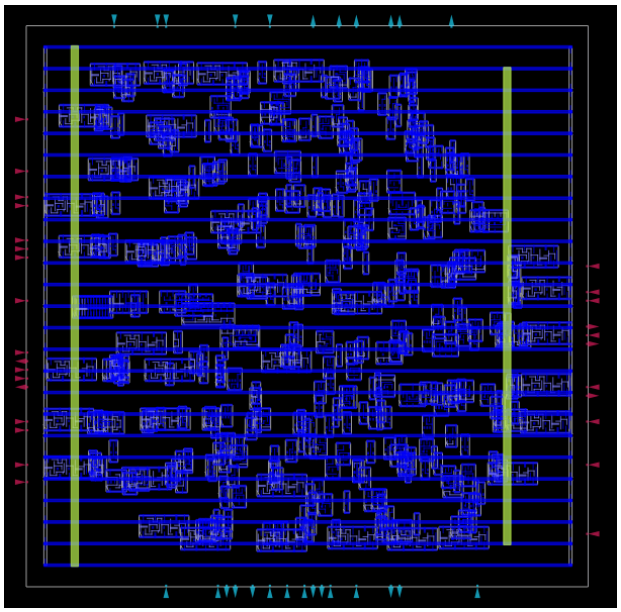
Transport-Informed Placement Initialisation Results

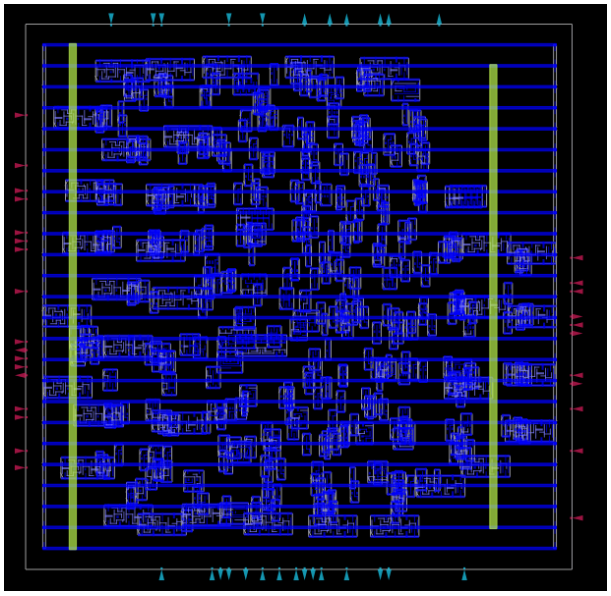
Placement Initialisation visualised:

Design NanGate45- GCD:
Before global placement (3_2_place_iop.odb):

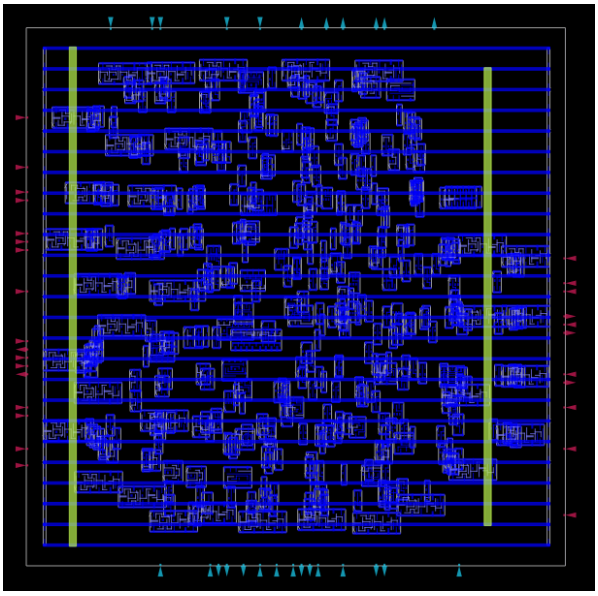


After global placement:

Electrostatic DREAMPlace



Transport-informed DREAMPlace



Stages of implementation:

1. The 3_2_place_iop.def and corresponding netlist files for all test designs are sourced from OpenROAD.

2. Using these DEF and netlist files, along with reference LEF files, we run the designs through the original (Electrostatics-based) DREAMPlace framework to generate new DEF files with initial placement information.

3. These output DEF files are then used as input to RePlAce (within OpenROAD) to perform global placement and produce the final DEF files.

4. With the baseline results established, we repeat steps 2 and 3 using our modified DREAMPlace framework (transport-informed DREAMPlace) to generate placement results based on our proposed approach.

HPWL Results:

After Initialization via DREAMPlace:

S.No.	Design	Post-Initialization HPWL (Electrostatic DREAMPlace)	Post-Initialization HPWL (transport-informed DREAMPlace)
1	GCD - ASAP7	1132950 um	918478 um
2	GCD - NanGate45	14334565 um	6357470 um
3	IBEX - ASAP7	213920210 um	70081116 um
4	IBEX - NanGate45	474917592 um	424702867 um
5	AES - ASAP7	45387092 um	35093639 um
6	JPEG - ASAP7	772177376 um	4983061775 um
7	JPEG - NanGate45	1293352066 um	1384533707 um

After Global Placement via RePlAce:

S.No.	Design	Post-GP HPWL (Electrostatic DREAMPlace -> RePlAce)	Post-GP HPWL (transport-informed DREAMPLace -> RePlAce)	Gain %
1	GCD - ASAP7	630002 um	628701 um	0.207
2	GCD - NanGate45	4365094 um	4380887 um	-0.362
3	IBEX - ASAP7	82538455 um	82512491 um	0.031
4	IBEX - NanGate45	487683018 um	487678062 um	0.001
5	AES - ASAP7	50939133 um	50889318 um	0.098
6	JPEG - ASAP7	224228460 um	224854673 um	-0.279
7	JPEG - NanGate45	1777643504 um	1769225398 um	0.474

Overall, the gain from using transport-informed DREAMPlace was **positive in 5 out of 7 designs**, showing modest improvements in post-global placement HPWL. While two designs saw slight degradations, the majority trend suggests a generally beneficial impact.

Timing Results:
Initialization via DREAMPlace:

S.No.	Design	Runtime (Electrostatic DREAMPlace)	Runtime (Transport-informed DREAMPLace)
1	GCD - ASAP7	1.538 s	175.894 s
2	GCD - NanGate45	6.723 s (186 iter)	384.648 s
3	IBEX - ASAP7	6.093 s	498.694 s
4	IBEX - NanGate45	147.074 s	537.438 s
5	AES - ASAP7	4.147 s	501.517 s
6	JPEG - ASAP7	13.379 s	559.428 s
7	JPEG - NanGate45	482.770 s	908.203 s

Note: Each design was run for 275 iterations under both the baseline and modified approaches. An exception was observed with GCD-Nangate45 using the Electrostatics-based DREAMPlace, which converged earlier and stopped after fewer iterations; this has been noted accordingly.

Global Placement via RePlAce:

S.No.	Design	RePlAce Runtime (Electrostatic DREAMPlace -> RePlAce)	RePlAce Runtime (transport-informed DREAMPLace -> RePlAce)	Gain %
1	GCD - ASAP7	3.35 s (310 iter)	3.77 s (310 iter)	-12.537
2	GCD - NanGate45	1.99 s (360 iter)	2.08 s (360 iter)	-4.523
3	IBEX - ASAP7	70.39 s (410 iter)	68.91 s (410 iter)	2.103
4	IBEX - NanGate45	97.01 s (2030 iter)	87.99 s (1870 iter)	9.298
5	AES - ASAP7	36.67 s (390 iter)	36.42 s (390 iter)	0.682
6	JPEG - ASAP7	209.40 s (470 iter)	228.47 s (470 iter)	-9.107
7	JPEG - NanGate45	323.68 s (2820 iter)	294.94 s (2130 iter)	8.879

Note: The iteration count is reported along with the runtime, and may differ across designs based on their complexity and convergence behavior.

Overall, **4 out of 7 designs** showed positive runtime gains when using transport-informed DREAMPlace during RePlAce global placement. Despite some degradation in runtime for a few cases, the modified approach demonstrated notable efficiency improvements in larger or more complex designs.

Density Results: (After Initialisation via DREAMPlace)

S.No.	Design	Post-Initialization Density (Electrostatic DREAMPlace)	Post-Initialization Density (transport-informed DREAMPLace)
1	GCD - ASAP7	5.000E+00	2.372E+01
2	GCD - NanGate45	2.176E+01	3.338E+01
3	IBEX - ASAP7	3.802E+01	6.097E+01
4	IBEX - NanGate45	1.485E+03	5.200E+01
5	AES - ASAP7	5.857E+01	5.715E+02
6	JPEG - ASAP7	1.565E+02	3.192E+01
7	JPEG - NanGate45	4.661E+03	5.161E+01