

# ISPD 2005/2006 Placement Contest Updates

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Gi-Joon Nam  
IBM Corp.

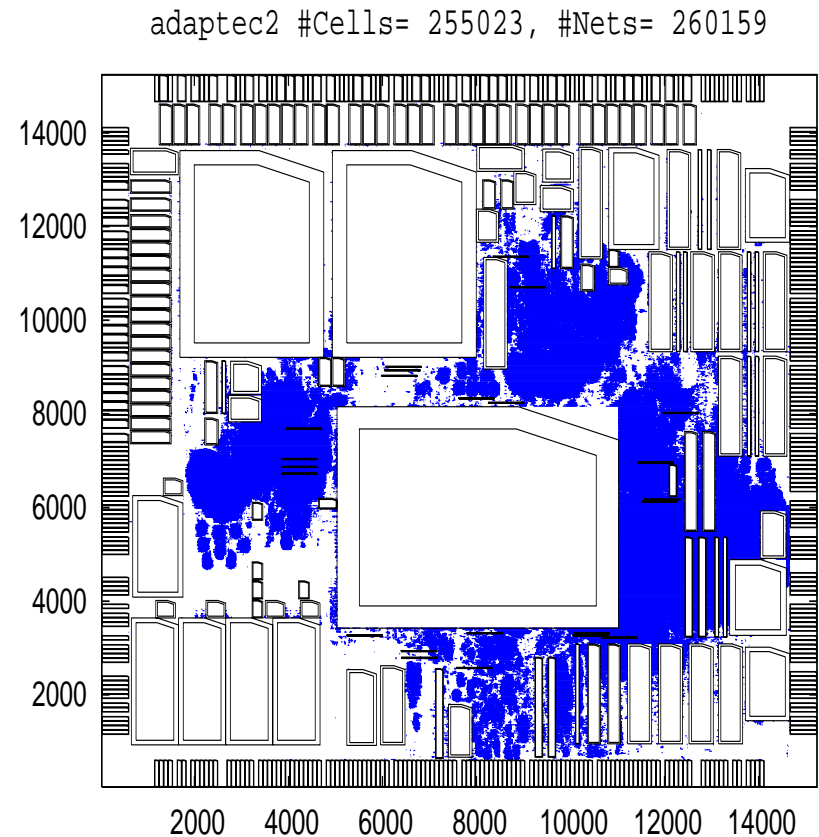
# ISPD Placement Contest

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- ISPD hosted two placement contest in 2005 and 2006
- Open contest for physical design academic community
- Common goals
  - Further accelerate developments in placement research via new sets of benchmarks
  - Encourage to share placement binary and results to make a better quality comparisons
  - Provide an educational forum on for future placement researchers
- Total 16 new benchmark circuits were released

# ISPD 2005/2006 Placement Benchmark Suites

- Industrial high performance ASIC designs
- Represent today's and tomorrow's physical design challenges
  - White space management
  - Perimeter/Area array IOs
  - Mixed-size placement
  - Challenging floorplans
  - Placement algorithm scalability
  - Density target
- All circuits and perl scripts are available at ISPD website



# ISPD 2005 Placement Contest

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# In a nutshell.....

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- 9 academic placers participated
  - Aplace, Capo, Dragon2005, FastPlace, FengShui, Kraftwerk, MFAR, mPL, NTUPlace
- HPWL was used as sole quality metric
  - No timing metric
  - No congestion metric
  - No CPU time limit
- Analytic algorithms dominated

# ISPD 2005 Benchmark Suite Stats

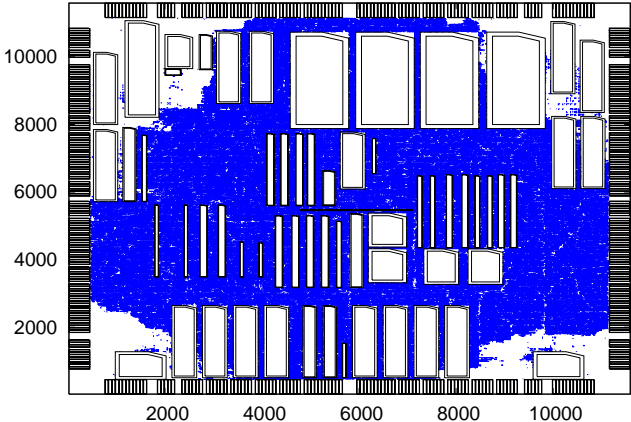
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<b>Name</b>	<b>#Objs</b>	<b>#Movs</b>	<b>#Fixed</b>	<b>#Nets</b>	<b>#Total Pins</b>	<b>#Pins from M</b>	<b>#Pins from F</b>	<b>Peri. IOs</b>	<b>Dens-ity%</b>
<b>adaptec1</b>	<b>211K</b>	<b>210904</b>	<b>543</b>	<b>221142</b>	<b>944053</b>	<b>923513</b>	<b>20540</b>	<b>480</b>	<b>75.71</b>
<b>adaptec2</b>	<b>255K</b>	<b>254457</b>	<b>566</b>	<b>266009</b>	<b>1069482</b>	<b>1045699</b>	<b>23783</b>	<b>407</b>	<b>78.59</b>
<b>adaptec3</b>	<b>452K</b>	<b>450927</b>	<b>723</b>	<b>466758</b>	<b>1875039</b>	<b>1843852</b>	<b>31187</b>	<b>0</b>	<b>74.53</b>
<b>adaptec4</b>	<b>496K</b>	<b>494716</b>	<b>1329</b>	<b>515951</b>	<b>1912420</b>	<b>1876563</b>	<b>35857</b>	<b>0</b>	<b>62.67</b>
<b>bigblue1</b>	<b>278K</b>	<b>277604</b>	<b>560</b>	<b>284479</b>	<b>1144691</b>	<b>1131856</b>	<b>12835</b>	<b>528</b>	<b>54.19</b>
<b>bigblue2</b>	<b>558K</b>	<b>534782</b>	<b>23084</b>	<b>577235</b>	<b>2122282</b>	<b>1979597</b>	<b>142685</b>	<b>0</b>	<b>61.80</b>
<b>bigblue3</b>	<b>1097K</b>	<b>1095519</b>	<b>1293</b>	<b>1123170</b>	<b>3833218</b>	<b>3790107</b>	<b>43111</b>	<b>0</b>	<b>85.65</b>
<b>bigblue4</b>	<b>2177K</b>	<b>2169183</b>	<b>8170</b>	<b>2229886</b>	<b>8900078</b>	<b>8710667</b>	<b>189411</b>	<b>0</b>	<b>65.30</b>

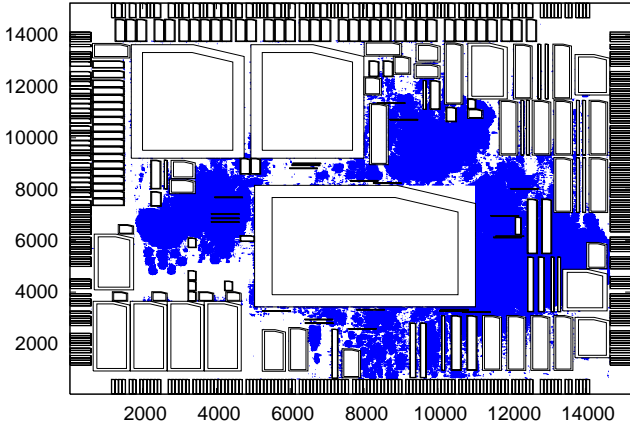
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# ISPD 2005 Benchmark Suite

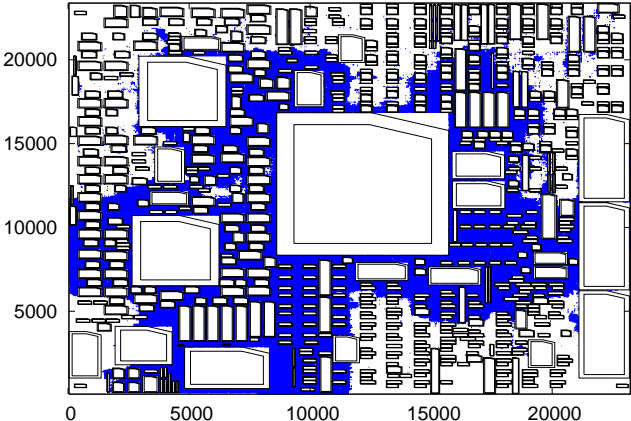
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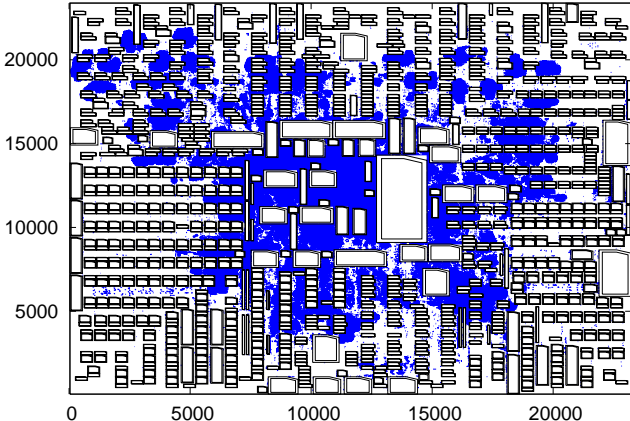
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adaptec3 #Cells= 451650, #Nets= 466295

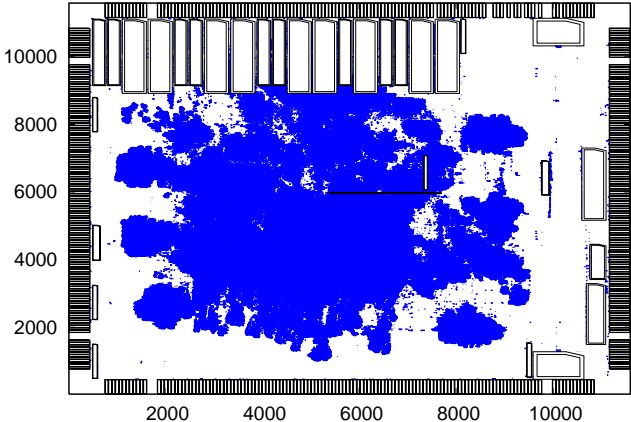


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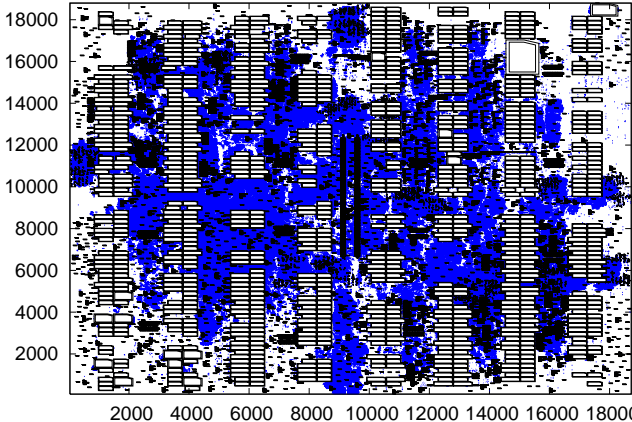


# ISPD 2005 Benchmark Suite

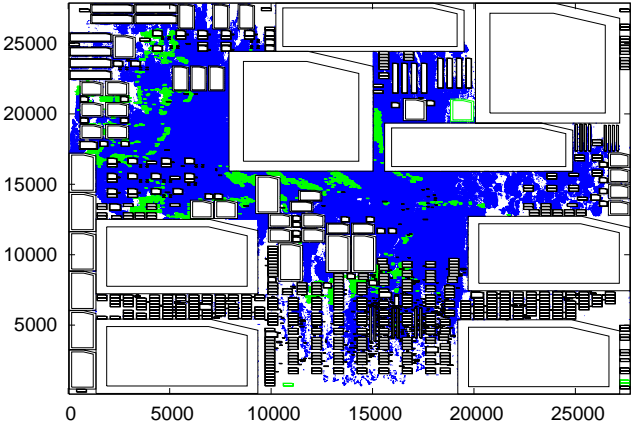
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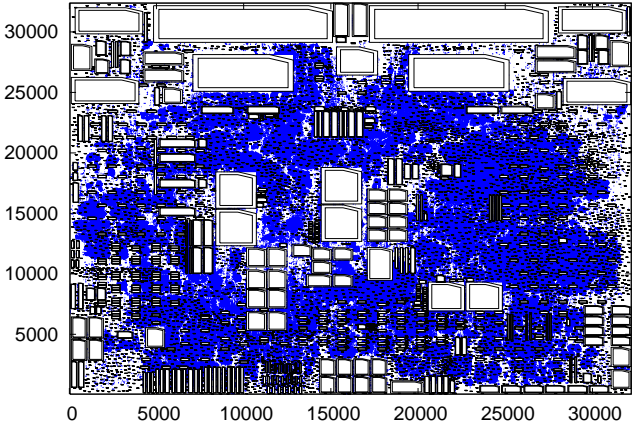
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bigblue3 #Cells= 1096812, #Nets= 1122340



bigblue4 #Cells= 2177353, #Nets= 2228903



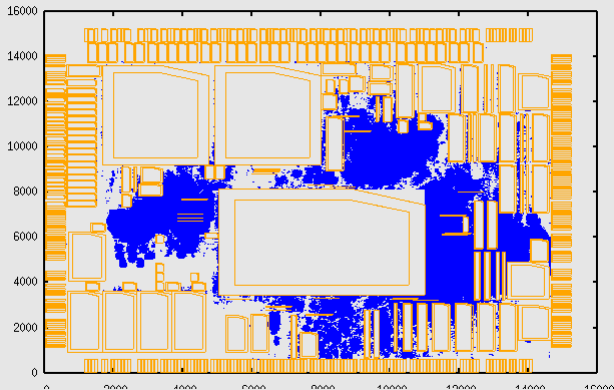
# Contest Results

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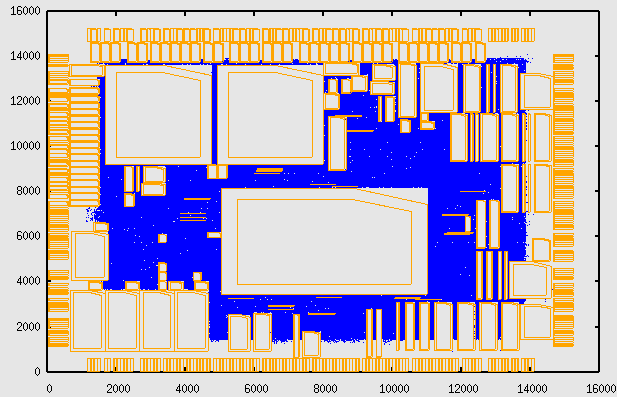
	adaptec2	adaptec4	bigblue1	bigblue2	bigblue3	bigblue4	Ratio
APlace	87.31	187.65	94.64	143.82	357.89	833.21	1.00
mFAR	91.53	190.84	97.70	168.70	379.95	876.28	1.06
dragon	94.72	200.88	102.39	159.71	380.45	903.96	1.08
mPL	97.11	200.94	98.31	173.22	369.66	904.19	1.09
FastP	107.86	204.48	101.56	169.89	458.49	889.87	1.16
Capo	99.71	211.25	108.21	172.30	382.63	1098.76	1.17
NTUP	100.31	206.45	106.54	190.66	411.81	1154.15	1.21
fs50	122.99	337.22	114.57	285.43	471.15	1040.05	1.50
K&D	157.65	352.01	149.44	322.22	656.19	1403.79	1.84

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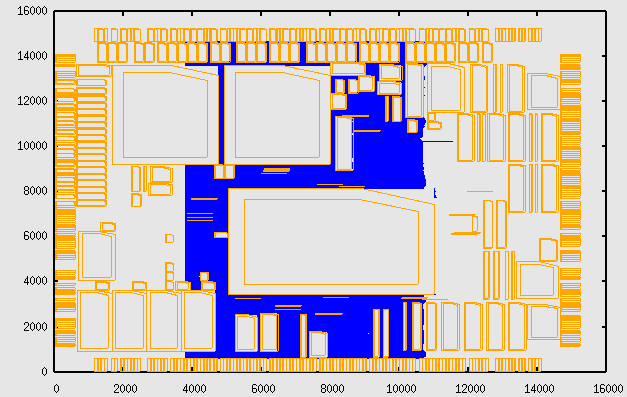
aplace,adaptec2 HPML= 8,715e+07



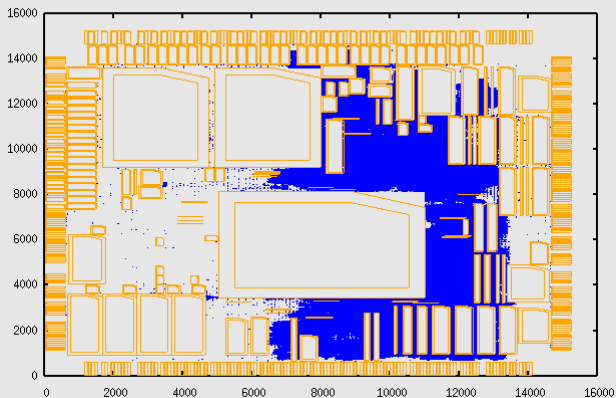
kraftwerk,adaptec2 HPML= 1,575e+08



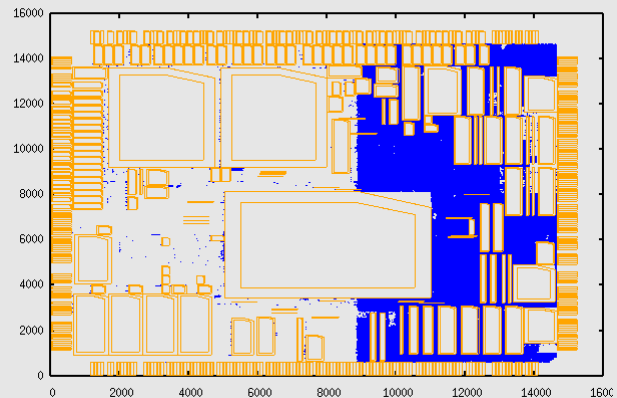
fs50,adaptec2 HPML= 1,223e+08



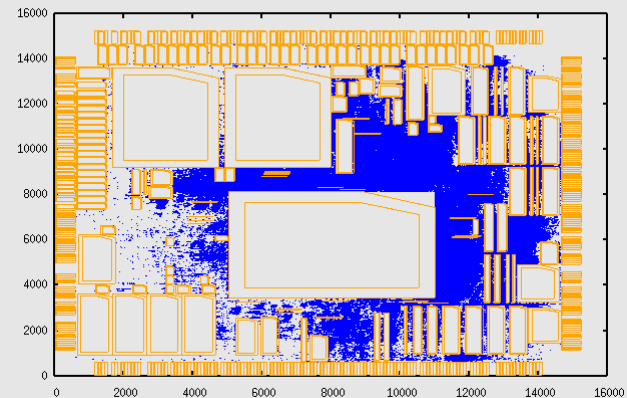
dragon,adaptec2 HPML= 9,46e+07



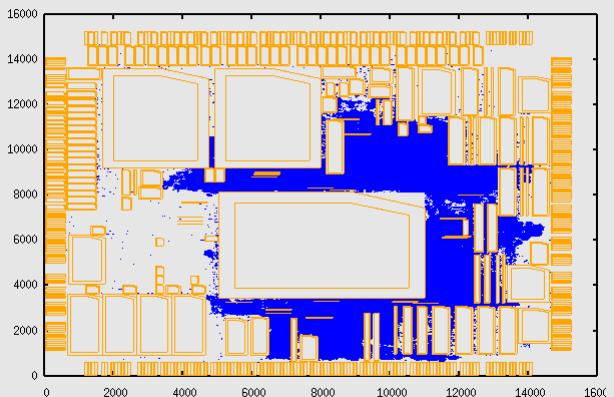
capo,adaptec2 HPML= 9,955e+07



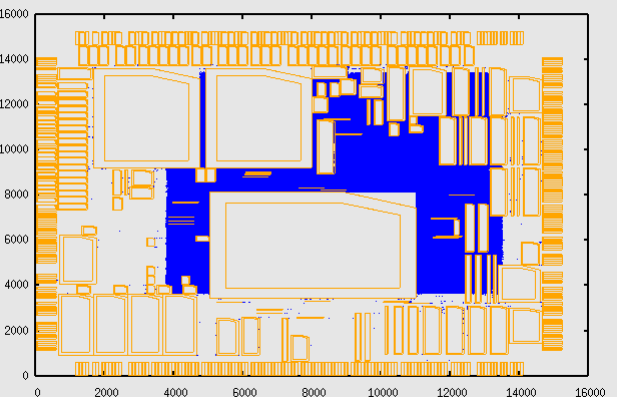
fastplace,adaptec2 HPML= 1,077e+08



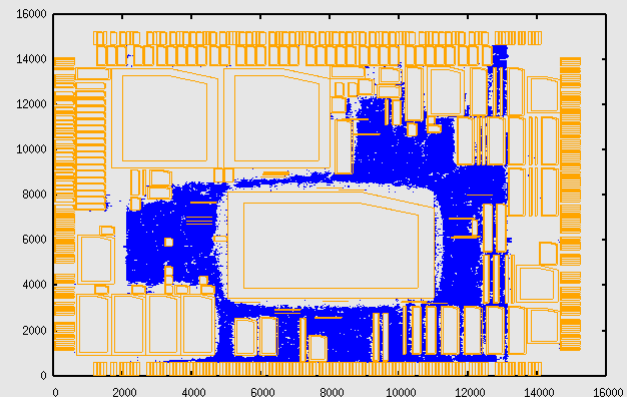
nfar,adaptec2 HPML= 9,132e+07



ntuplace,adaptec2 HPML= 9,994e+07



npl,adaptec2 HPML= 9,759e+07



# ISPD 2006 Placement Contest

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# In a nutshell...

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- 9 teams again
  - APlace3, Capo, DPlace, Dragon, FastPlace, Kraftwerk, mFAR, mPL6, NTUPlace
- Provide another suite of real placement benchmarks with associated density targets
- More advanced form of quality of metric
  - $HPWL * (1 + Scaled\_overflow\_factor + CPU\_factor)$
  - Wire length
  - Bin overflows over density target
  - Runtime

# ISPD 2006 Benchmark Suite Stats

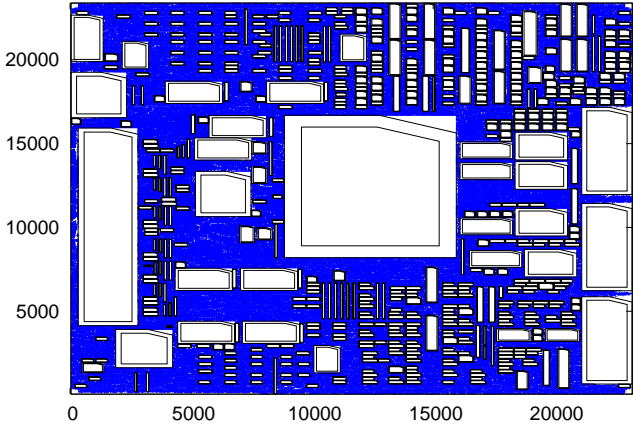
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<b>Name</b>	<b>#Objs</b>	<b>#Movs</b>	<b>#Fixed</b>	<b>#Nets</b>	<b>Density %</b>	<b>Utilization %</b>	<b>Density Target%</b>
<b>adaptec5</b>	<b>843128</b>	<b>842482</b>	<b>646</b>	<b>867798</b>	<b>78.64</b>	<b>49.98</b>	<b>50</b>
<b>newblue1</b>	<b>330474</b>	<b>330137</b>	<b>337</b>	<b>338901</b>	<b>85.73</b>	<b>83.20</b>	<b>80</b>
<b>newblue2</b>	<b>441516</b>	<b>330239</b>	<b>1277</b>	<b>465219</b>	<b>86.14</b>	<b>61.66</b>	<b>90</b>
<b>newblue3</b>	<b>494011</b>	<b>482833</b>	<b>11178</b>	<b>552199</b>	<b>84.70</b>	<b>26.31</b>	<b>80</b>
<b>newblue4</b>	<b>646139</b>	<b>642717</b>	<b>3422</b>	<b>637051</b>	<b>65.72</b>	<b>46.45</b>	<b>50</b>
<b>newblue5</b>	<b>1233058</b>	<b>1228177</b>	<b>4881</b>	<b>1284251</b>	<b>74.54</b>	<b>49.56</b>	<b>50</b>
<b>newblue6</b>	<b>1255039</b>	<b>1248150</b>	<b>6889</b>	<b>1288443</b>	<b>59.27</b>	<b>38.78</b>	<b>80</b>
<b>newblue7</b>	<b>2507954</b>	<b>2481372</b>	<b>26582</b>	<b>2636820</b>	<b>76.46</b>	<b>49.31</b>	<b>80</b>

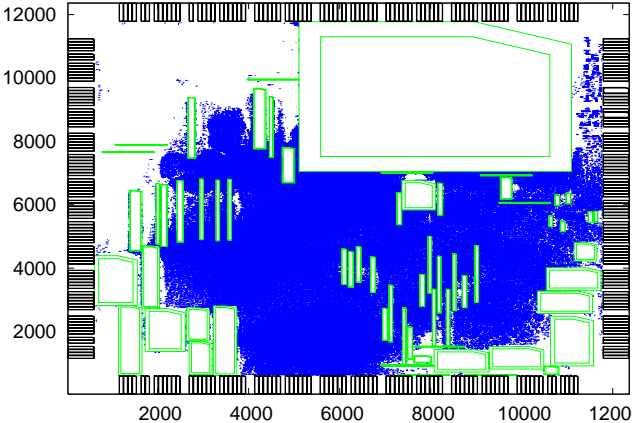
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# ISPD 2006 Benchmark Suite

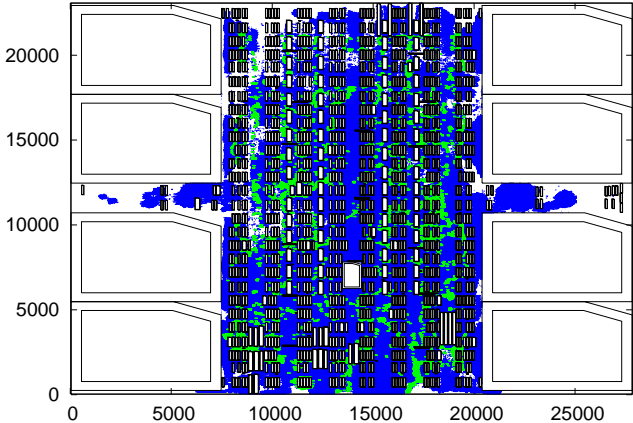
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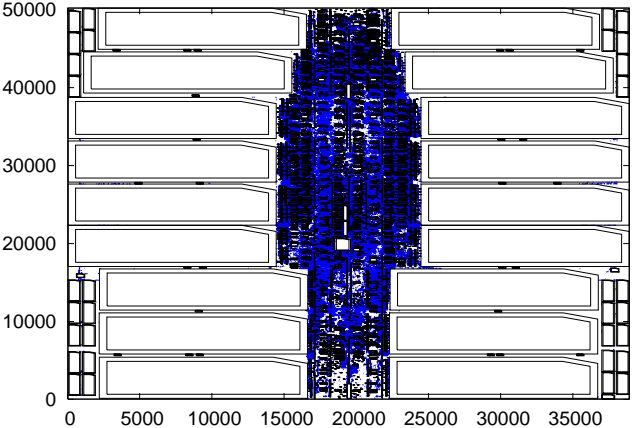
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newblue2 #Cells= 441516, #Nets= 463213

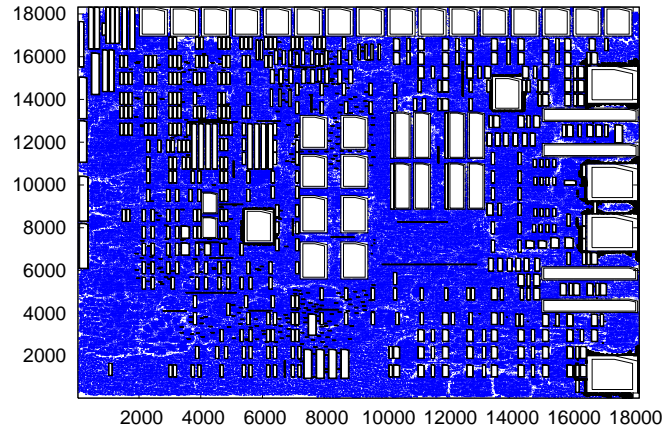


newblue3 #Cells= 494011, #Nets= 551667

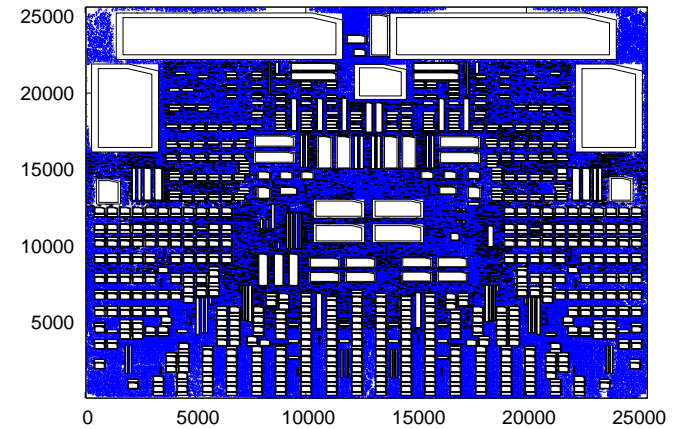


# ISPD 2006 Benchmark Suite

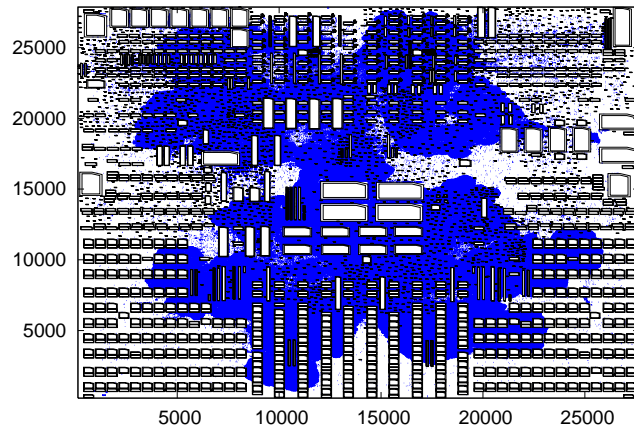
newblue4 #Cells= 646139, #Nets= 636195



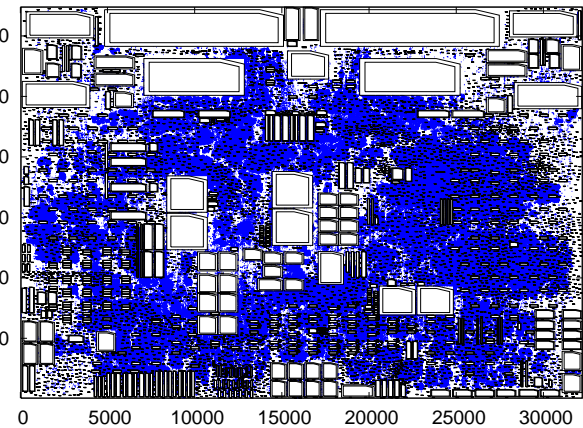
newblue5 #Cells= 1233058, #Nets= 1257555



newblue6 #Cells= 1255039, #Nets= 1286452



bigblue4 #Cells= 2177353, #Nets= 2228903



# Contest Results

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	ad5	nb1	nb2	nb3	nb4	nb5	nb6	nb7	Avg.
kraftwerk	1.01	1.19	1.00	1.00	1.01	1.04	1.00	1.00	1.03
mPL6	1.00	1.06	1.07	1.17	1.00	1.02	1.00	1.00	1.04
ntuplace	1.02	1.00	1.07	1.16	1.03	1.00	1.04	1.07	1.05
mFAR	1.09	1.23	1.09	1.16	1.09	1.13	1.03	1.04	1.11
APlace3	1.26	1.20	1.05	1.13	1.35	1.21	1.06	1.05	1.16
Dragon	1.08	1.21	1.29	1.90	1.05	1.13	1.03	1.23	1.24
FastPlace	1.82	1.22	1.02	1.37	1.35	1.76	1.04	1.05	1.33
DPlace	1.26	1.55	1.77	1.36	1.14	1.35	1.23	1.25	1.36
Capo	1.16	1.57	1.64	1.44	1.22	1.28	1.32	1.46	1.39

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# Contest Results

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	Avg. WL	Avg. Overflow Penalty%	Avg. CPU Factor%
kraftwerk	1.09	1.68	-5.04
mPL6	1.03	1.36	1.58
ntuplace	1.02	4.10	1.66
mFAR	1.11	2.71	-0.12
APlace3	1.10	3.82	5.31
Dragon	1.33	0.12	-5.90
FastPlace	1.18	22.09	-5.62
DPlace	1.34	9.32	-4.54
Capo	1.38	0.32	2.69

# Placement Contest Result Updates

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# Updates on ISPD 2005 Benchmark (HPWL)

	adaptec1	adaptec2	adaptec3	adaptec4	bigblue1	bigblue2	bigblue3	bigblue4
APlace3	79.50	87.31	218.00	187.65	94.64	143.82	357.89	833.21
mFAR	82.50	92.79	217.56	197.90	98.80	160.40	368.70	865.40
Dragon3	83.28	94.72	231.08	200.88	102.39	159.71	380.45	903.96
mPL6	77.85	90.99	215.87	193.94	97.27	151.76	345.11	830.30
FastPlace3	77.53	93.33	212.89	197.05	95.62	153.42	362.73	831.29
Capo	86.3	100.1	234.0	207.1	107.1	162.4	382.6	1098.8
NTUPlace3	80.93	89.85	214.20	193.74	97.28	152.20	348.48	829.16
DPlace	82.56	91.64	229.63	201.42	100.14	173.51	383.33	926.53
Kraftwerk	82.67	93.03	229.36	200.85	97.97	155.43	344.94	859.18
Vaastu	81.53	92.97	219.39	192.06	98.09	153.43	370.72	828.25

\*One mode run results except APlace3. i.e., placer is not tuned for each circuit.

# ISPD 2006 Benchmark (HPWL)

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	adaptec5	newblue1	newblue2	newblue3	newblue4	newblue5	newblue6	newblue7
APlace3	449.61	73.26	197.42	273.63	377.55	545.90	522.58	1098.26
mFAR	448.43	77.36	211.65	303.58	307.72	567.65	527.36	1135.80
Dragon3	435.97	79.82	251.61	437.58	336.94	609.24	562.81	1377.58
mPL6	425.12	66.90	197.53	283.80	294.43	530.67	510.40	1070.33
FastPlace3	441.08	74.66	197.31	279.64	266.82	526.01	520.23	1060.06
Capo	483.6	85.0	286.6	329.9	351.2	639.1	652.2	1348.2
NTUPlace3	375.05	60.36	198.63	278.87	271.01	469.95	482.19	1051.13
DPlace	433.06	89.18	215.12	322.39	266.52	578.52	579.86	1089.15
Kraftwerk	433.84	65.92	203.91	278.51	304.24	548.38	528.59	1126.58

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\*One mode run results including APlace3. i.e., placer is not tuned for each circuit.

# ISPD 2006 Benchmark (SHPWL)

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	adaptec5	newblue1	newblue2	newblue3	newblue4	newblue5	newblue6	newblue7
APlace3	520.97	73.31	198.24	273.64	384.12	613.86	522.73	1098.88
mFAR	476.28	77.53	212.90	303.91	324.40	601.25	535.96	1153.75
Dragon3	436.14	79.83	251.96	437.62	337.14	609.67	562.98	1378.27
mPL6	431.14	67.02	200.93	287.05	299.66	540.67	518.70	1082.92
FastPlace3	488.86	75.49	200.49	282.18	316.90	613.44	541.74	1091.78
Capo	485.63	85.20	287.20	329.93	354.11	640.76	652.52	1348.33
NTUPlace3	448.58	68.10	203.39	278.89	301.19	509.54	521.65	1099.66
DPlace	497.56	89.46	217.19	324.55	324.56	725.12	599.44	1215.32
Kraftwerk	449.48	66.19	206.53	279.57	309.44	563.15	537.59	1162.12

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\*One mode run results. i.e., placer is not tuned for each circuit.

# Conclusion

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- Total 16 new placement benchmarks
  - All derived from real ASIC designs
  - Variety of floorplans
  - 5 benchmarks with more than million objects
  - Currently extensively used in placement research
- Significant improvements during last 2 years
- <http://www.ispd.cc/pcontest>