DAC 2012 Contest
Routability-Driven Placement

http://archive.sigda.org/dac2012/contest/dac2012_contest.html

Detailed Results

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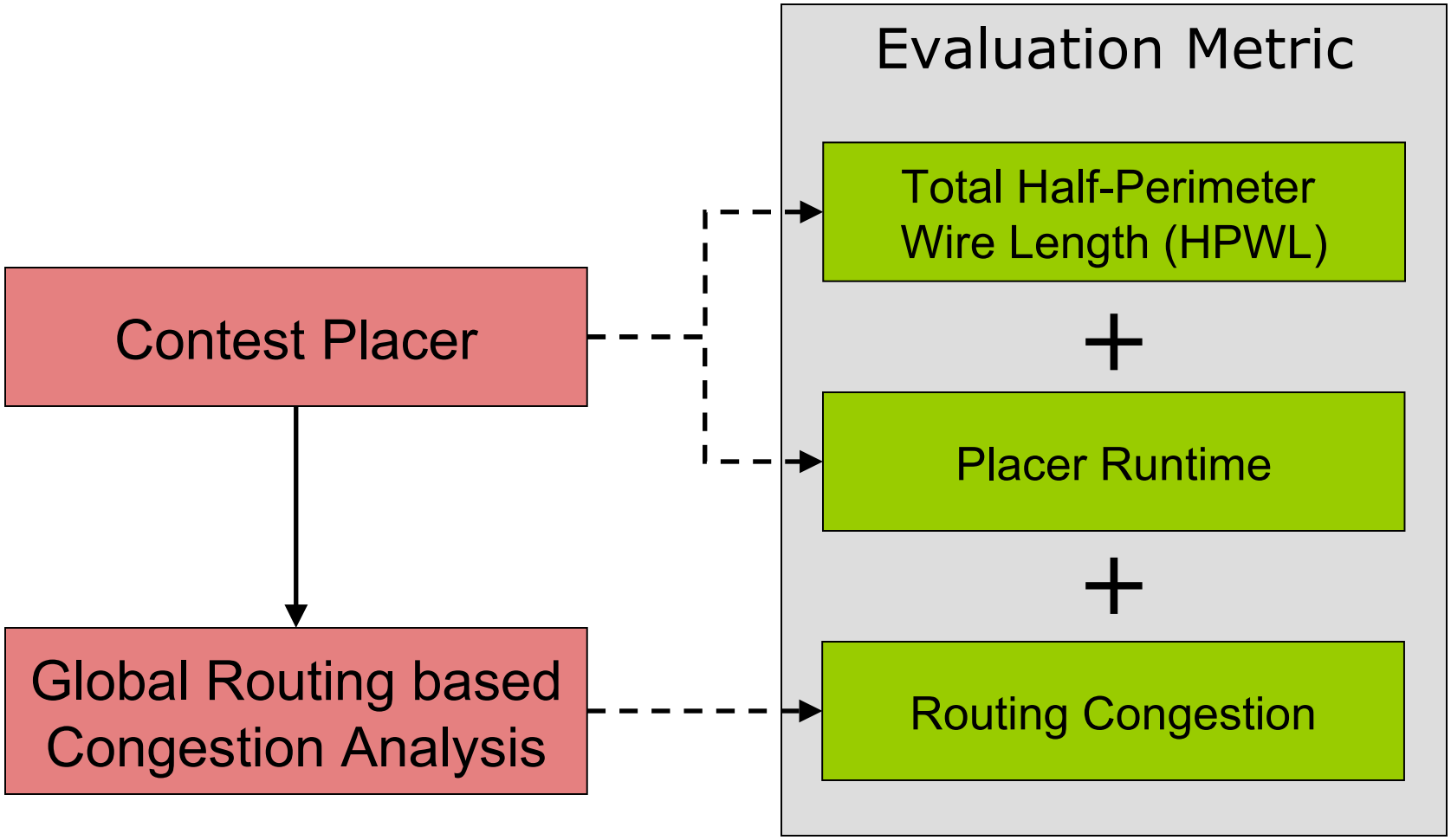
Contest Flow and Evaluation



Evaluation Metric: Routing Congestion

- **Congestion Metric**
  ACE(x): Average Congestion of the top x% congested g-edges

- **Peak Weighted Congestion**

$$PWC = \frac{k_1 \times ACE(0.5) + k_2 \times ACE(1) + k_3 \times ACE(2) + k_4 \times ACE(5)}{k_1 + k_2 + k_3 + k_4}$$

  $k_1 = k_2 = k_3 = k_4 = 1.0$

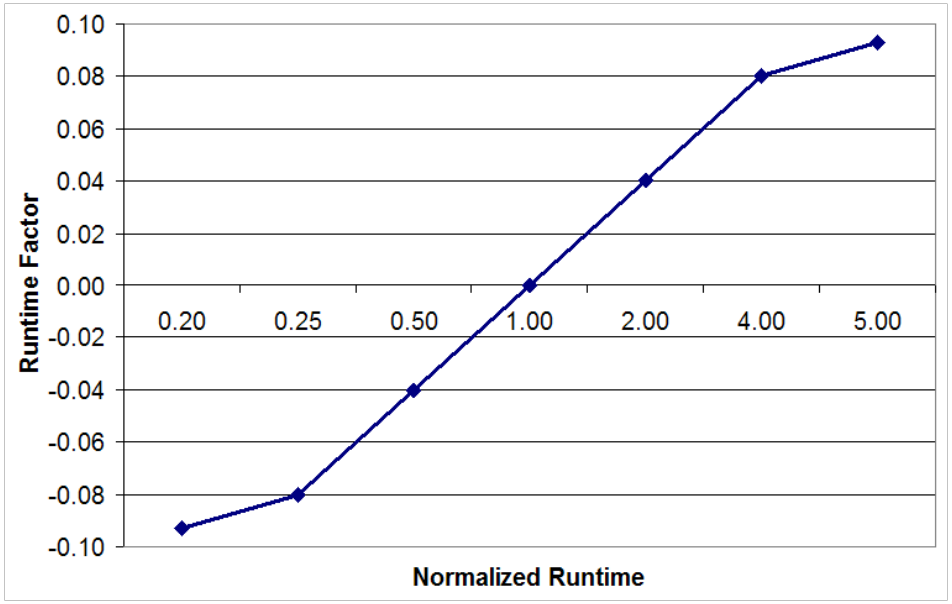
- **Routing Congestion**
  RC = MAX(100, PWC)

Congestion Objective: RC ≤ 100%

Evaluation Metric: Runtime

- For each design
  Normalized Runtime = $\frac{\text{Placer_Wall_Time}}{\text{Median_Wall_Time}}$

- Runtime Factor



±4% advantage for a 2X speed-up/slow-down
(capped at ±10% advantage)

Overall Quality Metric

Scaled Wire length considering routing congestion and runtime

$$\text{HPWL} \times \underbrace{(1 + 0.03 \times (RC - 100))}_{\text{Routability}} \times \underbrace{(1 + \text{Runtime_Factor})}_{\text{Runtime}}$$

- **Penalty Factor (0.03)**
  For every 1% excess Routing Congestion (RC > 100%), there is a 3% wire length penalty

Notes

- All experiments run on:
  - CPU: 64-bit Intel(R) Xeon(R) CPU X7560 @ 2.27GHz
  - OS: Red Hat Enterprise Linux Server release 5.2.
    Kernel release: 2.6.18-92.el5
- How were there final results obtained?
  - For each design, determine the normalized quality metric
  - For each placer, discard the worst normalized quality metric across all the designs
  - Find the total quality metric across all designs after discarding the worst normalized result
  - **Discarding the worst normalized result DOES NOT change the overall ranking**

DAC 2012 Benchmark Suite

Design	Total Nodes	Movable Nodes	Terminal Nodes	Term_NI Nodes	Total Nets	Total Pins	Util. (%)	Den. (%)
superblue19	522775	506097	286	16392	511685	1714351	78	49
superblue14	634555	567840	44743	21972	619815	2049691	72	50
superblue16	698741	680450	419	17872	697458	2280931	69	46
superblue9	846678	789064	37574	20040	833808	2898853	73	47
superblue3	919911	833370	55033	31508	898001	3110509	73	42
superblue11	954686	859771	67303	27612	935731	3071940	79	40
superblue6	1014209	919093	65316	29800	1006629	3401199	73	43
superblue2	1014029	921273	59312	33444	990899	3228345	76	28
superblue12	1293433	1278084	8953	6396	1293436	4774069	56	44
superblue7	1364958	1271887	66995	26076	1340418	4935083	76	58

HPWL and Runtime

Design	HPWL				Runtime (sec)			
	Ripple	NTUplace4	mPL12	SimPLR	Ripple	NTUplace4	mPL12	SimPLR
superblue19	158959943	150373835	173604975	158232401	2309	8450	11087	981
superblue14	227378858	225104247	257910173	238302024	2806	9341	10006	1247
superblue16	258914860	261601740	289166238	267169788	2737	8573	13670	1128
superblue9	257673825	236959695	277933168	253536425	4307	13129	14910	1821
superblue3	334256742	327314759	363730067	362786540	5432	14144	19294	2283
superblue11	356250224	341940017	422598340	346637133	3745	15263	18284	2342
superblue6	334567475	330487934	386542230	350050395	4944	11179	20508	2484
superblue2	651192039	611431799	710536896	629417564	6686	17466	23900	3125
superblue12	332609160	311794306	323674299	354998585	7635	34831	26107	3459
superblue7	423132070	390590183	447433972	428547754	11285	25983	22233	3025
Average (All designs)	**1.04**	**1.00**	**1.15**	**1.07**	**2.34X**	**7.24X**	**8.67X**	**1.00X**

Routing Congestion and Scaled_WL Evaluated using NCTU-GR Global Router

Design	Routing Congestion (RC)				Scaled_WL = HPWL × (1 + 0.03×(RC - 100))			
	Ripple	NTUplace4	mPL12	SimPLR	Ripple	NTUplace4	mPL12	SimPLR
superblue19	102.34	100.61	113.85	101.64	170122558	153105256	245723517	166033275
superblue14	100.59	100.07	101.22	101.39	231420458	225590330	267327862	248267208
superblue16	101.93	102.39	101.38	109.96	273879473	280370081	301165246	347027629
superblue9	105.05	102.48	105.34	102.83	296743795	254571093	322430933	275026596
superblue3	109.24	103.53	109.41	102.48	426879745	362006439	466453539	389732111
superblue11	100.17	100.02	102.33	104.96	358065653	342198756	452187368	398254619
superblue6	102.13	101.21	100.73	100.32	355916496	342470103	395037578	353390230
superblue2	104.50	100.68	129.27	110.28	739056223	623987045	1334367506	823555513
superblue12	100.92	100.02	122.29	100.76	341745525	311939381	540069520	363039980
superblue7	101.73	100.68	105.70	201.38	445073302	398510052	523905123	1731959680
Average (Across all designs)					**1.10**	**1.00**	**1.41**	**1.46**

Routing Congestion and Scaled_WL Evaluated using BFG-R Global Router

Design	Routing Congestion (RC)				Scaled_WL = HPWL × (1 + 0.03×(RC - 100))			
	Ripple	NTUplace4	mPL12	SimPLR	Ripple	NTUplace4	mPL12	SimPLR
superblue19	102.10	100.67	106.95	101.78	168963358	153408109	209790310	166655532
superblue14	102.79	101.25	103.08	103.79	246426040	233578740	281771864	265369579
superblue16	101.52	102.99	102.73	112.73	270754838	285070868	312866826	369173364
superblue9	105.91	105.97	109.07	106.58	303321084	279372141	353595924	303590084
superblue3	112.40	106.38	108.39	105.74	458556648	389952289	455244835	425276443
superblue11	101.04	101.02	101.45	102.43	367338948	352380026	440967746	371942929
superblue6	104.80	106.12	103.52	103.37	382792648	391159179	427374262	385409106
superblue2	108.90	102.76	112.43	115.91	825101081	662107335	975482144	929898735
superblue12	107.33	101.06	120.26	103.36	405779328	321754729	520368805	390838379
superblue7	105.66	101.82	104.91	135.81	494918313	411864822	513316874	888935920
Average (Across all designs)					**1.12**	**1.01**	**1.29**	**1.26**

Normalized Scaled_WL

Design	Evaluated using NCTU-GR				Evaluated Using BFG-R			
	Ripple	NTUplace4	mPL12	SimPLR	Ripple	NTUplace4	mPL12	SimPLR
superblue19	1.11	1.00	1.60	1.08	1.10	1.00	1.37	1.09
superblue14	1.03	1.00	1.19	1.10	1.06	1.00	1.21	1.14
superblue16	1.00	1.02	1.10	1.27	1.00	1.05	1.16	1.36
superblue9	1.17	1.00	1.27	1.08	1.09	1.00	1.27	1.09
superblue3	1.18	1.00	1.29	1.08	1.18	1.00	1.17	1.09
superblue11	1.05	1.00	1.32	1.16	1.04	1.00	1.25	1.06
superblue6	1.04	1.00	1.15	1.03	1.00	1.02	1.12	1.01
superblue2	1.18	1.00	2.14	1.32	1.25	1.00	1.47	1.40
superblue12	1.10	1.00	1.73	1.16	1.26	1.00	1.62	1.21
superblue7	1.12	1.00	1.31	4.35	1.20	1.00	1.25	2.16
Average (**)	**1.09**	**1.00**	**1.33**	**1.14**	**1.10**	**1.00**	**1.25**	**1.16**
Total (**)	**9.78**	**9.00**	**11.97**	**10.29**	**9.91**	**9.02**	**11.25**	**10.44**

** For each placer, discard the worst normalized Scaled_WL result when calculating the average and total values

Normalized Overall Quality Metric

Design	Evaluated using NCTU-GR				Evaluated using BFG-R			
	Ripple	NTUplace4	mPL12	SimPLR	Ripple	NTUplace4	mPL12	SimPLR
superblue19	1.08	1.05	1.71	1.00	1.07	1.05	1.45	1.00
superblue14	1.00	1.05	1.24	1.02	1.00	1.02	1.23	1.02
superblue16	1.00	1.09	1.21	1.20	1.00	1.13	1.27	1.29
superblue9	1.14	1.04	1.33	1.00	1.05	1.04	1.32	1.00
superblue3	1.16	1.04	1.36	1.00	1.14	1.02	1.21	1.00
superblue11	1.00	1.04	1.38	1.08	1.02	1.06	1.34	1.00
superblue6	1.05	1.06	1.26	1.00	1.04	1.11	1.25	1.00
superblue2	1.12	1.00	2.18	1.19	1.18	1.00	1.50	1.27
superblue12	1.00	1.00	1.70	1.01	1.16	1.00	1.59	1.06
superblue7	1.06	1.00	1.30	3.82	1.15	1.00	1.24	1.90
Average (**)	**1.05**	**1.03**	**1.39**	**1.06**	**1.07**	**1.03**	**1.31**	**1.07**
Total (**)	**9.46**	**9.27**	**12.50**	**9.51**	**9.61**	**9.29**	**11.81**	**9.64**

** For each placer, discard the worst normalized quality metric when calculating the average and total values

DAC 2012 Contest Ranking

- First Place
  - NTUplace4
  - National Taiwan University
  - Meng-Kai Hsu, Yao-Wen Chang
- Second Place
  - Ripple
  - The Chinese University of Hong Kong
  - Xu He, Tao Huang, Wing-Kai Chow, Lam Ka Chun, Evangeline F.Y. Young
- Third Place
  - SimPLR
  - The University of Michigan, Ann Arbor
  - Myung-Chul Kim, Jin Hu, Igor Markov
- Fourth Place
  - mPL12
  - UCLA / Beijing University
  - Jason Cong, Guojie Luo, Kalliopi Tsota, Bingjun Xiao