

IEEE SW Test Workshop

Semiconductor Wafer Test Workshop



Doron Avidar
Micron

June 12 to 15, 2011
San Diego, CA

Ghosting – Touchdown Reduction Using Alternate Site Sharing



Doron Avidar

Yossi Dadi

Fab12 Test Engineering

Introduction

- High parallelism testing on small to medium densities (up to 3K DPW on 200mm wafers) requires multiple touchdowns to complete wafer probing
- Testing parallelism is gated by tester resources available (which can be increased by channel sharing)
- Probe card array layout determines the probing efficiency per touchdown
 - Rectangular array – lower efficiency
 - FWA (full wafer array) – higher efficiency
- Decision to skip dies to reduce touchdown count is based on cost



Goal

- DPW, max parallelism, and probe card array layout determine touchdown count
- How can we reduce it even further and avoid skip dies?

Ghosting!



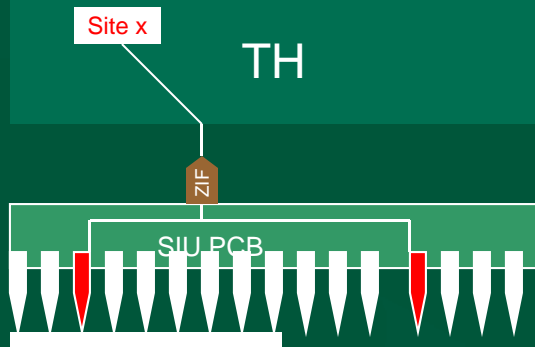
Ghosting Concept

- Expend probe card array beyond available tester resources
 - For example: //144 tester sites with //154 probe card sites
- Based on the wafer layout, electrically split some tester sites into X2 probe card sites
 - In the above example, need to split 10 tester sites into 20 probe card sites; all channels of a single tester site are shorted between two probe card sites
- At each touchdown, need to ensure only one of the shorted probe card sites will touch the wafer
 - The other probe card site is off the wafer (“ghosted”)



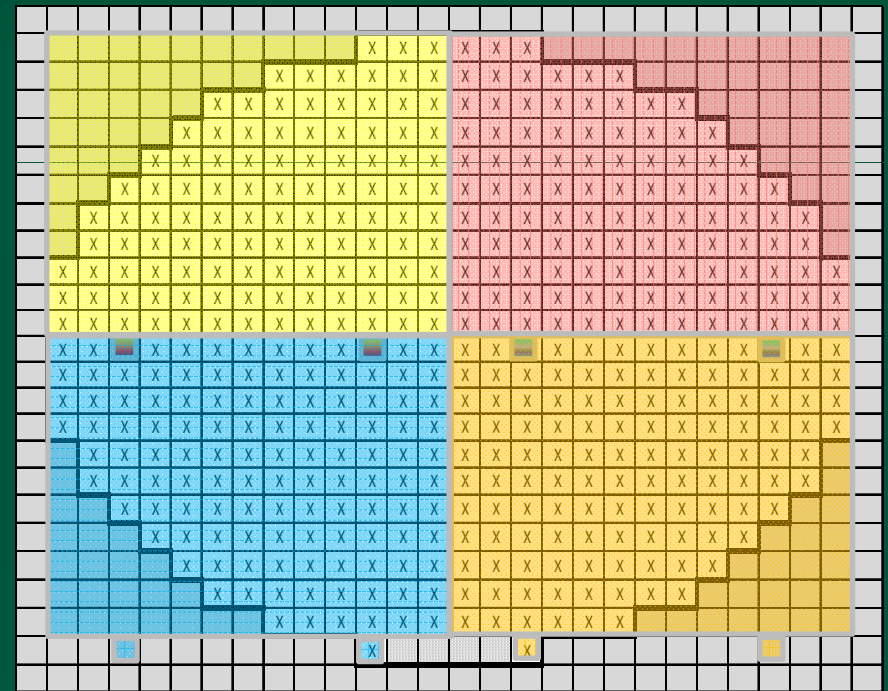
Ghosting Concept

1st example – POC product (2009)



1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26
27	28	29	30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49	50	51	52
53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68	69	70	71	72	73	74	75	76	77	78
79	80	81	82	83	84	85	86	87	88	89	90	91
92	93	94	95	96	97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112	113	114	115	116	117
118	119	120	121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140	141	142	143
144											145	

↑
Shorted sites
↑



PC array

Off
Off

Wafer coverage



June 12 to 15, 2011

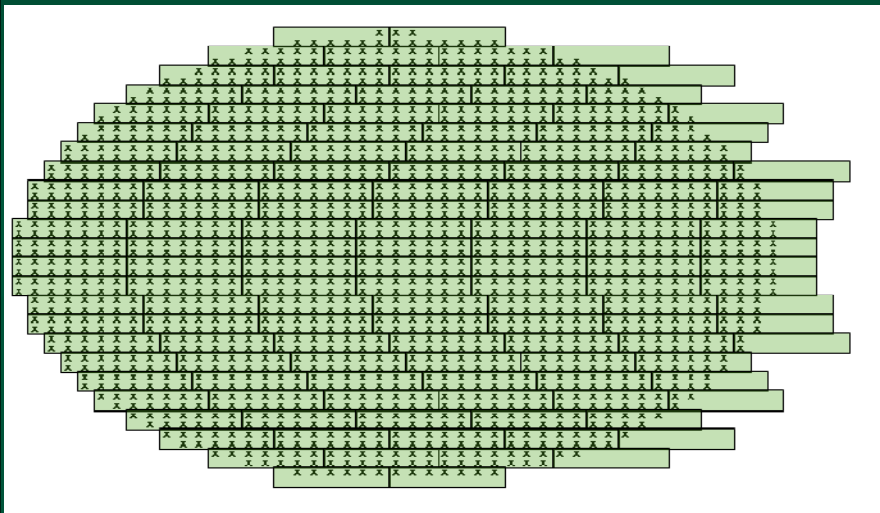
IEEE SW Test Workshop

5

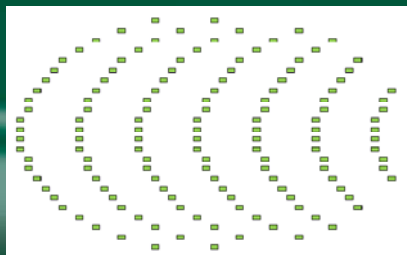
Ghosting Concept

2nd example – 8% TD reduction (2010)

Ghosting layout is based on known partial dies

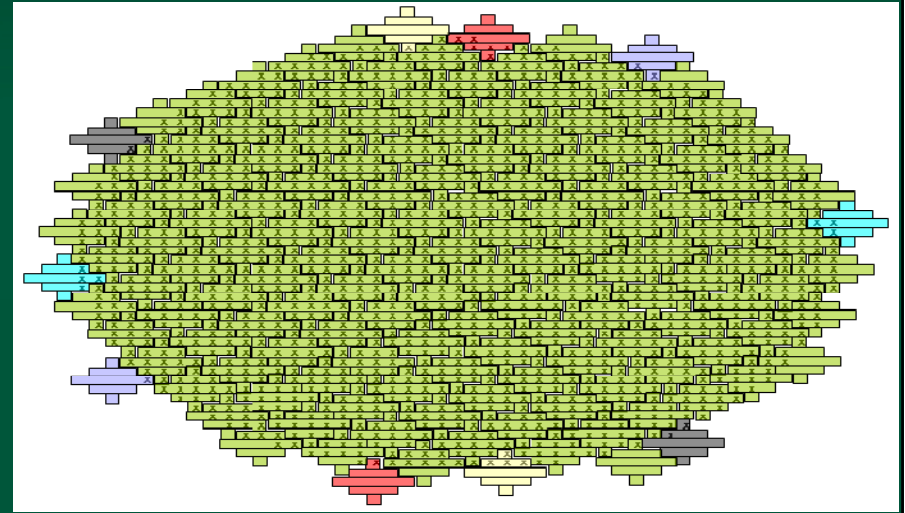


14TD FWA solution

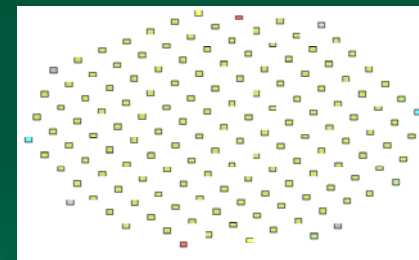


PC layout

June 12 to 15, 2011



13TD FWA/ghosting solution



PC layout

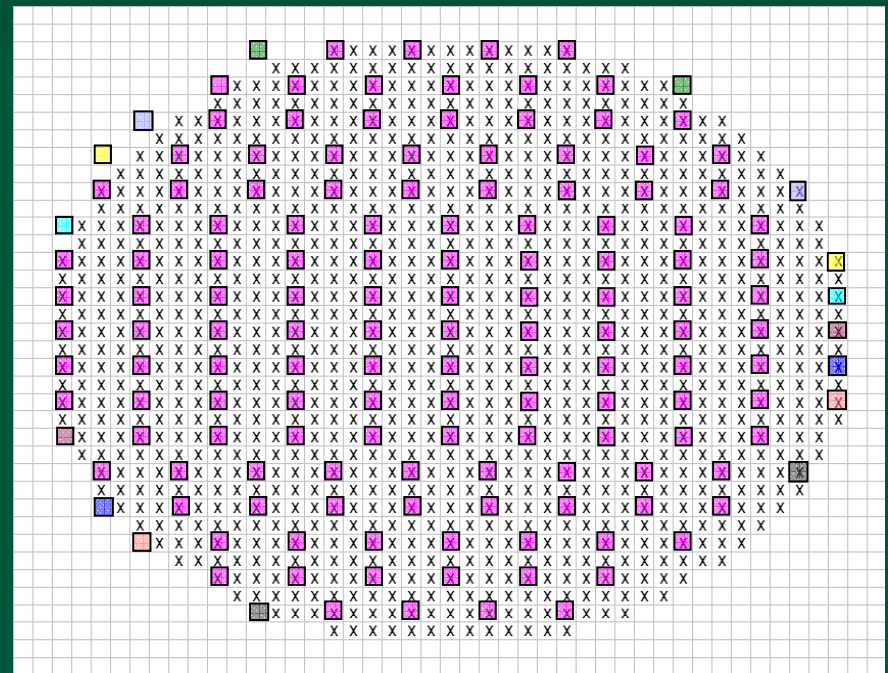
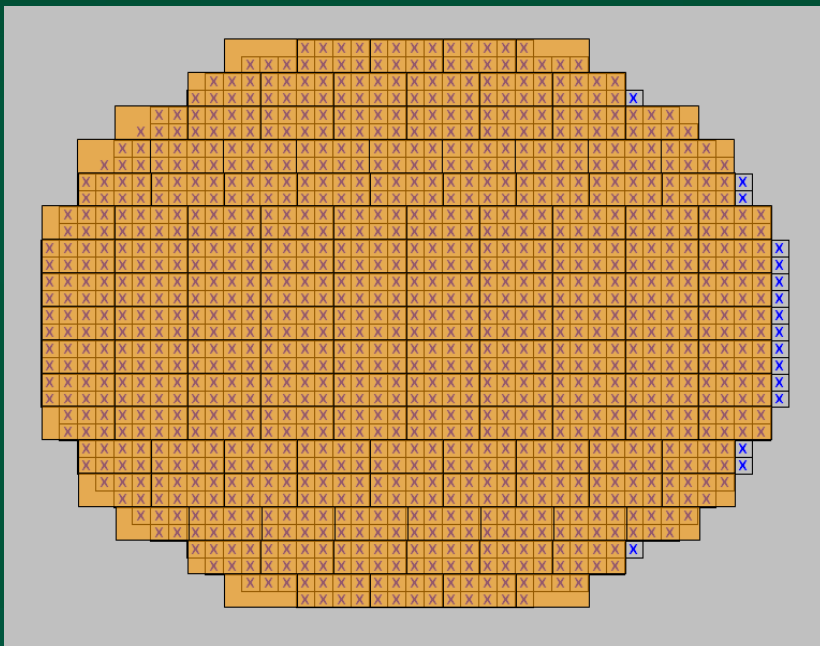
IEEE SW Test Workshop



Ghosting with Relays

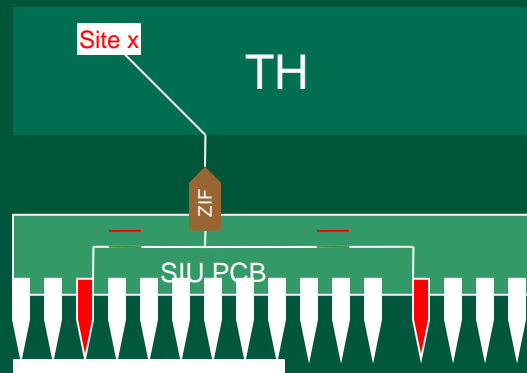
3rd example – 12% TD reduction (TBD)

Ghosting method using relays (to avoid short with partial dies)



Ghosting with Relays

- Every channel of a shared site is shorted with its ghosted site channel
- At every touchdown, all channel relays of the probing site are closed, and the channel relays of the ghosted site are open
- Requires available channel for relay control



Ghosting Implementation

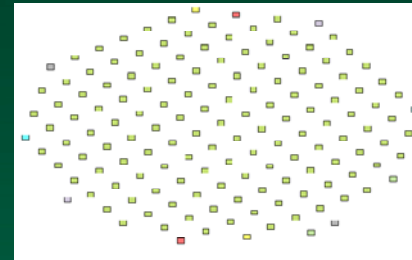
- Ghosting requires some manipulation in the probing environment to handle site activation at each touchdown
- Switching between ghosted sites at each touchdown requires multi-DUT capability
- Dummy multi-DUT probe card array is created to control site activation at each touchdown
 - For example, if tester resource is //144 and using //160 probe card sites, it requires to create //288 dummy array



Ghosting Implementation

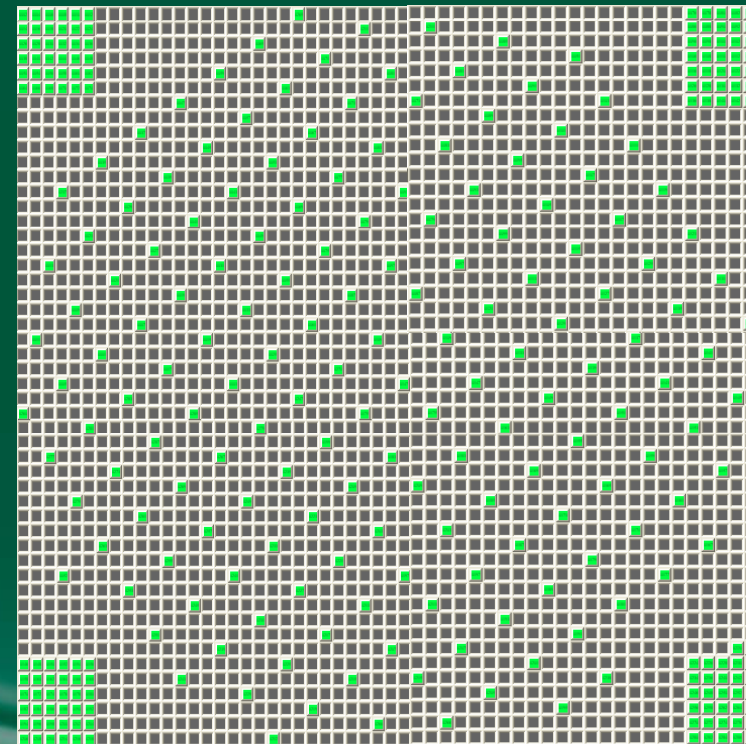
1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26
27	28	29	30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49	50	51	52
53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68	69	70	71	72	73	74	75	76	77	78
79	80	81	82	83	84	85	86	87	88	89	90	91
92	93	94	95	96	97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112	113	114	115	116	117
118	119	120	121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140	141	142	143
144												145

Probe card
array
//144 +
ghosted sites



0035	0037	0043	0059	0055	0069	0071	0081	0085	0093	0097	0105	0107
0031	0033	0039	0053	0057	0065	0075	0079	0089	0099	0103	0111	0119
0023	0029	0041	0047	0049	0061	0077	0083	0091	0101	0109	0115	0125
0017	0019	0027	0025	0045	0065	0075	0087	0113	0117	0121	0131	0129
0007	0011	0013	0015	0021	0031	0067	0095	0123	0127	0135	0133	0137
0005	0287	0283	0003	0009	0001	0271	0145	0139	0147	0149	0141	0143
0285	0281	0277	0279	0269	0241	0225	0189	0161	0157	0153	0151	0155
0275	0273	0265	0261	0245	0231	0211	0201	0187	0171	0163	0165	0159
0267	0259	0253	0249	0235	0227	0217	0207	0195	0181	0173	0169	0167
0263	0255	0247	0239	0233	0223	0213	0205	0203	0197	0185	0177	0175
0257	0251	0243	0237	0229	0219	0221	0209	0199	0193	0191	0183	0179
		0215								0216		
0036	0038	0044	0060	0056	0070	0072	0082	0086	0094	0098	0106	0108
0032	0034	0040	0054	0058	0064	0074	0080	0090	0100	0104	0112	0120
0024	0030	0042	0048	0050	0062	0078	0084	0092	0102	0110	0116	0126
0018	0020	0028	0026	0046	0066	0076	0088	0114	0118	0122	0132	0130
0008	0012	0014	0016	0022	0052	0068	0096	0124	0128	0136	0134	0138
0006	0288	0284	0004	0010	0002	0272	0146	0140	0148	0150	0142	0144
0286	0282	0278	0280	0270	0242	0226	0190	0162	0158	0154	0152	0156
0276	0274	0266	0262	0246	0232	0212	0202	0188	0172	0164	0166	0160
0268	0260	0254	0250	0236	0228	0218	0208	0196	0182	0174	0170	0168
0264	0256	0248	0240	0234	0224	0214	0206	0204	0198	0186	0178	0176
0258	0252	0244	0238	0230	0220	0222	0210	0200	0194	0192	0184	0180

Probing
map
//288



Next Steps

- Develop the ghosting with relays solution
 - Find component that can switch all channels of a site using one control channel
 - Explore ghosting method on designs that already embed site sharing (X2/X4 power supply and driver sharing)
- Continue to implement ghosting on new designs to ensure lowest touchdown count possible



Summary

- Ghosting is a low-cost solution to ensure lowest touchdown count will be achieved without skipping dies
 - Invest effort in probe card array layout vs. die layout
- Ghosting is beneficial for designs with multiple touchdown count
- Ghosting requires some manipulation of probing environment to handle the alternate site sharing
 - Depends on Multi DUT configuration



Thank you for listening

Questions?



June 12 to 15, 2011

IEEE SW Test Workshop

13

Backup



June 12 to 15, 2011

IEEE SW Test Workshop

14

Yield comparison Ghosted vs. Non-Ghosted

No impact using Ghosting



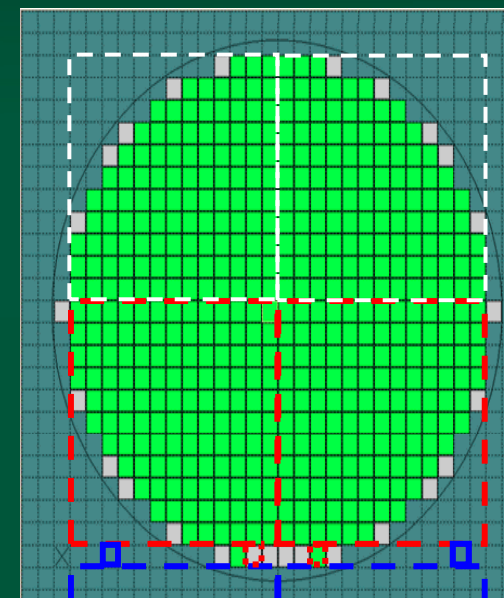
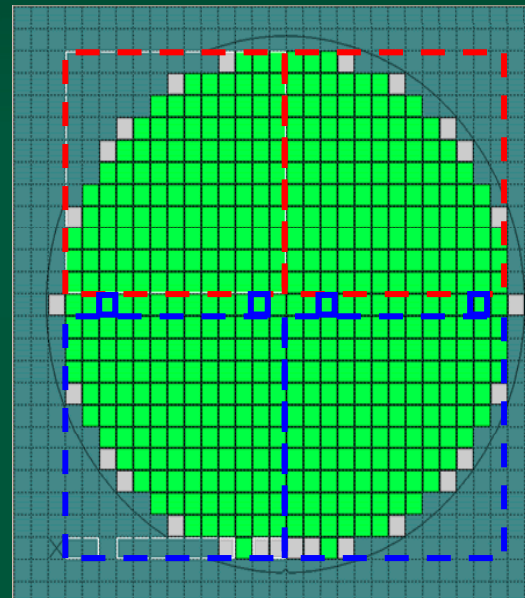
Ghosting Implementation

TD# 1, 2

TD# 3,4

Prober map

0035	0037	0043	0059	0055	0069	0071	0081	0085	0093	0097	0105	0107
0031	0033	0039	0053	0057	0063	0073	0079	0089	0099	0103	0111	0119
0025	0029	0041	0047	0049	0061	0077	0083	0091	0101	0109	0115	0125
0017	0019	0027	0025	0045	0065	0075	0087	0113	0117	0121	0131	0129
0007	0011	0015	0015	0021	0051	0067	0095	0125	0127	0135	0133	0137
0005	0287	0283	0003	0009	0001	0271	0145	0139	0147	0149	0141	0143
0285	0281	0277	0279	0269	0241	0225	0189	0161	0157	0153	0151	0155
0275	0273	0265	0261	0245	0231	0211	0201	0197	0193	0163	0165	0159
0267	0259	0255	0249	0235	0227	0217	0207	0195	0181	0173	0169	0167
0263	0255	0247	0239	0233	0223	0213	0205	0203	0197	0185	0177	0175
0257	0251	0245	0237	0229	0219	0221	0209	0199	0193	0191	0183	0179
	0215								0216			
0036	0038	0044	0060	0056	0070	0072	0082	0086	0094	0098	0106	0108
0032	0034	0040	0054	0058	0064	0074	0080	0090	0100	0104	0112	0120
0024	0030	0042	0048	0050	0062	0078	0084	0092	0102	0110	0116	0126
0018	0020	0028	0026	0046	0066	0076	0088	0114	0118	0122	0132	0130
0008	0012	0014	0016	0022	0052	0068	0096	0124	0128	0136	0134	0138
0006	0288	0284	0004	0010	0002	0272	0146	0140	0148	0150	0142	0144
0286	0282	0278	0280	0270	0242	0226	0190	0162	0158	0154	0152	0156
0276	0274	0266	0262	0246	0232	0212	0202	0188	0172	0164	0166	0160
0268	0260	0254	0250	0236	0228	0218	0208	0196	0182	0174	0170	0168
0264	0256	0248	0240	0234	0224	0214	0206	0204	0198	0186	0178	0176
0258	0252	0244	0238	0230	0220	0222	0210	0200	0194	0192	0184	0180



- Active sites
- Non active sites



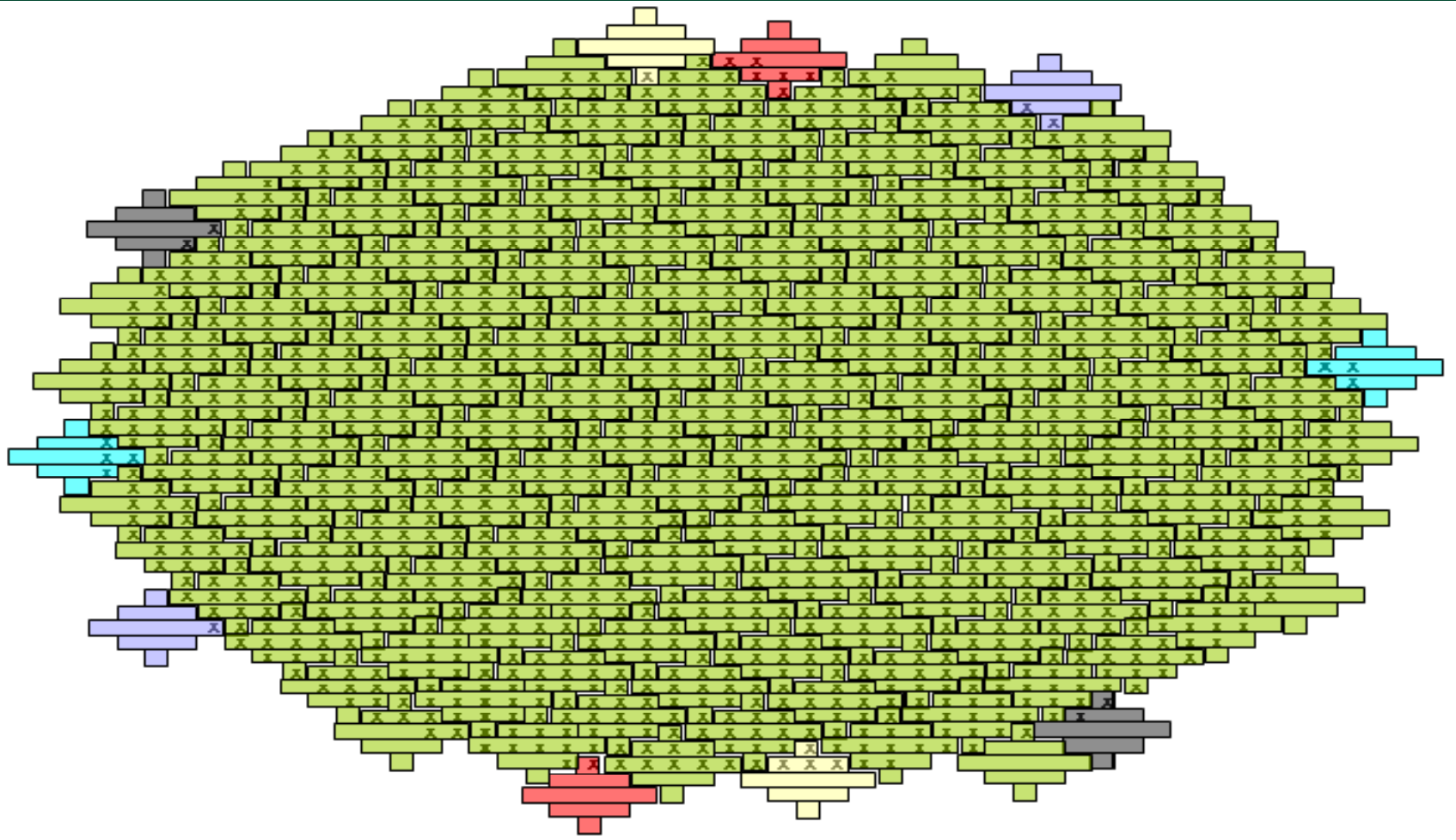
June 12 to 15, 2011

IEEE SW Test Workshop



16

Ghosting Concept



June 12 to 15, 2011

IEEE SW Test Workshop



17