IBM Microelectronics

Automated Large Block Placement Strategies

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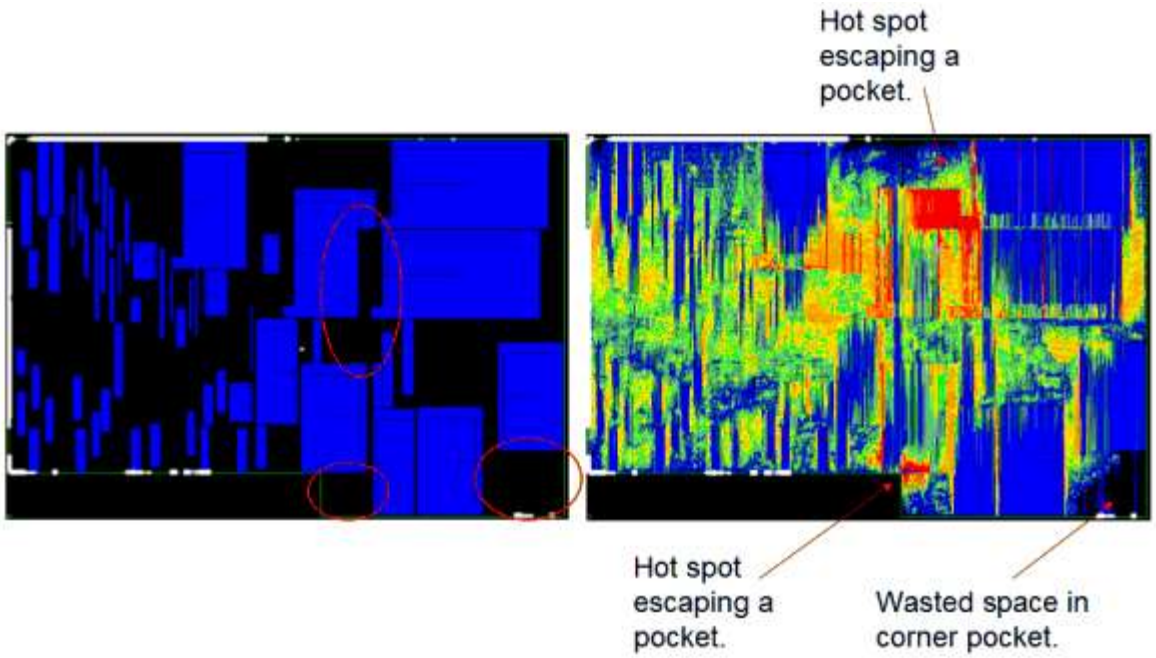
Introduction

- One of the most fundamental processes in physical design is large block placement – but the best method for this is still generally manual placement.

- What are some of the currently utilized strategies for Automated Large Block Placement?
  - What are the limitations that hinder wider adoption of these methods?
- What are further strategies that can be used to overcome these limitations?

Extension of Small-Cell Algorithms

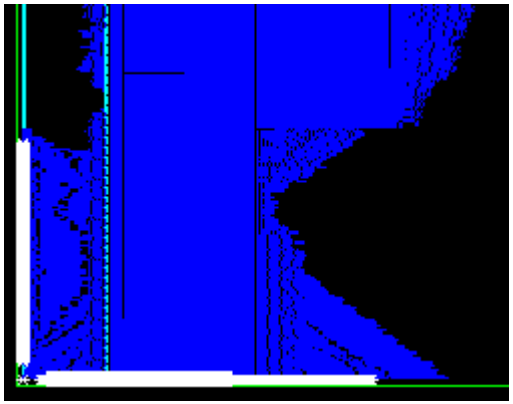
- One class of strategies involves extending the use of algorithms that place small cells in the design.
  - The first issue with this is modeling of blockage associated with placement of large cells, which is not an issue with “dust logic”.



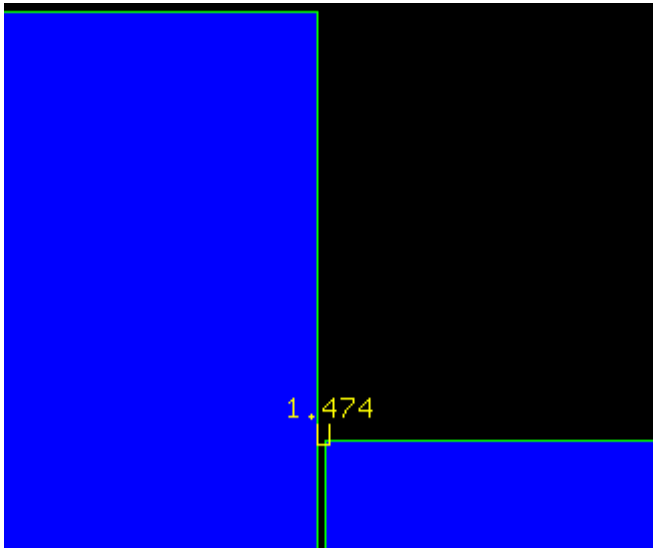
Extension of Small-Cell Algorithms (cont.)

- These types of algorithms also generally have limited modeling of design requirements associated with large blocks.

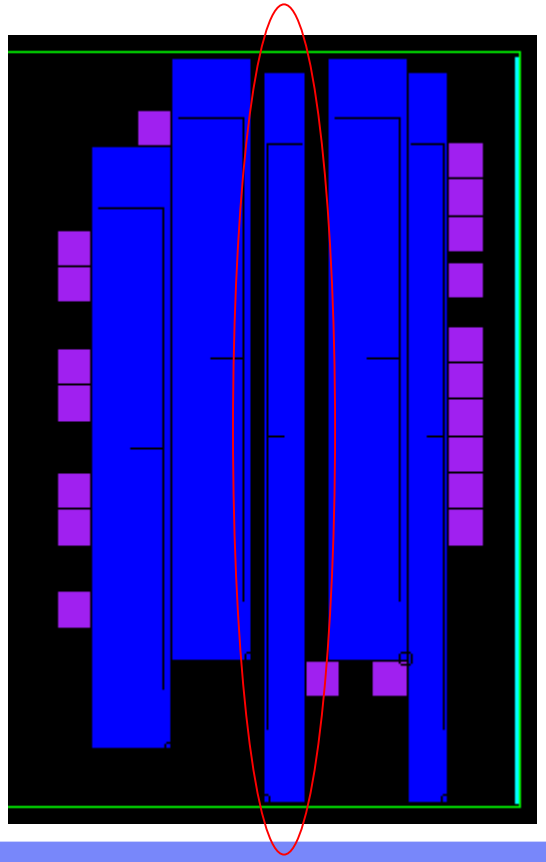
Affinity Logic



Spacing/Abutment

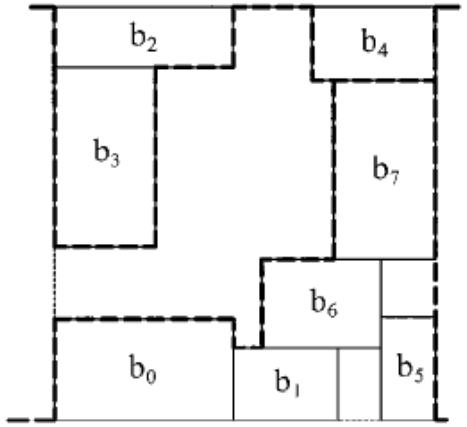


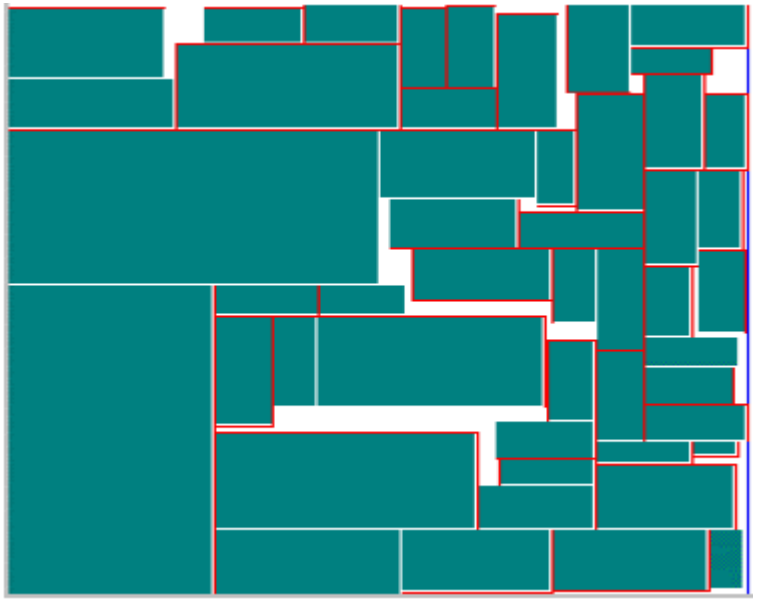
Decap Placement



Packing Algorithms

- Another class of strategies is to employ packing techniques to organize large blocks wrt design edges & each other.
  - These methods still suffer from tendencies to create “pocketing” and limited modeling of large block design requirements.

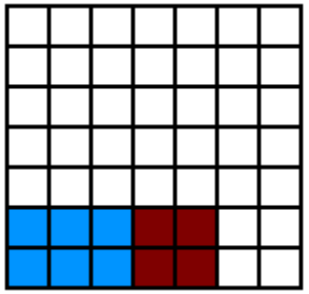




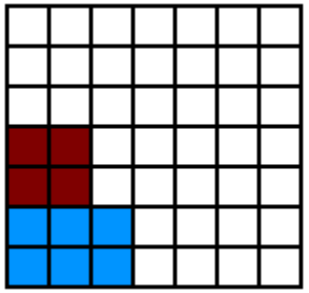
Enforcing Design Rules by Grouping

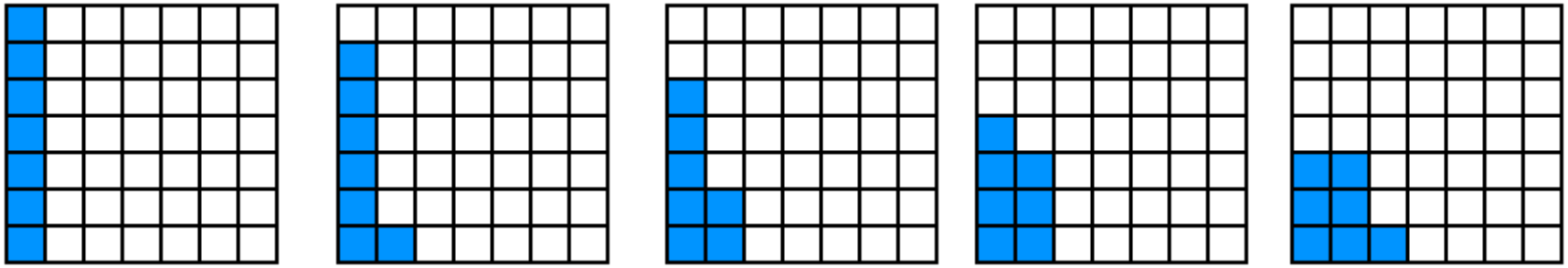
- Organize large blocks into groups / subgroups hierarchically.
- Evaluate group placements within a block-level grid.
- This allows for easy use of abutment and aligned groupings, which in turn enforces design rules.

Horizontal Subgroup



Vertical Subgroup



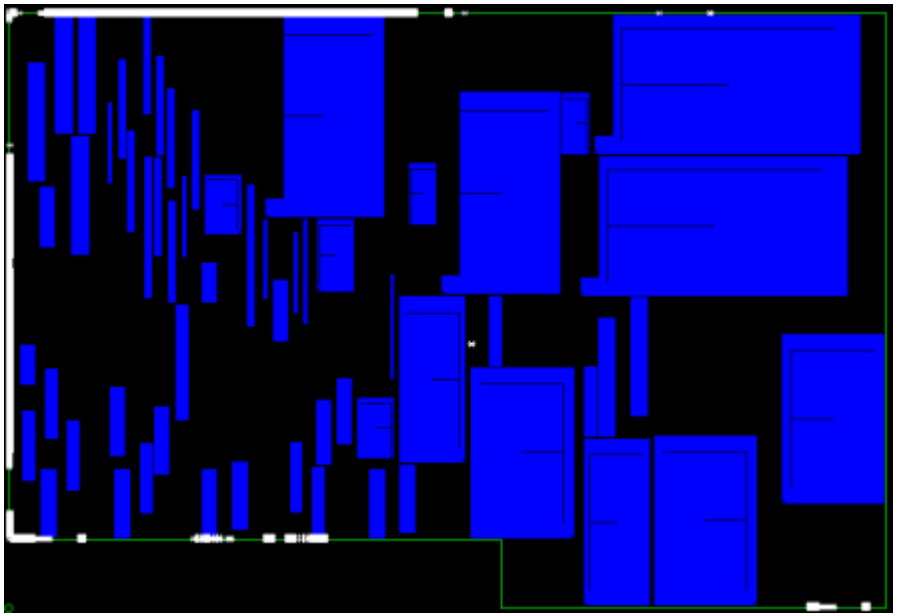


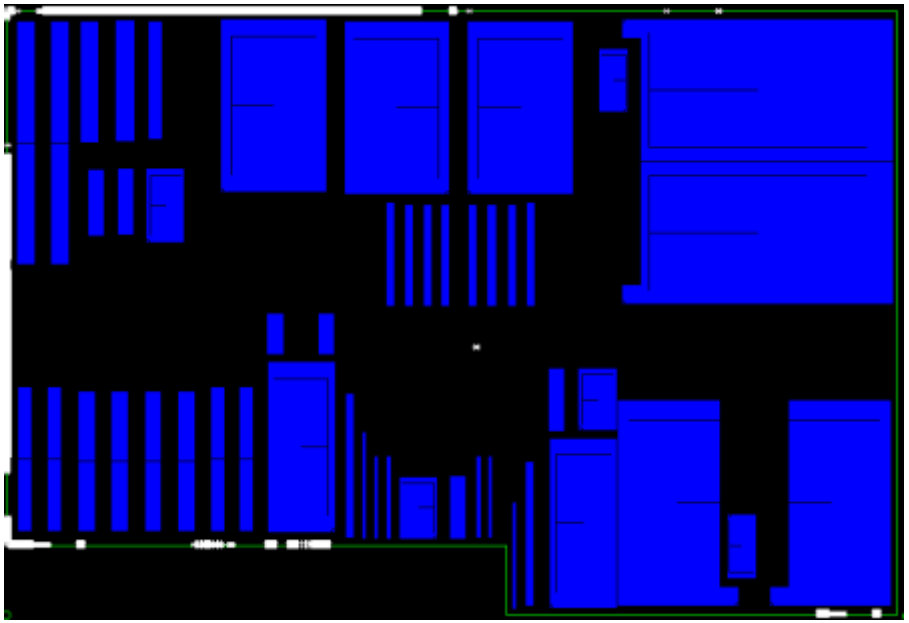
OK NO NO OK NO

Creating Placement Regularity

- Humans have a natural desire for order, and manually created placements reflect that.
  - This orderly placement generally leads to better QoR (wiring congestion / timing slacks), further driving acceptance.

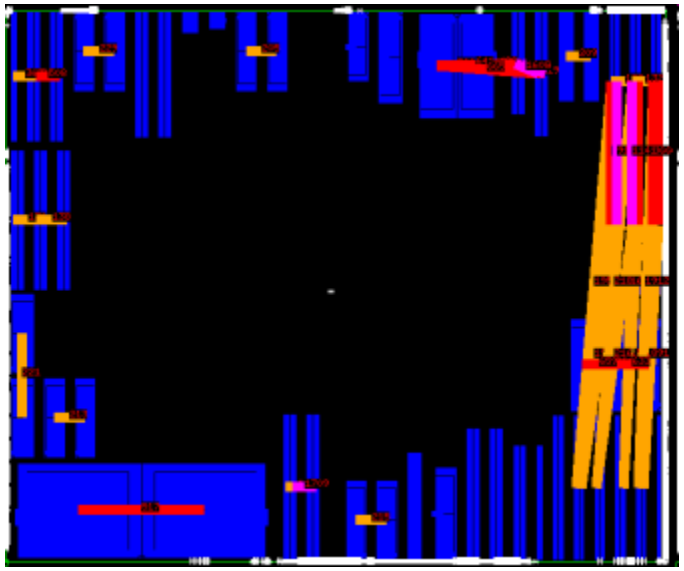
Which of these floorplans would you rather have?





Creating Placement Regularity (cont.)

- Organizing large blocks into groupings gets us part of the way towards regularity. Memories will be banked together, similar to a manual placement.
- To create inter-group regularity, associations between groups and with design edges need to be introduced.
  - Leverage packing algorithms to create alignment between groups and design edges.
  - Leverage associations between groups to promote reasonable inter-group alignment.



Conclusion

- Large block placement is generally a manual process because current methods do not produce results that designers find desirable.
  - Increasing design sizes add pressure for automated solutions.
- Current methods show limited flexibility with design rules, are prone to leaving suboptimal congestion situations and generate complex layouts that are hard for designers to debug.
- By using block groupings and leveraging placement packing and inter group associations, we can generate correct by construction placements that are understandable to designers, have reasonable QoR and minimize TAT.

Backup

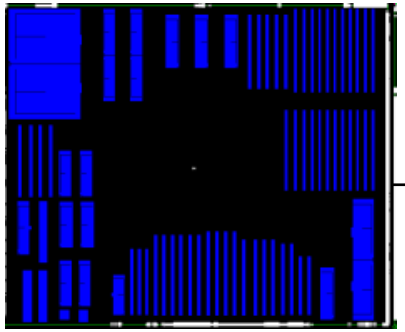
Example 1: High Congestion Design

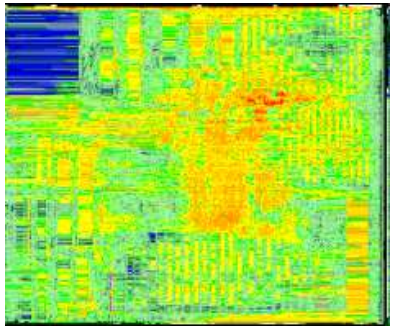
Wire Cng

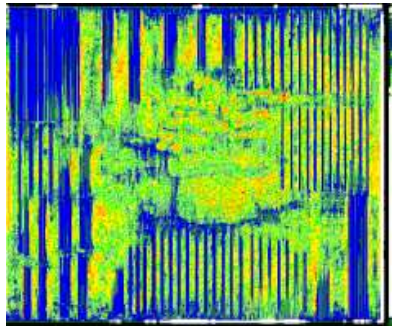
Tmg Slack

(TAT)

Manual







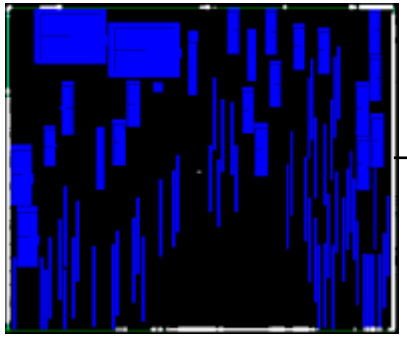
81.2%

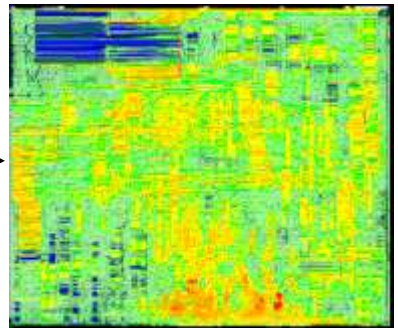
100ps

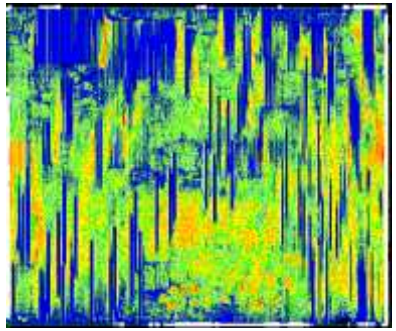
(weeks)

Current

Method







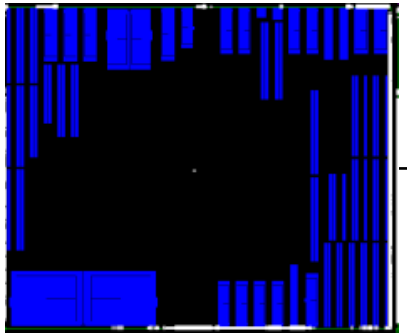
81.3%

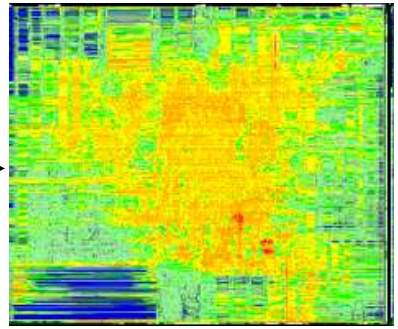
100ps

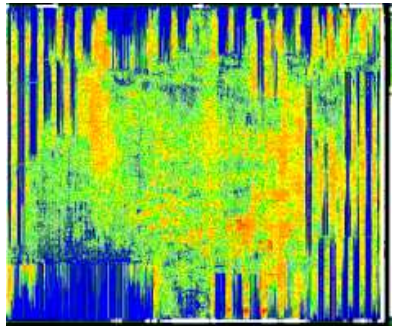
(116m)

New

Method





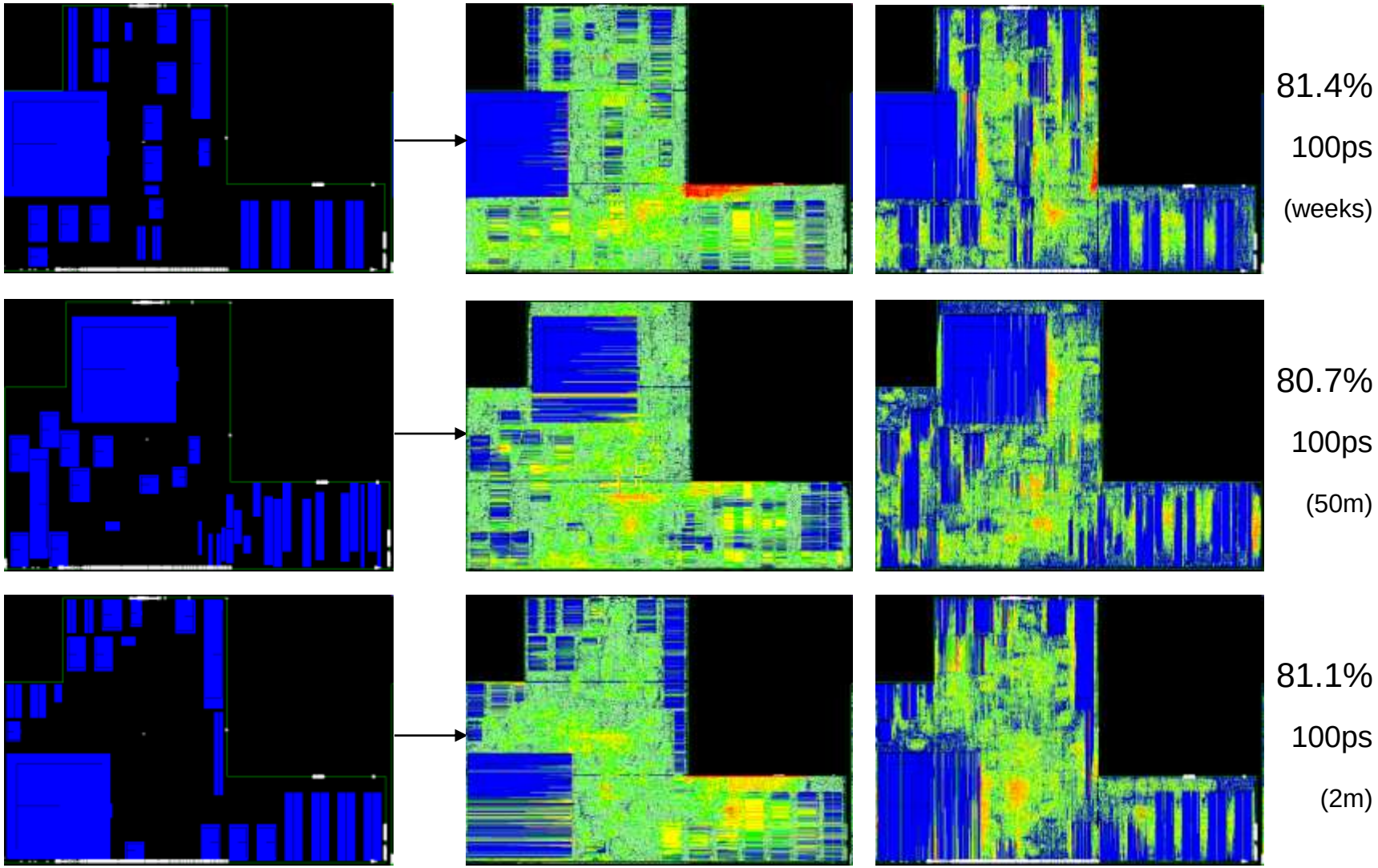


81.9%

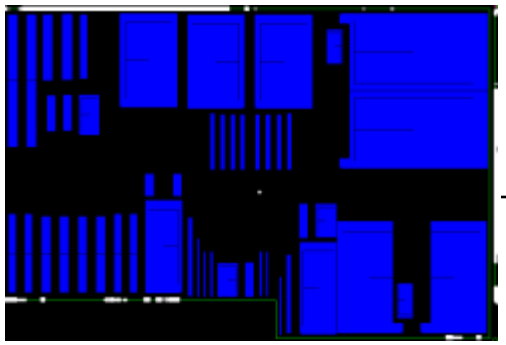
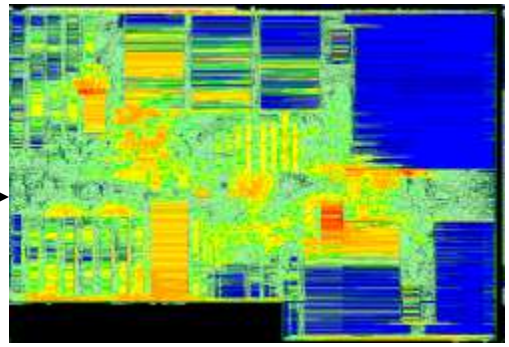
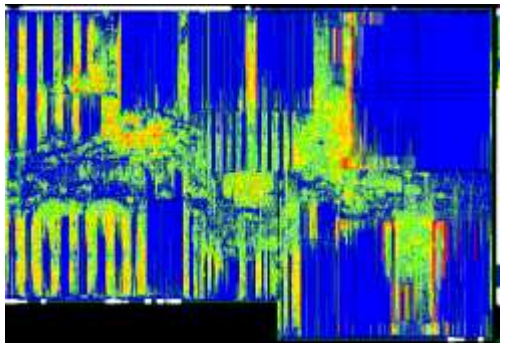
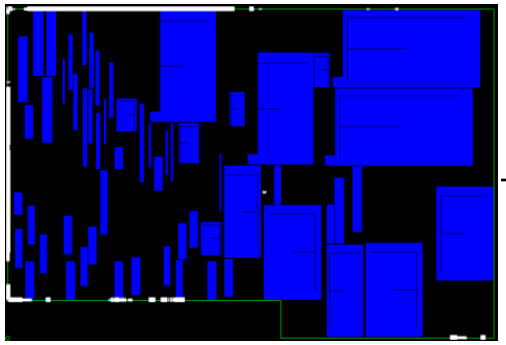
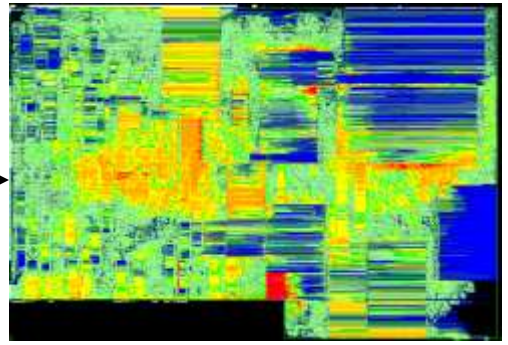
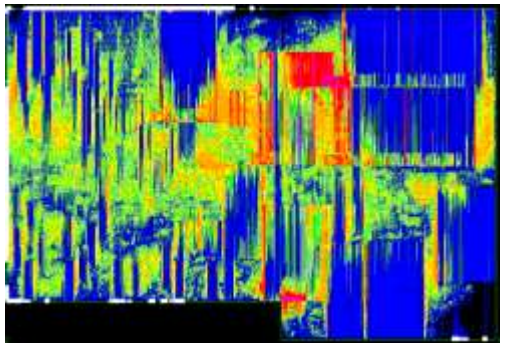
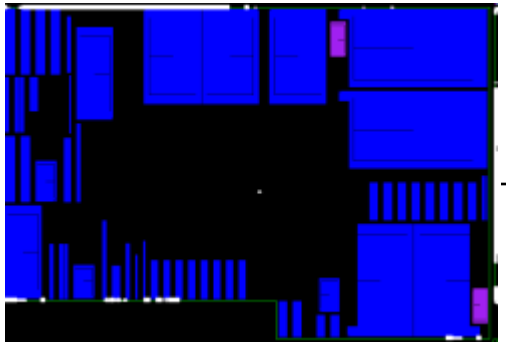
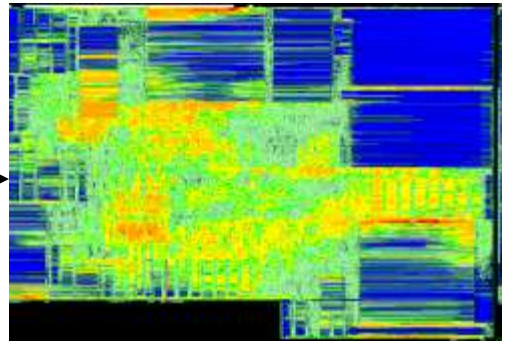
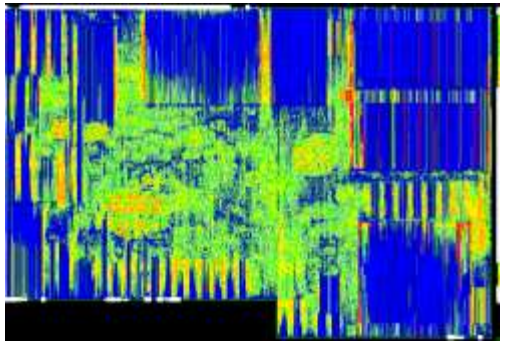
88ps

(21m)

Example 2: Small Rectilinear Design



Example 3: Large Rectilinear Design

			Wire Cng	*Tmg Slack*	*(TAT)*
Manual				81.0%	-304ps	(weeks)
Current Method				82.8%	-500ps	(67m)
New Method				80.9%	-180ps	(6m)