

HOW TO ACCOMMODATE DESIGN CHANGES USING STANDARD CELL LIBRARY

ECO-Kit Library
ARM

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Agenda

- ❑ Introduction: ECO
- ❑ Why ECO-Kit Library?
- ❑ ECO-kit fabric Architecture
- ❑ ECO-kit Library design
- ❑ ECO-kit cells: Layout
- ❑ ECO Placement Methodology
- ❑ Fix Silicon Bug with ECO-kit
- ❑ The design before ECO placement and after ECO placement
- ❑ Timing result before and after ECO placement

Introduction: Engineering Change Order(ECO)

- ❑ ECO is a design stage for post silicon fix (timing/functionality) using metal mask
- ❑ What is spare cells and Why Spare cell?
- ❑ Where and how many spare cells?
- ❑ Flavor of spare cells?
- ❑ Placement of spare cells: RTL level or implementation(P&R) level
- ❑ What to do with the input of the spare cells?
- ❑ Leakage issue with spare cells!!!...
- ❑ Distribution of spare cells
- ❑ What if fix requires more spare cells than what was placed in the design?....

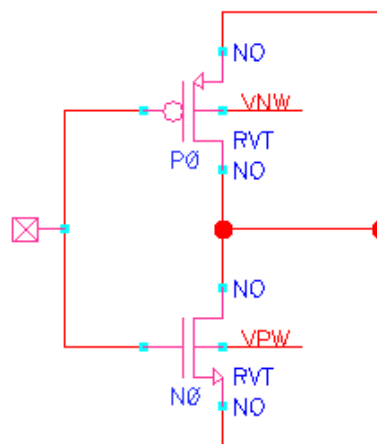
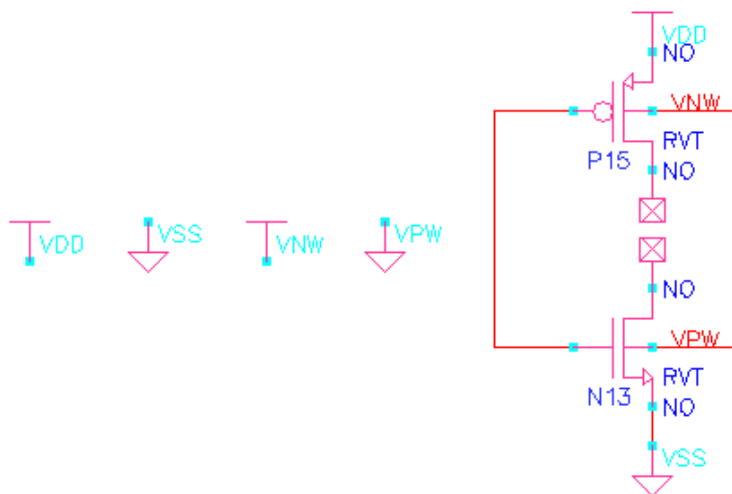
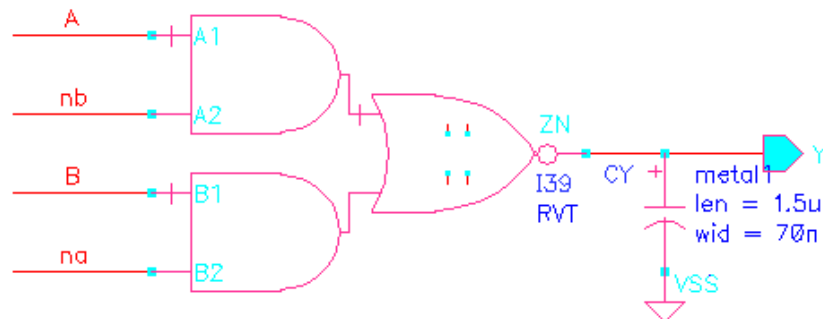
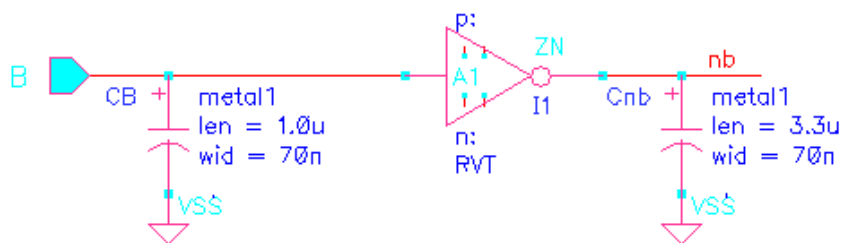
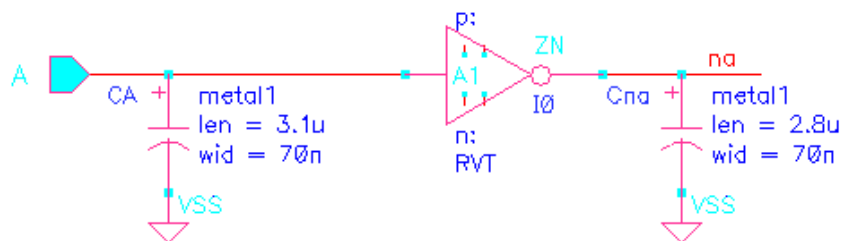
ECO-kit Library

- ❑ ECO-kit Library is a solution for the “limitation of spare cell methodology for ECO”
- ❑ Generic Fabric over and around of empty space of the chip/design
- ❑ A logic gate and flops can be realized using generic Fabric structure
- ❑ No spare cells, No extra leakage, No extra area!!.
- ❑ Different flavors of gate of required drive strength can be realized anywhere in the design
- ❑ During ECO stage, after metamorphosing the generic Fabric into the real logic, timing/power/physical analysis can be done using ECO characterized library
- ❑ **Only Metal/Contact Masks are needed after fixing the defective design using ECO library**
- ❑ Physical of ECO library is an art of Fabrics...

Art of Fabric: ECO-kit Architecture

- ❑ Different technologies and library architecture require different fabric cell architecture for minimizing area, maximizing pin accessibility and routability.
- ❑ The cell height, boundary conditions and the NWEELL location will be same as the Standard Cell library architecture.
- ❑ ECO-kit supports all kinds of complex cells of a given Library by using single fabric
- ❑ There will be one and only one type of fabric for any given ECO-kit library of a given technology/product
- ❑ The Fabric cell can have multiple fingers, however type of fabric will be intact

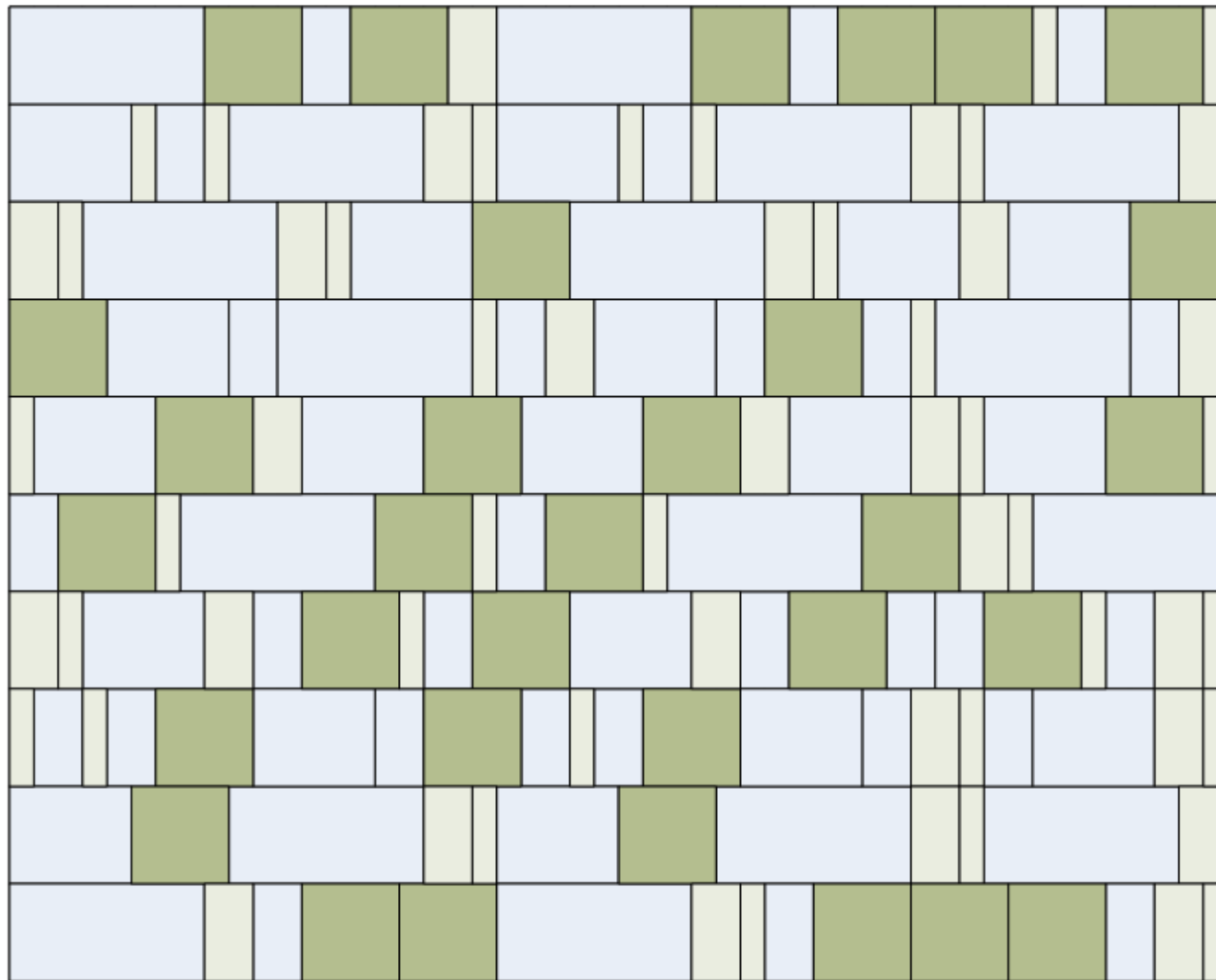
ECO-kit Schematics



ECO Methodology using ECO-kit

- ❑ Place the designed FILLECO/FILLECOCAP cells as regular filler cells within a block of placed standard cells wherever possible
- ❑ Place the regular FILL cells at locations where the area is less than the ECO fabric cell
- ❑ If the design change is required after mask creation has begun, replace the ECO FILL cells with ECO Logic cells
- ❑ Re-route after placement.
- ❑ Perform the timing and Physical verification.
- ❑ Meet the timing... you are done!.
- ❑ **Only contact and metal masks need to be changed in fabrication.**

ECO Placement Methodology



- Base Cell
- ECO Fill Cell
- Base Fill Cell

ECO Placement in P&R

Freeze Silicon ECO

- ❑ ARM Cortex-M3 core is used in our experiment
- ❑ ECO is done to fix hold violation of dead ARM Cortex-M3
- ❑ The critical path needs buffer to fix the issue
- ❑ After primary analysis, it has been found out that BUF_X8 is needed to fix the critical path of hold violation
- ❑ Buf_X8 require 8 Fabric
- ❑ Search for Fabric where we have 8 in chunk (near to the required critical path)
- ❑ Place the ECO buffer cells at the place of 8 groups of fabric structure
- ❑ See the placement in figure-2

Before ECO Placement in P&R

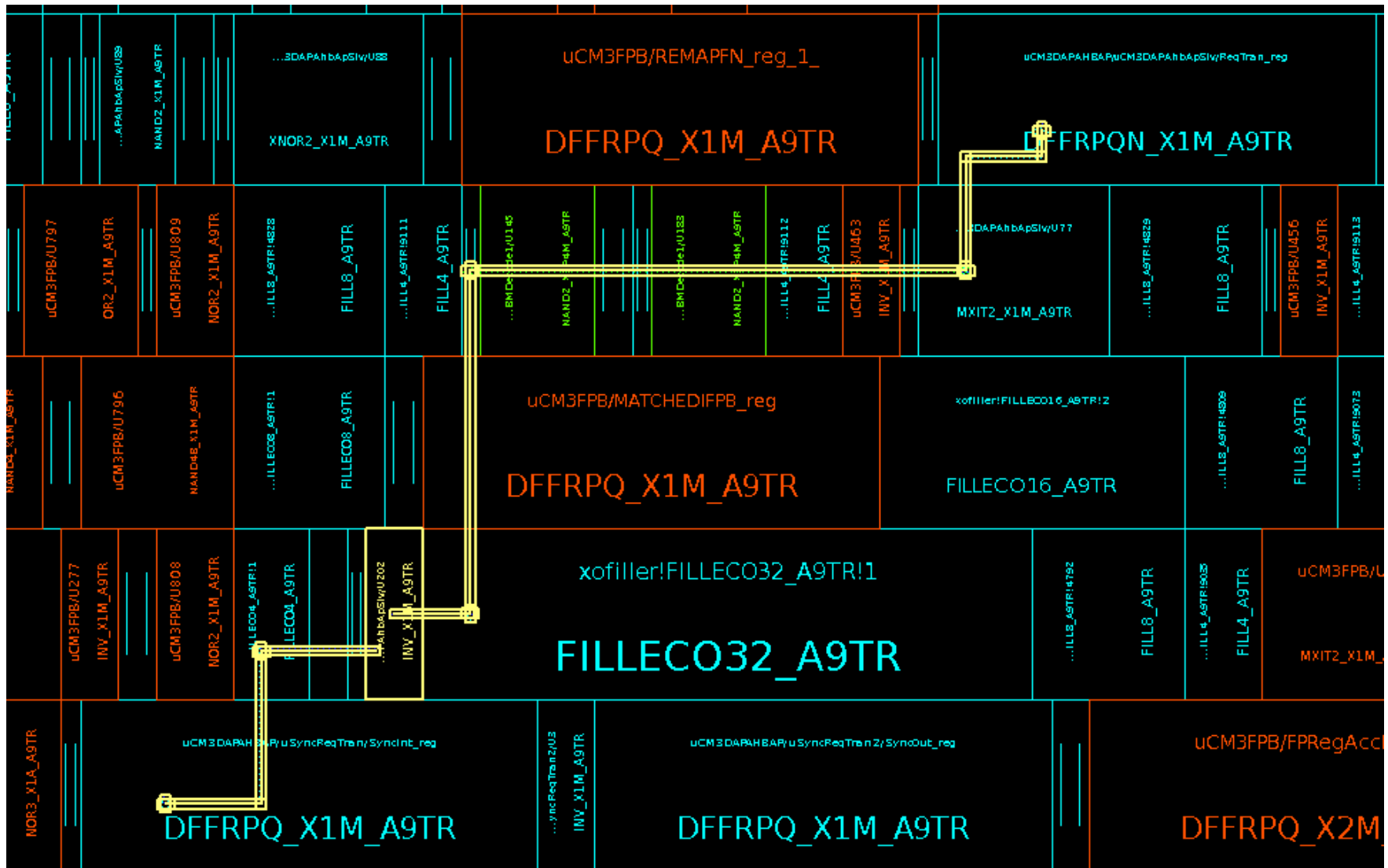


Figure: 1

Results

Before ECO		After ECO		
Leakage Power : 54.0406 uW		54.0373 uW		
Hold Violation :	data required time	1.20	data required time	1.21
	data arrival time	-1.10	data arrival time	-1.45
	slack (VIOLATED)	-0.10	slack (MET)	0.23

Conclusion

- ❑ ECO library is the perfect solution for Engineering Change Order
- ❑ The ECO Library would attract to those designers who have already struggled with spare methodology of ECO.
- ❑ The challenge in ECO library approach is there in the art of Fabric design such that all required functional cell can be realized with proper routability option for any ECO functional cells.
- ❑ Place the ECO filler in the design phase and metamorphosed them in real logic at the stage of Engineering Change Order
- ❑ No extra filler-leakage, no extra area required for ECO with ECO-library

Thanks!!...