



# Automated MIMCAP insertion solution for Turn-Around-Time Reduction

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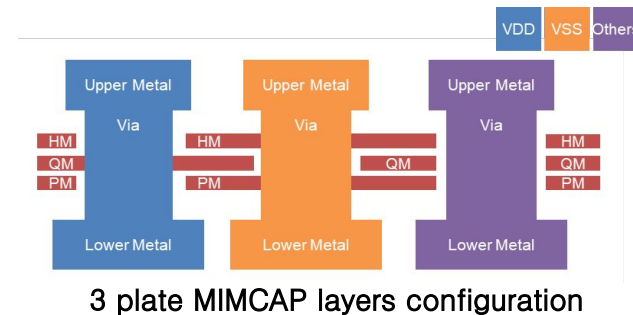
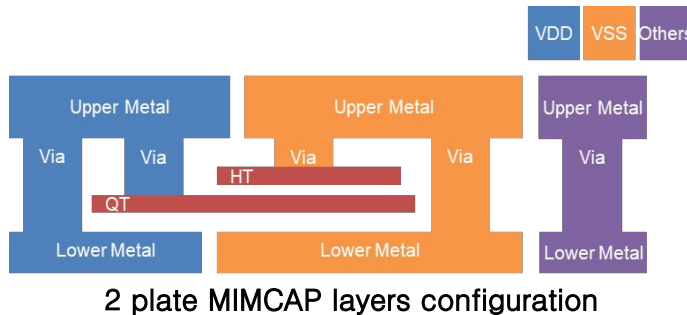
# Motivation

- **Why MIMCAP?**

- At lower process node, device density increases at high gigahertz frequency, simultaneous switching of densely packed devices can cause sharp fluctuations in voltage, current in power supply network, leading to sharp IR drops and noise which can give rise to SI and chip reliability issues
- MIMCAP(Metal-Insulator-Metal capacitance) layer can be formed between topmost and one below layers of process technology which can be put with very high density across whole core region

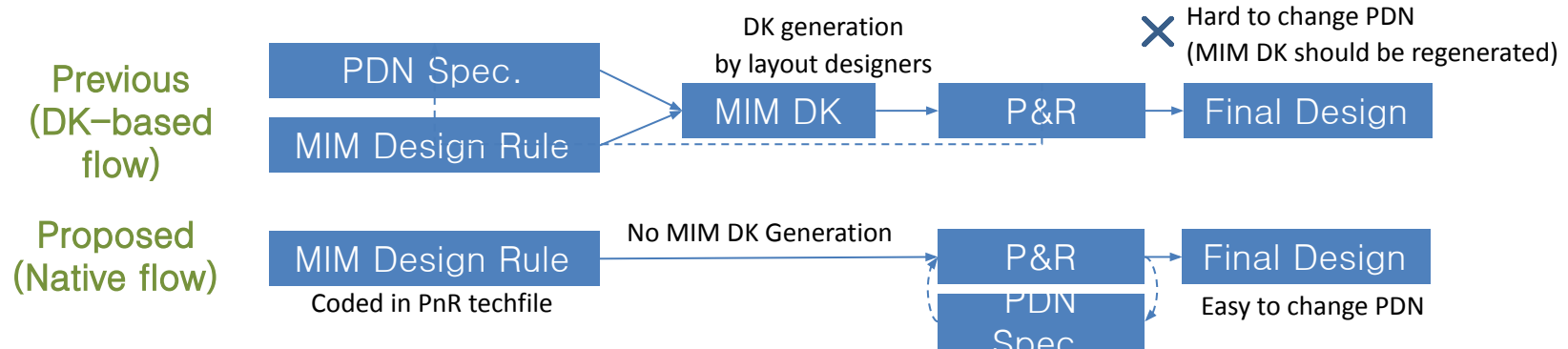
- **Basic type of MIMCAP**

- 2 plate MIMCAP : Single capacitor, needs additional PG vias to connect to PG grid
- 3 plate MIMCAP : Stacked capacitor, uses existing PG vias, and provide better capacitance



# Main Idea

- **Previous & proposed MIMCAP insertion method**



- **Previous method : DK-based**

- MIMCAP-cell that made as a cell-LEF unit have been used (It's similar with a BUMP-cell placement)
- It should be aligned with power-stripe locations to connect PG nets since it's a tile style
- In this cell-type MIMCAP, users must create a new MIMCAP cell whenever the power-plan layer and stripe-pitch changed

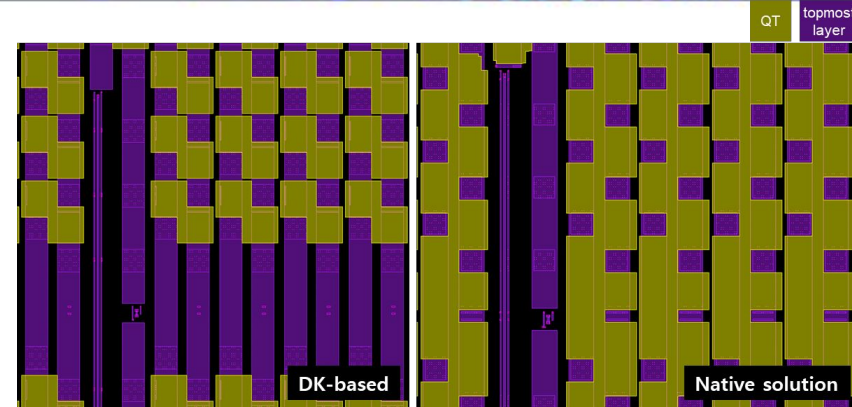
- **Proposed method : Native solution**

- Insert flexible polygon-type MIMCAP shapes by tool feature which was enhanced/developed by us
- The shape and area of MIMCAP can be inserted flexibly according to the PG nets
- We developed this native solutions with commercial EDA

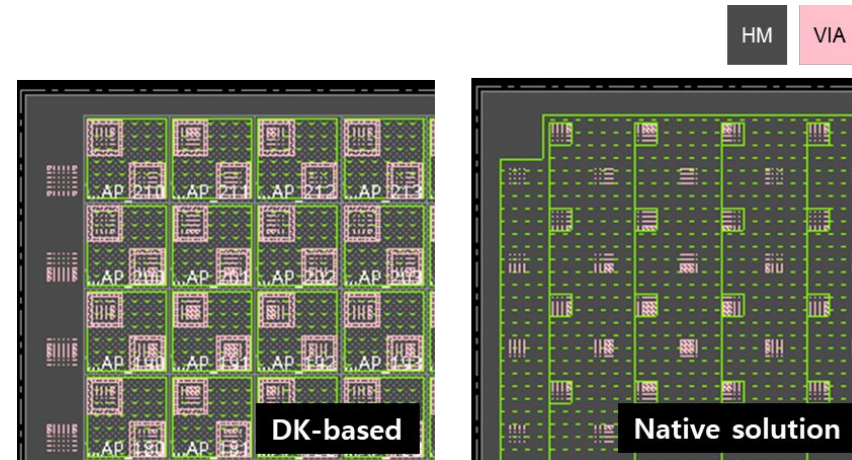
# Main Idea

- **MIMCAP insertion**

- MIMCAP layers can be inserted between topmost layer and (topmost -1) layer
- Previous(DK-based) method has splitted MIMCAP segments due to the limitations of the cell arrangement method, therefore, smaller MIMCAP area is inserted than the proposed method because native solution can draw MIMCAP layers without split
- Furthermore, if PDN is configured irregularly, the proposed method can draw MIMCAP to areas where DK-based cannot cover, which increases efficiency



2 plate MIMCAP insertion comparison between previous(DK-based) and proposed method

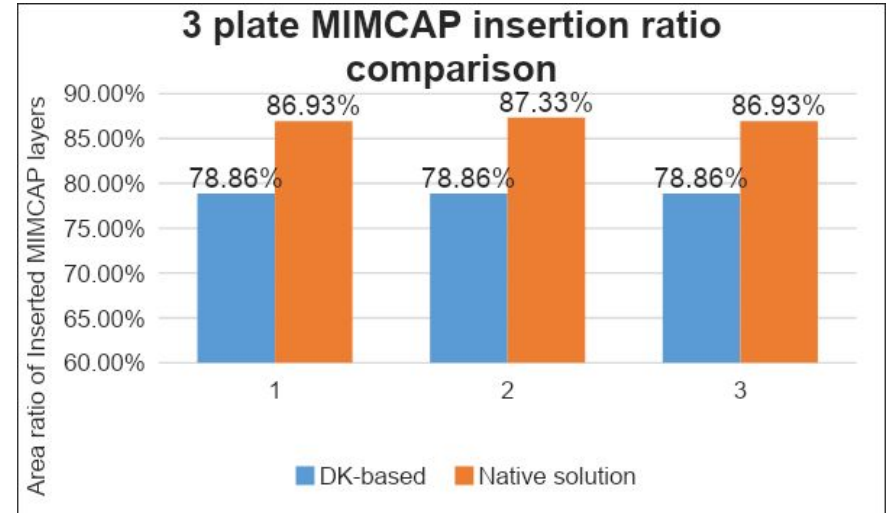
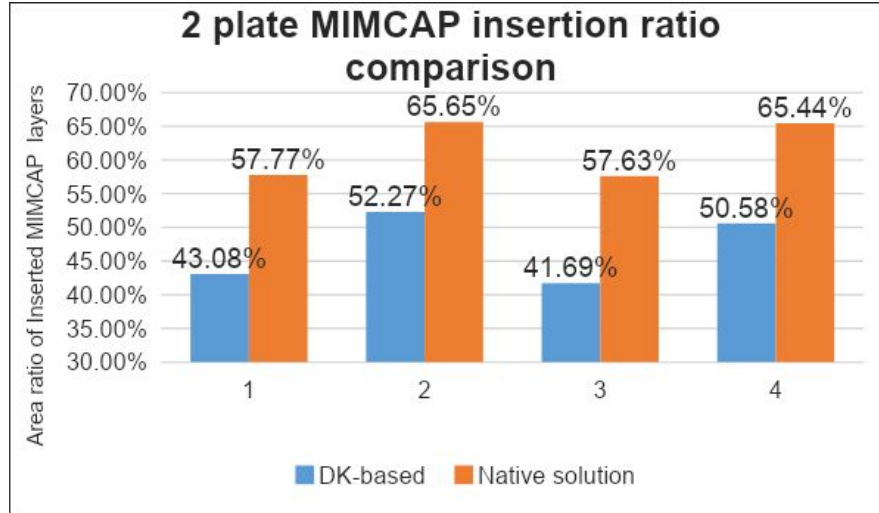


3 plate MIMCAP insertion comparison between previous(DK-based) and proposed method



# Evidence

## • Evaluations



- **We evaluated this new insertion feature based on some industrial design by comparing previous insertion method(DK-based)**
  - New approach for inserting MIMCAP shows more insertion area than DK-based insertion method
  - If top two layers were used for routing purpose(not a power purpose only) such as clock routing, the benefits of this automation flow will be greater because those two layers are more irregular
  - Furthermore, this automated MIMCAP insertion flow can save a lot of development time, as no special MIMCAP cells need to be created

# Summary

- **Conclusion**

- This novel automated MIMCAP solution works seamlessly in PnR tool which is much easier for insertion of large capacitances to strengthen PG mesh
- More capacitance area can be achieved compared to DK based approach
- Proposed solution also requires less development time as this method is automated while DK based method needed to change MIMCAP cell every time a change in PG grid occurs
- Therefore, huge development cost can be saved with better QoR