

# Sub-wavelength Lithography: How will it affect your Design flow?

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# DISCLAIMER

- I am not a Lithographer
- It's the k-factor, not the wavelength

# CONCLUSIONS

- Manufacturing processes will drive huge increases in layout manipulation.
- Some of this can be hidden from designers, but will impact tapeout TAT.
- Some cannot be hidden, and will require new tools and methodologies
- In both cases, the “software processes” must be part of new technology qualification

# Driving Factors

- Optimizing process window (vs. optimizing process-nominal image)
- Manufacturing-aid non-functional shapes ("fill and cheese")
- From OPC to PPC
- Strong PSM
- Increasing influence of interconnects
- Tightening of ACLV requirements
- End of the Mask-makers Holiday
- Design for Yield
- Increasing diversity of technology and rate of its introduction
- Emergence of SOCs (Systems On a Chip)

All drive more manipulation of layout shapes -- the "data process" -- to enhance Manufacturing processes downstream.

# Some Data Processes Can't be Hidden from Designers

- Some must be exposed and modelled (e.g., fill)
- Hiding some would give up too much (e.g., PSM groundrules)

Requires qualitatively new groundrules, e.g.:

- Density rules
- Process window rules (e.g., 50/50 line space duty cycle)

Requires new tools to help designers satisfy groundrules:

- For custom layout, optimization and migration tools
- For synthesized layout, “Phase-smart”, “yield-smart”, etc. P&W

# Some Data Processes *can* be hidden from Designers

- WYDIWWF, e.g. “classic” OPC
- But this occurs at worst time (tape-out) when layouts are most complex (full chip)

Ownership issues:

- Who pays for computation (time and \$\$\$)?
- Who pays for errors?

Drives interesting issues for us (tool providers):

- Improving performance (parallel, incremental)
- Improving reliability

# New Technologies...

- ...cause qualitative changes in rules and tools
- ...cause quantitative increases in computation
- ...cause migration of existing layouts

New process effects must be characterized

- Need tools/methodologies for test site development
- Need data analysis/modelling/optimization tools (e.g., to select OPC that maximizes process window)

***Technology Qualification must start including qualification of "data processes"***