



# Introduction to NanoPoint

Brightfield Inspection

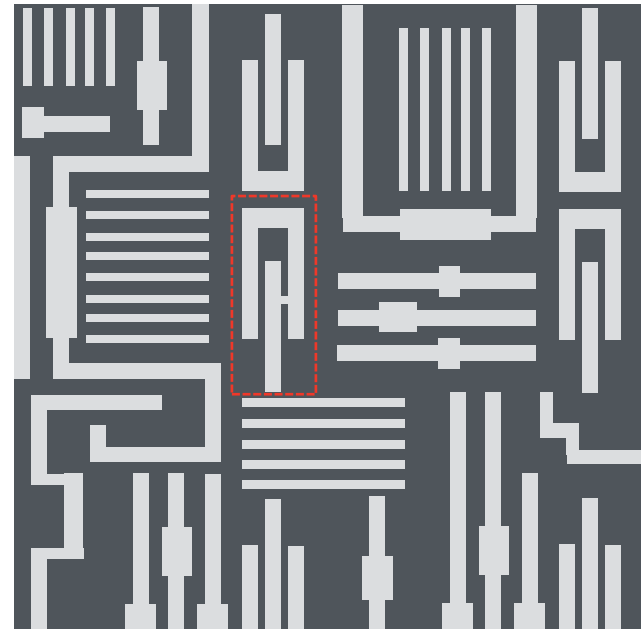
*Sensitivity enhancement for the most challenging defect types*

Wafer Inspection Division



# NanoPoint: Extending Optical Inspection

- Patented technologies extend optical inspection to detect very tiny defects
- Focuses inspection on yield-critical pattern locations
- Defect discovery and process monitoring with unprecedented speed and precision
- Runs in parallel with traditional defect inspection
- Available as an option on 29XX Series optical patterned wafer defect inspection systems

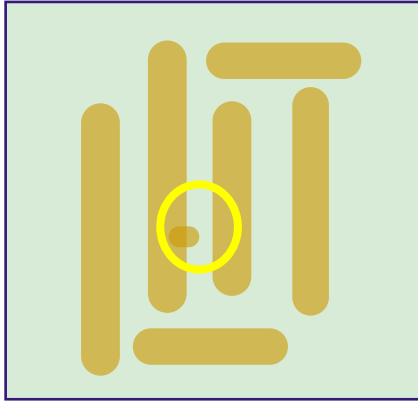


# Shrinking Design Nodes

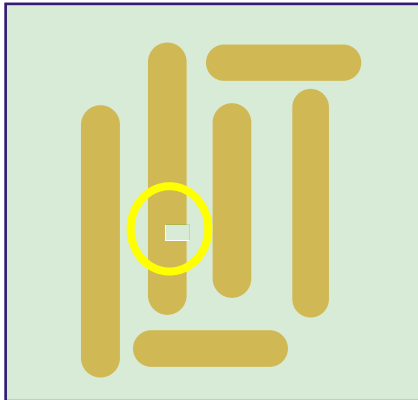
Nuisance at Larger Design Rules is Defect of Interest at Smaller Design Rules

**Yesterday**

Non-killer Cu Protrusion

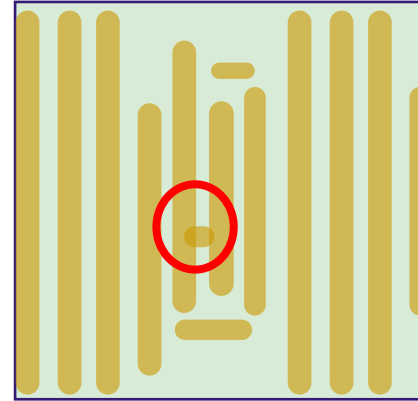


Non-killer Cu Intrusion

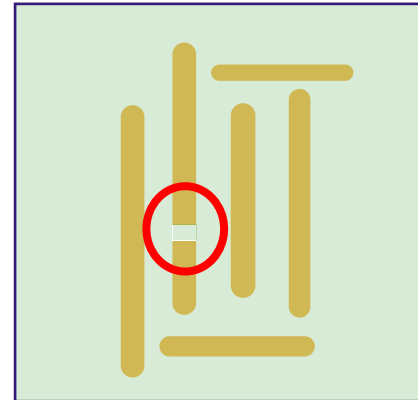


**Today**

**Killer** Cu bridge due to denser geometry



**Killer** Cu Line Open due to smaller DR

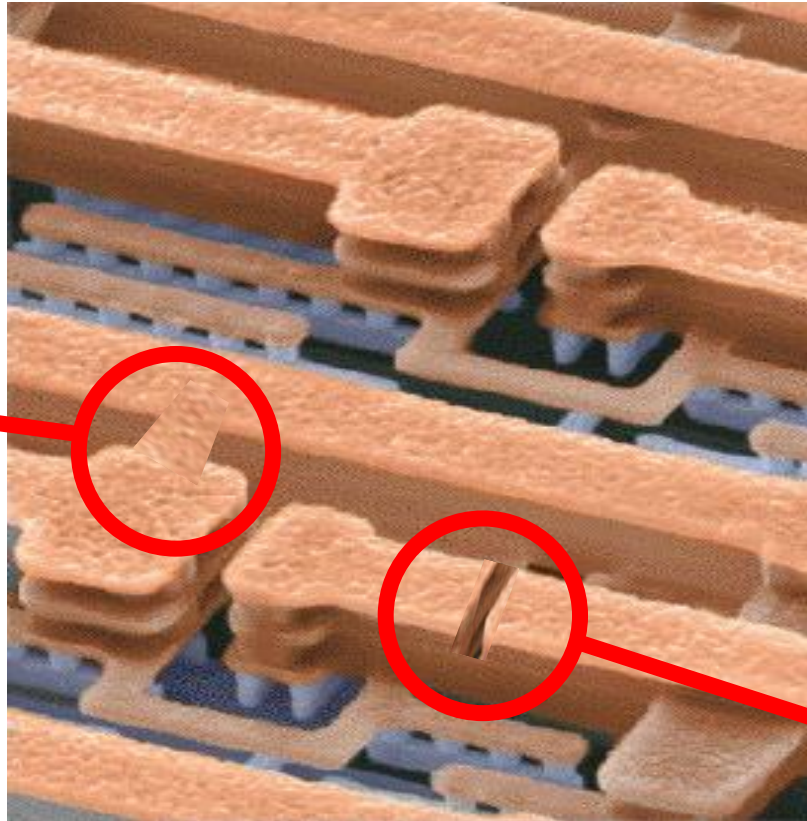


# What are some of these defects?

## BEOL Yield Killing Defects

Bridge due to design weak point or CMP dishing -

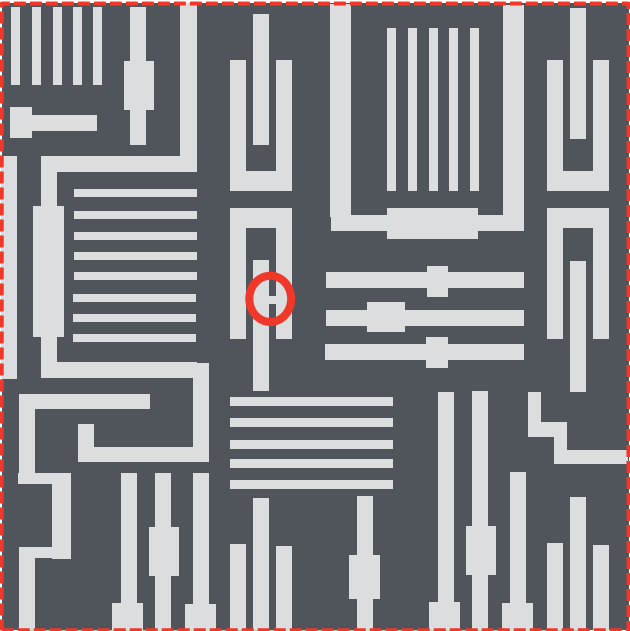
Device fails due to short circuit



Line open due to design weak point or contaminated process tools –  
Device fails due to open circuit

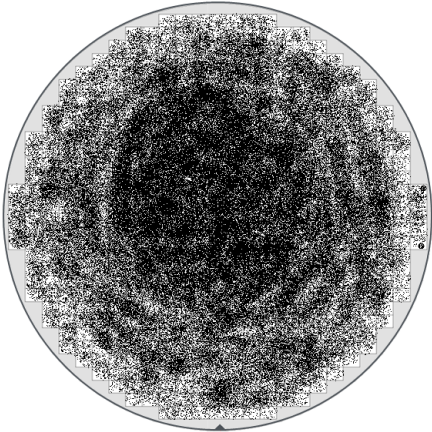
Original image from <http://materials.usask.ca/photos/>

# Challenges in detecting these defects



 Detection Frame     Defect of interest

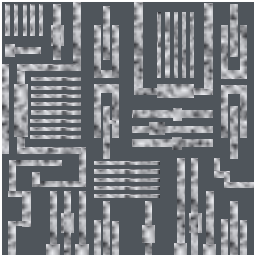
**Goal:** Detect and report yield-critical defects that can indicate design issues or process drift



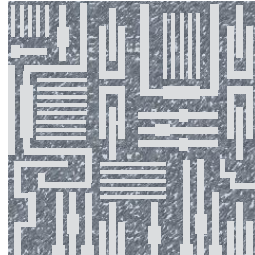
**Challenge:** Traditional inspection of all die areas can result in millions of defects per wafer inhibiting identification of the most critical defects



Line edge roughness



Current-layer grain



Previous-layer noise

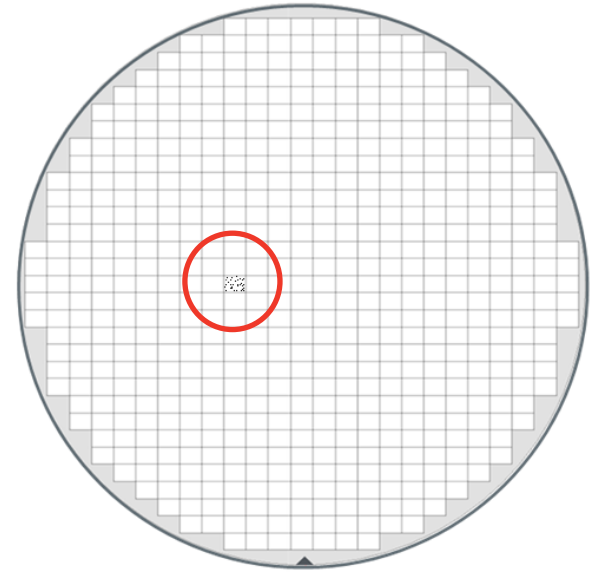


Color variation

**Reason:** Process-related noise sources can produce high nuisance rates or require less sensitive inspection settings

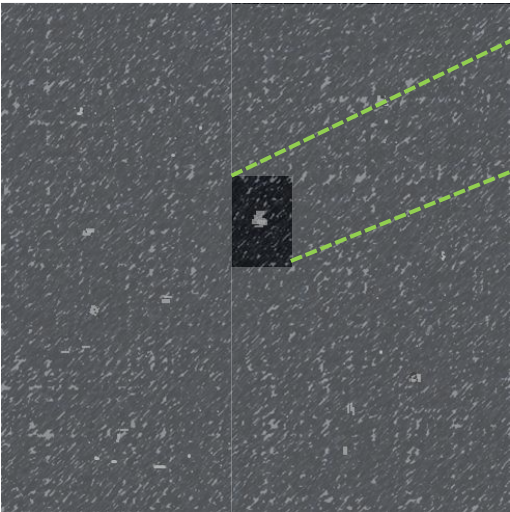
# Alternate Method of Defect Discovery

- e-Beam inspection of suspected critical patterns
- Slow inspection: one die on one wafer in seven days
- Huge manual review burden
- Long cycle time for defect discovery, sourcing, resolution

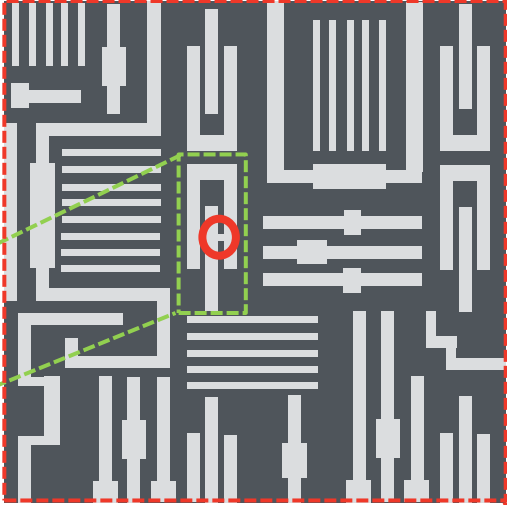


# NanoPoint: Signal-to-Noise Benefit

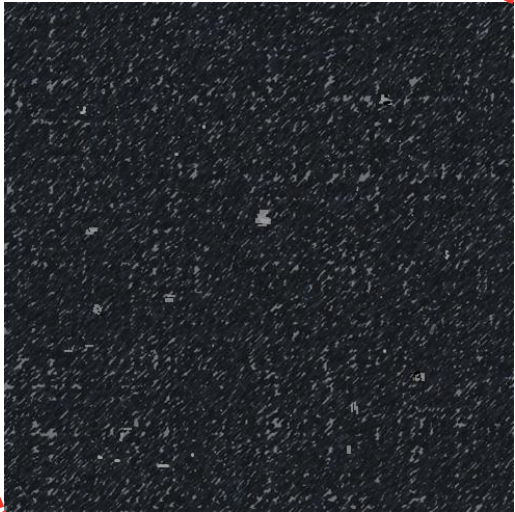
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Targeted inspection of critical patterns greatly improves signal-to-noise for yield-critical defects



Traditional

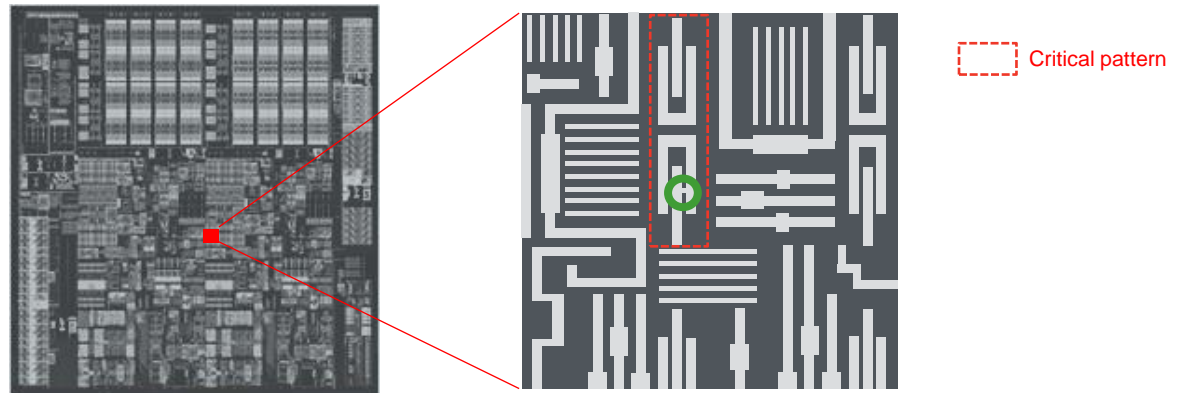


Strong defect signal, but overwhelmed by noise

# How do you know where to look?

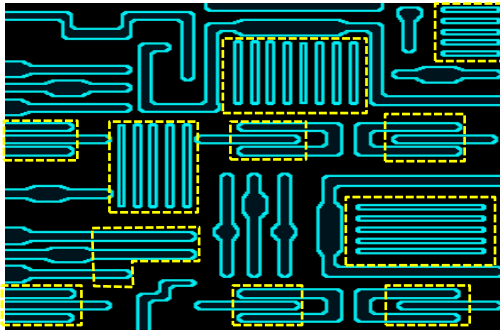
Two ways:

- Use imaging capability of optical inspector (29XX) to find patterns of interest



[http://www.intel.com/pressroom/archive/releases/2010/20100107comp\\_sm.htm](http://www.intel.com/pressroom/archive/releases/2010/20100107comp_sm.htm)

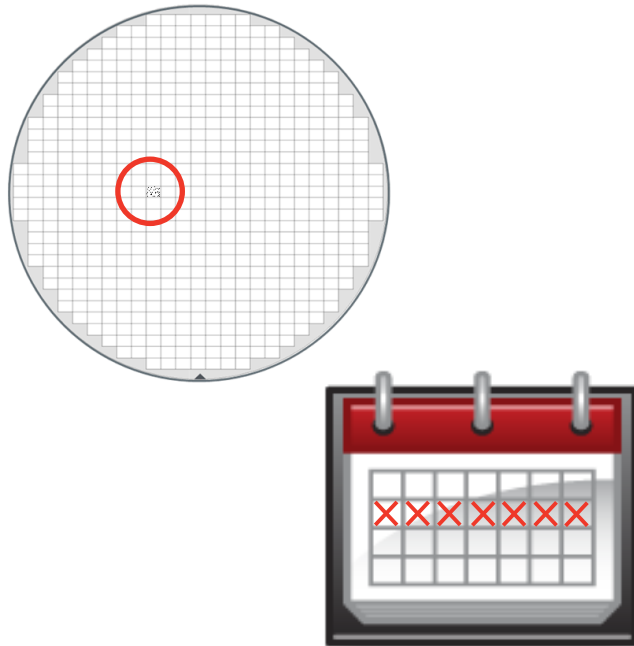
- Use design information to find patterns of interest





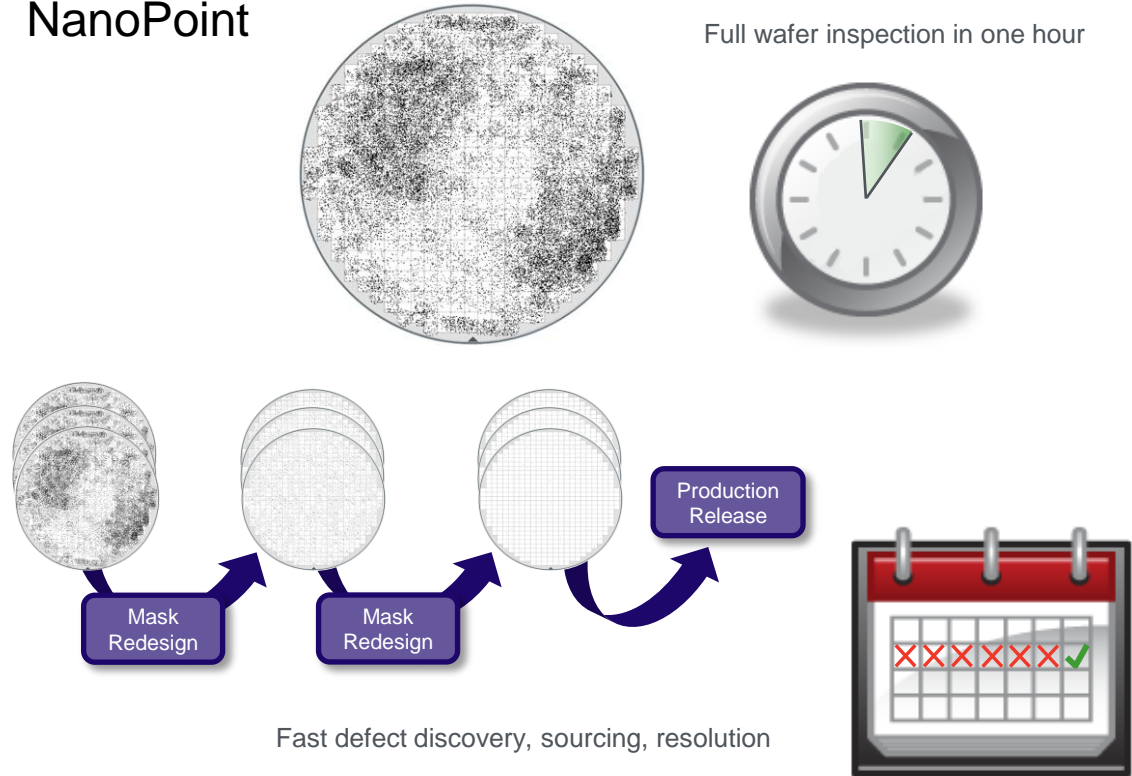
# NanoPoint versus Alternate Method: Defect Discovery

Alternate



- e-Beam inspection: Several orders of magnitude slower, impacting sampling
- Huge manual review burden
- Long cycle time for defect discovery, sourcing, resolution

NanoPoint

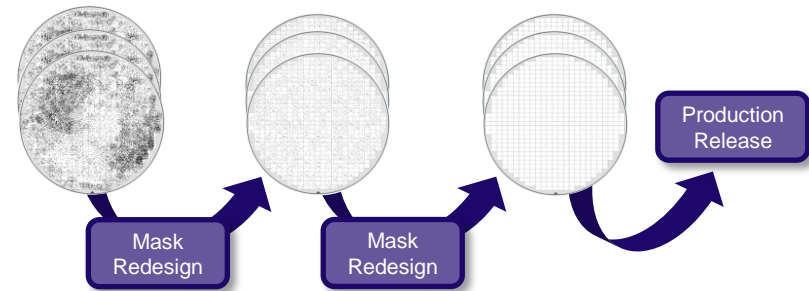


Fast defect discovery, sourcing, resolution

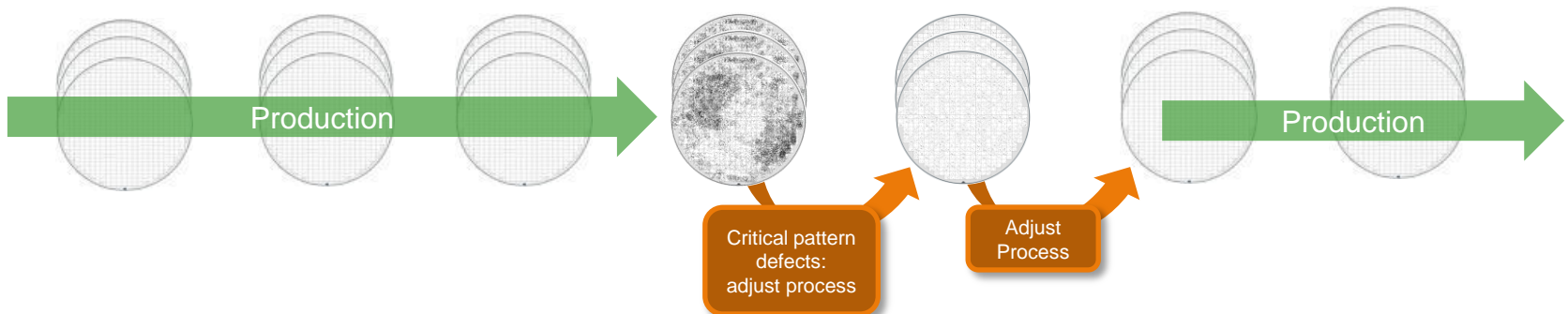
- Optical inspection speed enables full wafer data collection from multiple wafers and multiple lots
- Inspection results are populated with defects of interest
- Wafer-level signatures

# NanoPoint Use Cases

- Defect Discovery: Accelerated identification and resolution of design issues during chip development



- Process Monitor: Early warning of process drift through high sensitivity production monitoring



# e-Beam Review Remains Critical



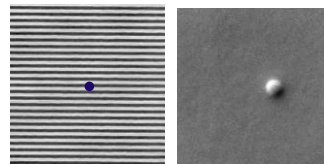
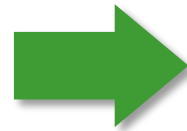
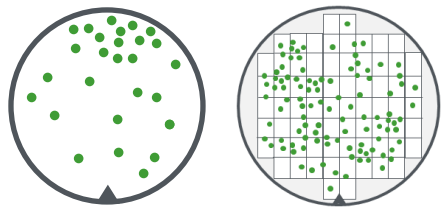
**29XX**  
Optical Patterned Wafer Inspection



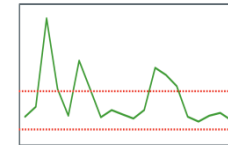
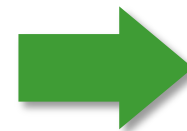
**eDR-7100**  
e-Beam Defect Review & Classification



**Klarity**  
Defect Data Analysis and  
Management System



High Resolution Defect Images



Trend Chart

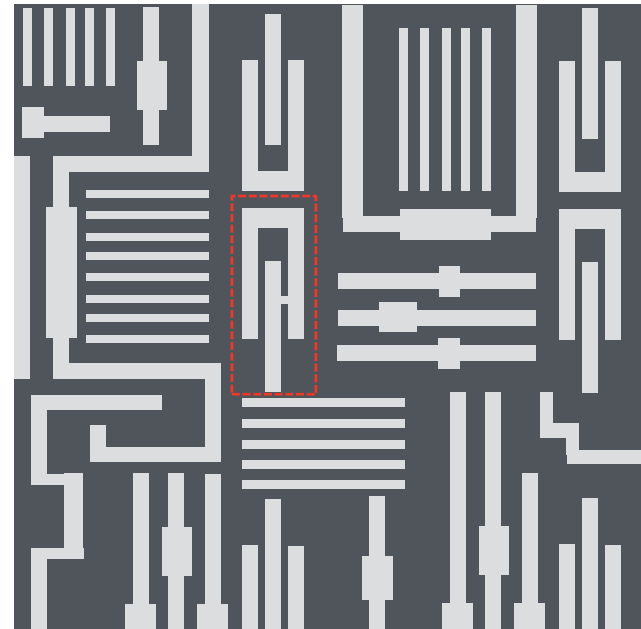


Defect Pareto

- Ability of eDR-7100 to communicate quickly and accurately with NanoPoint-enabled 29XX remains critical to identify defect type

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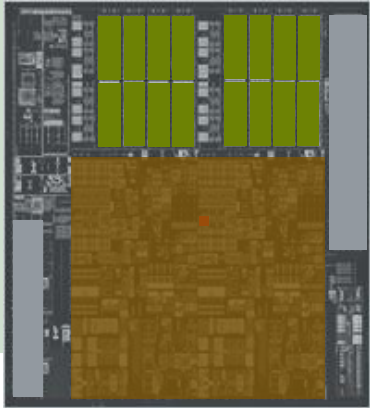




# NanoPoint: Concept

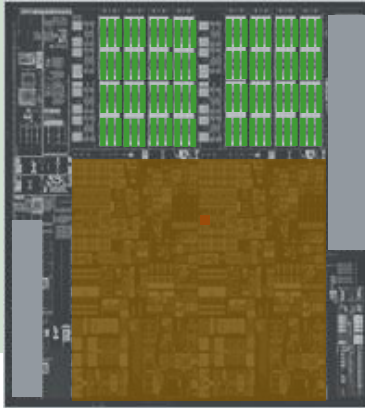
Care areas use different thresholds to maximize sensitivity across varying patterns within the die

Manual



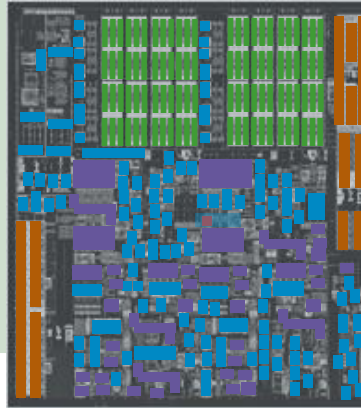
User manually draws care areas: tedious process with subjective placement

Assisted



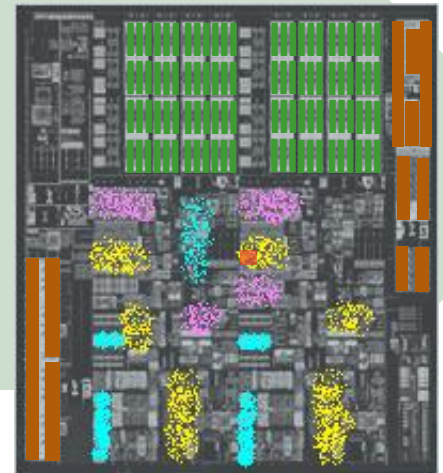
Algorithms find and draw care areas for embedded SRAM structures

Design-aware



Design information leveraged to generate thousands of small care areas – grouping similar patterns

NanoPoint

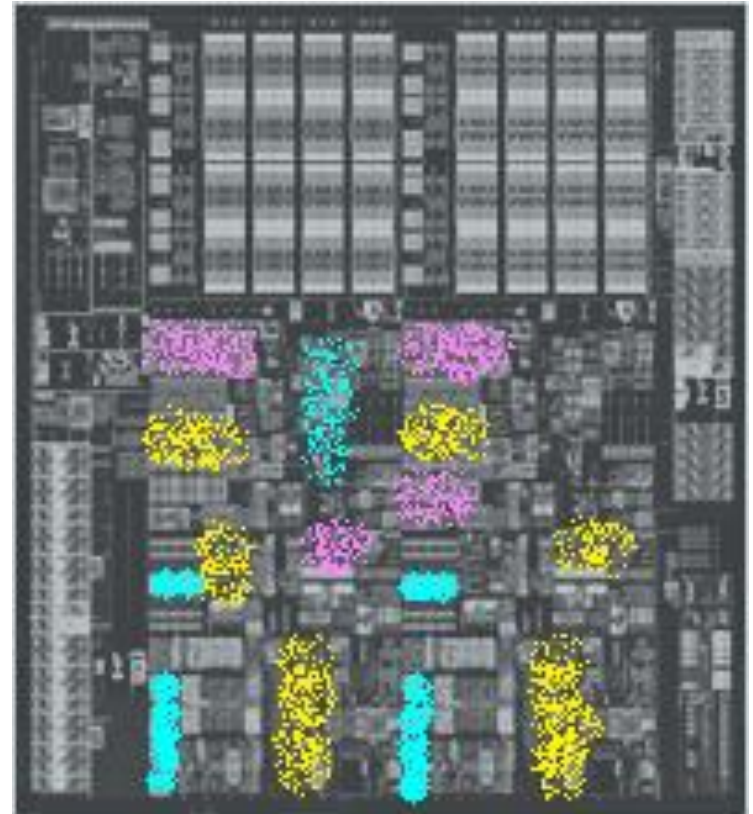


Automatic generation of millions of very tiny care areas based on user-defined patterns of interest

Original image from [http://www.intel.com/pressroom/archive/releases/2010/20100107comp\\_sm.htm](http://www.intel.com/pressroom/archive/releases/2010/20100107comp_sm.htm)

# NanoPoint

- Innovation using precise pattern information focuses inspection resources
- Defect discovery and monitoring with unprecedented speed and precision
- Can be run in parallel with traditional defect inspection
- Available as an option on 29XX Series optical wafer defect inspection systems



Original image from [http://www.intel.com/pressroom/archive/releases/2010/20100107comp\\_sm.htm](http://www.intel.com/pressroom/archive/releases/2010/20100107comp_sm.htm)