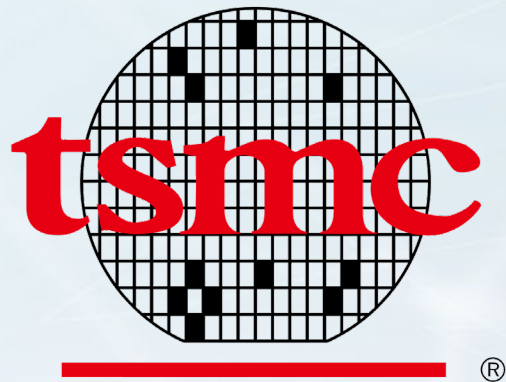




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Integrated Solution for HPC Testing in AI Era

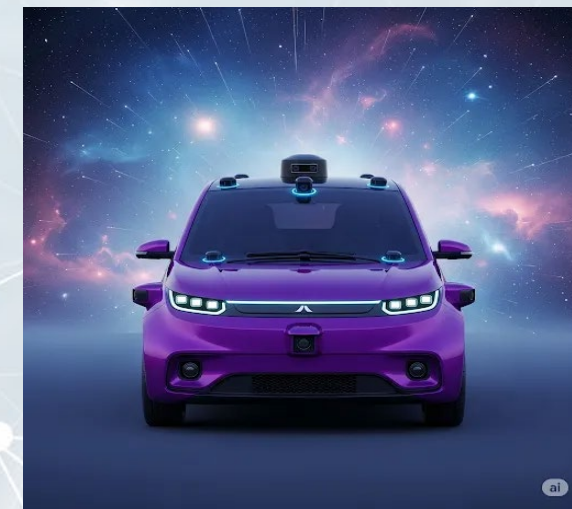
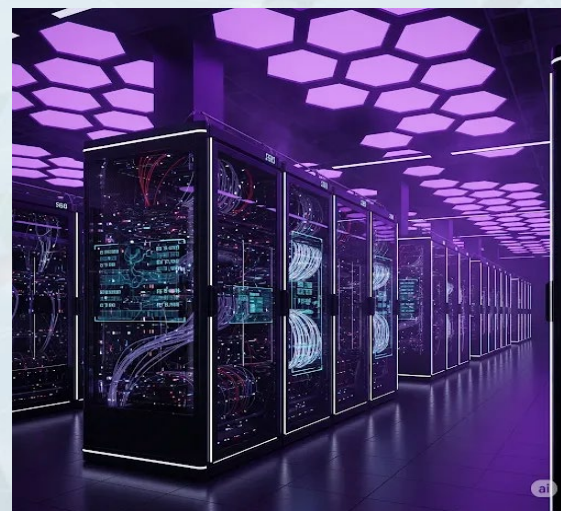
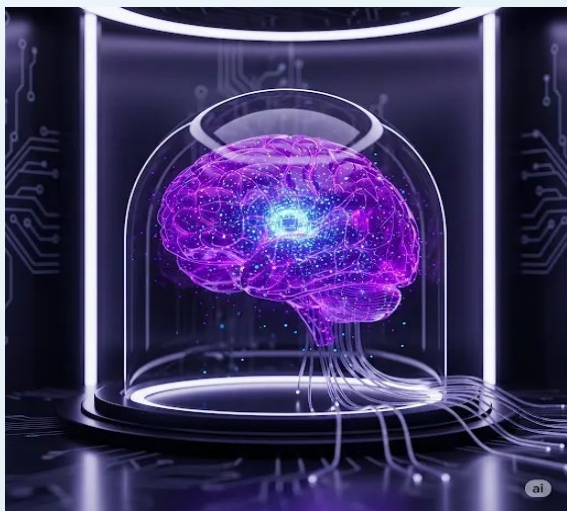


Kenny Tang
Oscar Lee

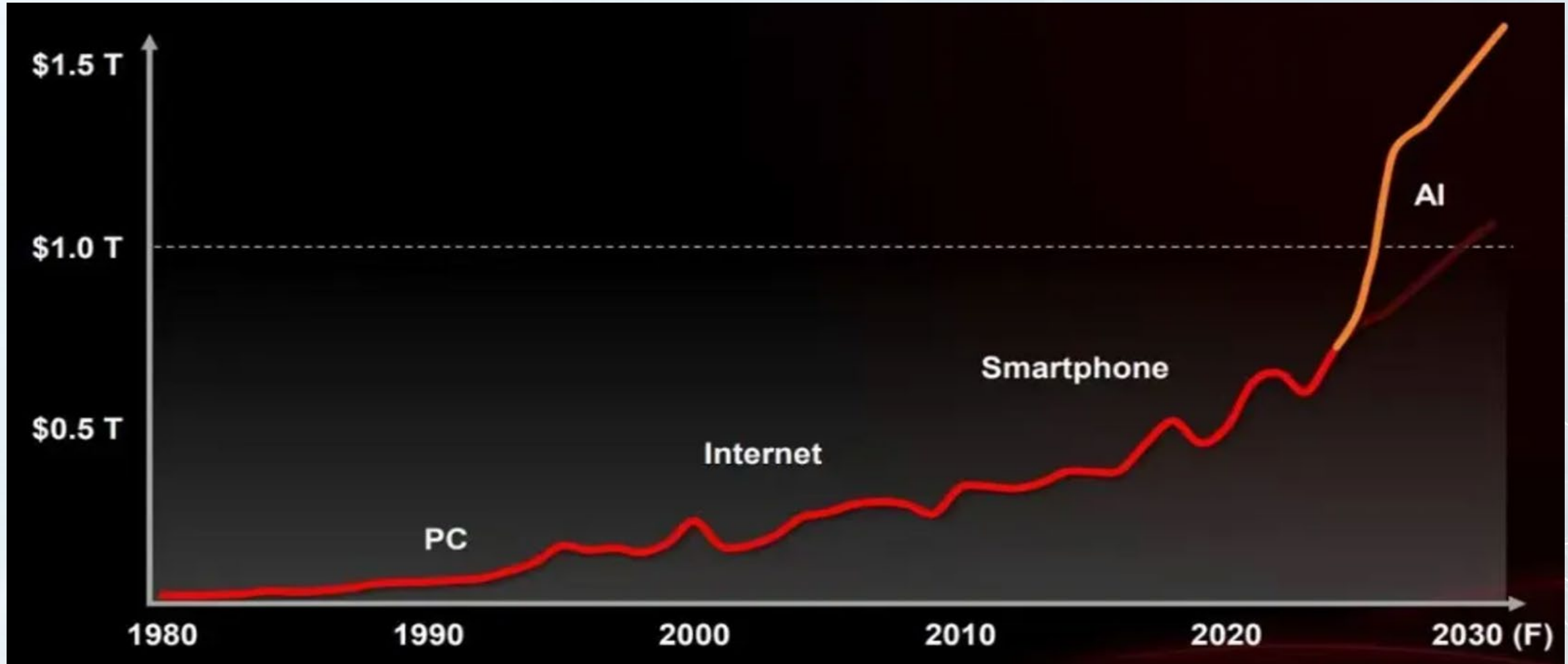
Overview

- **Introduction**
 - Product Roadmap
 - AI Technology Platform Testing and Challenging
- **Integrated Solutions for Thermal**
 - Uniform Current Distribution (UCD)
 - Thermal Dissipation Structure (TDS)
 - Active Temperature Control
- **Summary**

AI is now everywhere



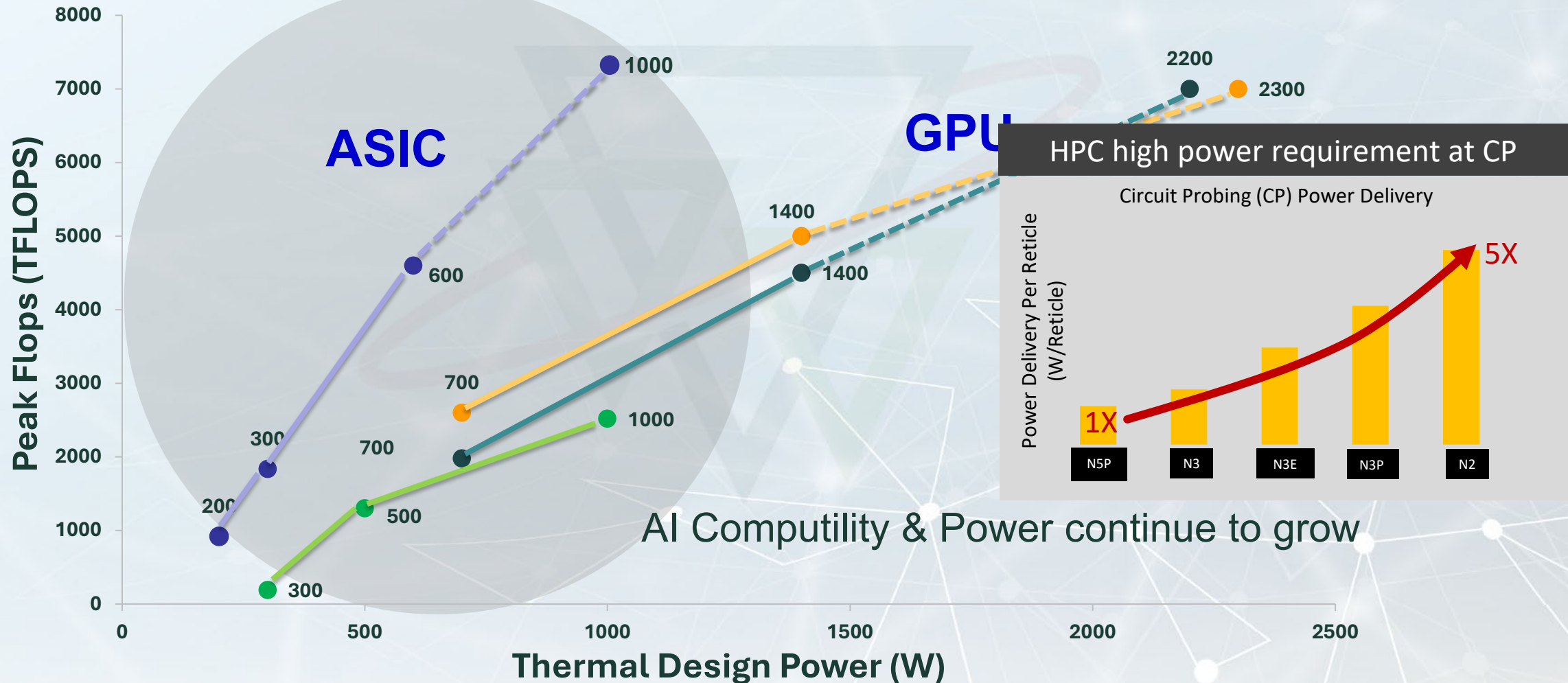
Semiconductor \$1T Milestone Accelerated



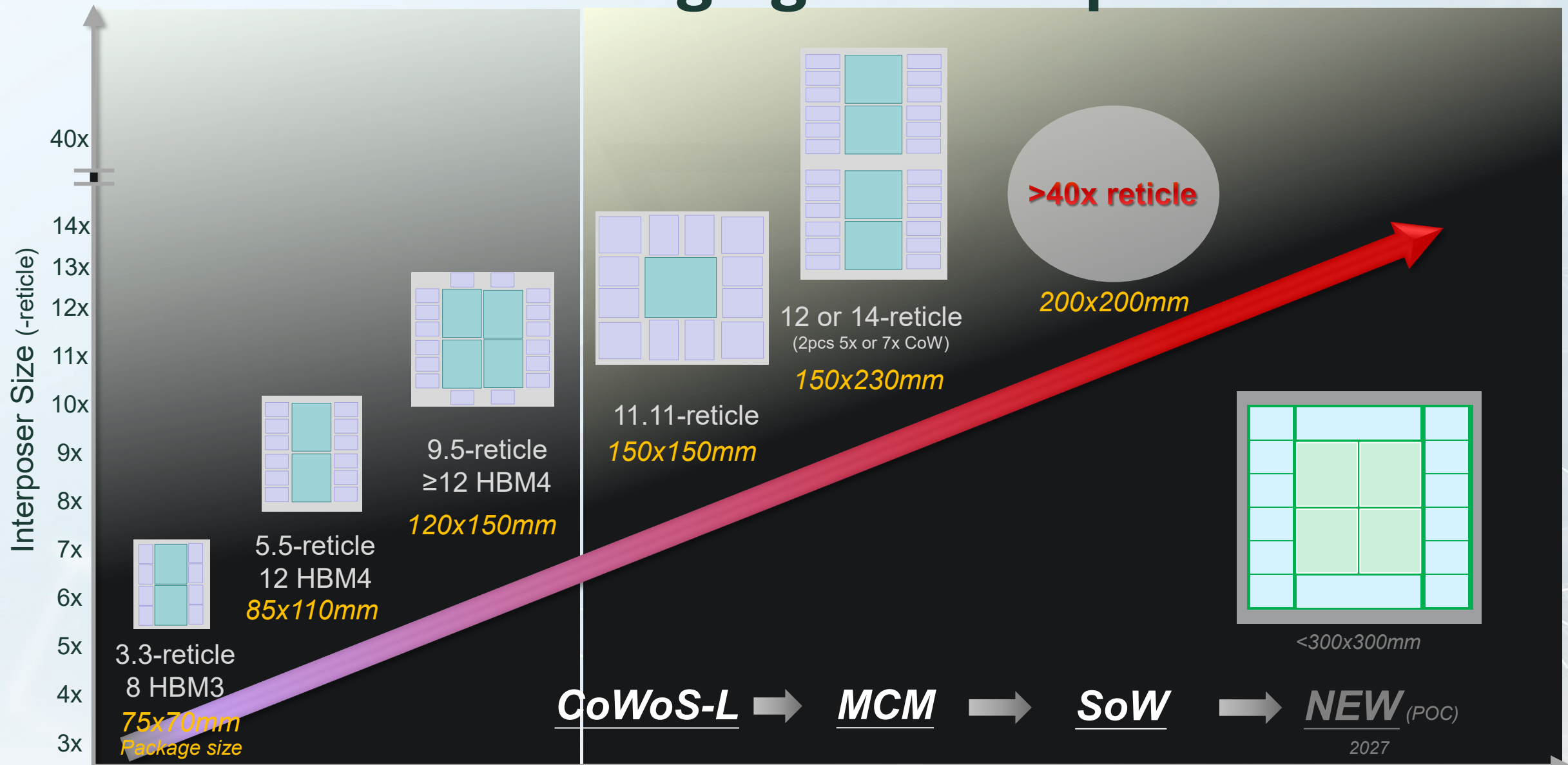
Source: TSMC 2026 Symposium

HPC Power Trend

HPC Product Trend (TDP vs Peak Flops)



Packaging RoadMap

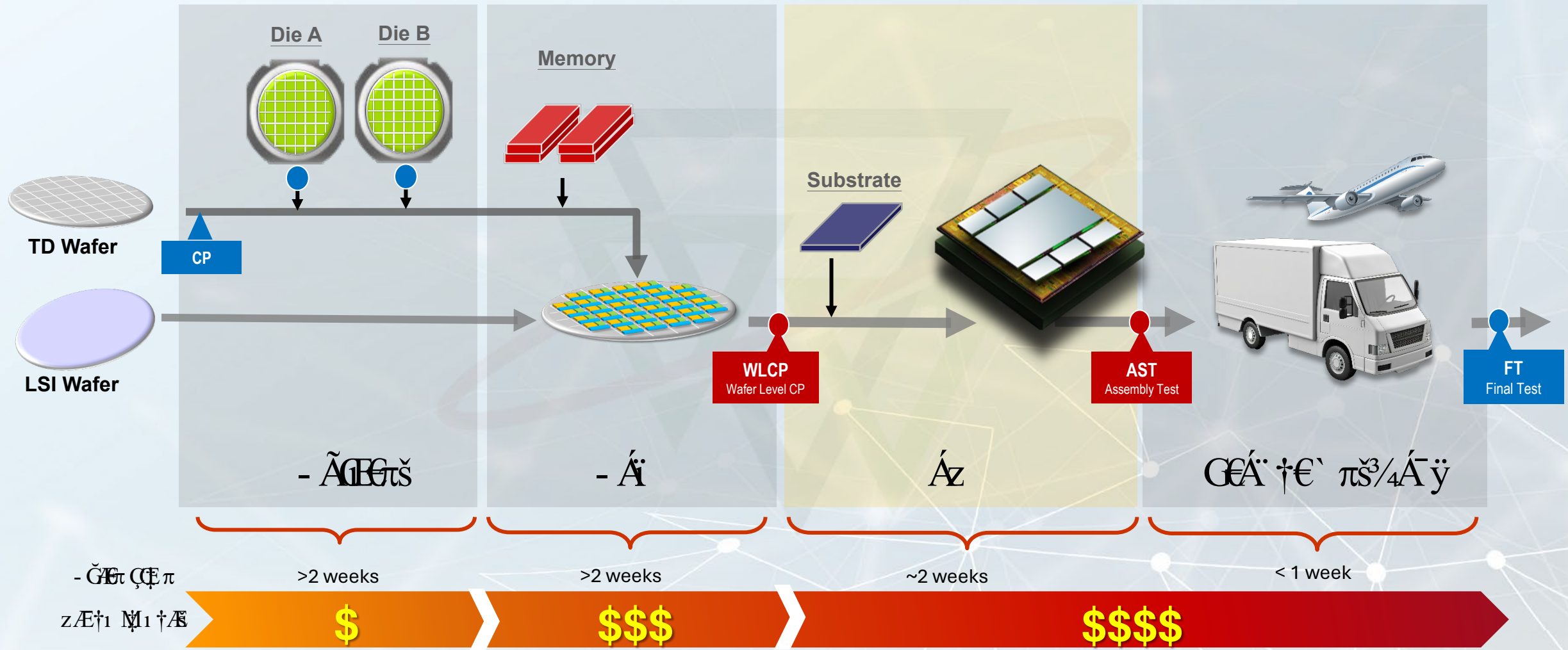


Now

SWTest 35th Anniversary | Carlsbad CA, June 8 – 10, 2026

Security C - TSMC Secret

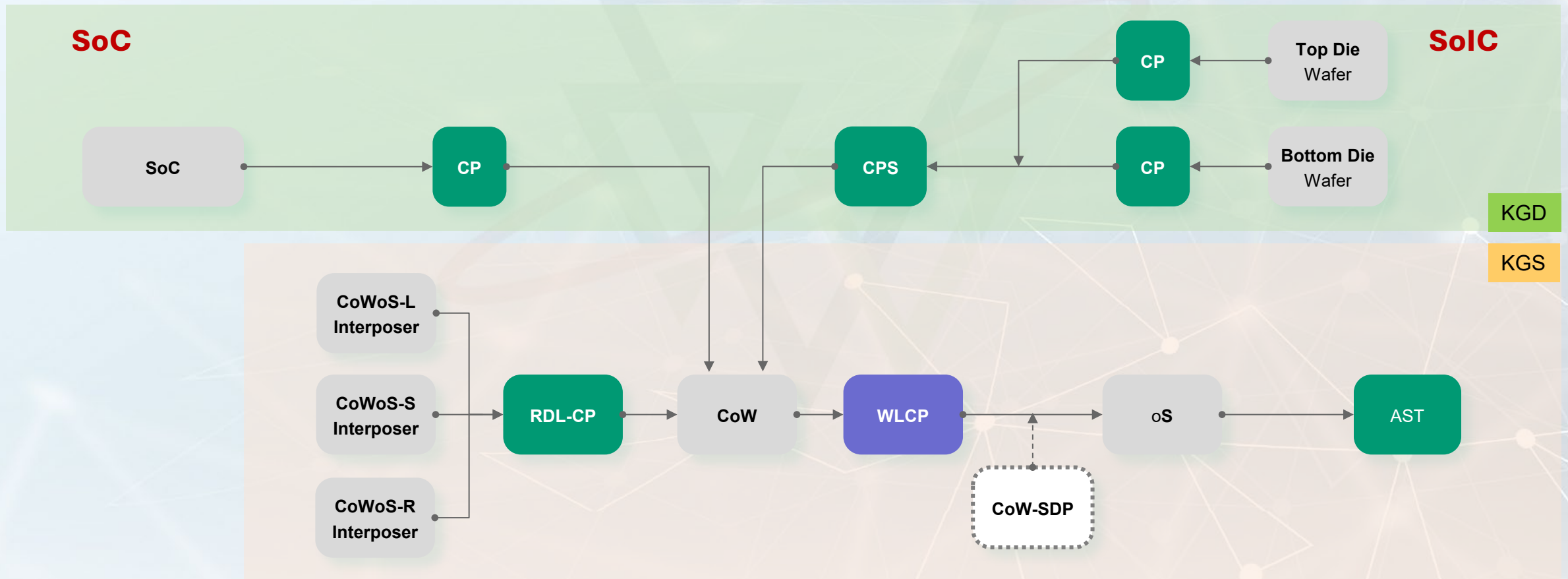
CP Testing for Early Detection



** TD: Top Die
LSI: Local Silicon Interconnect

Distributed Test

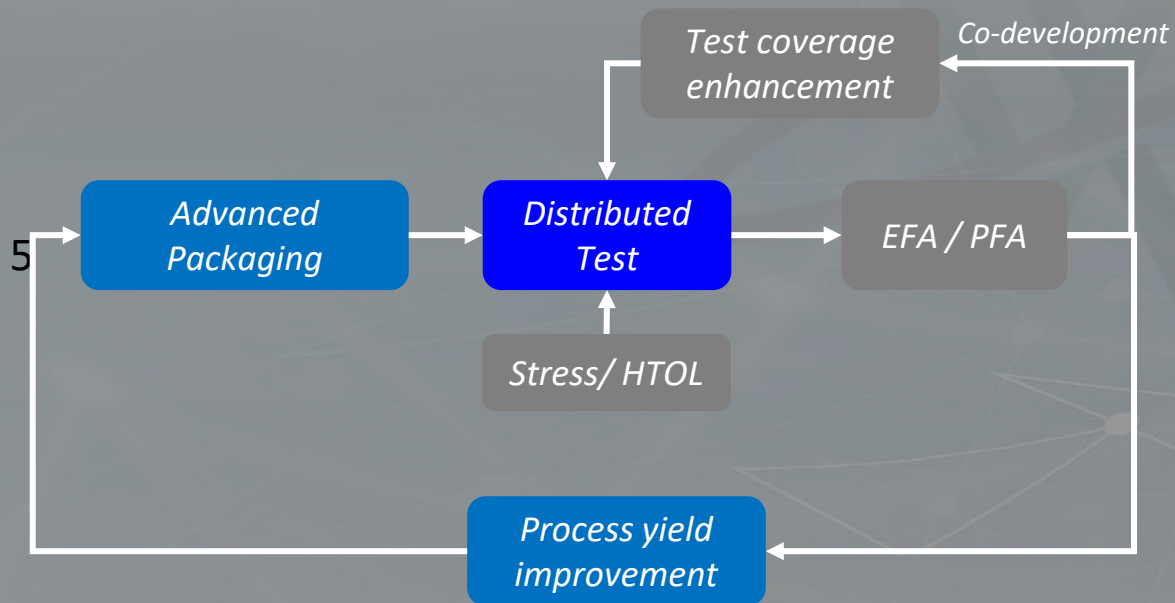
- Boosting test coverage through distributed test architectures, including CP (CP/LSI/IVR/RDL) for KGD, CPS for KGS, AST for assembly quality



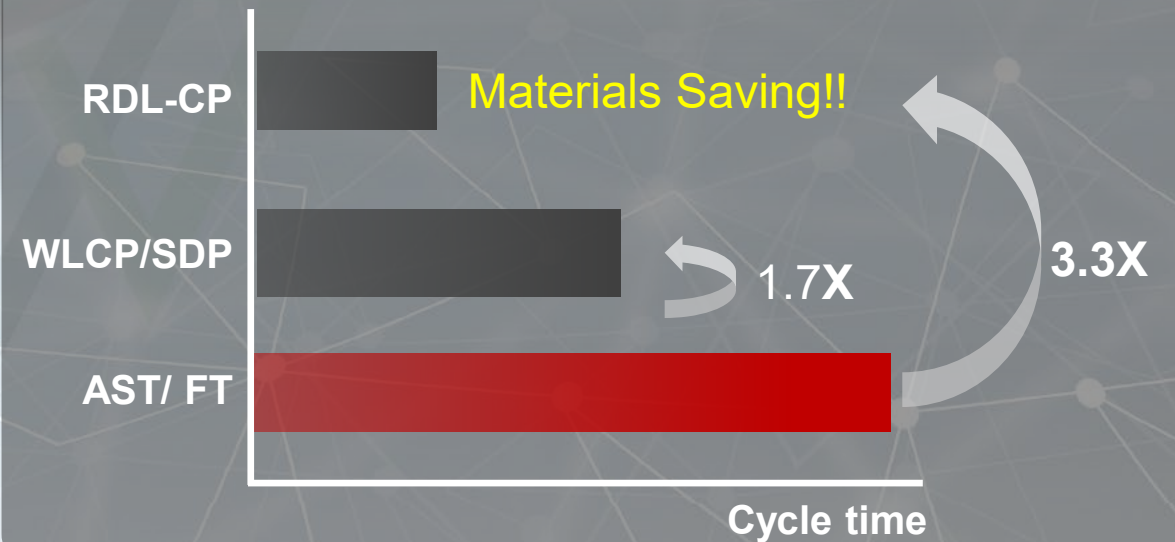
Fast and Cost-effective Testing

- Accelerate DPPM reduction by collaborating with customers and fab.
- Early process excursion detection and cost saving.

Fast Yield Learning Flow

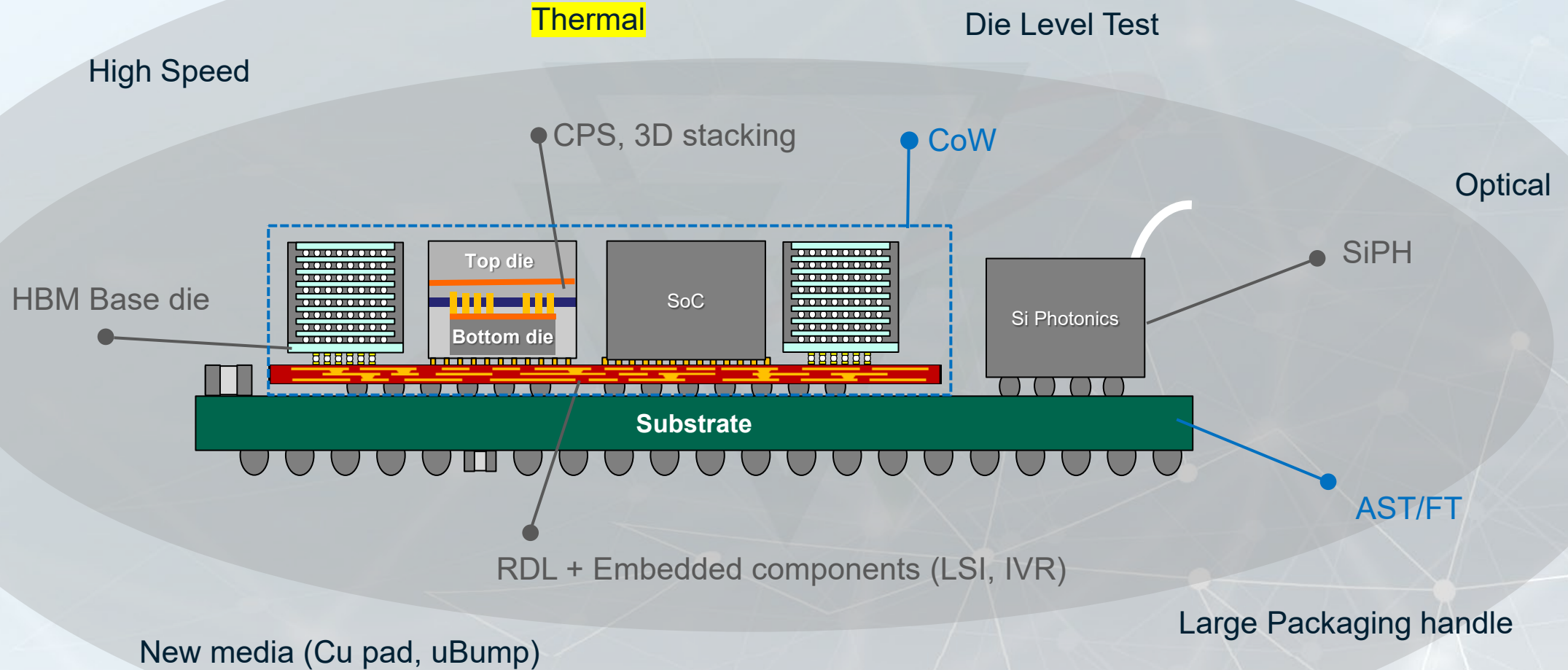


Fast Stop-n-Fix



AI Technology Platform Testing

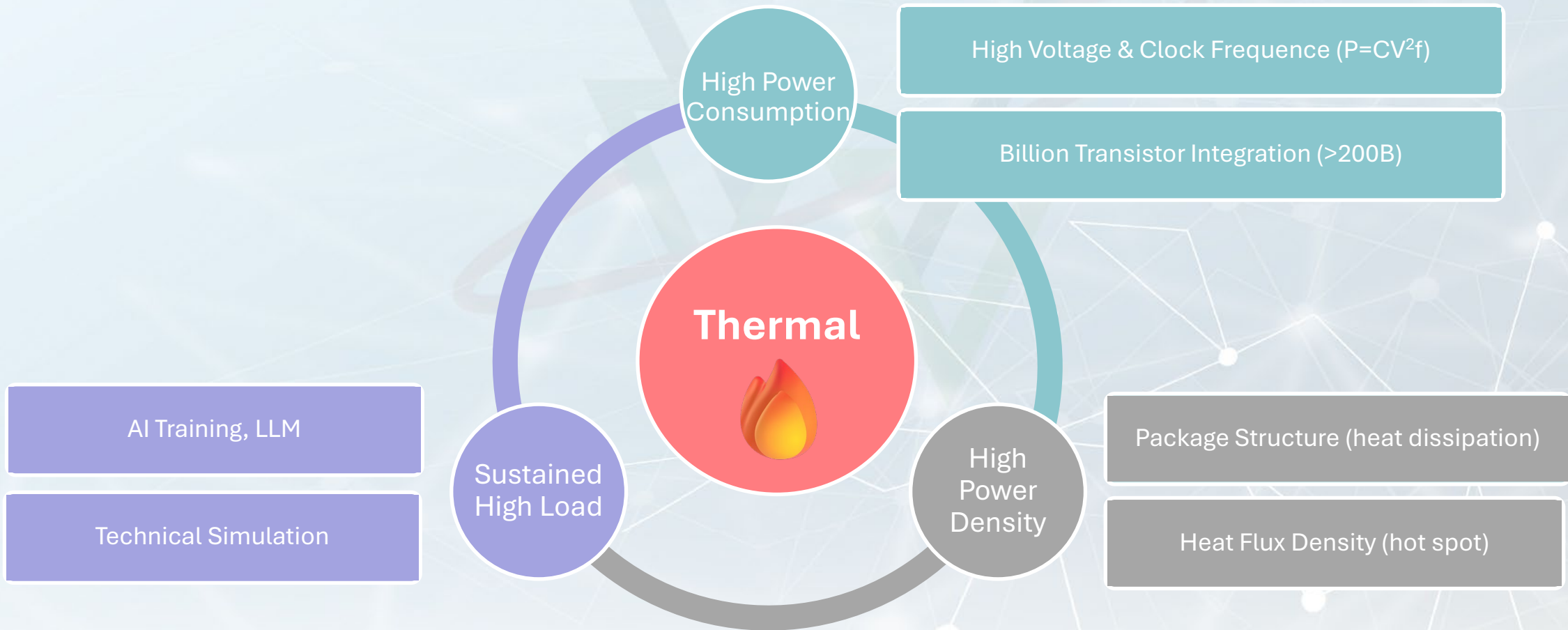
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HPC Thermal Management: A Necessity

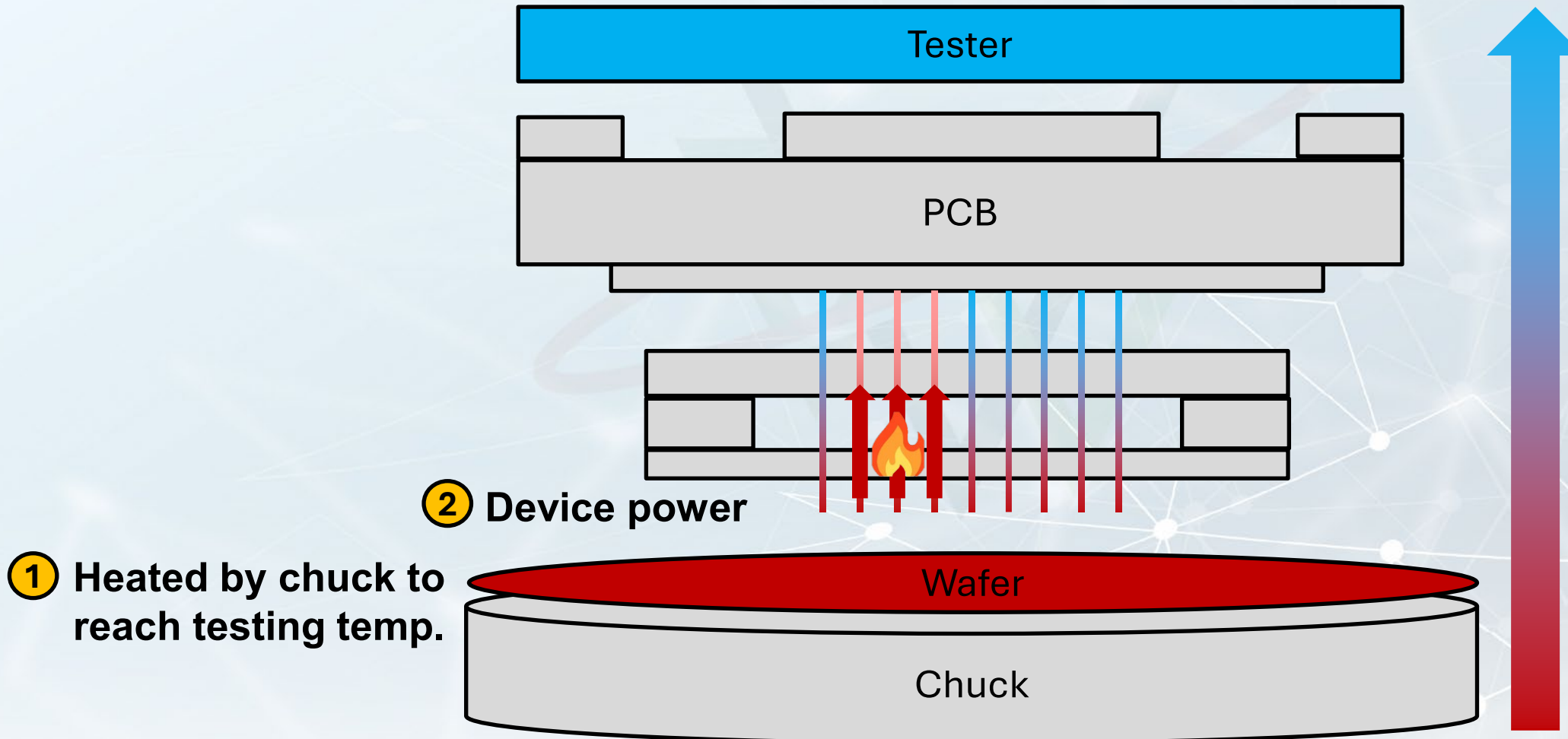
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- Extreme computational density and speed drive high power consumption and concentrated heat, presenting a major thermal challenge for HPC chips.



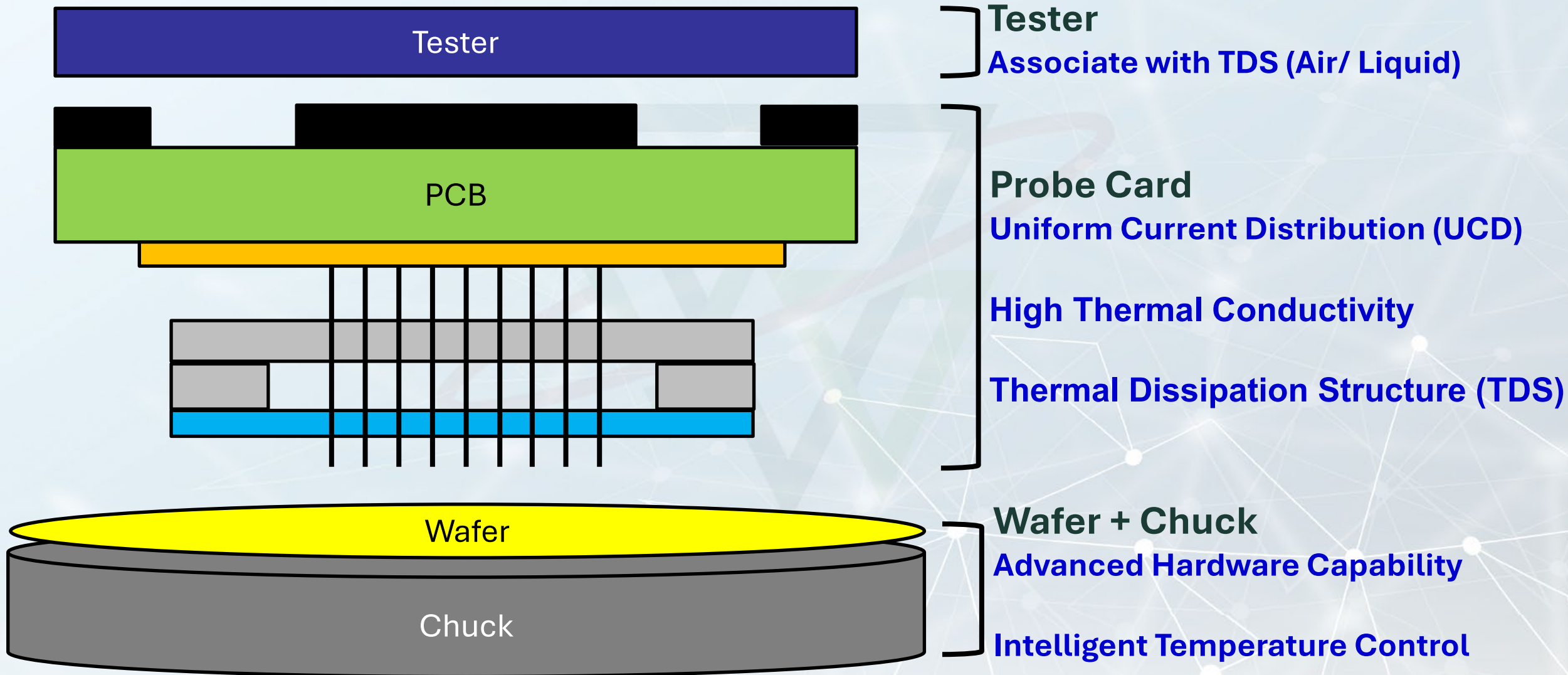
Integrated Solutions for Thermal

- Heat is from (1) Chuck thermal equilibrium (2) Device power



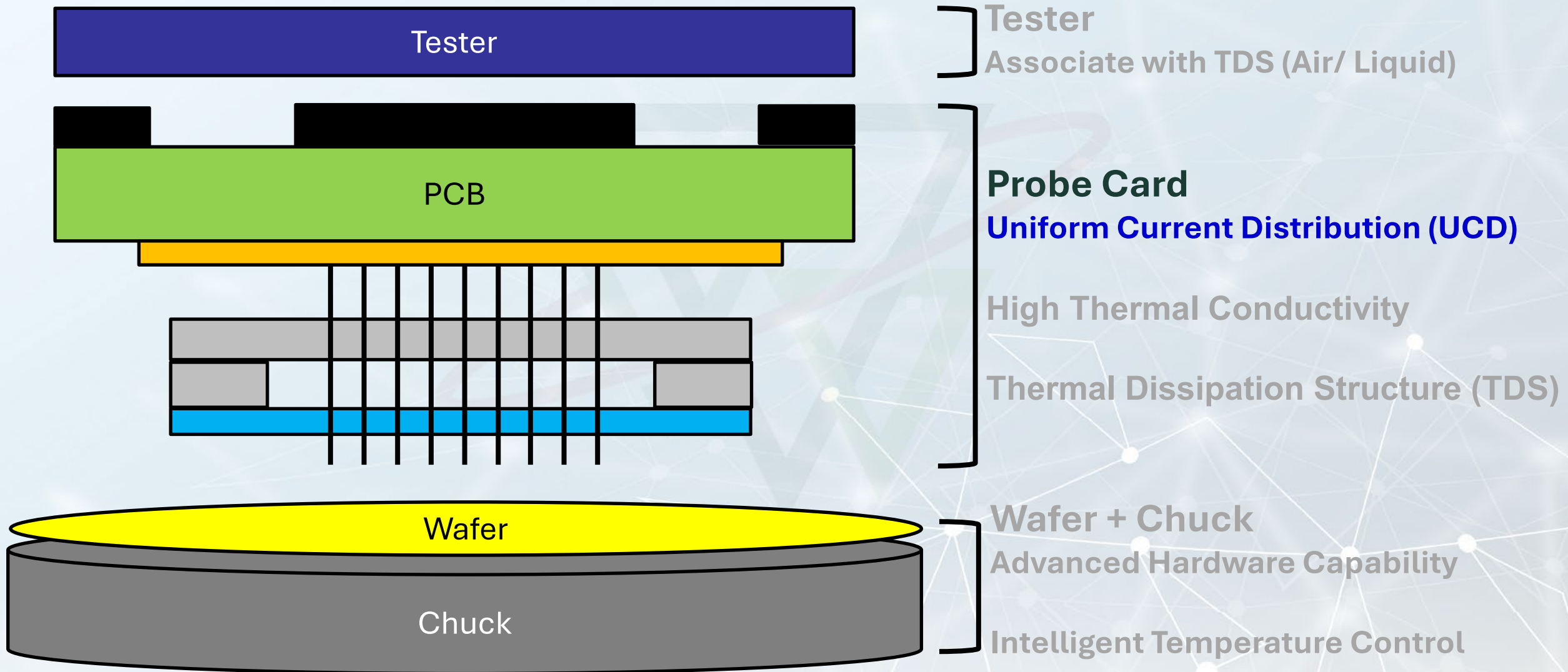
Integrated Solutions for Thermal

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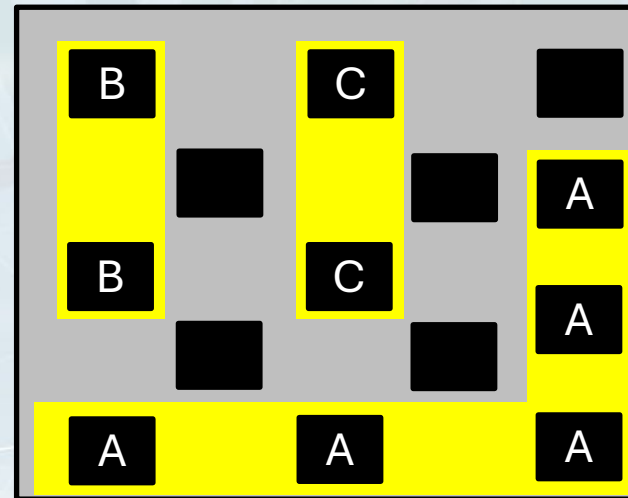
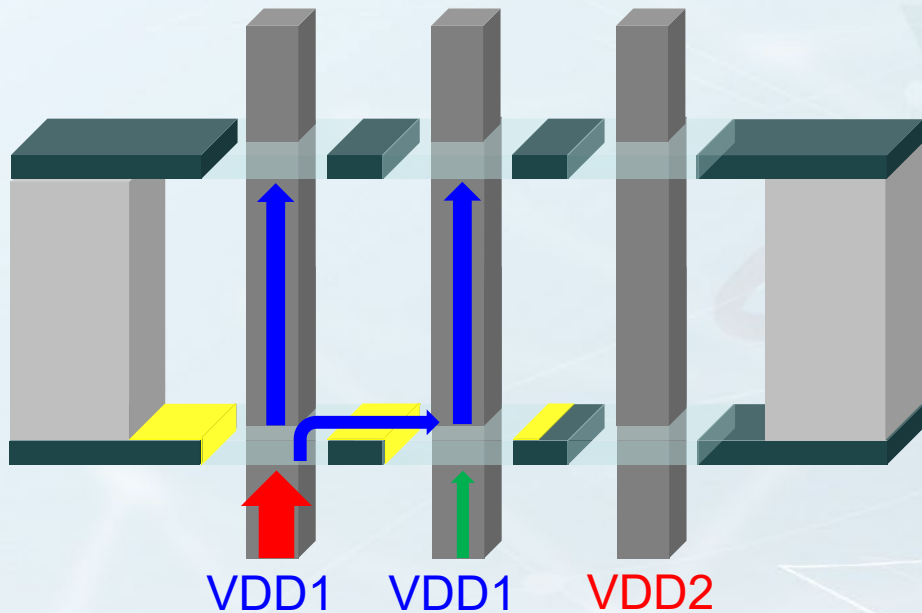
Integrated Solutions for Thermal

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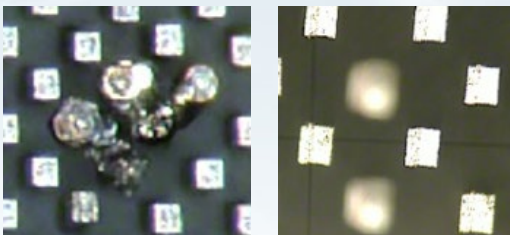
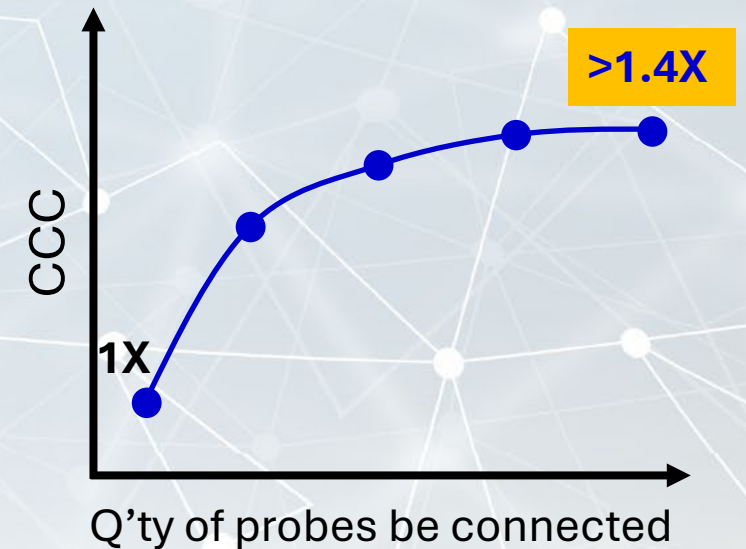
UCD (Uniform Current Distribution)

- To enhance current distribution uniformity, the metal trace is coated on PH to connect the same power rails.
- CCC could be improved > 40%.



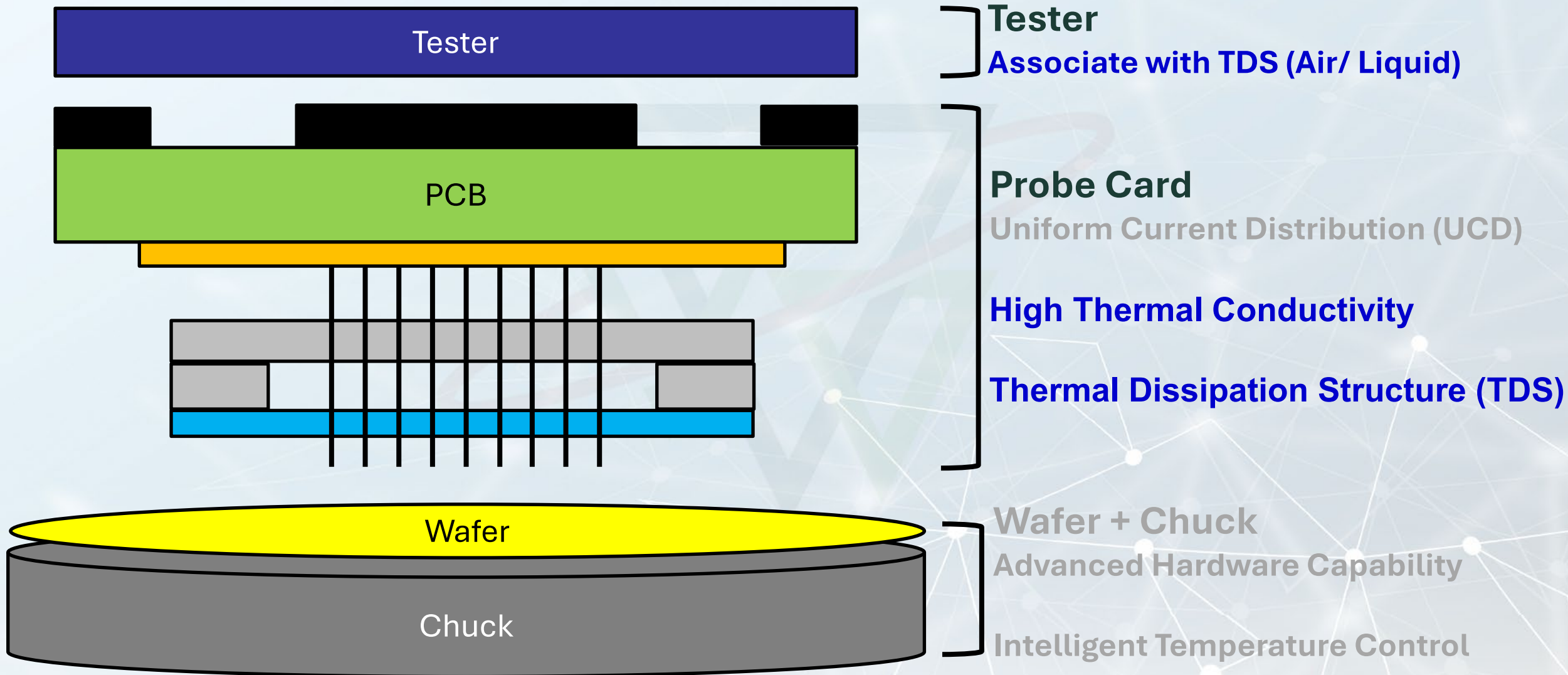
Connect the same power group

- 1) Improvement could > 40%
- 2) Saturate with connected q'ty



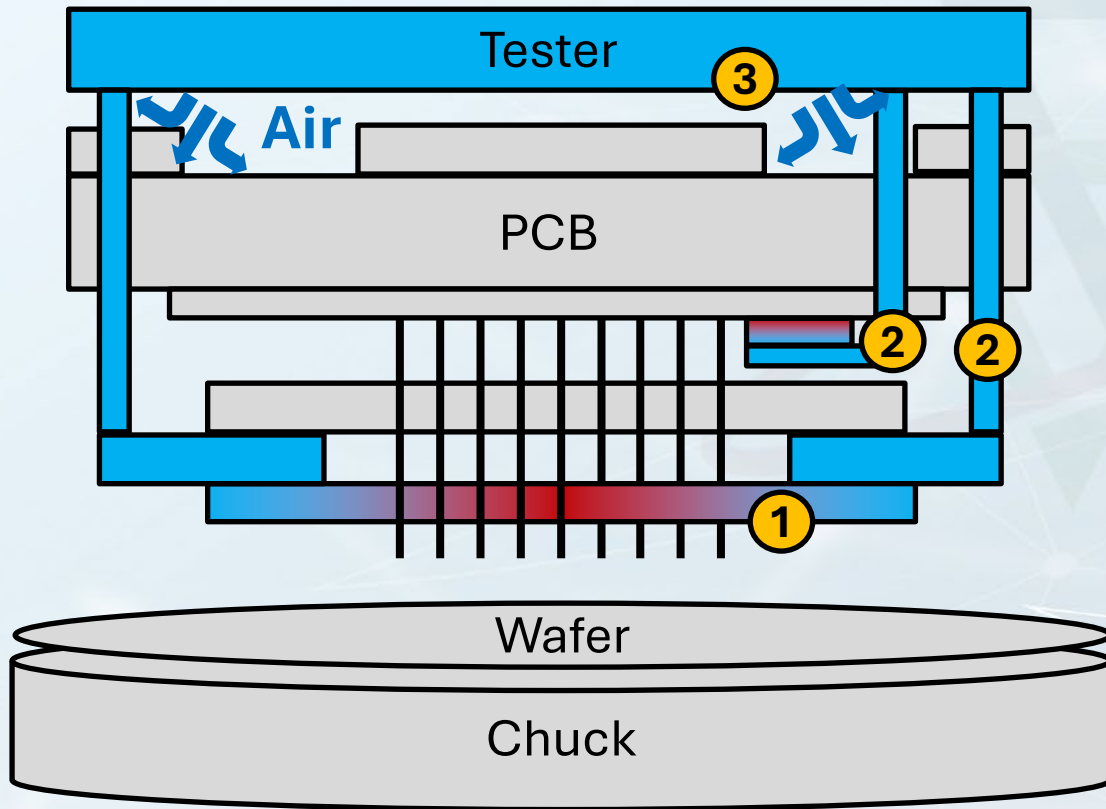
Integrated Solutions for Thermal

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Thermal Dissipation Structure (TDS) ^{35th} ANNIVERSARY

- To enhance the thermal dissipation, integrated structure are designed.



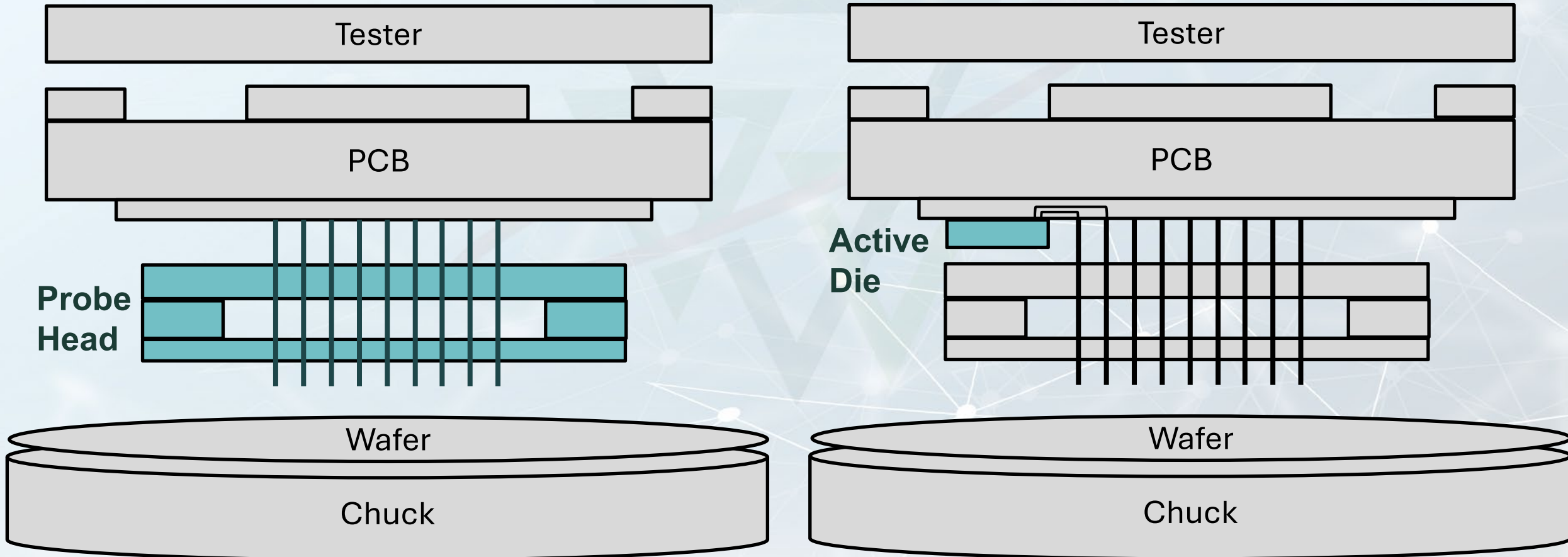
Key Structure

- ① Material to improve thermal conductivity **3X**
- ② Accessories to enhance thermal transfer **5X**
- ③ Enlarge Tester air purge **4X** to dissipate heat

Thermal Dissipation Structure (TDS)

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- TDS Design for Key Objectives. (1) Probe Head, (2) Active Die

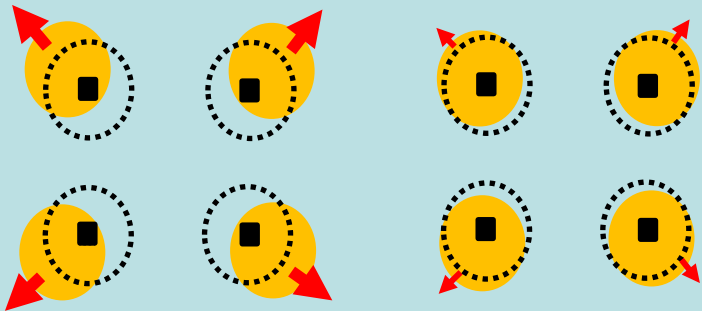


Thermal Dissipation Structure (TDS) ^{35th} ANNIVERSARY

- Benefits for PH Cooling.

Decrease Equilibrium Temp

➡ Improve Alignment due to CTE difference

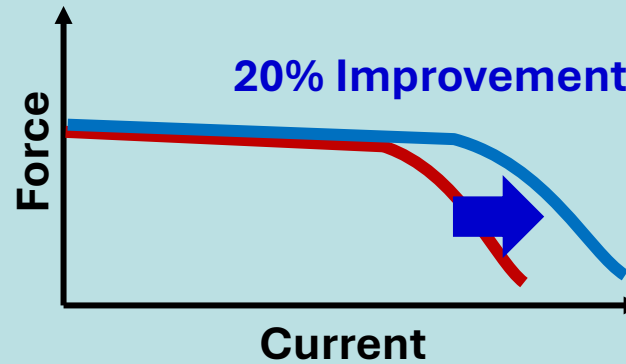


$T \downarrow, \Delta d \downarrow$

(Probe to MLO pad)

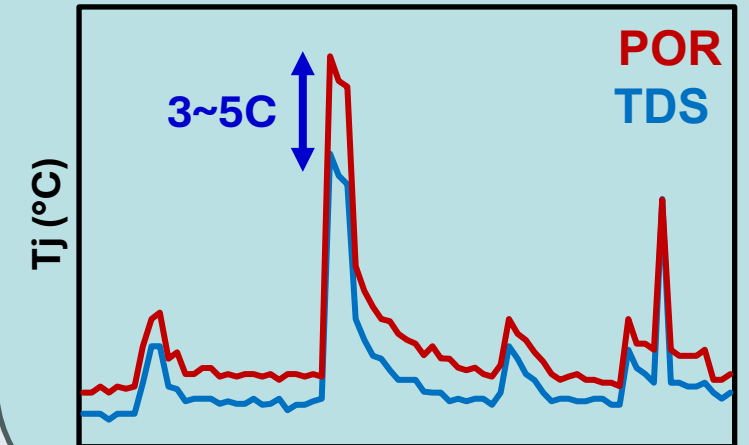
Increase Probe CCC

➡ Avoid Tip Burnt



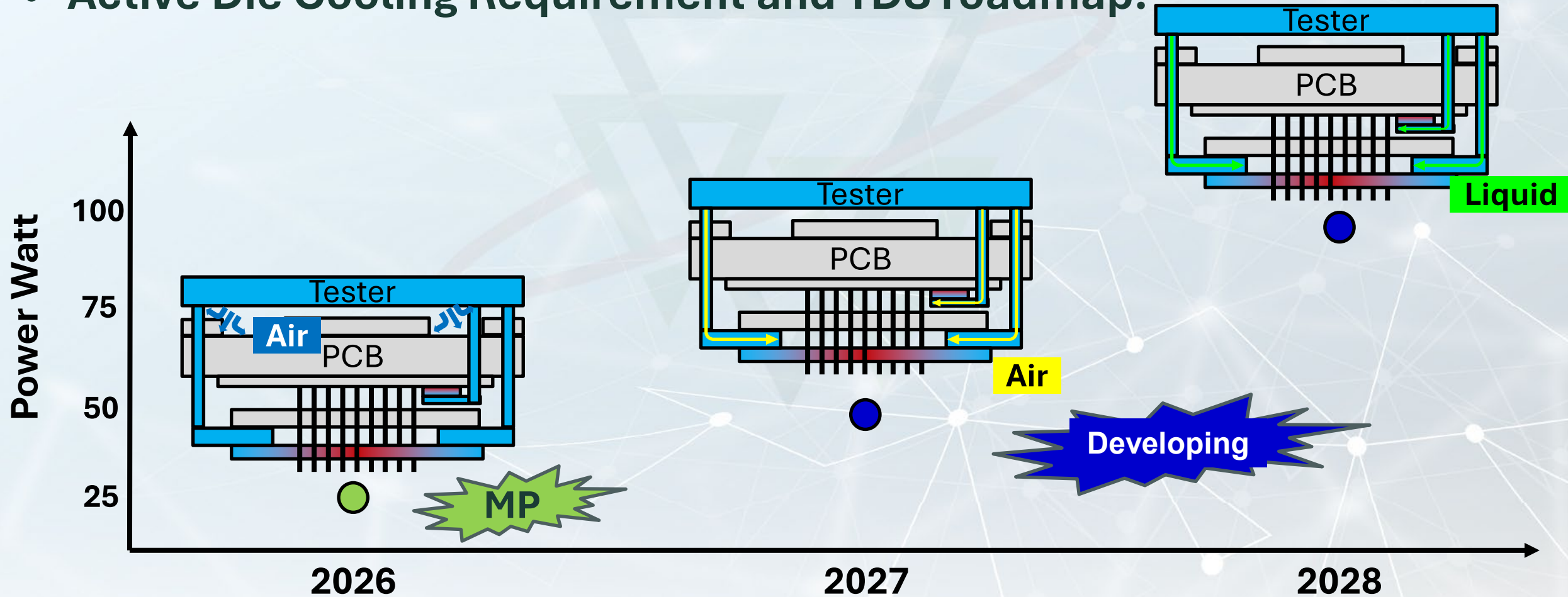
Stabilize DUT T_j

➡ Avoid Thermal Runaway



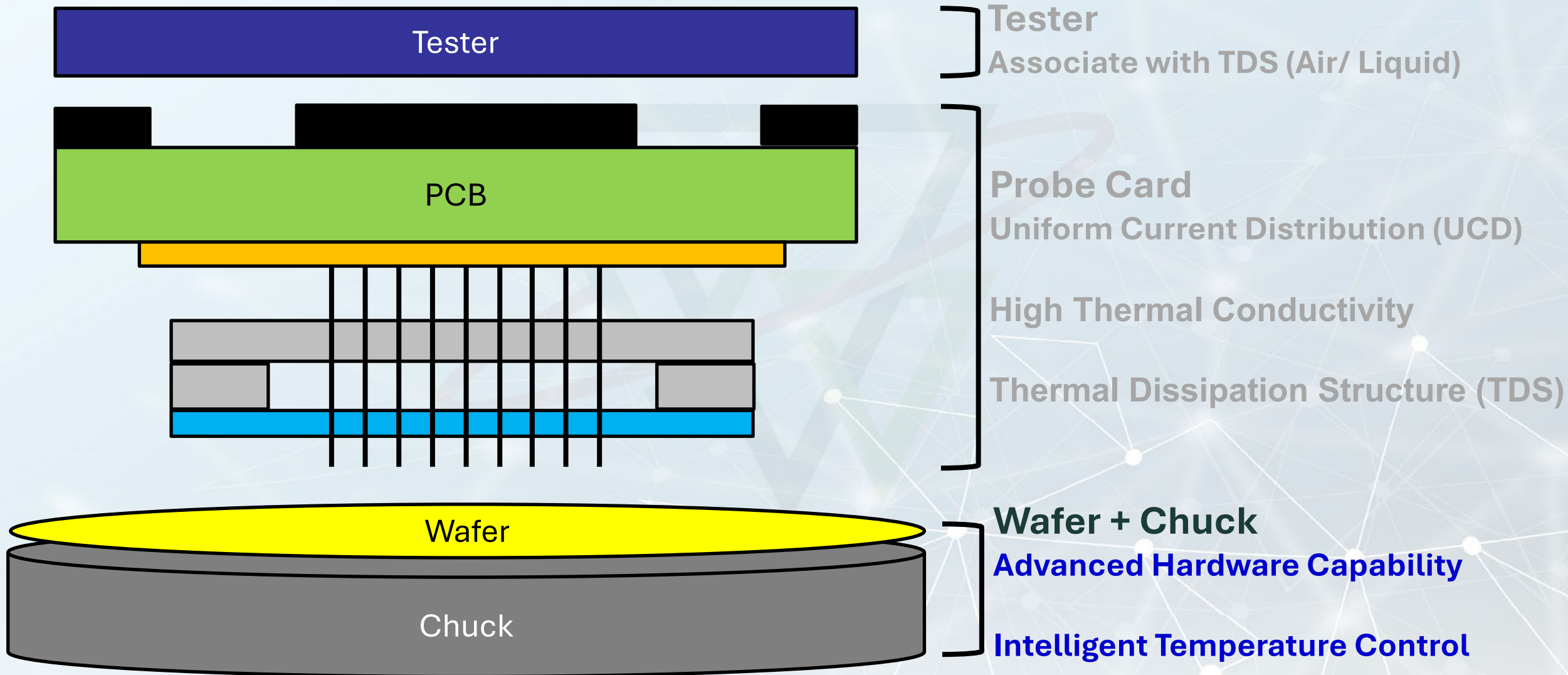
Thermal Dissipation Structure (TDS) ^{35th} ANNIVERSARY

- Maintain the working temperature of active die under specific temp.
- Active Die Cooling Requirement and TDS roadmap.



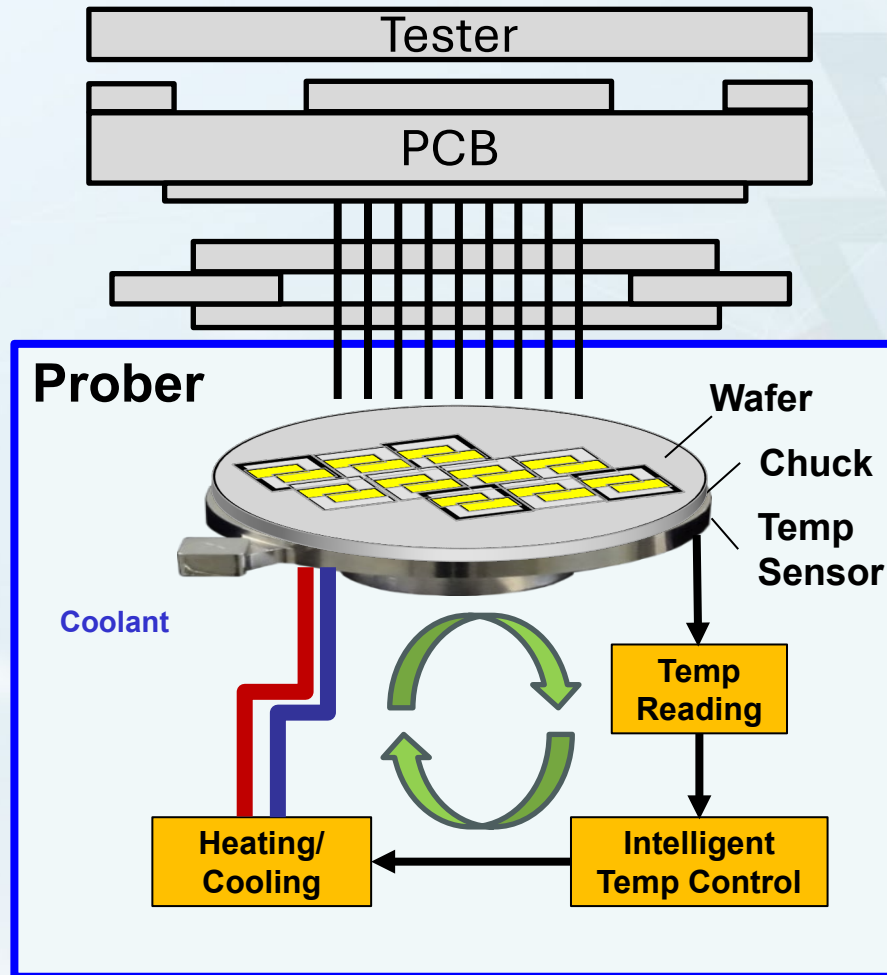
Integrated Solutions for Thermal

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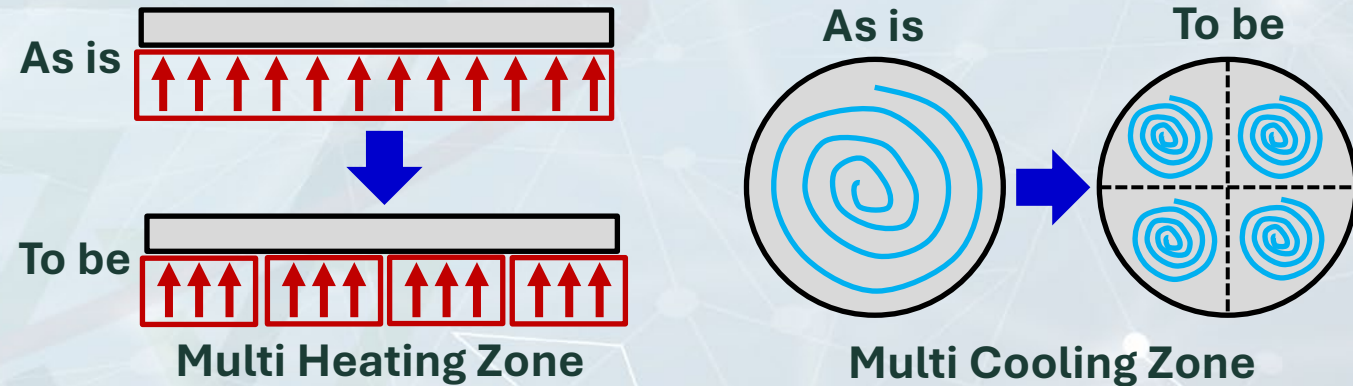


Active Temperature Control

- Integrated solution to combine H/W and S/W.



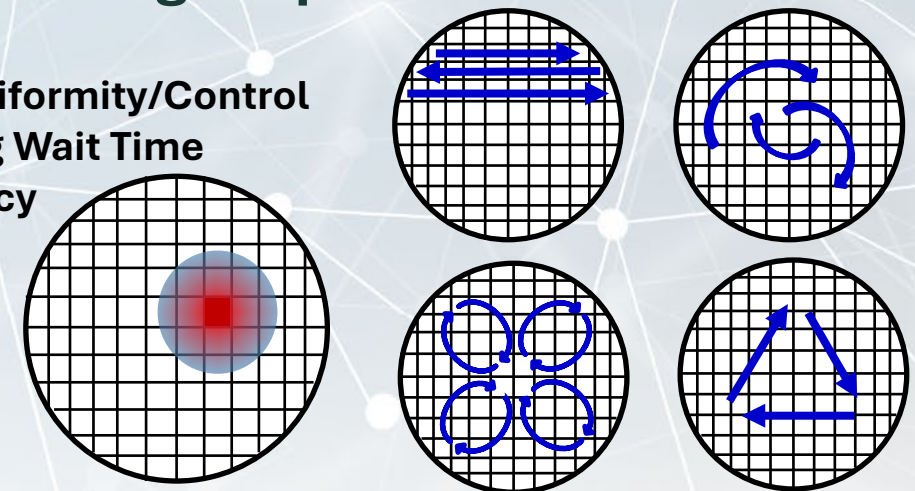
- Multi-Sensor and Control Zone



- Optimize Probing Sequence

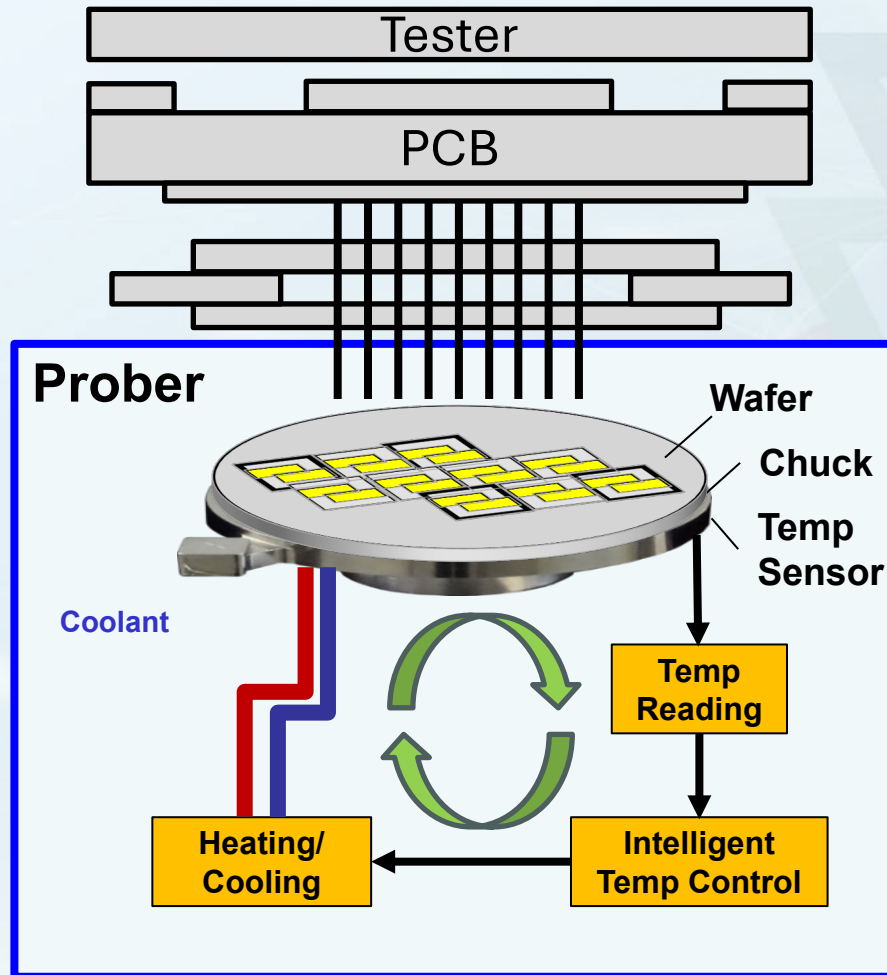
<Goal>

- Temperature Uniformity/Control
- Heating/Cooling Wait Time
- Probing Efficiency

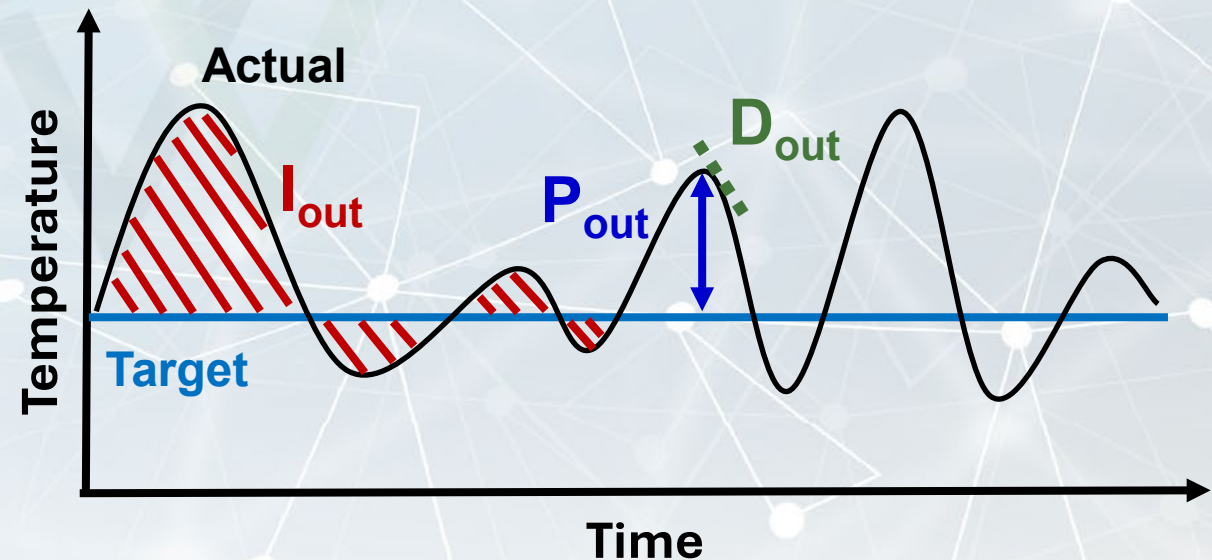


Active Temperature Control

- Integrated solution to combine H/W and S/W.

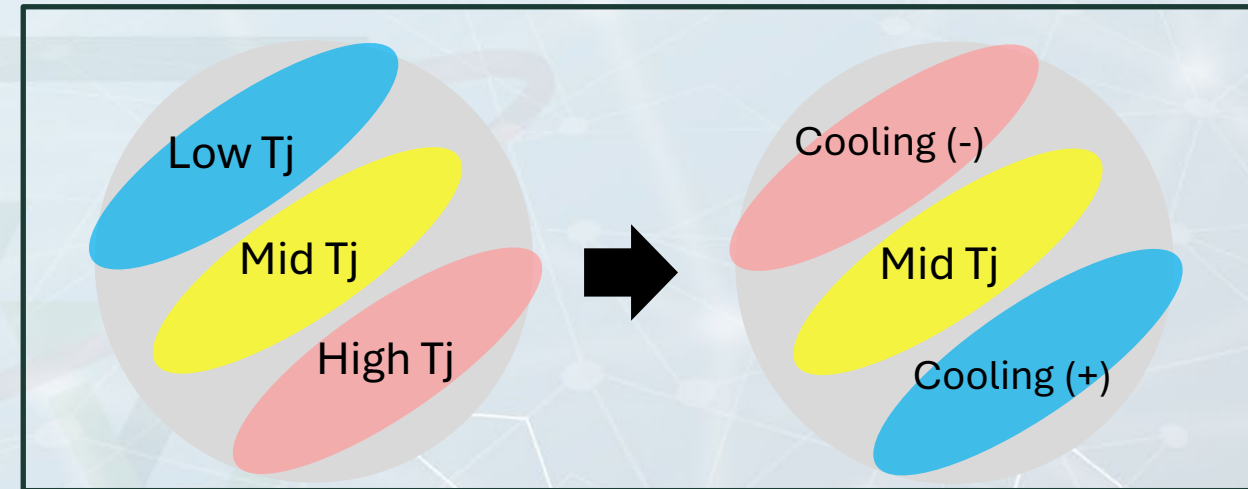
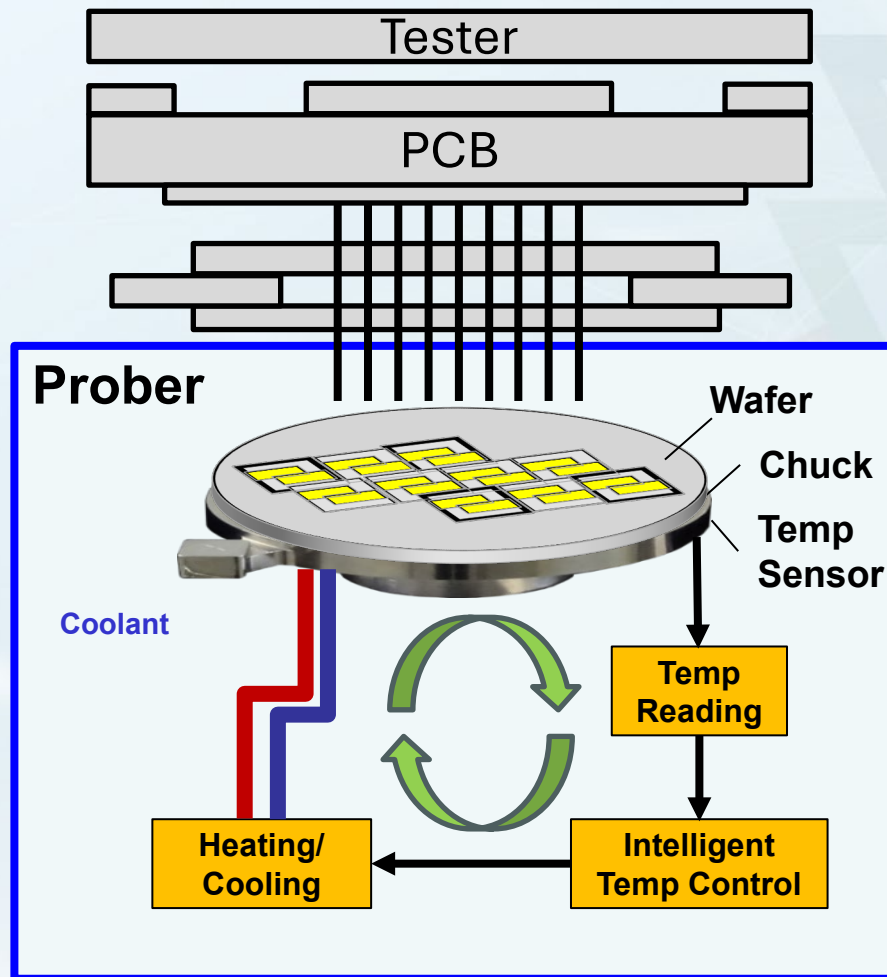


- **Active Temperature Control by P-I-D**
 - **Proportional (P_{out}):** Adjust current error
 - **Integral (I_{out}):** Based on Past error
 - **Derivative (D_{out}):** Predict future error



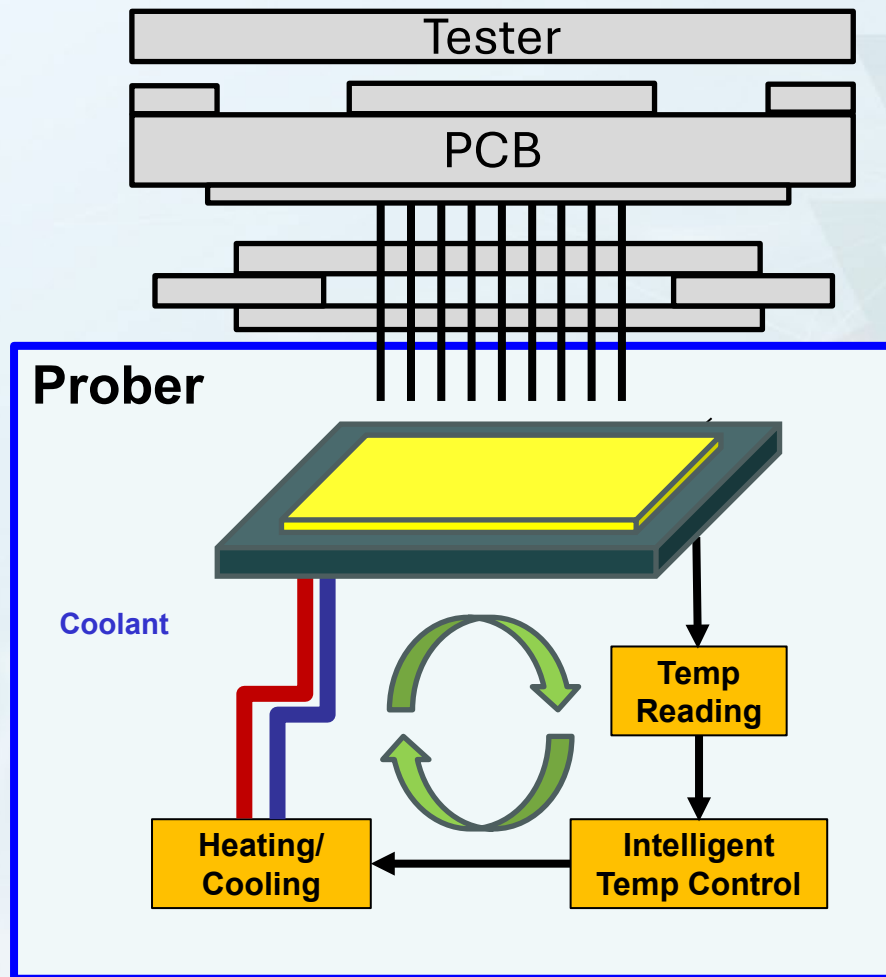
Active Temperature Control

- Integrated solution to combine H/W and S/W.



Active Temperature Control

- Integrated solution to combine H/W and S/W.



<Singulated Die Probing>

- **Chuck Capability**
 - Support Die size: ~ 100mm x 100mm
 - Multi Heating/Cooling zones
 - Power Density: >200W/cm²
- **Probing Technology**
 - Pin Count: >800K
 - Probe force control to avoid die shift

Summary

- **The rapid expansion of AI technology introduces several challenges in testing, particularly in thermal management.**
- **To effectively manage thermal challenges, integrated solutions combining the tester, probe card, and chuck are essential.**
- **With successful AI chip testing, AI in turn makes us more capable and efficient.**

Summary

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