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**Production Test Considerations**

Scott Bulbrook

Co-Founder, VP Engineering at DA-Integrated

31 Years in the semiconductor industry

Engineering background: Fab, Design, Test, Device Physics

Management and Business background:

Responsible for Operations, Product Definition, Finance, Development

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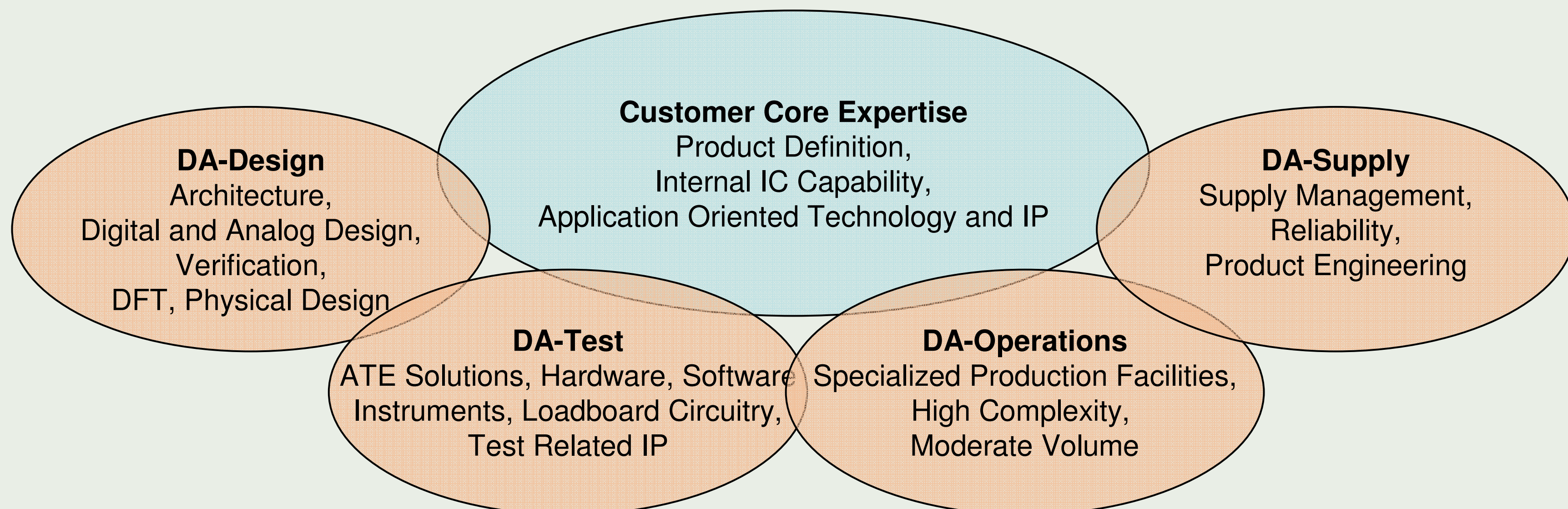
DA-Integrated features the full suite of tools and expertise of a fabless semiconductor company, offered as pure play services, complementing our customer's core capability.



# 3D Package Production Test – Not an (Incremental) Big Challenge

At the highest level of abstraction,

the emergence of 3D packaging technology does not really present any *new* challenges

Simply because it does present the opportunity to combine technologies in new ways, 3D packaging accelerates the need for advancement in the IC production test industry already being created by industry advances such as SOC Devices, Embedded Transducers, New Defect Mechanisms, expensive packages, etc etc

Perhaps 3D packaging also presents some new opportunities!

# Production Test Big Challenges

The issue for production test is always the same

- What do I specifically need to test to ensure absence of defects and correct performance?
- What are the relevant defect mechanisms that I seek?
- How do I stimulate and observe all nodes in order to achieve the test objectives?
- What instruments do I need to stimulate and observe?
- How do I do all this and still meet the cost targets?

Rule 1 – create a production test strategy in parallel with product definition or perish (circa 1980)

# 3D Package Production Test – Opportunities

Perhaps 3D packaging also presents some new opportunities!

Connectivity between devices are now additional nodes that must be observed or stimulated:
Can we have access to them as test points?

3D Packaging enables inclusion of a wide range of technologies:
Can some of the devices include contributions to the test of other devices?
Can we include a special test related chip in the stack?

# Known Good Die

3D Packaging requires a high level of quality for individual components, this means Known Good Die

Known Good Die Testing challenges can be broken into 3 groups

1. Testing is Hard

Most testing challenges are specific to the chip, probing makes bringup trickier, not impossible.

2. Contacting Technology

We are now blessed to have technologies available at probe that have superior performance in all respects to that of package contacting technologies. They may seem expensive to people relative to $5,000 cantilever probe cards. The real cost is trivial as part of a product development involving 3D packaging.

3. Post Test Handling

A fundamental assumption with production test is that defects cannot be introduced by post-test processes.

In 3D Packaging, this means that KGD does not allow us to scale back the final package test.

Bottom Line: Known Good Die is already solved

# The Production Test Mantra – BIST, TAP, BOST, Pipeline

Production Test is Stimulation and Observation of internal and external nodes

- Exercise and observe absence of all potential defects
- Prove performance where correct-by-construction cannot be assumed

BIST, TAP, BOST, Pipeline

BIST – self test circuits included in die (extend to include die testing each other in 3DP)

TAP – provide access to internal nodes through ports rather than direct contact

BOST – instrumentation around DUT to augment ATE

Pipeline – multiple test insertions to provide overall reduction in test solution capital and overall increase in throughput by eliminating reconfiguration and settling times

None of this can be done unless planned for at Product Definition

# A peek at the future – The Instrument-less Tester

As we become more sophisticated at implementing BIST, TAP, BOST, Pipeline, the ATE itself does less and less

Hey Designers – once the chip tests itself, does test cost go to zero?

No. The production environment around the test instruments is the most important element.

There is a minimum hourly rate for production services, this number is relatively constant and independent of:

- DUT
- Test System
- Location (low cost labour, subsidized capital and lax environmental laws do not help production test costs)
- Throughput (outs per hour)

ATE Industry is on a vector leading to the instrument-less test system

This ITE system helps to optimize the real costs of production (traditional ATE is relatively weak)

These ITE systems exists in various forms today and are widely deployed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# Conclusions

3D Package based products require fully comprehensive Final Package Test

3D Package based products require every form of test related best practices

Relevant defect mechanisms in 3DP will be discovered the hard way

Known Good Die is solved and will have zero impact on adoption of 3D Packaging

New Test-Related Industry will Emerge around test IP and devices for 3D Package Products

3D Package Products will accelerate evolution of Production Test Industry

# Thank You

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