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TestConX™

Archive

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Reimagining the Device Under Test Interface, A Multi-Dimensional Problem

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TERADYNE

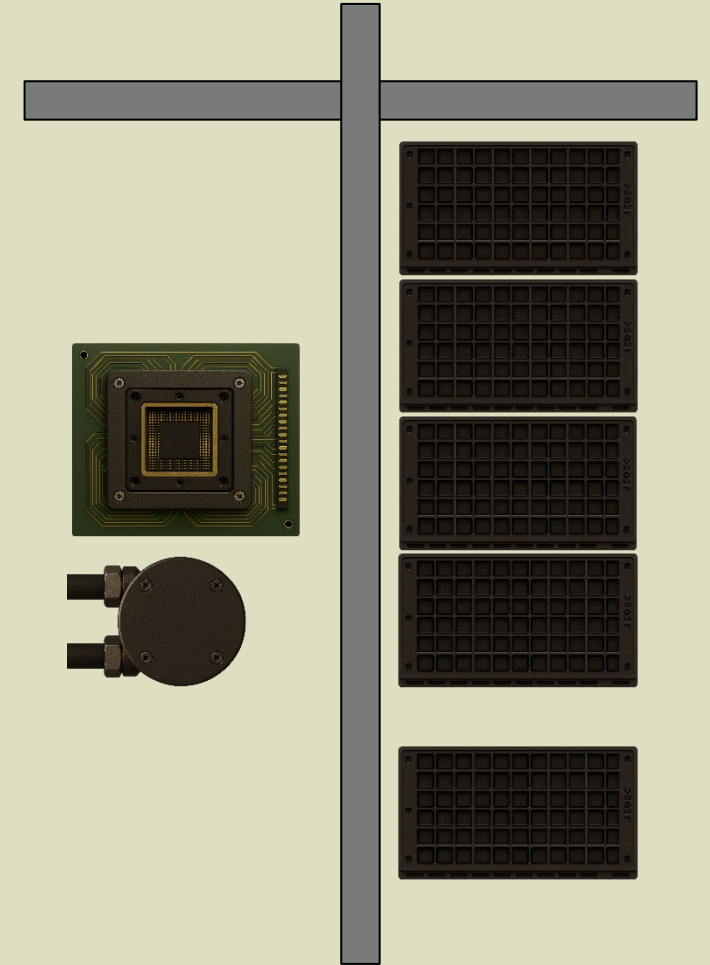
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Agenda

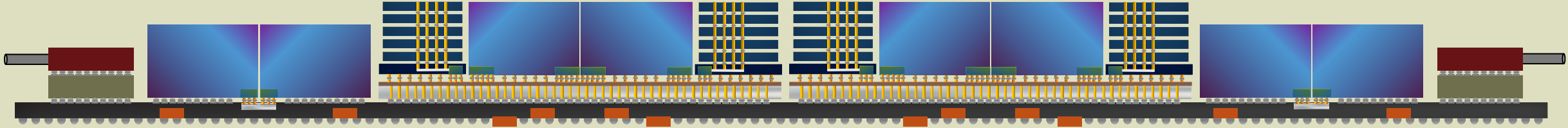
- Traditional Test Handler
- Trends in Advanced Packaging
- Emerging Challenges
- Future Test Handler

Traditional Package Handler

- Tray handling system to interface with factory media
- Electrical interface board with a socket
- Pick and place gantry to move device from input tray to socket and back to output tray based on test result
- Plunger to apply socketing force
- Thermal solution to manage device temperature



Trends in Advanced Packaging



- Performance demands at the system level drive integration closer to the die
 - High bandwidth, low power die to die interconnect enables design disaggregation
 - Eliminates power / performance penalty associated with off-chip communication
- Modular interposer and bridge interconnect technologies enable significant area increase
 - Heterogeneous integration enables optimal process selection for power, performance, density and design reuse
- Substrate and interposer embedded passive and active components enable power efficiency
- High speed electrical and optical interconnect enable shoreline bandwidth

Emerging Challenges

- Complex substrates and interposers drive unique test insertions
- Package size increase requires new handling solutions
- Package geometry and structure may require a force profile for socketing
- High total power and thermal density along with 3D distribution require complex thermal design
- Transition to co-packaged copper and optical interconnect drives topside connectorization
- Ultimately the package becomes the system

Handling

- Increased size
 - Tray size increase
 - Single device size up to full tray size
- Increased weight
 - Limited substrate area for pick
 - Higher forces during movements
 - Drop risks

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135.9mm x 322.6mm



258mm x 537.6mm

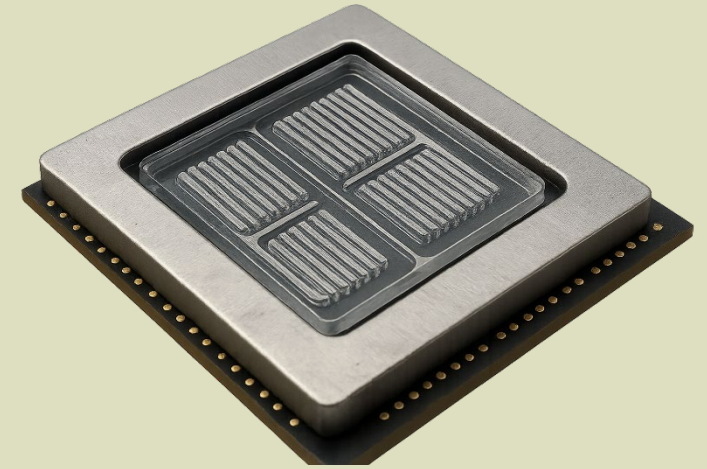
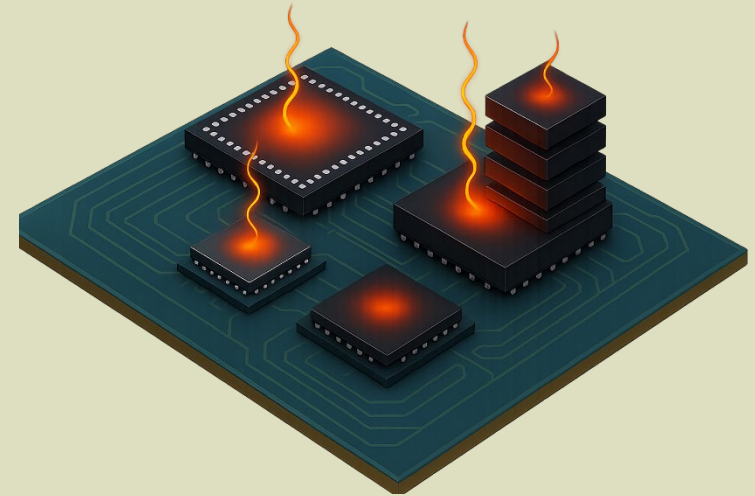
Socketing Force

- Large number of bottom side contacts
 - Potential for new contact geometries for improved power delivery performance
 - Increasing total force
- Multiple zone, individually controlled socketing force
 - Large area
 - Increased warpage
 - Multiple die heights with real world tolerances
 - Limited substrate contact area
 - Structural integrity differences between 2.5D and 3D constructions



Thermal Management

- Complex 3D thermal structures
 - Increasing thermal density
 - Multiple heat sources distributed in space
 - 10s to 100s of thermal sensors
 - Increased thermal resistance due to multiple interface transitions
- End use transitioning from air to liquid cooling
 - >2x thermal capacity
 - Higher integration of system level thermal solution
- Liquid cooling transition from cold plate to immersion and direct fluid microchannel designs
 - Device specific manifold design for temporary interface
 - Leak mitigation, detection and safety system integration
 - Liquid purge at end of test
 - New paradigm for junction temperature control



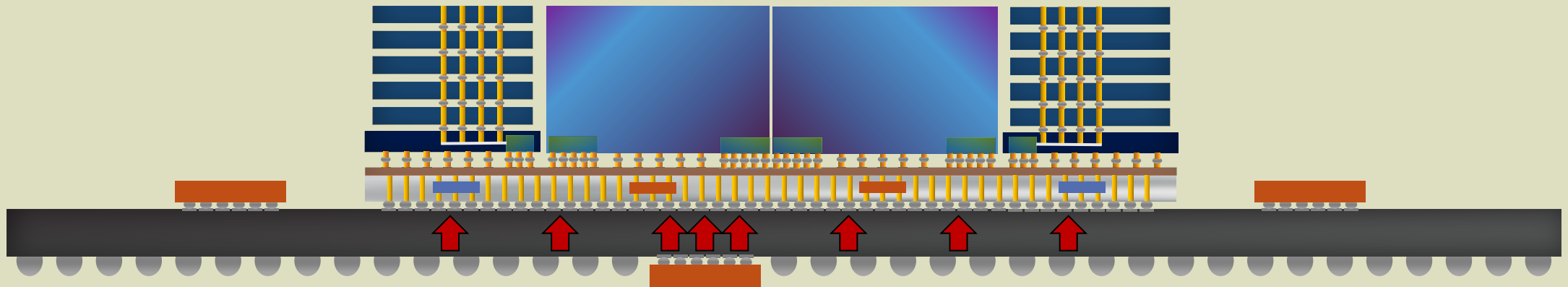
Electrical Connections

- Shoreline density limitations of traditional package interconnect drive shift to co-packaged solutions
 - Top side, multi-axis copper and optical connectors with unique alignment requirements



Electrical Connections

- Increased loss drives improvements in power delivery network to enable higher voltage at point of load
 - Advances in thermal control enable higher power delivery
 - Reduce resistive loss and heat generation with vertical power delivery vias through substrate, interposer and bridge structures
 - Embedded passive devices for bypass filtering and voltage regulation
 - Active voltage regulators, surface mount or embedded



Future ~~Package~~ “System” Handler

- Large form factor packages
- Controlled, zonal socketing force application
- Configurable thermal telemetry and multizone control options from traditional thermal head through direct liquid impingement solutions
- Multi axis actuation with passive and/or active alignment for top side electrical and optical connectors
- With low index times, few interrupts, fast change over...
- Applicable to Final Test and System Level Test

Opportunity

- Enable ecosystem of ingredients for thermal and electrical interfacing
- Simplify integration effort, controls implementation
 - Common definition of building blocks
 - Hardware and software interfaces
 - Test program and/or handler recipe control

Summary

- Trends in advanced packaging enable full system on package integration
- Emerging needs for thermal control and electrical connections drive need to re-architect the interface layer
- Opportunity for industry level building block solutions to simplify design and minimize custom effort

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