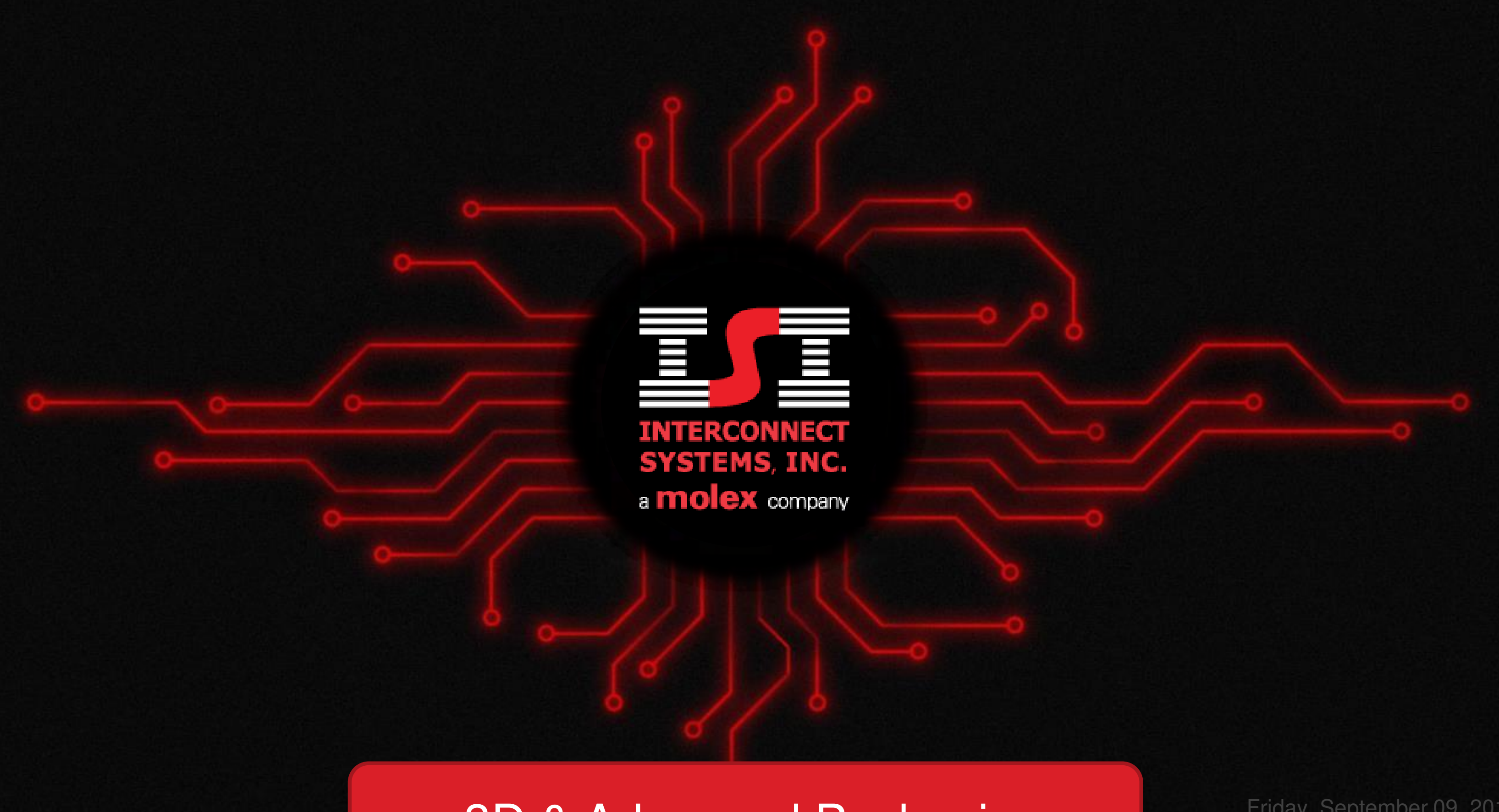


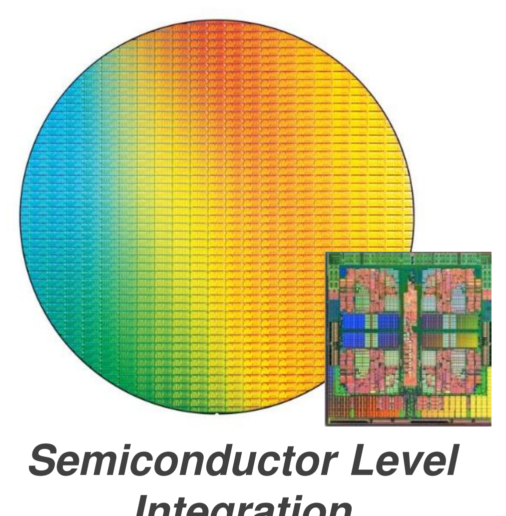
3D & Advanced Packaging

Friday, September 09, 2016

3D & ADVANCED PACKAGING IS NOW WITHIN REACH

WHAT IS NEXT LEVEL INTEGRATION?

Next Level Integration blends **high density packaging** with **advanced interconnect** to **quickly deliver** miniaturized solutions



Semiconductor Level Integration

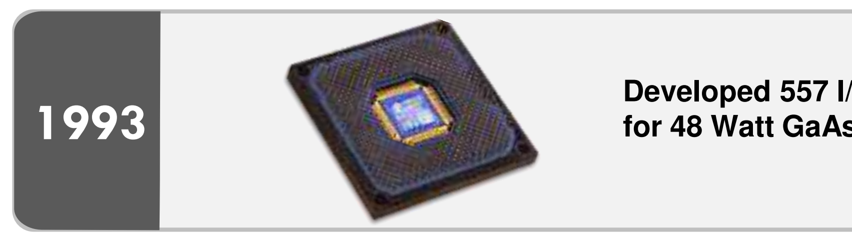
Next Level Integration

System Level Integration

Going forward, ISI believes that packaging technology will play as big a role as transistor evolution in advancing Moore's Law

DEVELOPING IC PACKAGES SINCE 1987

KEY MILESTONES



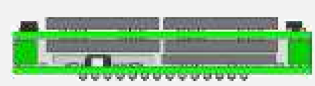
1993

Developed 557 I/O PPGA for 48 Watt GaAs die

2001

Invested in equipment & clean room to provide IC assembly services

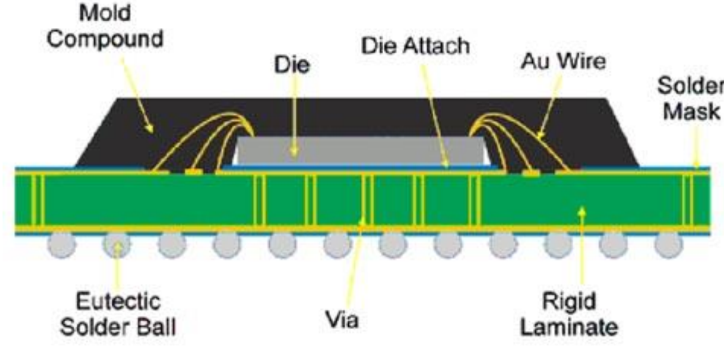
2010



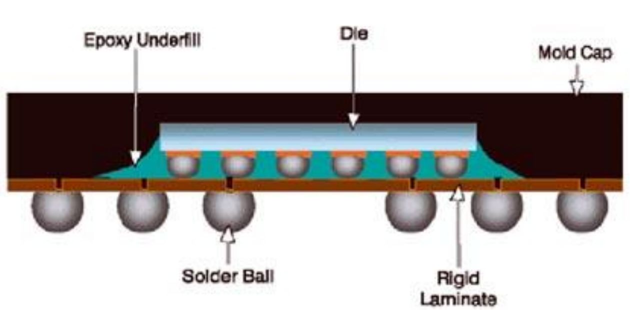
Significantly increased 3D & stacked die capabilities

IC PACKAGING 101

Die Attach & Wire Bond



Flip Chip & Underfill



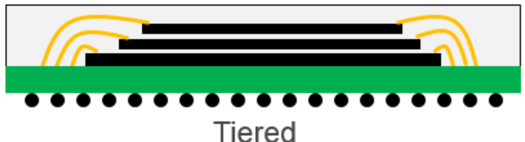
ISI designs multi-die modules utilizing both Wire Bond and Flip Chip die.

PACKAGING TECHNOLOGIES

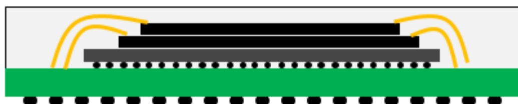
3D Die Stacking

- Multiple processes qualified
- Utilize standard die - no TSVs (through silicon vias) required

Examples:

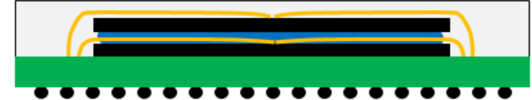


Tiered
'Wedding Cake'



Flip Chip + Tiered
'Wedding Cake'

Same Size Die Stacked with Spacers



Center Bond using
Z-Controlled Die Attach

INTERCONNECT SYSTEMS, INC.

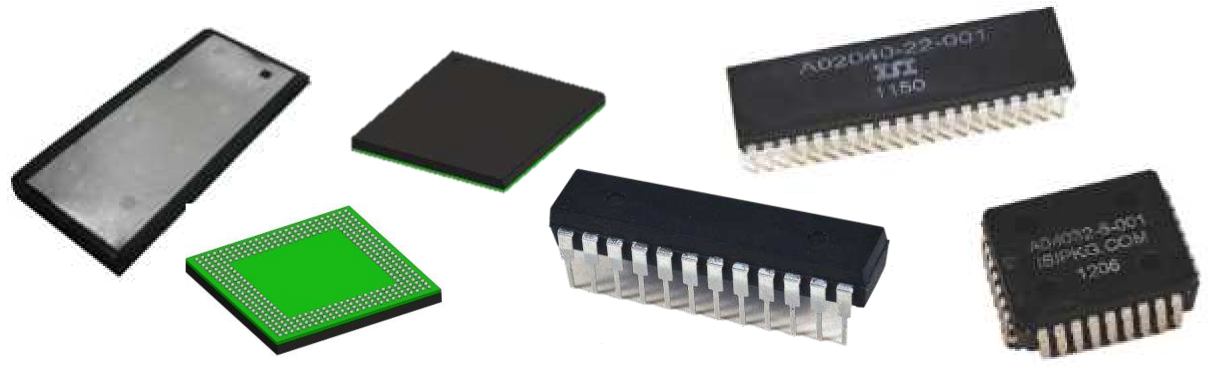
PACKAGING TECHNOLOGIES

Thermoset Overmolding

Multiple packaged ICs, bare die, and passive components can be ‘molded’ into single, monolithic component

- Thermoset epoxy is same type of material used in standard BGA and QFP packages
- Does not melt or soften during subsequent reflow processes
- Ultra-fine particle size can underfill BGAs and flip chips and also provide wirebond encapsulation

Ideal for rugged environments



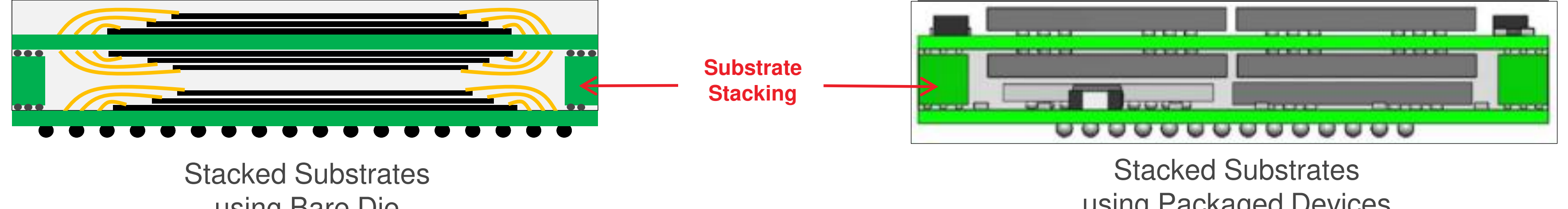
Cross-Section

PACKAGING TECHNOLOGIES

3D Substrate Stacking

ISI designs and manufactures high-density z-axis interconnect to facilitate stacking of thin substrates

- 0.4mm pitch and above (area array)
- Precision dimensions / thin walls minimize keep-out area



Stacked Substrates using Bare Die

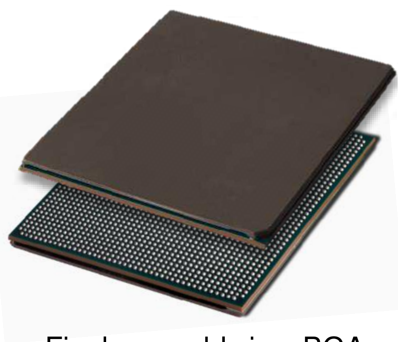
Stacked Substrates using Packaged Devices

INTERCONNECT SYSTEMS, INC.

ADVANCED PACKAGING EXAMPLES

System in Package

45x45mm BGA
2 Flip Chip Die
3 Wire Bond Die
2 Packaged ICs
Multiple Passives



Final assembly is a BGA package with heat spreader

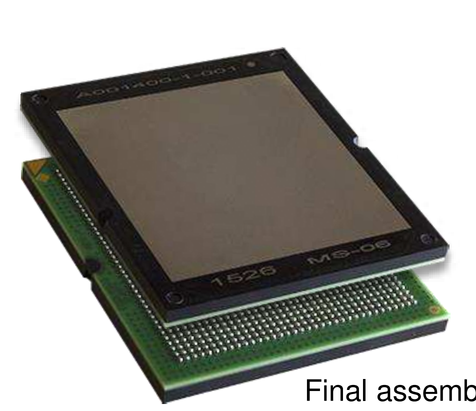
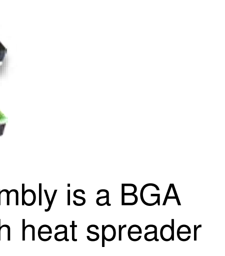
INTERCONNECT SYSTEMS, INC.

ADVANCED PACKAGING EXAMPLES

2.0”
1.5”
1.0”
20mm
.5”
10mm
40 x 45 mm (1.57” x 1.77”)

Atom + DDR3 Module

40x45mm BGA
(1) Intel Atom Processor
(9) SDRAM DDR3L x8 (x72 bank)
Integrated Heat Spreader
Overmolded for High Reliability applications

Final assembly is a BGA package with heat spreader

ADVANCED PACKAGING EXAMPLES

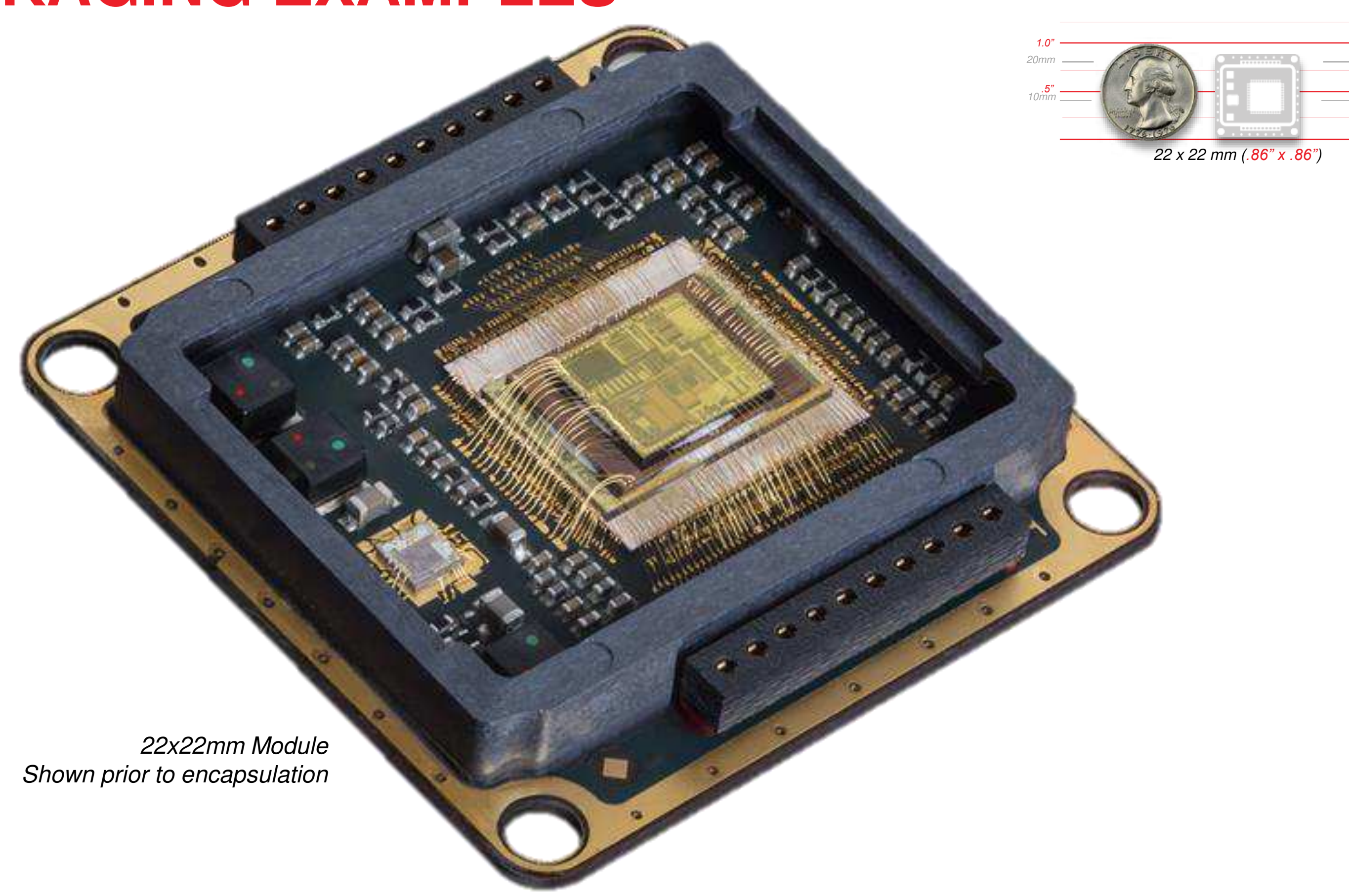
System in Package (SiP)

4 Die Stack:

- Processor
- DDR
- Flash
- ADC

VR Die & Passives

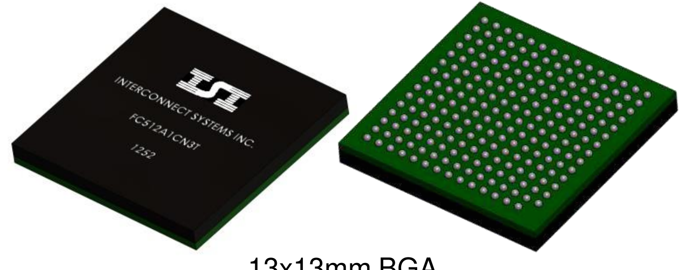
HiLo Connector for Stacking



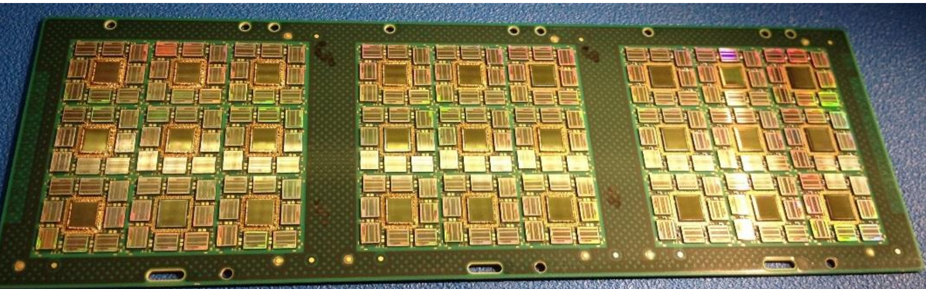
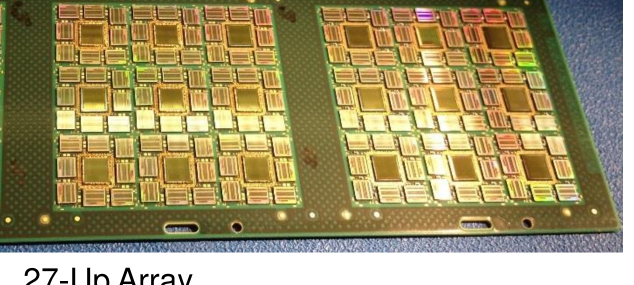
22x22mm Module
Shown prior to encapsulation

ISI FC512 CONFIGURATOR

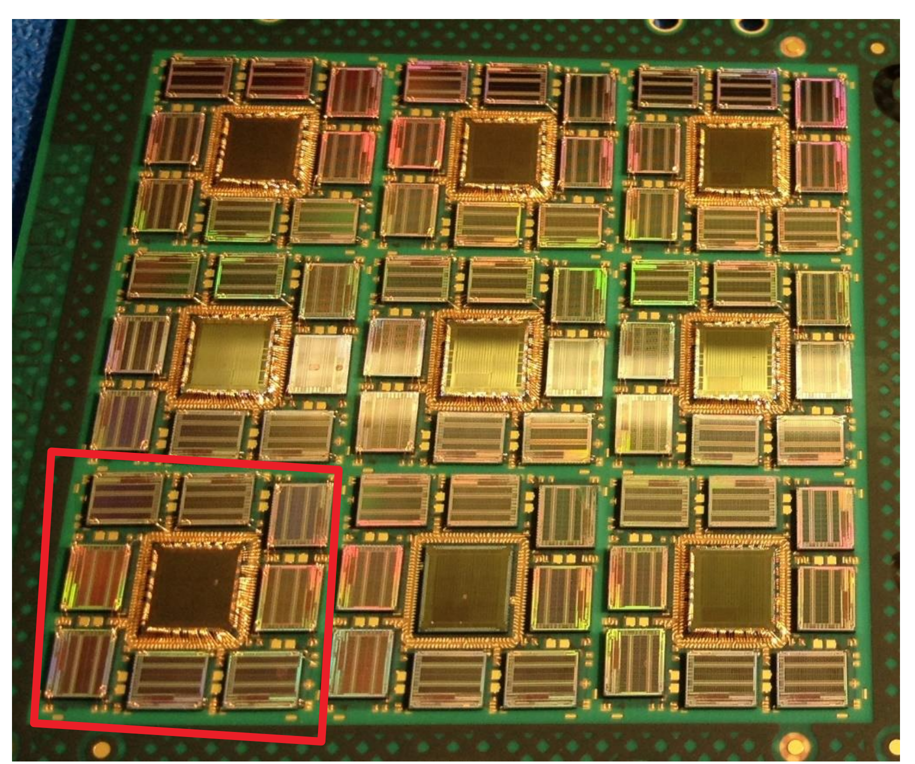
BGA Package
- 13x13mm body size
- 9 die module
- 224 balls
- 0.8mm pitch



13x13mm BGA

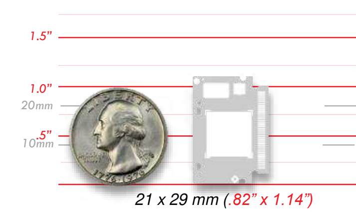



27-Up Array



9-Up Array

ADVANCED PACKAGING EXAMPLES



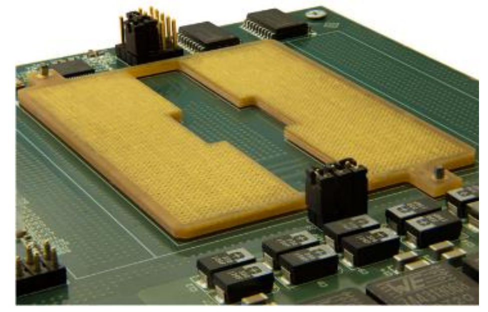
Micro FPGA Compute Node

Flip Chip FPGA Die
(2) Multi-Die DDR3 packages
Power management
Card Edge Interface

ADVANCED PACKAGING EXAMPLES

32 Node Compute Cluster

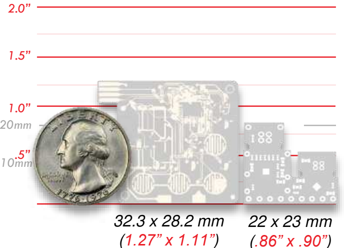
Each Micro FPGA Compute Node is enclosed in a heat spreader



32 nodes are inserted into water-cooled Master Module

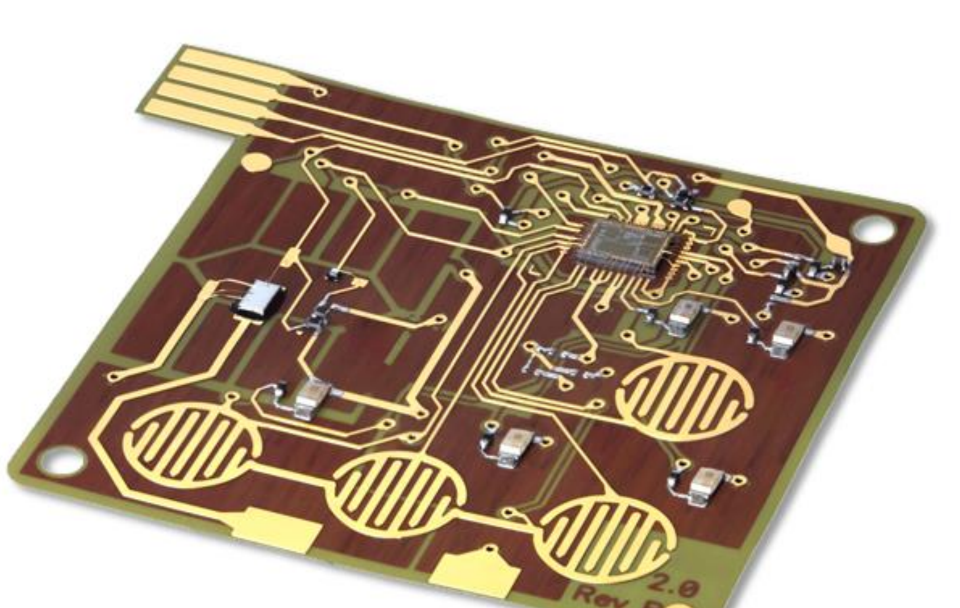
Master Module interfaces to system board through custom 2368 pin ISI HiLo socketing system

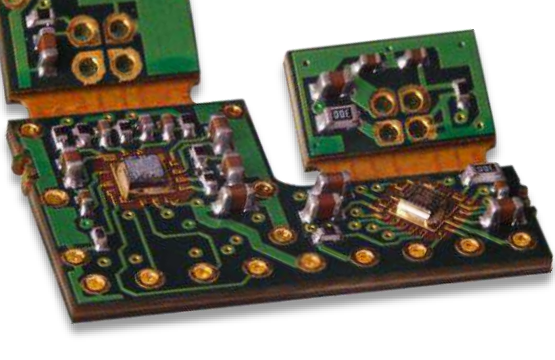
ADVANCED PACKAGING EXAMPLES



Chip on Flex

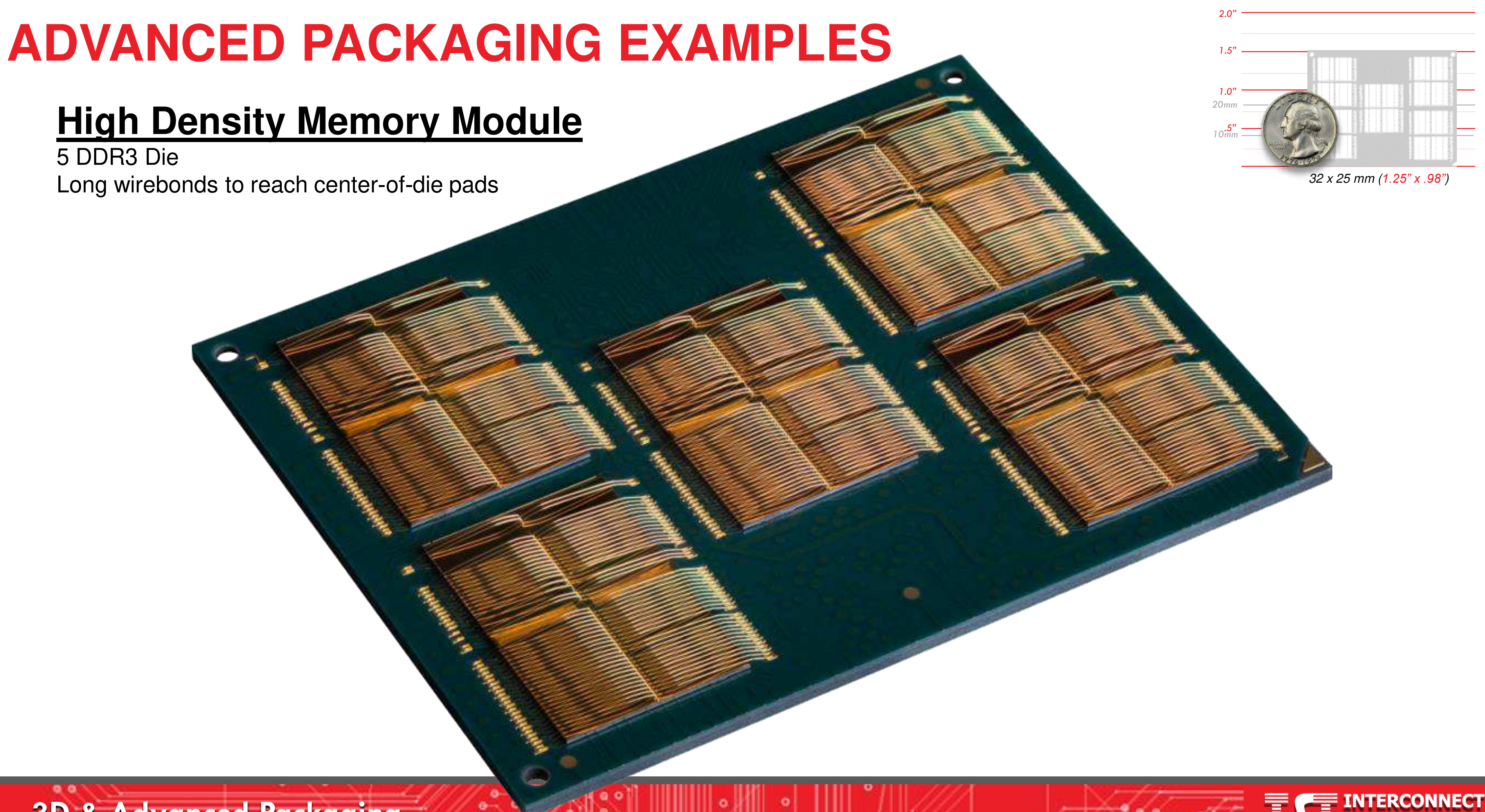
3 wire bond die
Passives
Embedded in smart credit card



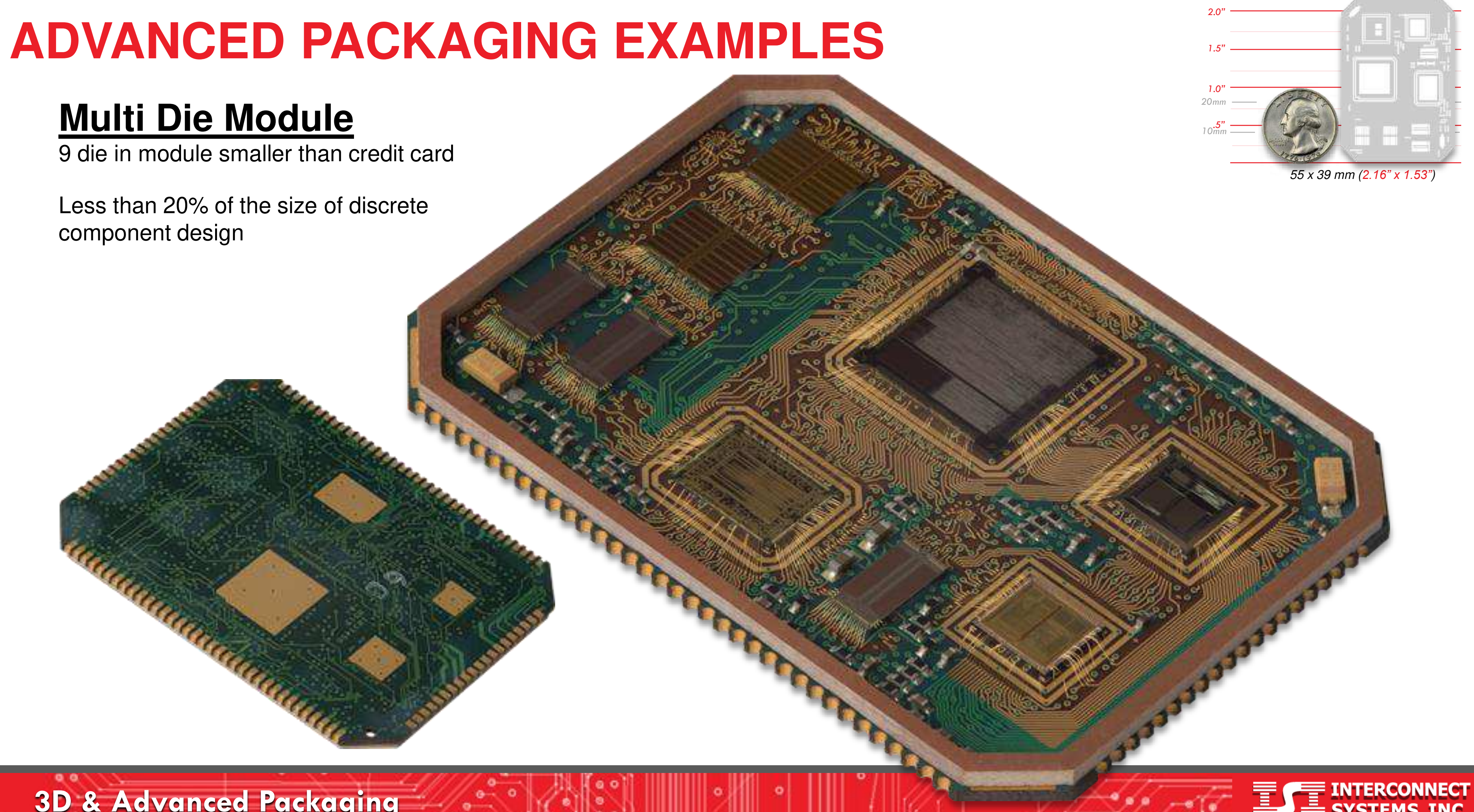


Chip on Rigid-Flex

Dual die design
Flex portion allows 90 orientation of sensors

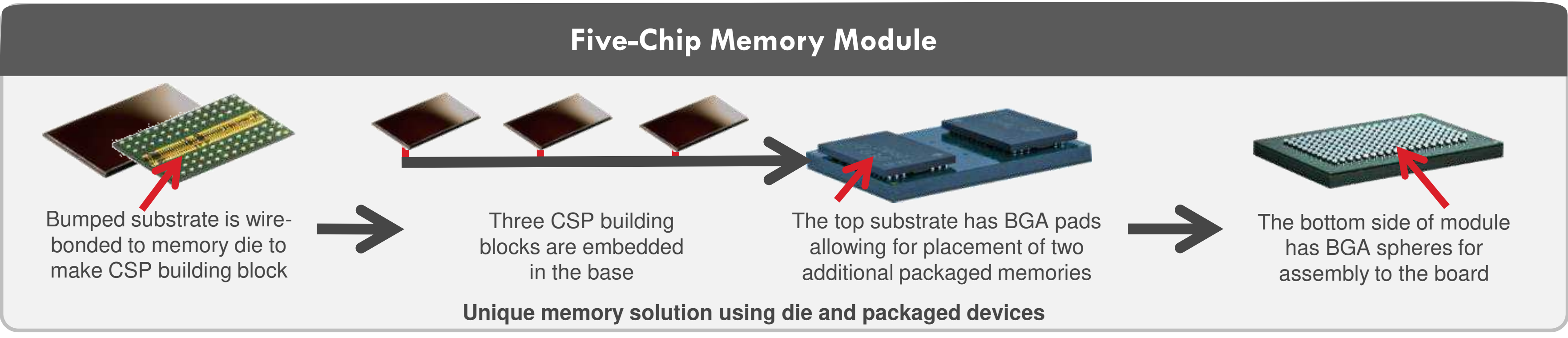

ADVANCED PACKAGING EXAMPLES
High Density Memory Module
5 DDR3 Die
Long wirebonds to reach center-of-die pads
2.0”
1.5”
1.0”
20mm
.5”
10mm
32 x 25 mm (1.25” x .98”)
3D & Advanced Packaging
INTERCONNECT SYSTEMS, INC.

ADVANCED PACKAGING EXAMPLES
Liquid Crystal on Silicon (LCoS) Package
Large LCoS die (30mm+)
Precise mechanical tolerances to provide alignment to optical system
Very flat heatsink (+/- 0.0005”) to prevent image distortion
Material set Engineered to be stable over operating temp range
High volume cost-sensitive application
2.0”
1.5”
1.0”
20mm
.5”
10mm
61.6 x 67.3 mm (2.42” x 2.64”)


ADVANCED PACKAGING EXAMPLES
Multi Die Module
9 die in module smaller than credit card
Less than 20% of the size of discrete component design
2.0”
1.5”
1.0”
20mm
.5”
10mm
55 x 39 mm (2.16” x 1.53”)
3D & Advanced Packaging
INTERCONNECT SYSTEMS, INC.

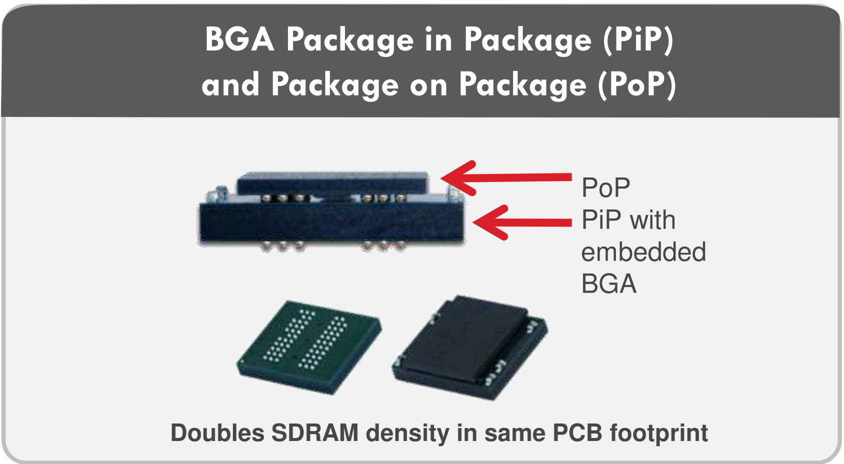
HIGH-DENSITY MEMORY SOLUTIONS

Five-Chip Memory Module



Unique memory solution using die and packaged devices

BGA Package in Package (PiP) and Package on Package (PoP)



Doubles SDRAM density in same PCB footprint

Flash Stacks

Up to 4X Density

INTERCONNECT SYSTEMS, INC.

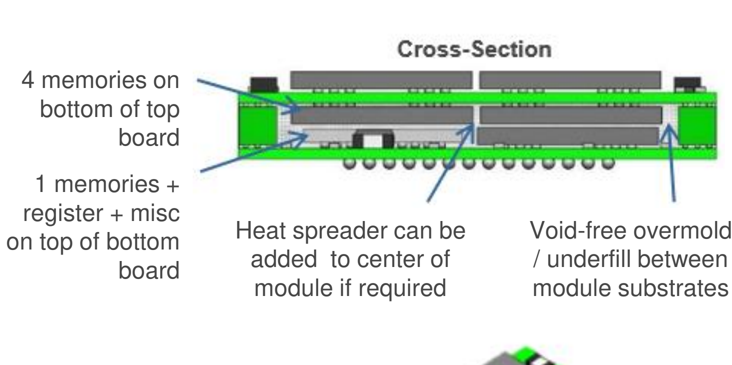
3D DDR3 MODULE

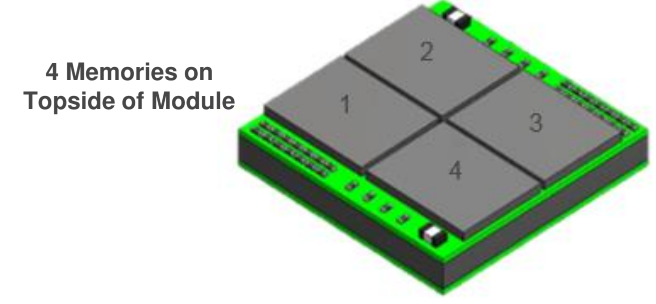
Customer's Challenge

- Customer required high density compute nodes for HPC application

ISI's Solution

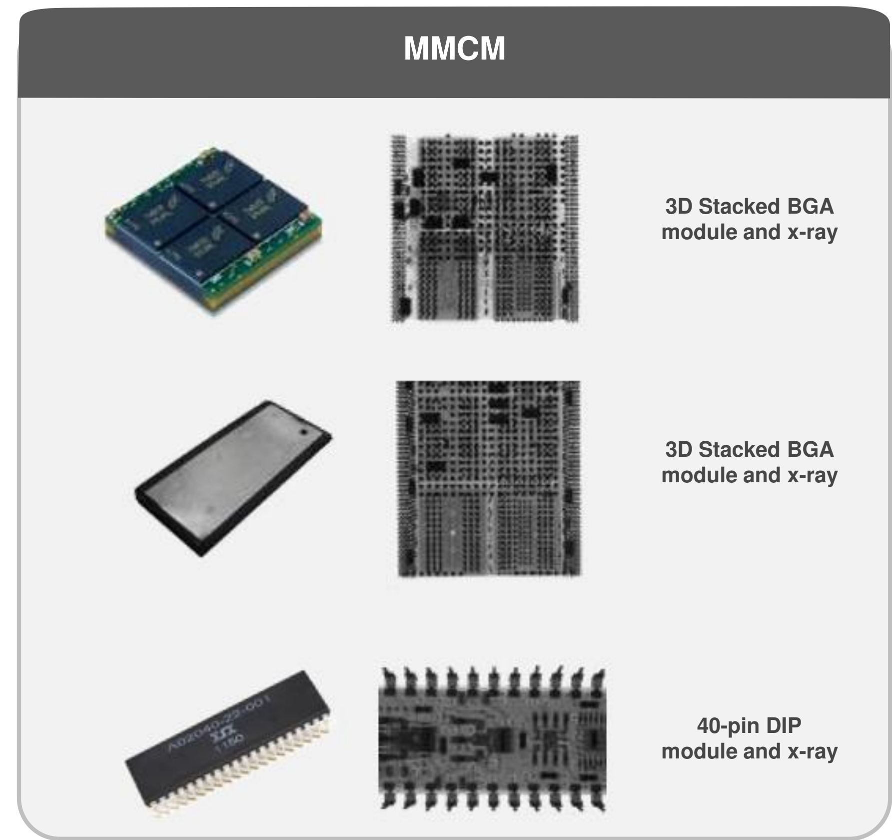
- Placed overmolded 3D-DIMM modules on bottom side of PCB, directly under the FPGA
- Eliminated 14 layers on customer PCB by mapping 3D-DIMM module pin-out directly to FPGA pins, connect by though-hole via
- Lower profile design increased airflow, and allowed compute nodes to be stacked together on a tighter pitch
- Freed up massive real estate
- Improved signal integrity by dramatically reducing trace length from FPGA to DDR3



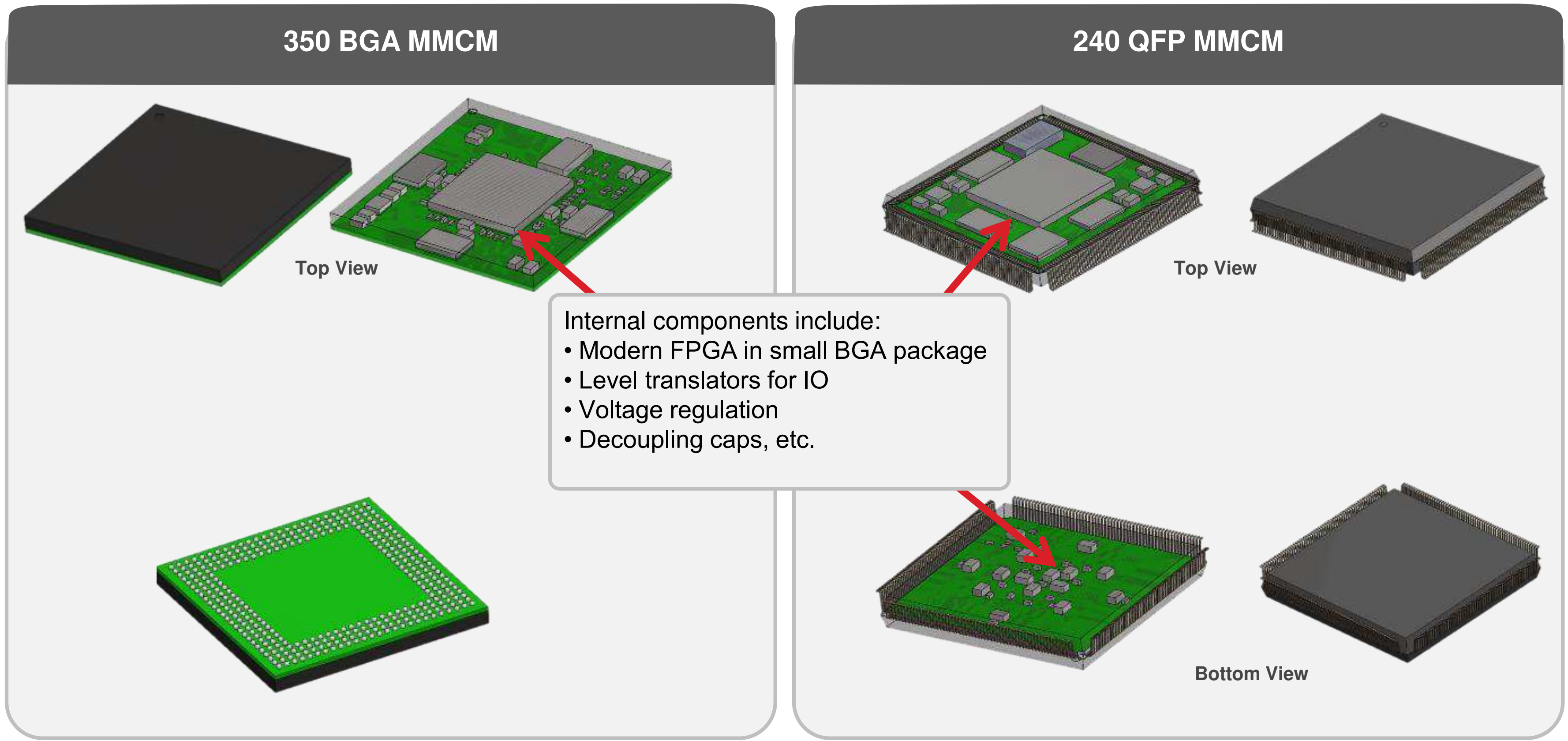


MMCM: MOLDED MULTI-COMPONENT MODULES

- Complex, multiple components integrated in a single module
    - Bare or packaged die + passive electronic components overmolded with thermoset epoxy
- Ideal for miniaturized, rugged applications in harsh environments
- An affordable way to ruggedize electronic modules
- Modules can be designed to directly replace obsolete devices



MULTI COMPONENT PACKAGES



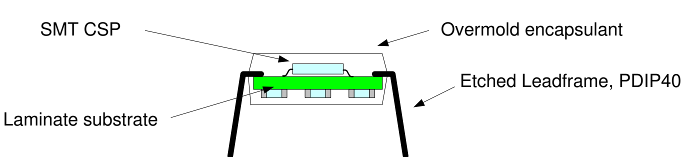
40-PIN DIP PACKAGE FOR AVIONICS

Customer's Challenge

- Avionics customer faced obsolescence on part, needed alternative IC package
- Redesigning avionics main board would mean requalification
- Due to high temp and vibration requirements, a standard non-overmolded adapter would not be an option

ISI's Solution

- After in-depth cost analysis, customer determined it would be more cost effective to design an ISI overmolded 40-pin DIP package to replace current IC package
- The rugged overmolded design consisted of off-the-shelf packaged parts on an FR4 PCB with ISI lead frame pins
- Non-molded prototypes delivered and tested within 4-6 weeks
- Molded prototypes met customer qualifications and delivered within 2 weeks after approval
- ISI solution flexible to meet any of the customer's future redesign issues



THANK YOU!

Contact ISI to engage on your next project:

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