

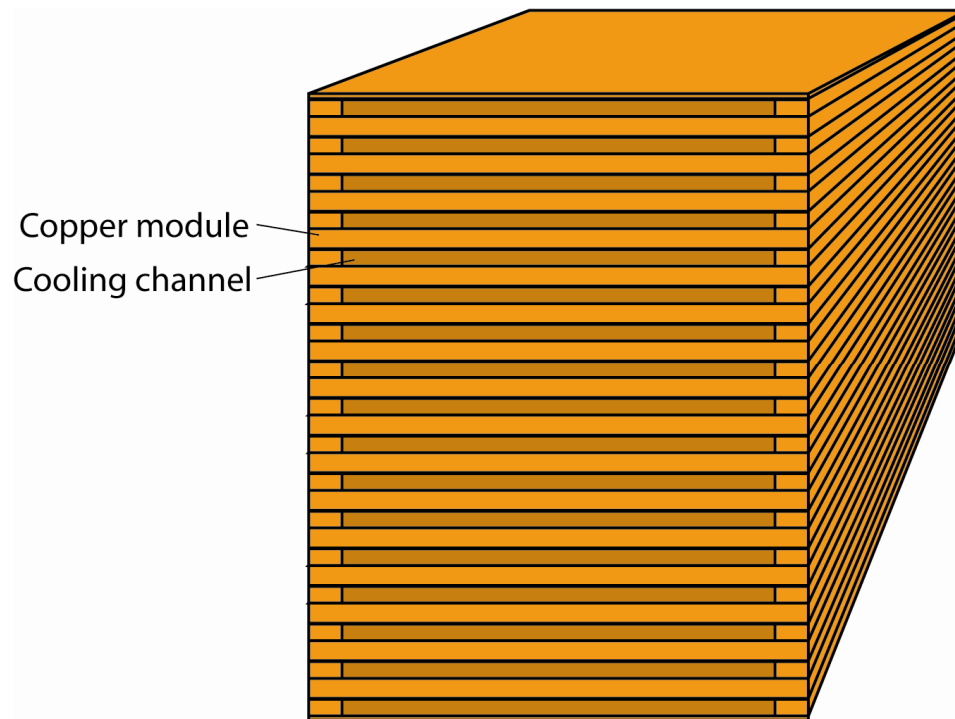


REPAIRABLE 3D SEMICONDUCTOR SUBSYSTEM

Peter C. Salmon
Sysflex, Inc
psalmon@sysflex.biz



Build a next-generation 64-way server, in 10 easy steps



Premise: We can break the rules on the inside if we use a standard interface on the outside.

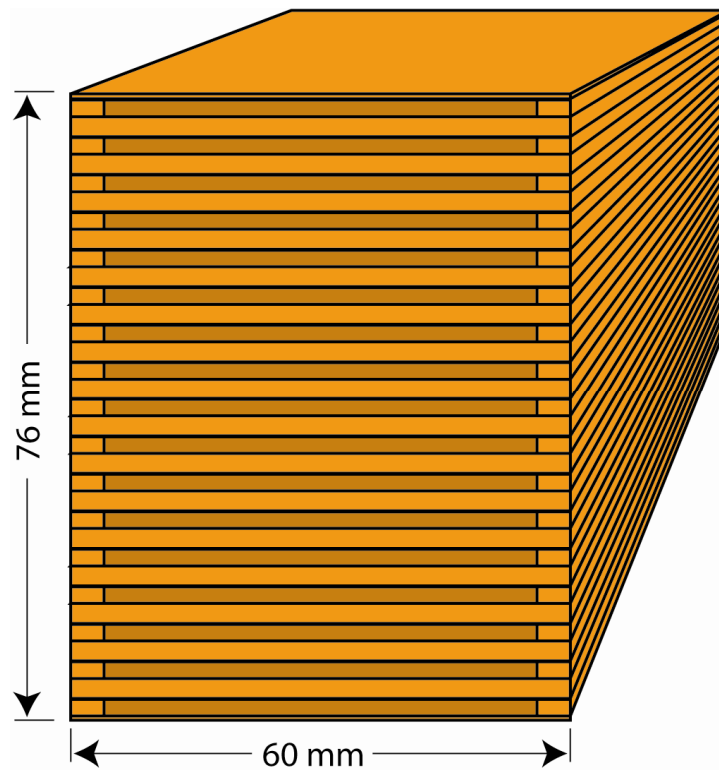


10 easy steps

1. Define the chip set for each module
2. Layout a module on two 60 x 60 mm substrates
3. Build the substrate
4. Build the interconnection circuits
5. Bump the chips
6. Assemble the chips
7. Test and rework the chips
8. Stack the modules
9. Test and rework the modules
10. Add cooling circulation system

The target, advanced 64-way server

- 100X size reduction
- \$3M machine:
 - Faster
 - Lower cost
 - Better cooled
 - More reliable





1) Define the chip set for each module

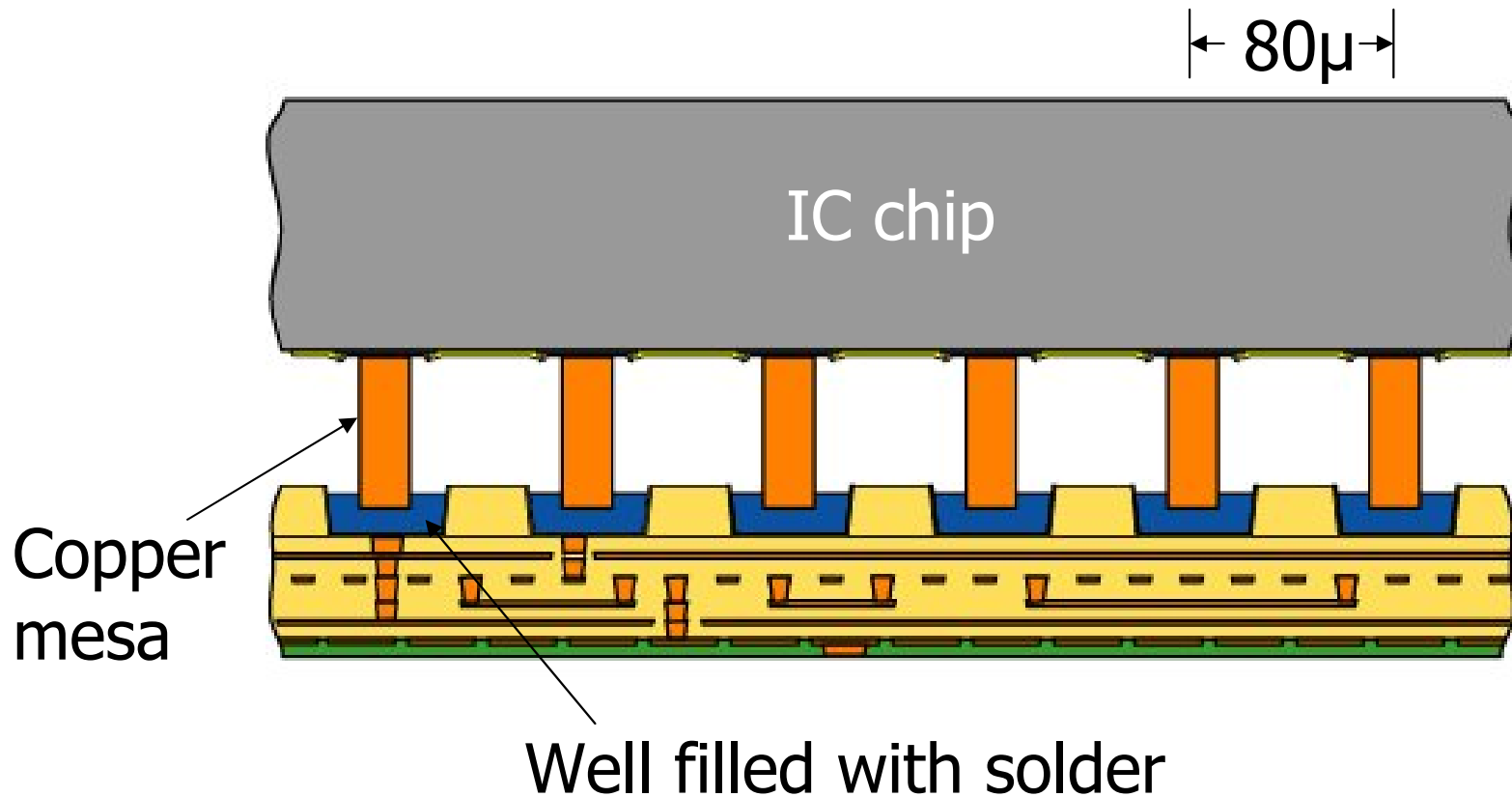
	# chips	size
4-way proc., 3.33 GHz, 64-bit, 8MB L3 cache	1	L
4Gb DDR2-667 RAM	8	M
Memory interface	4	L
Legacy I/O	2	L
Power distribution	6	S
Electro-optic interface *	2	S
Test *	1	S
Total	24	

* To be developed



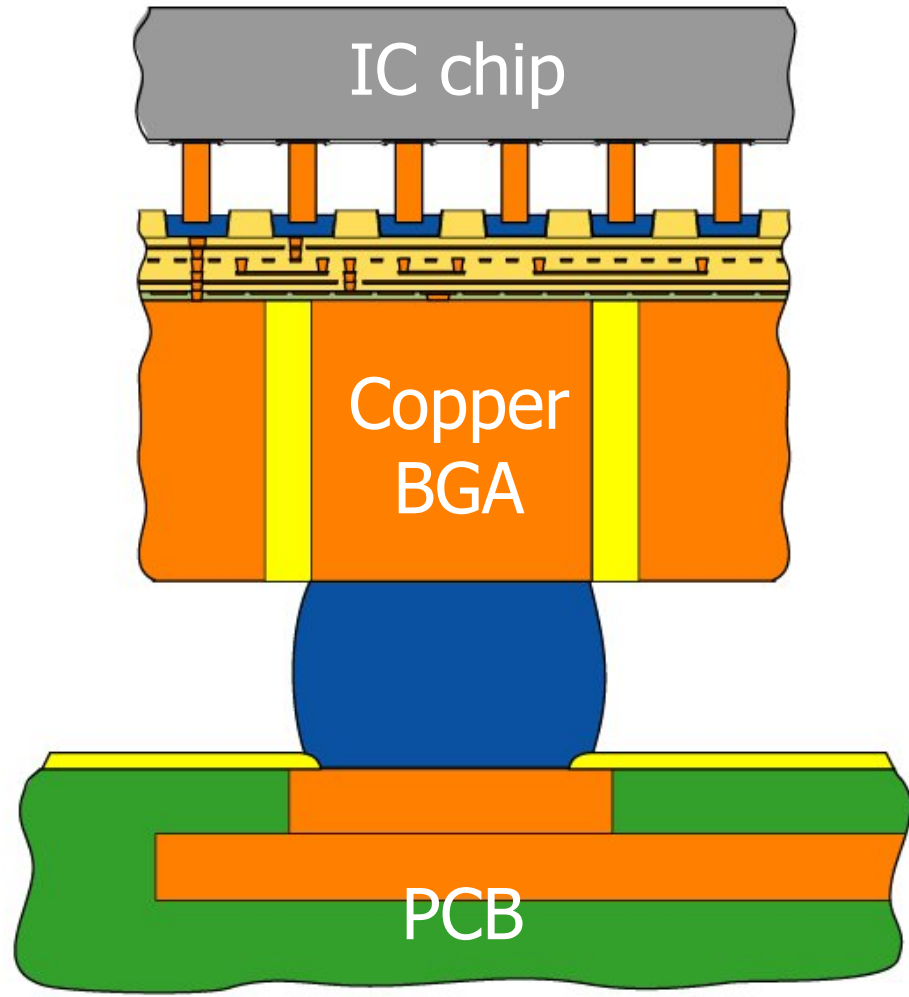
Layout a module on two 60 x 60 mm substrates

Improved flip chip connection

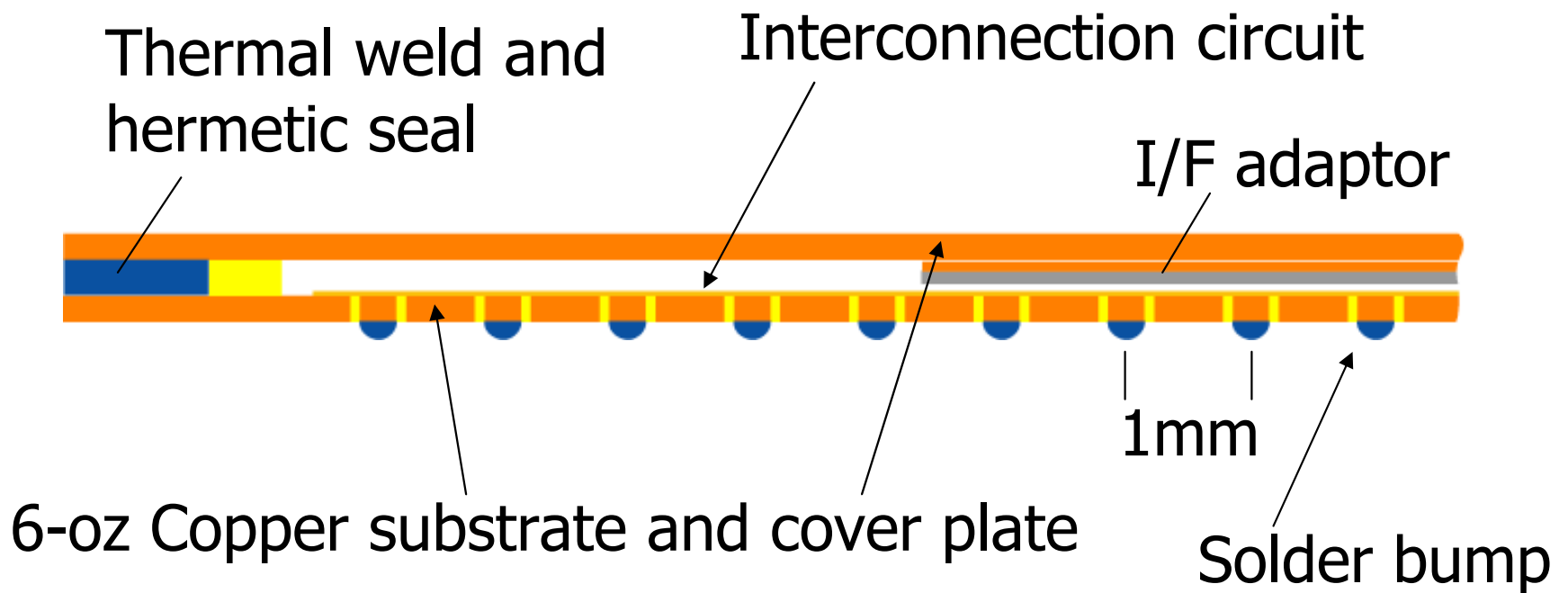


- Good relief of thermally induced stresses
- Deep wells remove criticality of planarity
- Re-workable
- Low force insertion – okay with low-k

Chip-to-board stack-up using copper BGA

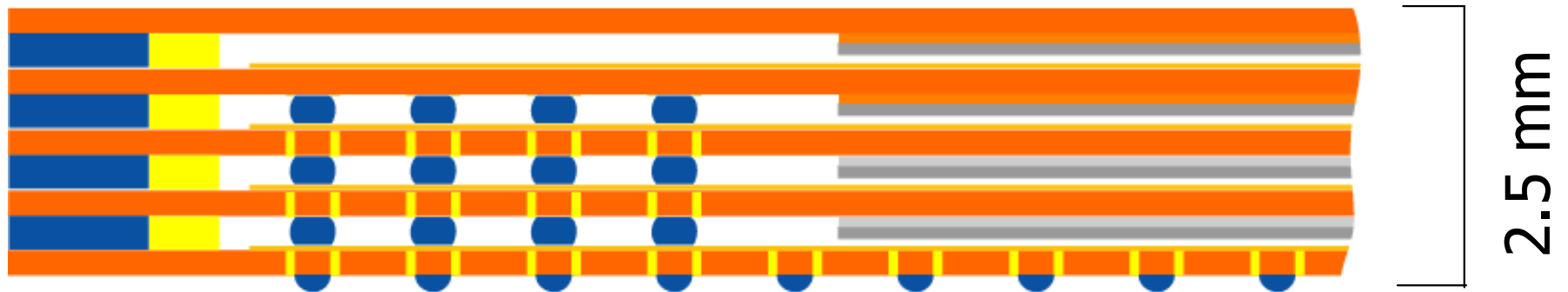


Copper BGA



- Notes:
- 1) Hermetic
 - 2) Standard BGA interface to PCB
 - 3) Some radiation protection

Stacked Copper BGA

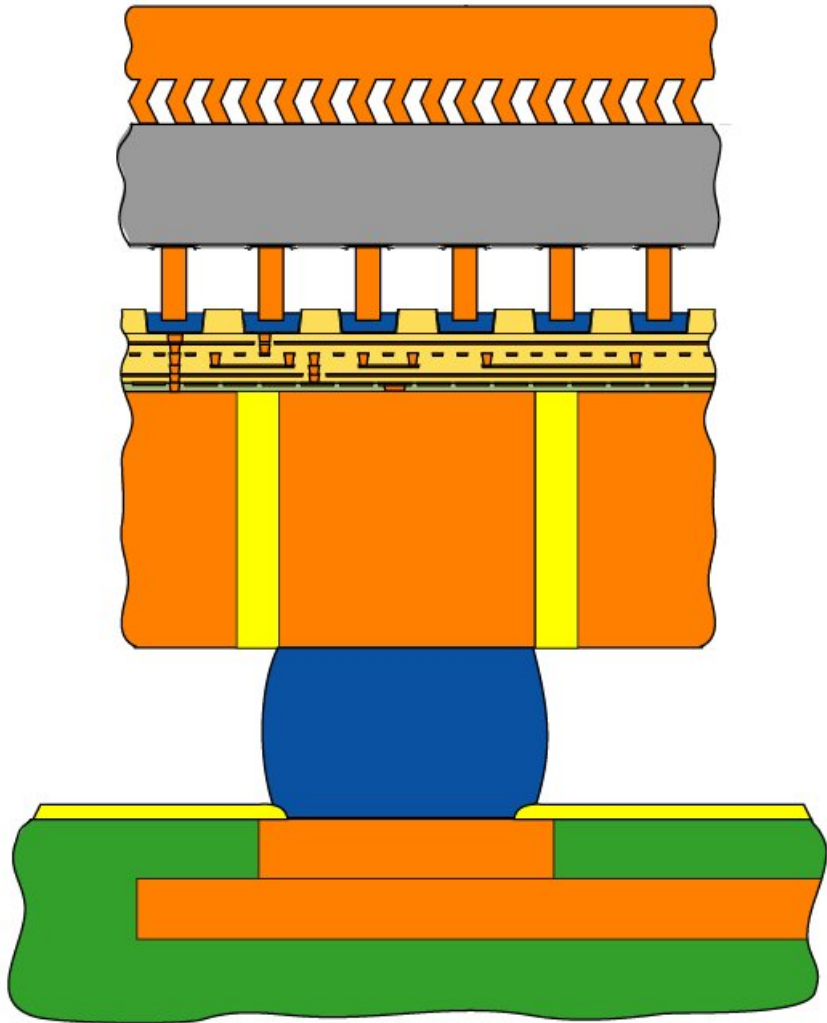


40 mm square area

~ 80 chips

~ 500 watts

Socket for testing known good die



- Fill wells with liquid conductor
 - temporary attachment
- Deep wells make planarity less critical
- Small vertical force
 - okay for low-k dielectrics
- Full speed functional test
 - Really known good die (RKGD)
- $\sim 80\mu$ minimum pad pitch
- Can manage high-power chips
- Adaptable for burn-in



Summary

For 3D packaging:

- Copper solutions take a path between high and low risk
 - Not as risky as wafer-to-wafer bonding but more risky than glass-epoxy
 - Achieve ~ 100X size reduction for a blade server
 - Probably support 10Gbps signaling rate
 - Address heat management problems
 - Address assembly yield problems
 - Available materials and processes – not inherently expensive