#### **Area Array Probe Card Interposer**

Raphael Robertazzi IBM Research 6/4/01





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# Outline

- Motivation:
  - Probe Cards for Testing Complex ICs in the Developmental Stage.
  - Hand Wired Space Transformer Limitations.
  - Bandwidth / Power Supply Bypassing for High Speed / High Current Parts.
- Interposer Concept / Implementation.
- Experimental Results.
- Conclusions.





#### **Motivation**

- Developmental Testing of Complex ICs.
  Space XFM Required.
  - Probe Cards Need to be Manufactured Quickly (<12 weeks). Ceramic Modules Not an Option.</li>
  - Membrane Probe Technology Still Too Immature for Complex Area Arrays of Ports.
  - Needle Cards Unusable.





#### Hand Wired Space Transformer Limitations

- Bandwidth < 600 MHz</li>
   Rise time > 2nS
- Current < 30 Amps</li>
- Prone to Net List Errors





### Requirements For Two ICs Under Development

- Microprocessor Part
  - More Than 7000 Ports.
  - Probe Card #1 Accessed 866 Ports.
  - Current Draw 100 Amps At Full Speed
  - Clock Line Bandwidth > 1GHz.
- Communications Part
  - 10 Gb/s Input Port
  - High Quality RF By Pass.
  - Power Net Diagnostics (Noise).



#### **Desirable Performance Enhancements**

- High Speed I/O Lines (1-10 GHz and Beyond).
- High (100 Amp) Current Drive, More Power Pins, and Low Inductance By Pass.
- Power Grid Diagnostics.
- Lithographic Implementation of the Power Net.
- Ability to Repair Nets.
- Decreased Probe Card Fabrication Time.



#### Hand Wired Space Transformer Cobra Probecard







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#### **Application of the Interposer**





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#### **Interposer Features**





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#### Interposer Photo (Standard Flex Process)

Through \_ Connection



High Speed
 Line
 VDD Plane

#### Kapton Substrate





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#### Interposer Photo (Micro-Via Flex Process)



Through \_\_\_\_\_ Connection

Kapton Substrate





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#### **Interposer Schematic**







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# **Interposer on Test System**









#### **TDR Characterization**







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#### **TDR Results**





# $\tau = 1.15 \text{ nS}.$

#### TDR of J971 Cobra Card, TDR With Interposer Mounted, $\tau$ = 250 pS.



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#### **TDT Characterization**







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#### **TDT Results**





TDT of Interposer + Cobra Head,  $\tau$  = 246 pS. TDT of Interposer Alone,  $\tau = 214 \text{ pS}.$ 



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#### **S** - Parameter Characterization



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**Quartz Substrate** 

#### **S** – Parameter Results



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#### **Cobra Head Bandwidth Estimates**



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#### **Interposer For Biasing**







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## **Current Capacity**

- - 350 Wires ⇒ 6900 Mils.
- 1Oz Cu = 1.4 Mils Thick
  - @1 inch diameter ⇒ 4400 Mils.
- Calculated Resistance = 0.19 m $\Omega$ , Injecting on a 10 Inch Circle and collecting On a 1 Inch Circle, for 1.8  $\mu\Omega$ –cm, 1 Oz. Copper.

1 Oz Plane Can Provide at Least 64% of the Capacity of a Large (350 wire) Power Net





#### **Bias Experiment**



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#### Conclusion

- Demonstrated 4X Bandwidth Improvement Over Hand Wired Space XFM Alone.
- Bandwidth Limitation Gated by Connector, Not Cobra Head.
- Interposer Can Add Extra Current Supply Capacity and High Quality, Low Inductance By Pass Capacitance.

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 Interposer Provides a Quick Repair / Reroute Capability for Probe Card.

