



Burn-in & Test Socket Workshop

March 3-6 , 2002

Hilton Phoenix East/Mesa Hotel
Mesa, Arizona

IEEE

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**Burn-in & Test Socket
Workshop**

Technical Program

Keynote Address

Tuesday 3/05/02 8:00PM

“Tooling: The Other ‘Capital’ Equipment”

Steven B. Strauss

ITTO Manager

Intel Corporation

Tooling: The Other “Capital” Equipment

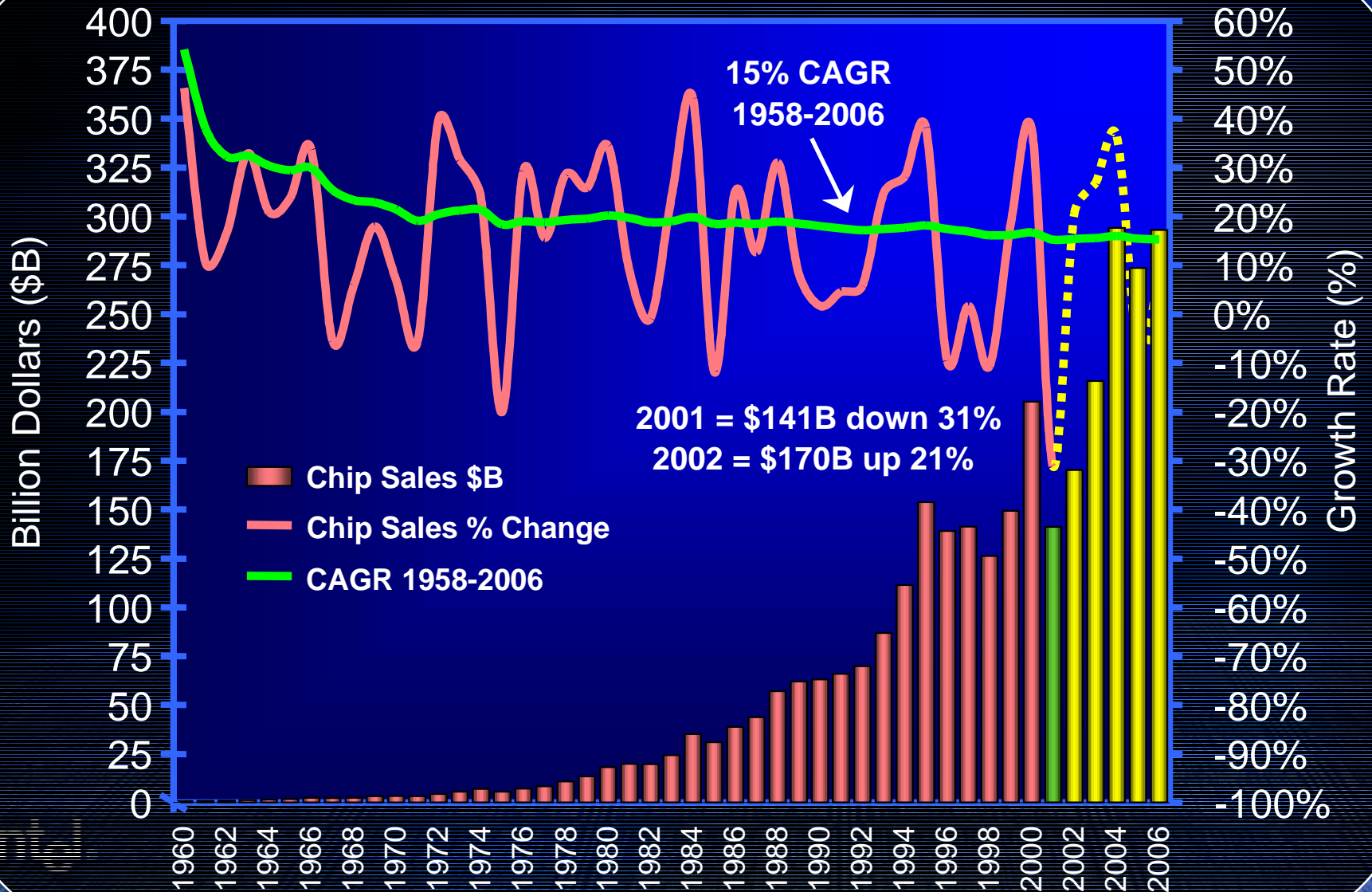
Steven B Strauss
Intel Test Tooling
Operation Manager
Chandler, Arizona



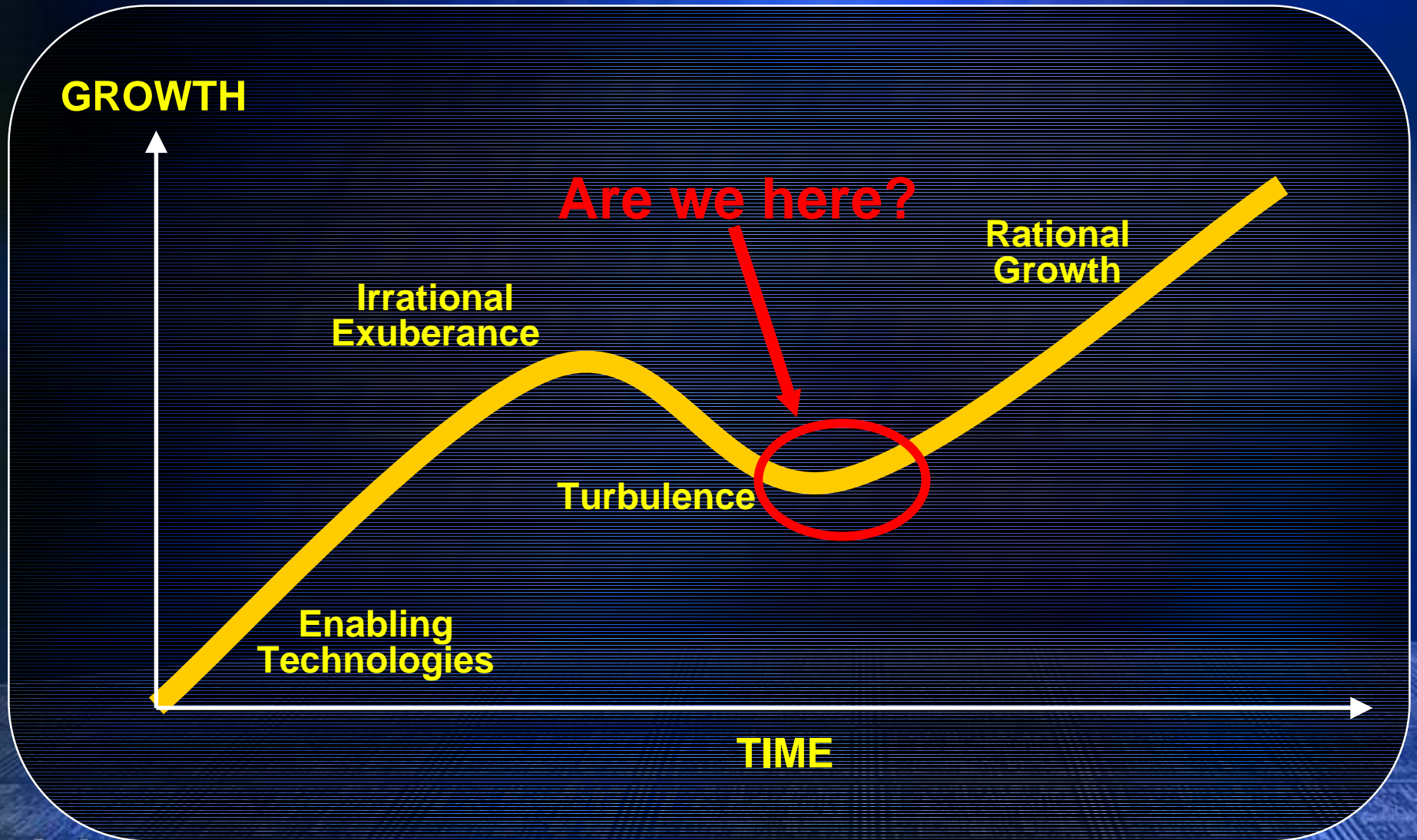
Key Messages:

- We have just experienced one of the worst economic downturns in the history of this industry
- Technical challenges continue to accelerate
- Increasing costs have driven changes in Capital Equipment for Test
- The Tooling Supply industry has not changed to meet customer needs in solutions, cost, or capability
- It's time

The economic world we live in: Semiconductor Industry Cycles



The economic world we live in: Lessons Learned?

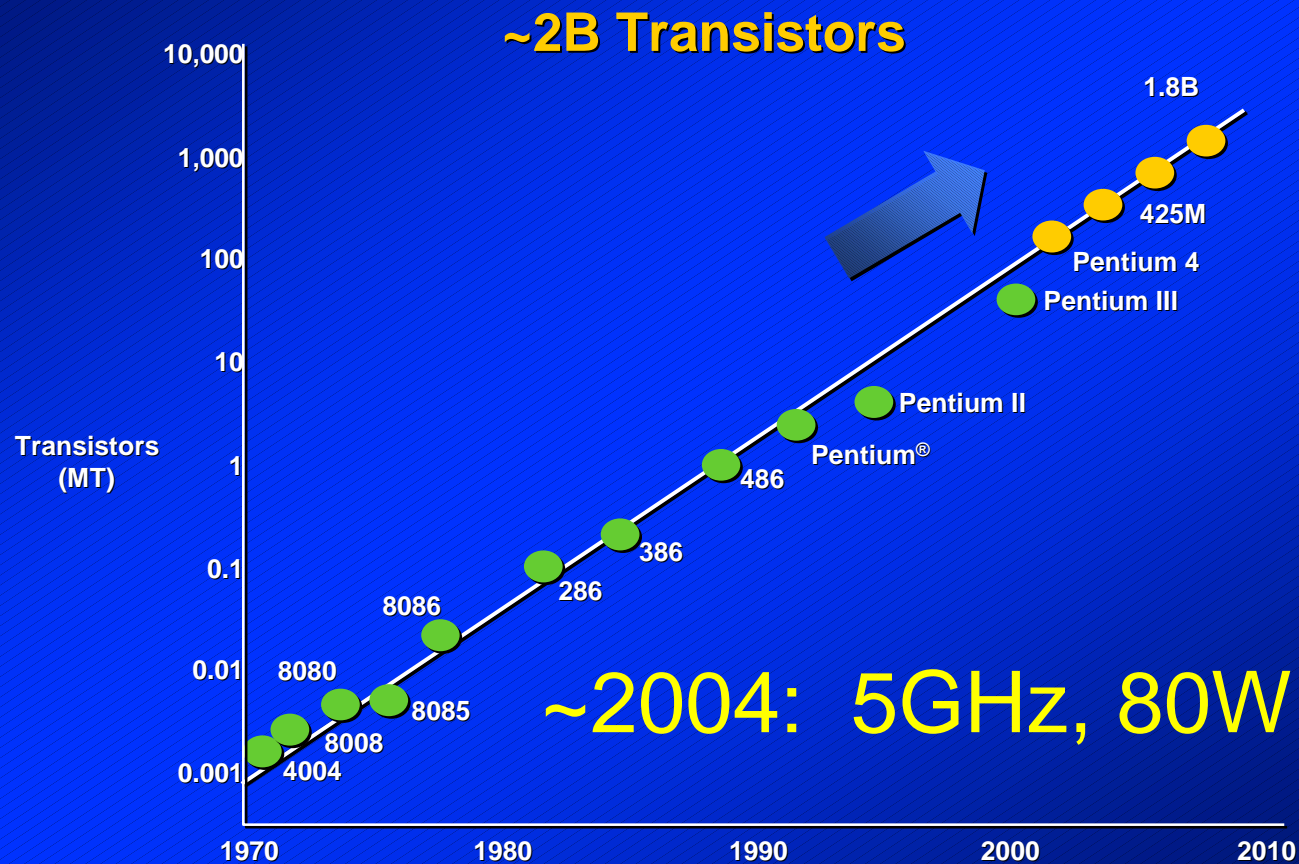


“If the automobile industry advanced as rapidly as the semiconductor industry, a Rolls Royce would get 500,000 miles per gallon of gas and it would be cheaper to throw it away than park it.”

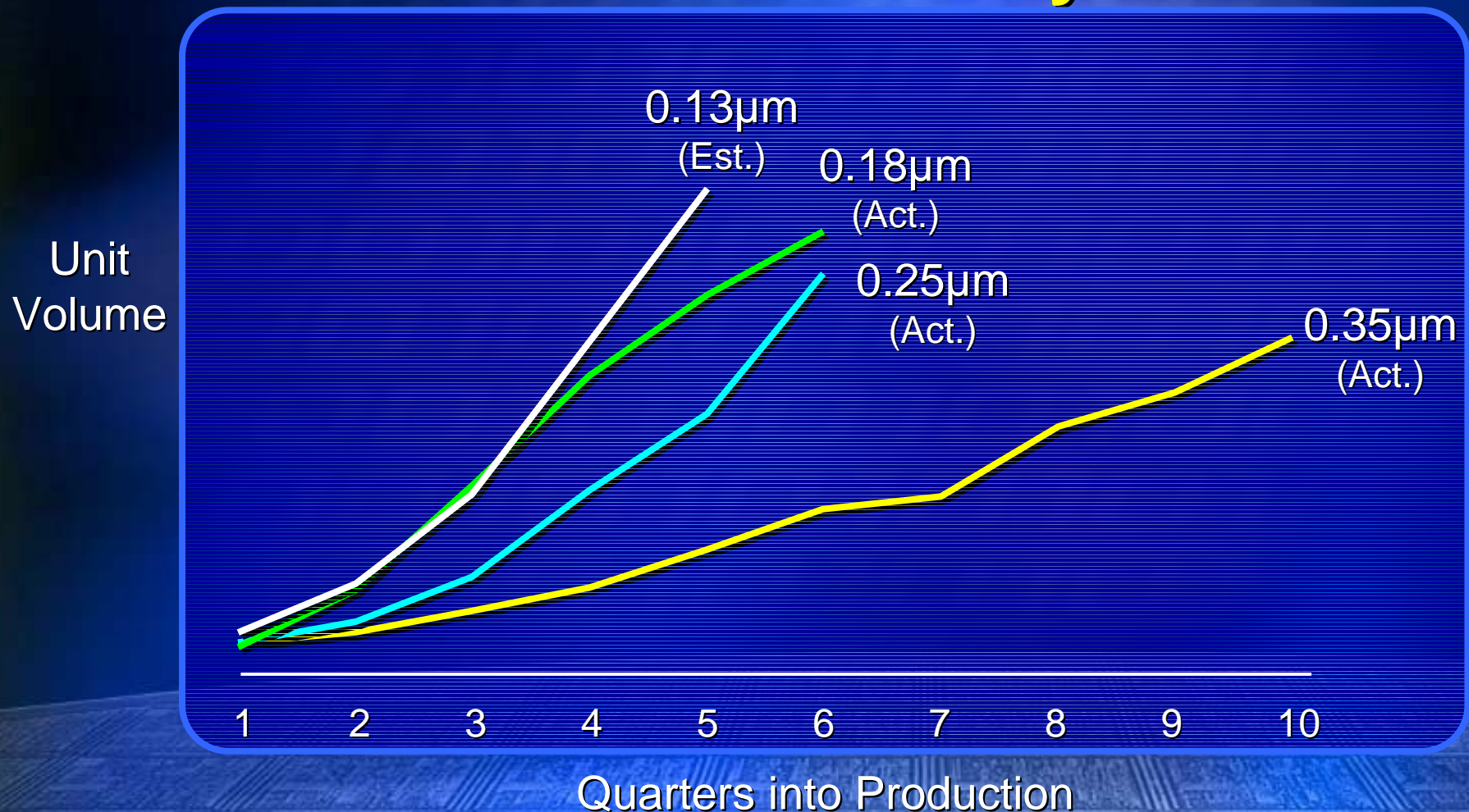
*– Gordon E. Moore
Chairman Emeritus, Intel Corporation*

The Technical World we live in: Extending Moore's Law

Transistors doubling every 2 years toward a billion transistors



The Technical world we live in: The Volume Lifecycle

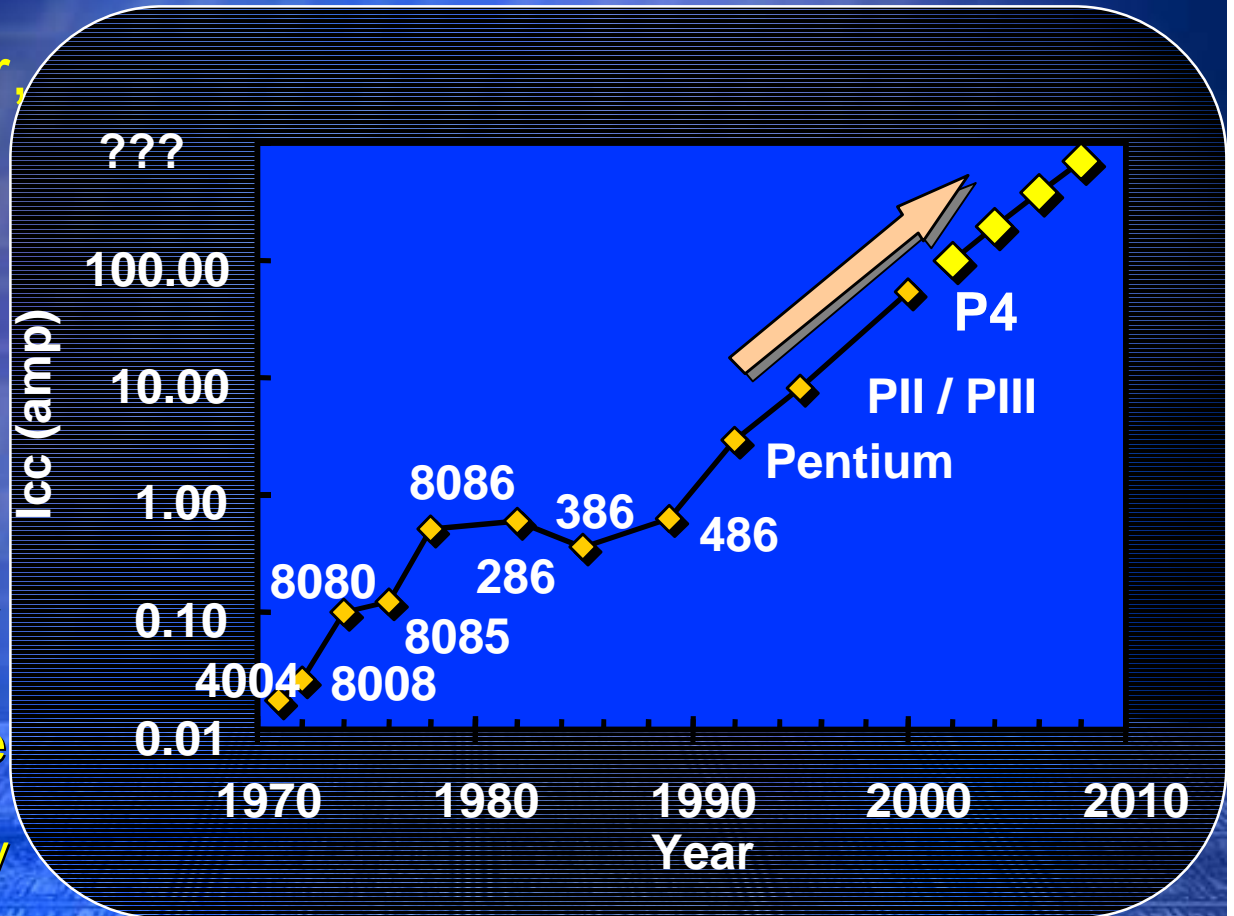


No time for Mistakes - Get It Right The First Time

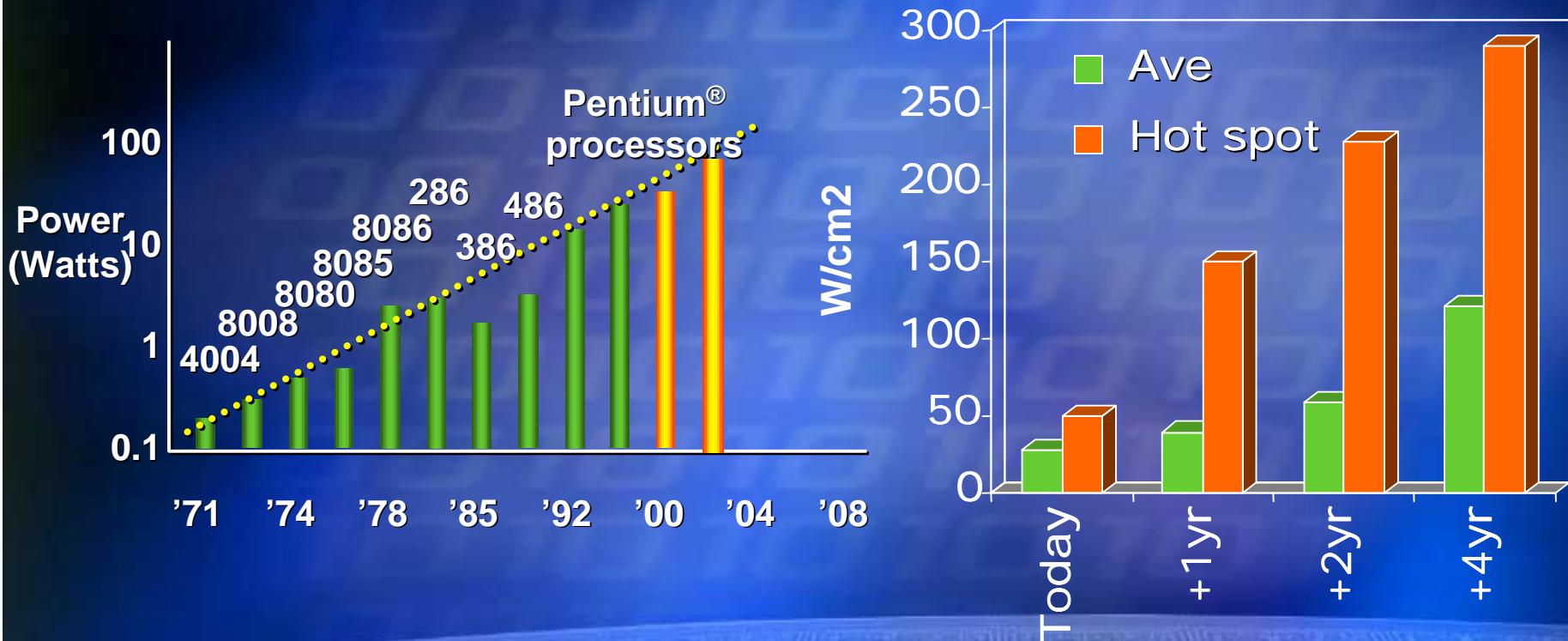
The Technical World we live in:

Power Delivery

- Issue
 - How do you deliver a lot of noise free power, quickly
 - Power in = Heat Out
- Capabilities needed
 - 2X improvement in capacitance and inductance needed / generation
 - Need to optimize the complete silicon to tester power delivery solution

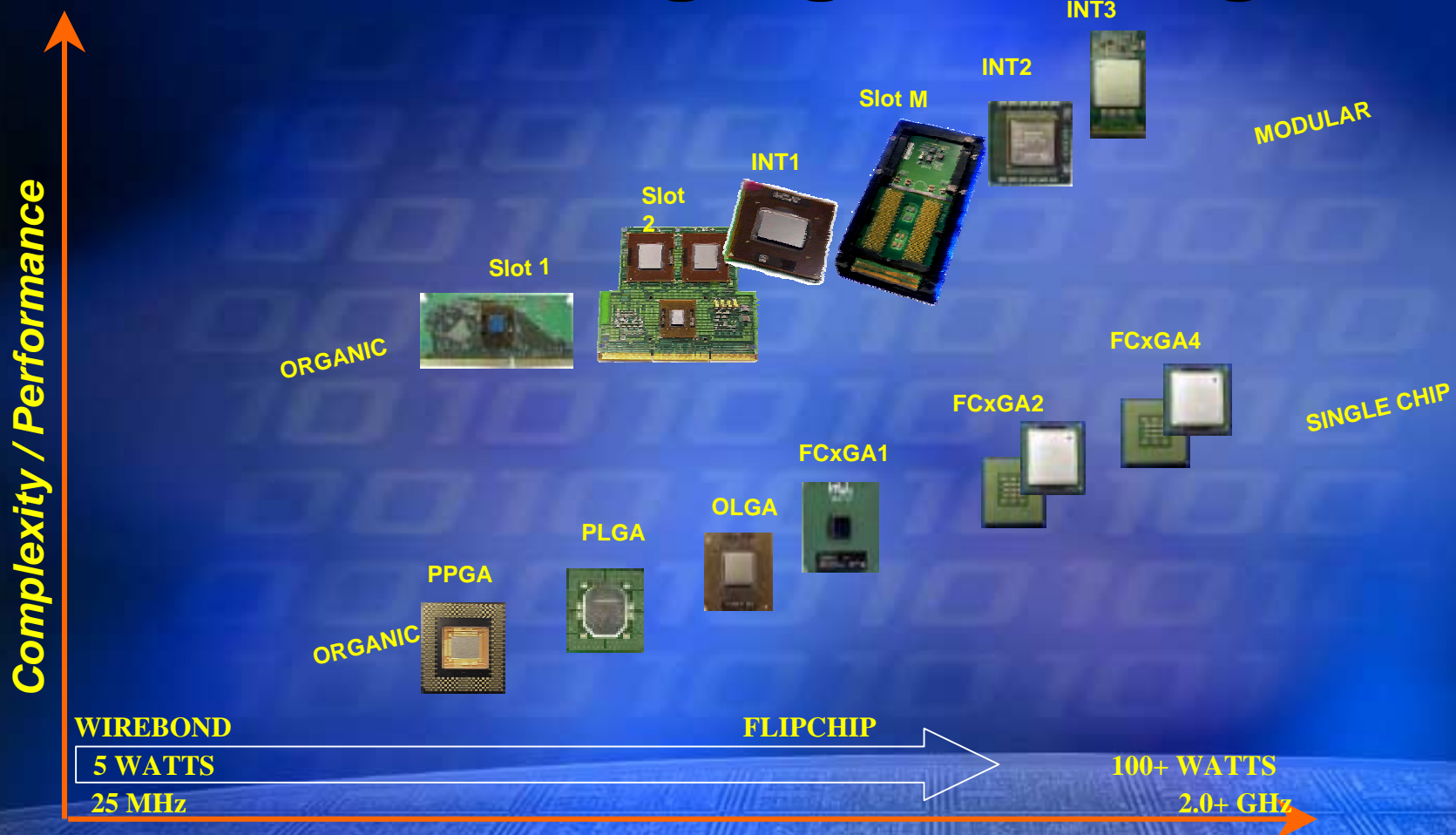


The Technical World we live in: Power Density will get worse



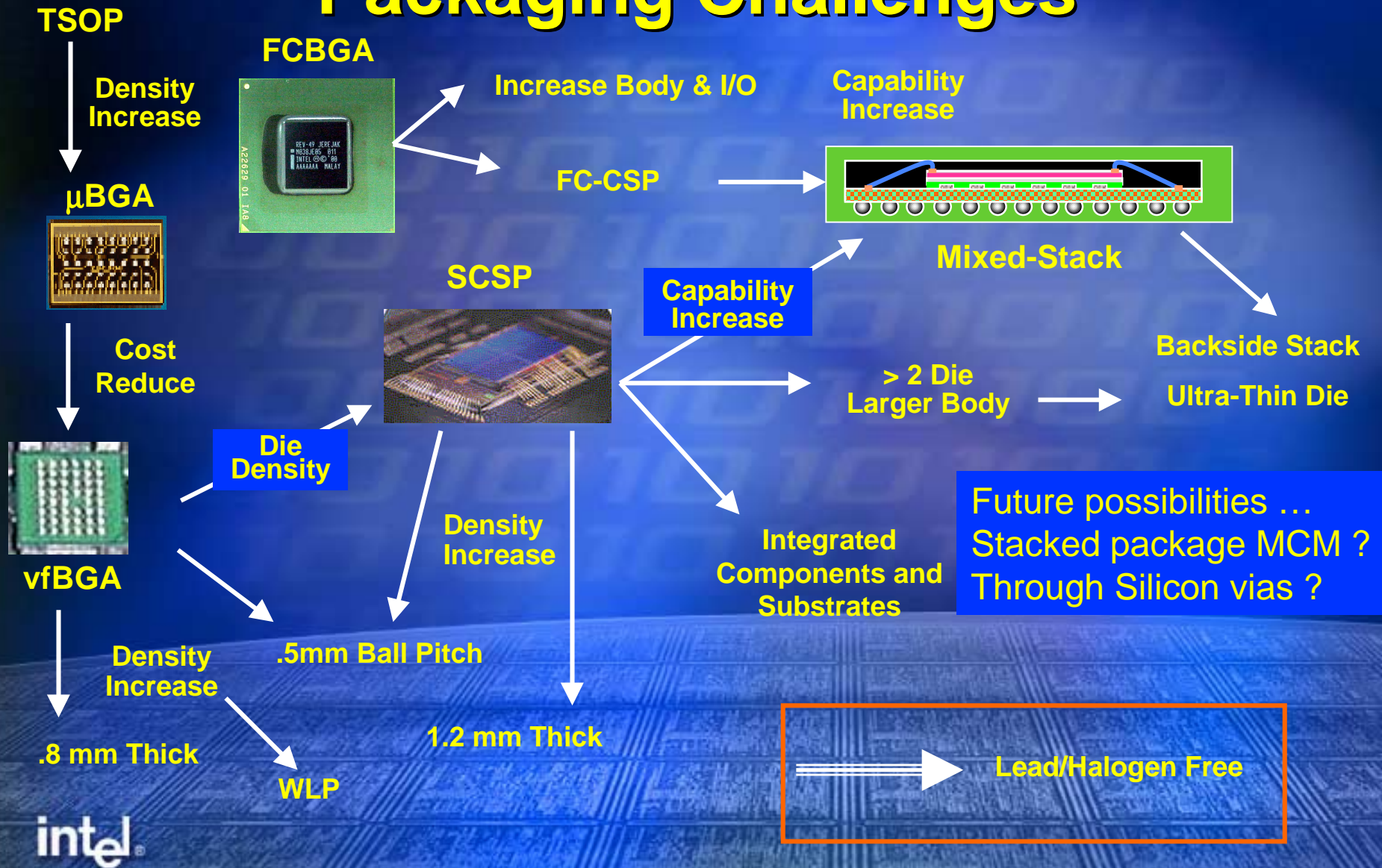
How rapidly can we innovate new thermal solutions / interface materials ?

CPU Packaging Challenges

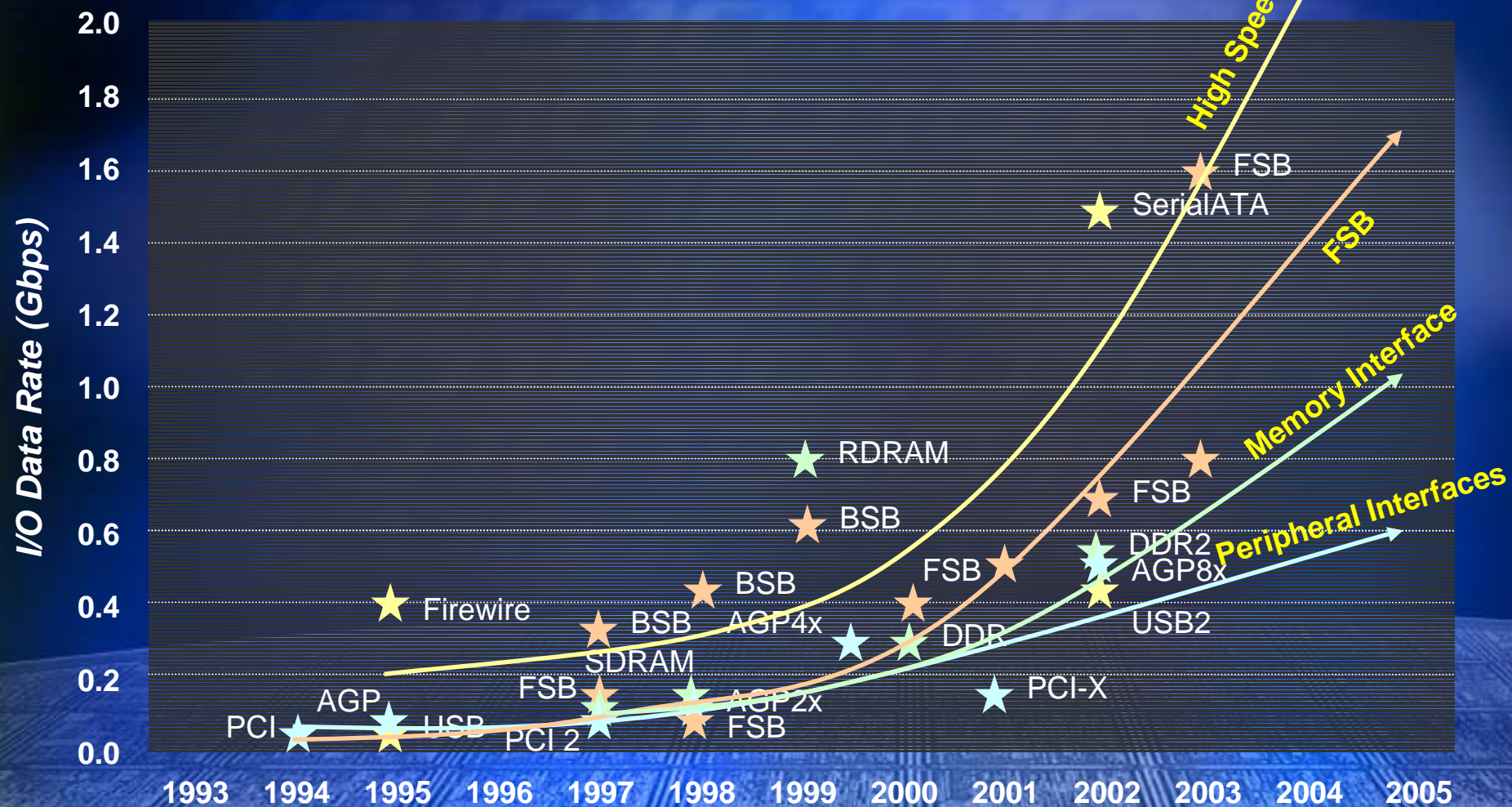


- Current & power are increasing
- Voltage scaling lowers noise margins
- Frequency push for performance > 3 GHz
- Form-factors continue to segment

Communications Products Packaging Challenges

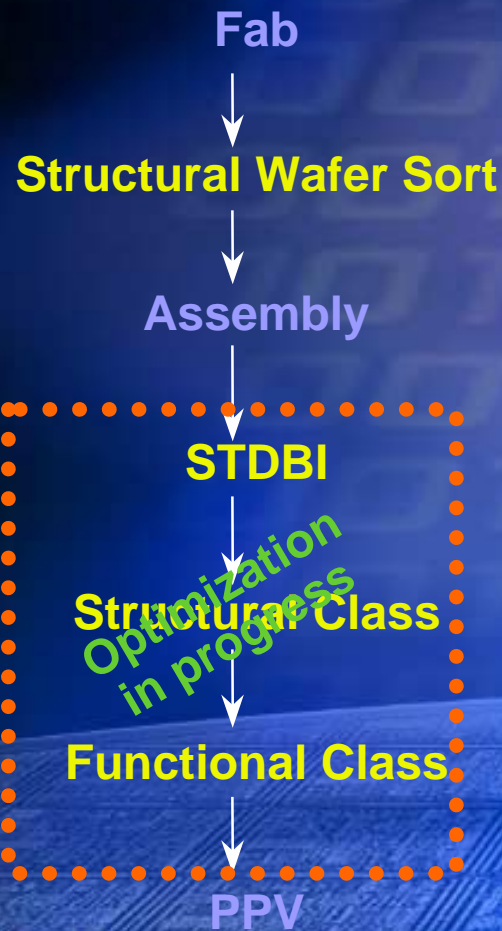


The Technical World we live in: Device I/O Trends

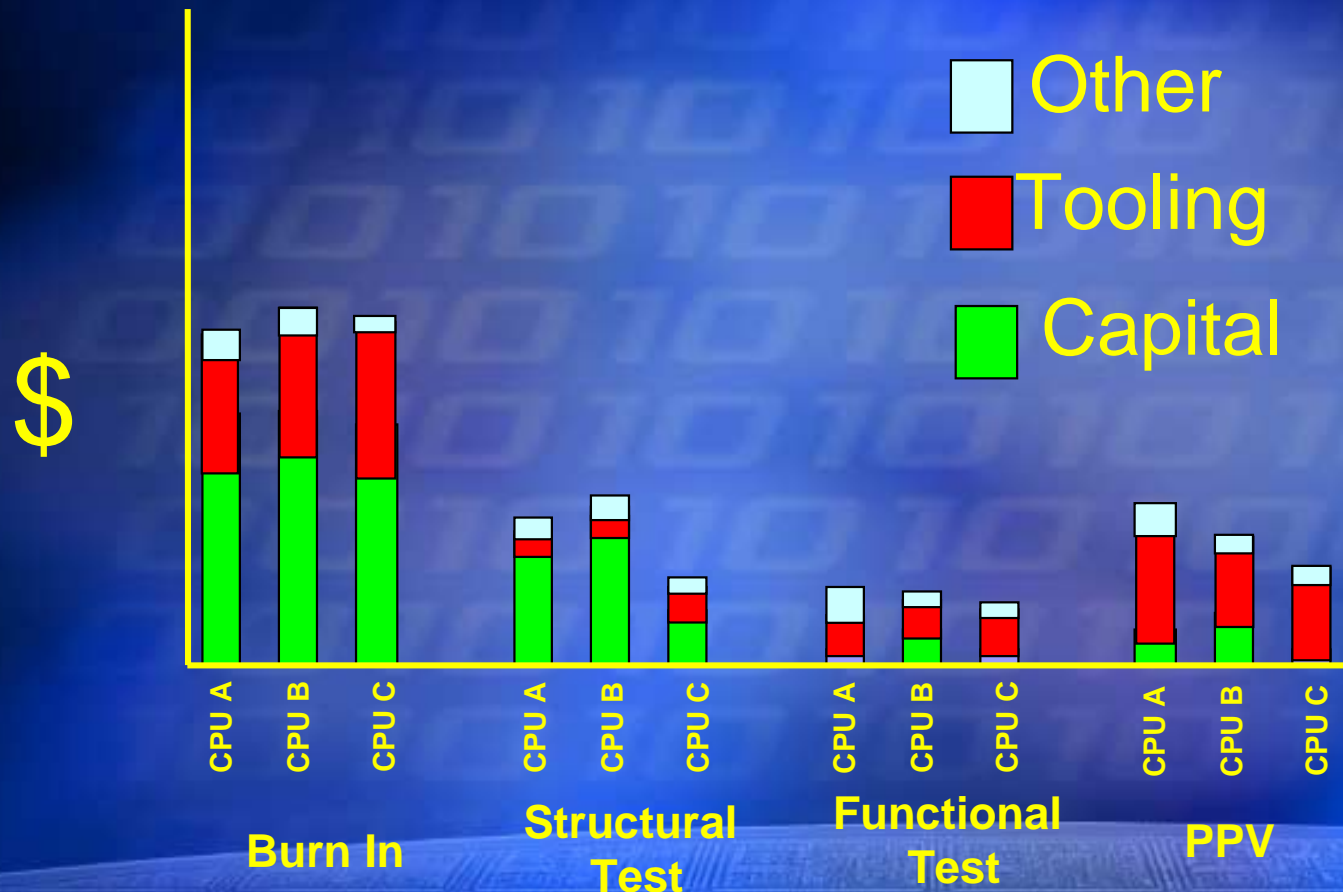


The Manufacturing World we live in: Test Flow Revolution

- The test industry has changed
 - Implemented advanced DFT to manage test complexity
 - Eliminate capability treadmill
 - Enable parallel test in complex designs
- Migrate significant percentage of test content to less expensive structural test
 - Enables capital cost reduction
 - Deliver state-of-the-art capabilities
 - Simplified tester hardware designs
 - Optimized content and flow

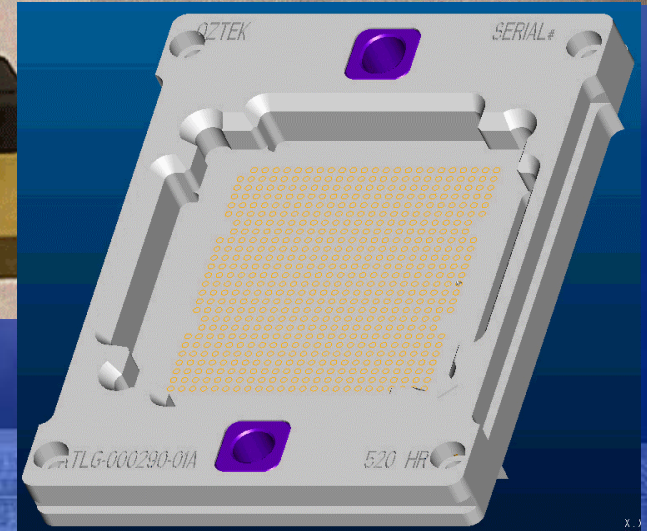
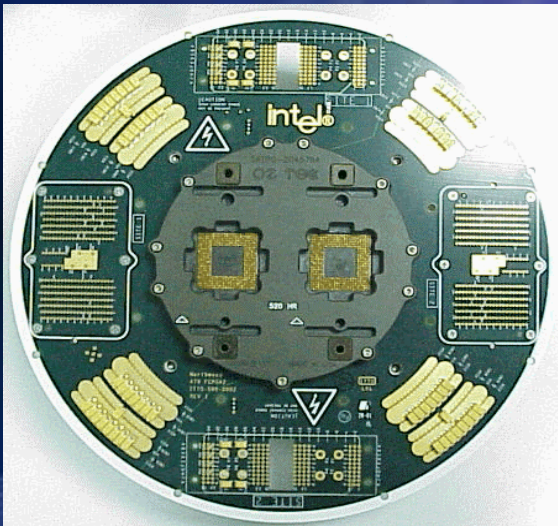
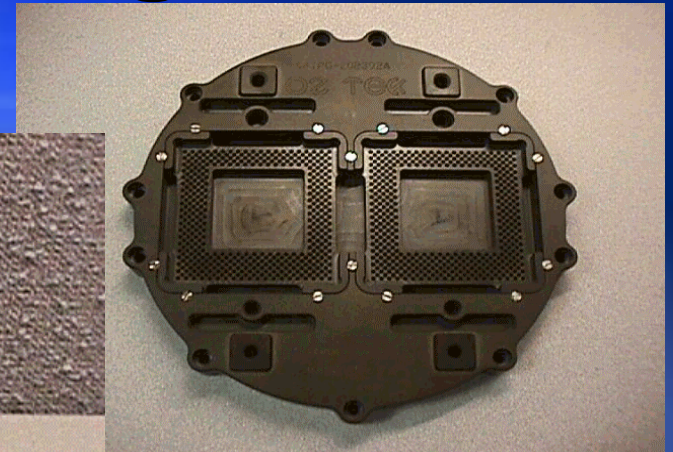
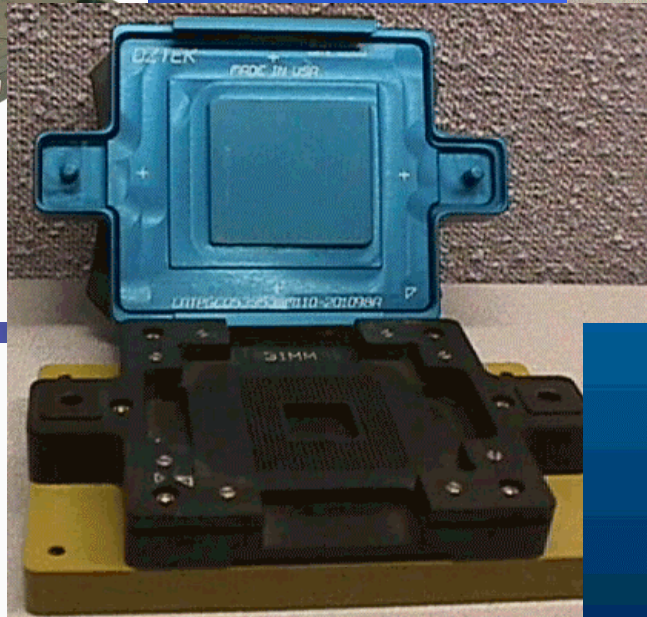
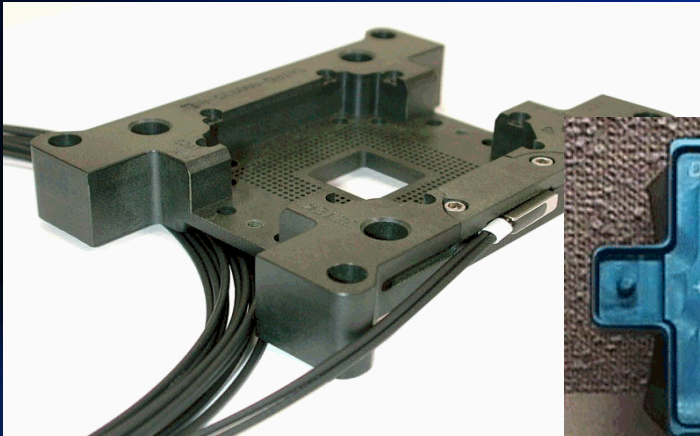


Capital vs. Tooling



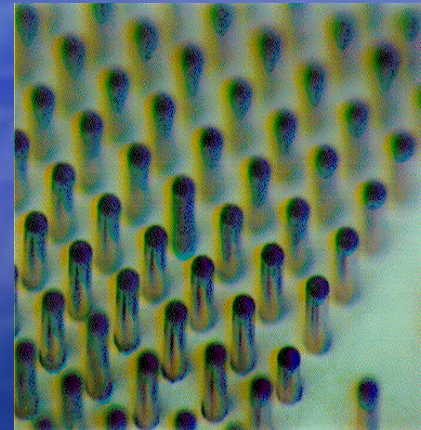
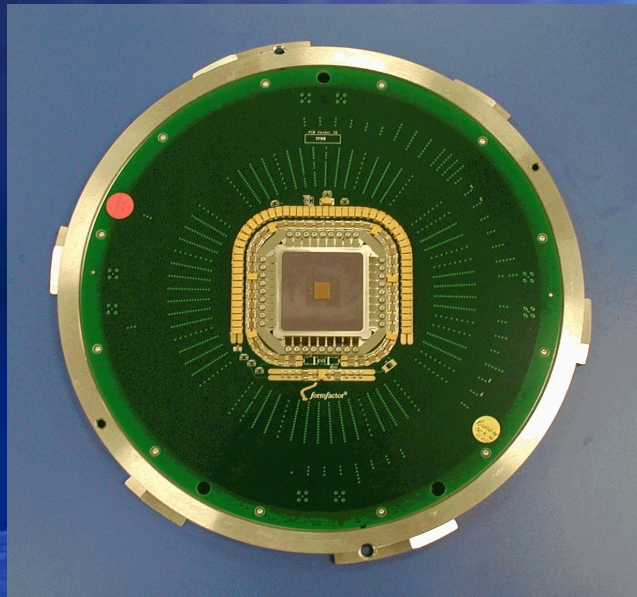
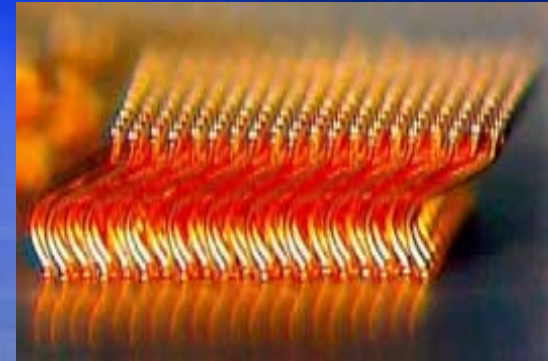
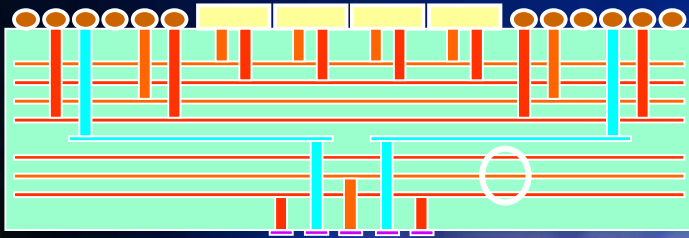
- Historically Capital Equipment got all the attention
- But... We are buying less and less Test Capital
- And... Tooling is becoming a bigger and bigger %

What is Tooling?



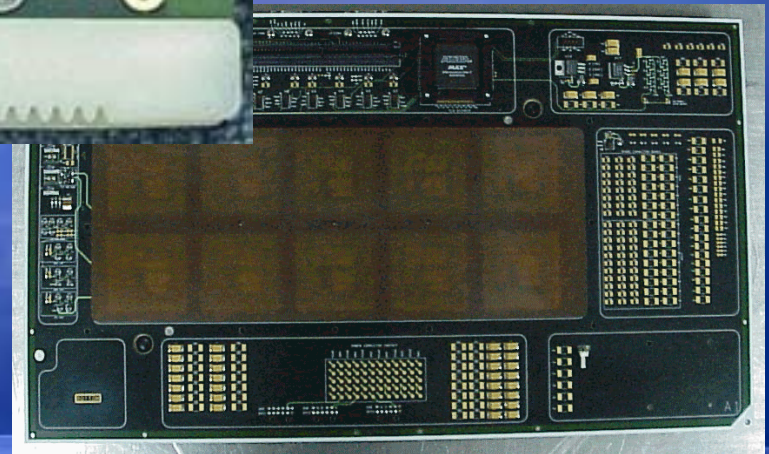
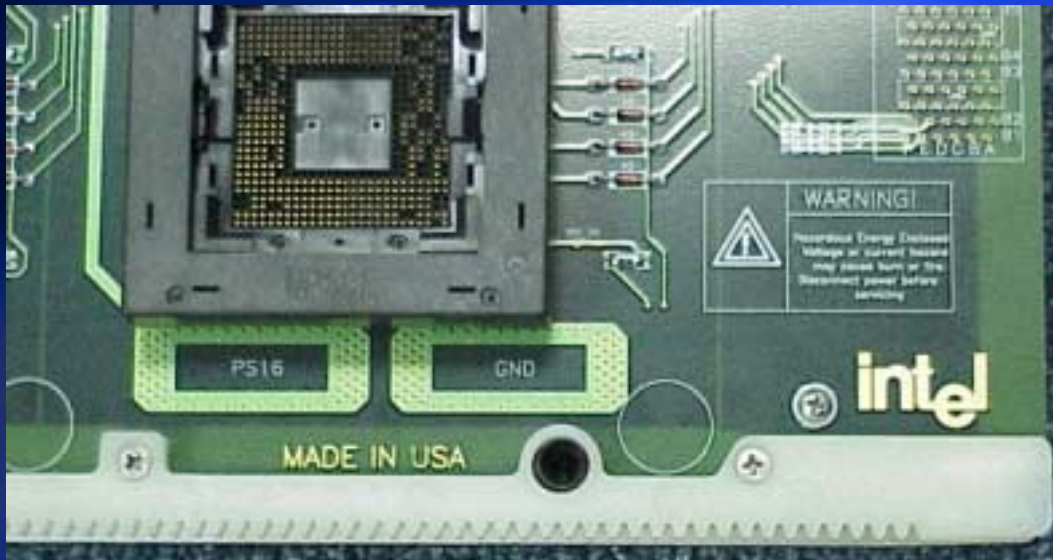
**Big Iron Tester Interfaces:
PCB's, Contactors, Pogo Pins**

What is Tooling?



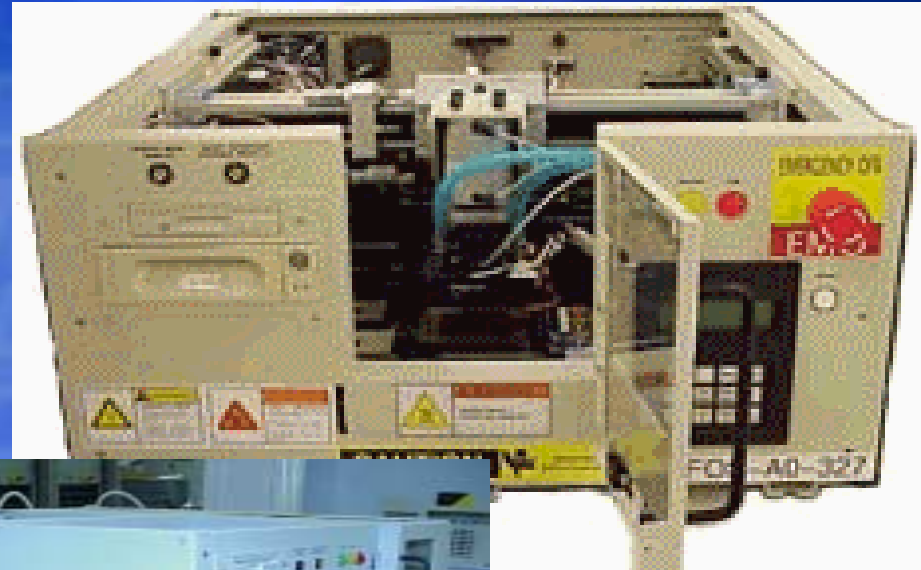
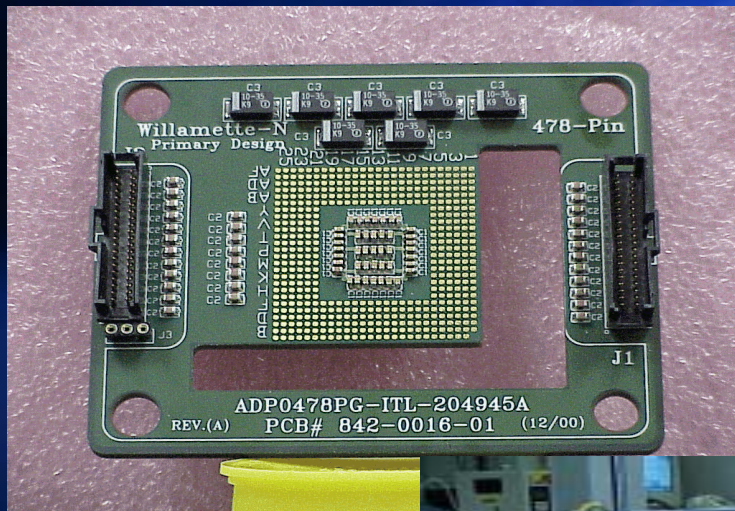
**Wafer Test: Probe Cards, Probes,
Space transformers**

What is Tooling?



Big Boards and Sockets: Burn in, Massively parallel test and fusing

What is Tooling?



intel

Box or Use Based Testing

Tooling:

Provides a temporary Thermal Mechanical and/or Electrical interface to the DUT

Is custom to products

Is dependent on and customized to: Packaging form factors, Electrical and Thermal requirements and Device Function

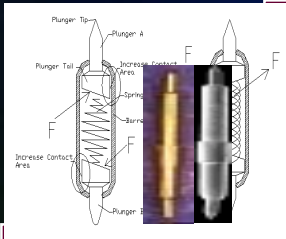
Has demand that is driven by product ramp cycles and is renewed and upgraded by product, package etc...

Provides supplier and supply chain challenges like no other commodity

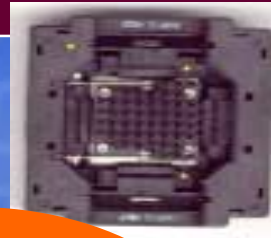
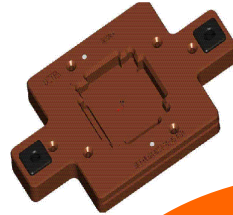
Is a technology, development and HVM enabler!

What does it takes to deliver tooling in this environment ?

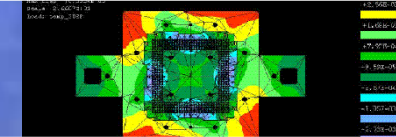
Contact Technology



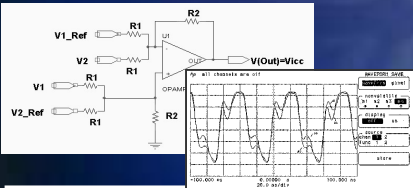
Socket/Contactor Design and Fabrication



Thermal Control / Mechanical Actuation



Electrical & Test Circuit Design

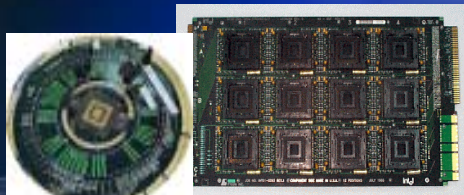


System Integration

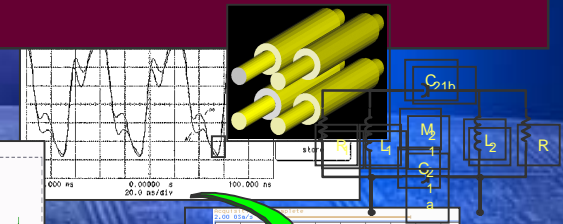
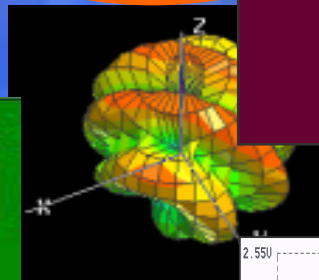


REQUIRED TOOLING COMPETENCIES

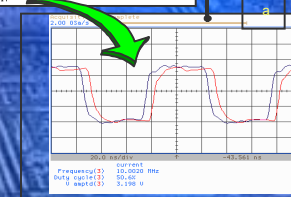
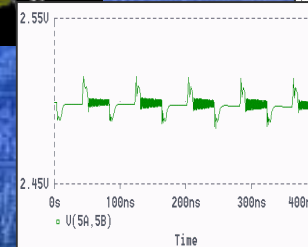
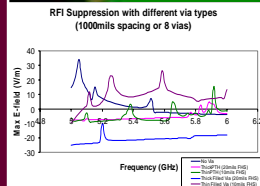
PCB Technology / Design Methodologies



High Speed/Data Rate & Power Delivery Modeling/Simulation



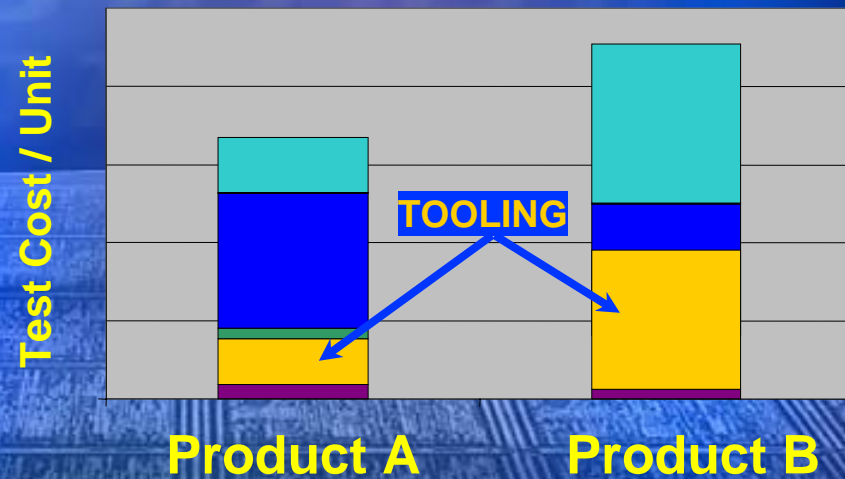
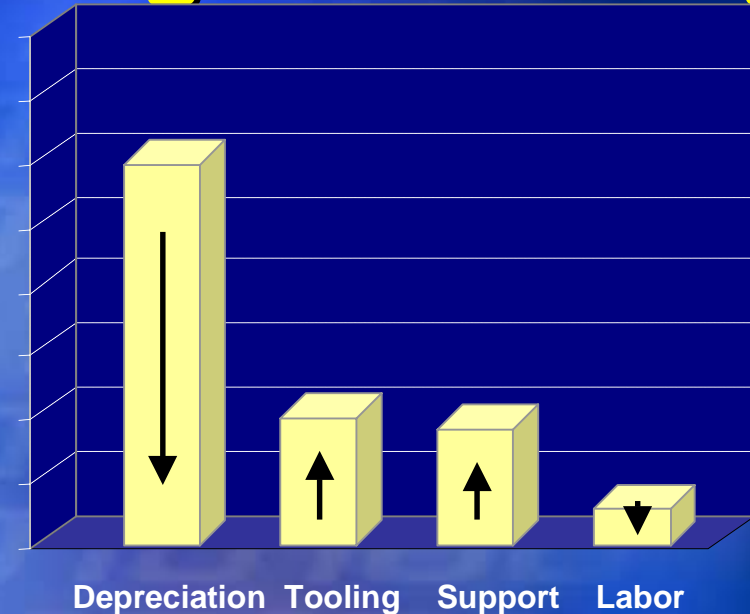
RF/EMC Modeling & Simulation



**Tooling Suppliers are
not keeping up!**

The Treadmill Challenge in Tooling

- NPI increasing at 40% to 50% per year
 - More custom designs
- Steep Product Ramps - GIRTFT
- Product Health is a big lever
- Tooling and Service costs are increasing as an overall percentage of test cost



Tooling suppliers

- **Are there any “turn key” tooling suppliers?**
 - The tooling industry is fragmented
- **The Capital Analogy:**
 - Buy capital equipment – One stop shopping
 - You don't buy the pieces from 2-3 suppliers!
- **Lets buy a Burn In board**
 - 1 supplier for design
 - 1 supplier for PCB manufacturing
 - 1 supplier for sockets
- **Who stands by the final product? The Customer ?**

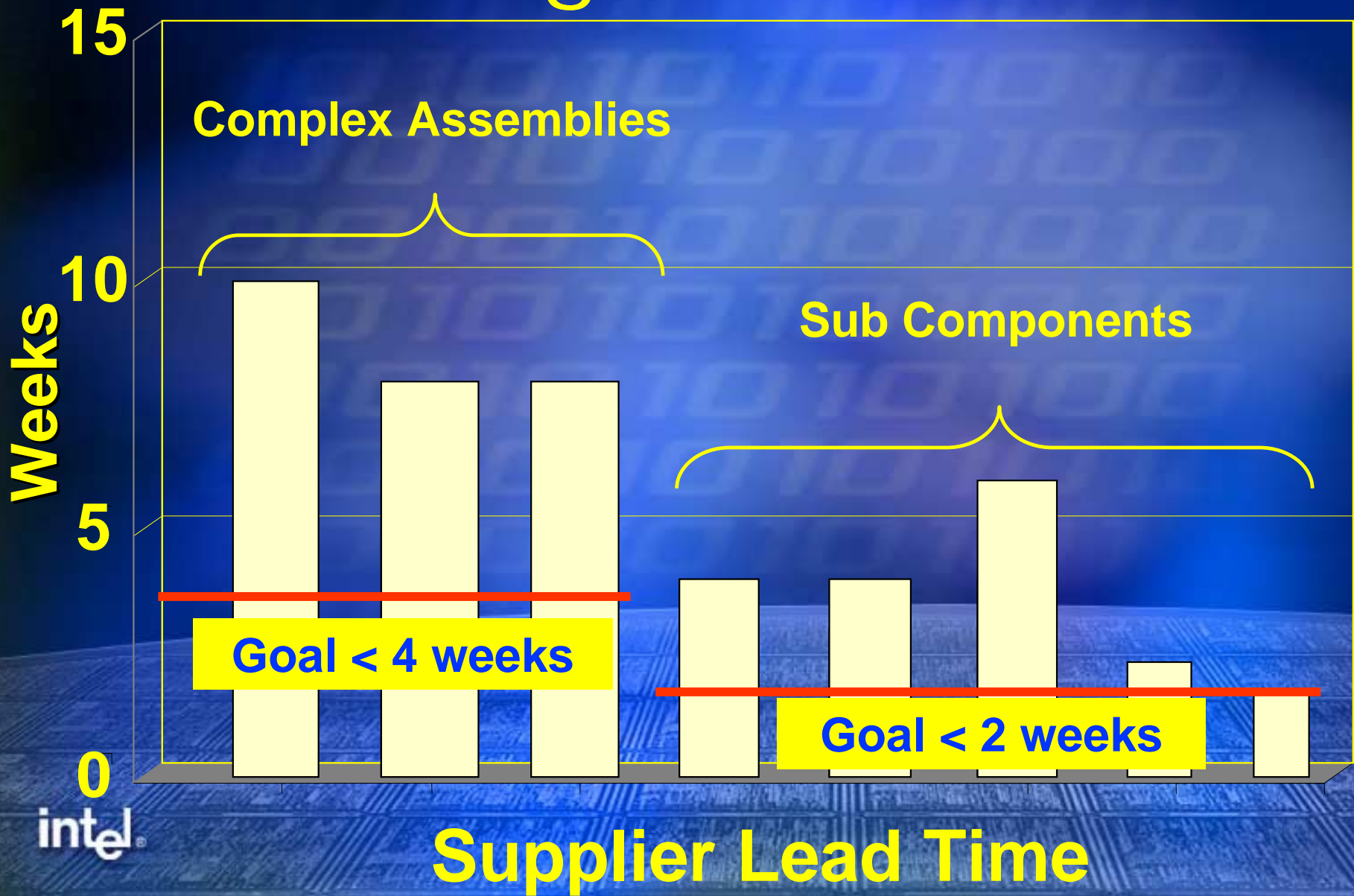
**The Tooling Supply Chain Needs to
provide Solutions, not components**

Today's Tooling Supply Chain

- Tooling suppliers fall into 2 categories
 - Component manufacturers
 - Integrators or Assemblers
- A typical tooling supply chain contains 2-4 poorly synchronized suppliers
 - Design
 - Custom component design and manufacturing
 - Assembly or Integration
 - HVM support

This industry infrastructure will not achieve the requirements of the next generations

Tooling Lead Time



The Next Generation Tooling Supply Chain

- **Is proactively on the “treadmill”**
 - Technically
 - Economically
 - Logistically
- **Enables fungible designs that last 2-3 process generations**
- **Is in sync with the specific technologies of the customers**
- **Provides turn key solutions**
- **Has 2 - 4 week lead times**
- **Is low, low, low cost and continues to drive costs down**

What it takes

- Evolution will not yield these goals!
- The scaling treadmill that the industry has relied upon needs to be replaced by disruptive technologies
- If you want to survive you must:
 - invest in disruptive technologies
 - cannibalize your current ones
 - acknowledge that your business model will be completely different in 2 years.

Can you do this? If not you won't survive!

About 1/2 of you will be around in 2 years

Will you be one of them?

“We sometimes refer to the definition of insanity as doing the same thing the same way over and over again, hoping for a different result. If you want to achieve different results -- **better results** -- you have to do things differently. Success is not accidental. It happens because people plan carefully and they lay the necessary groundwork to get the right result in the end.”

-- Craig Barrett
President and CEO, Intel Corporation
December 29, 2000