

# The need for a Revolution in Test Tooling

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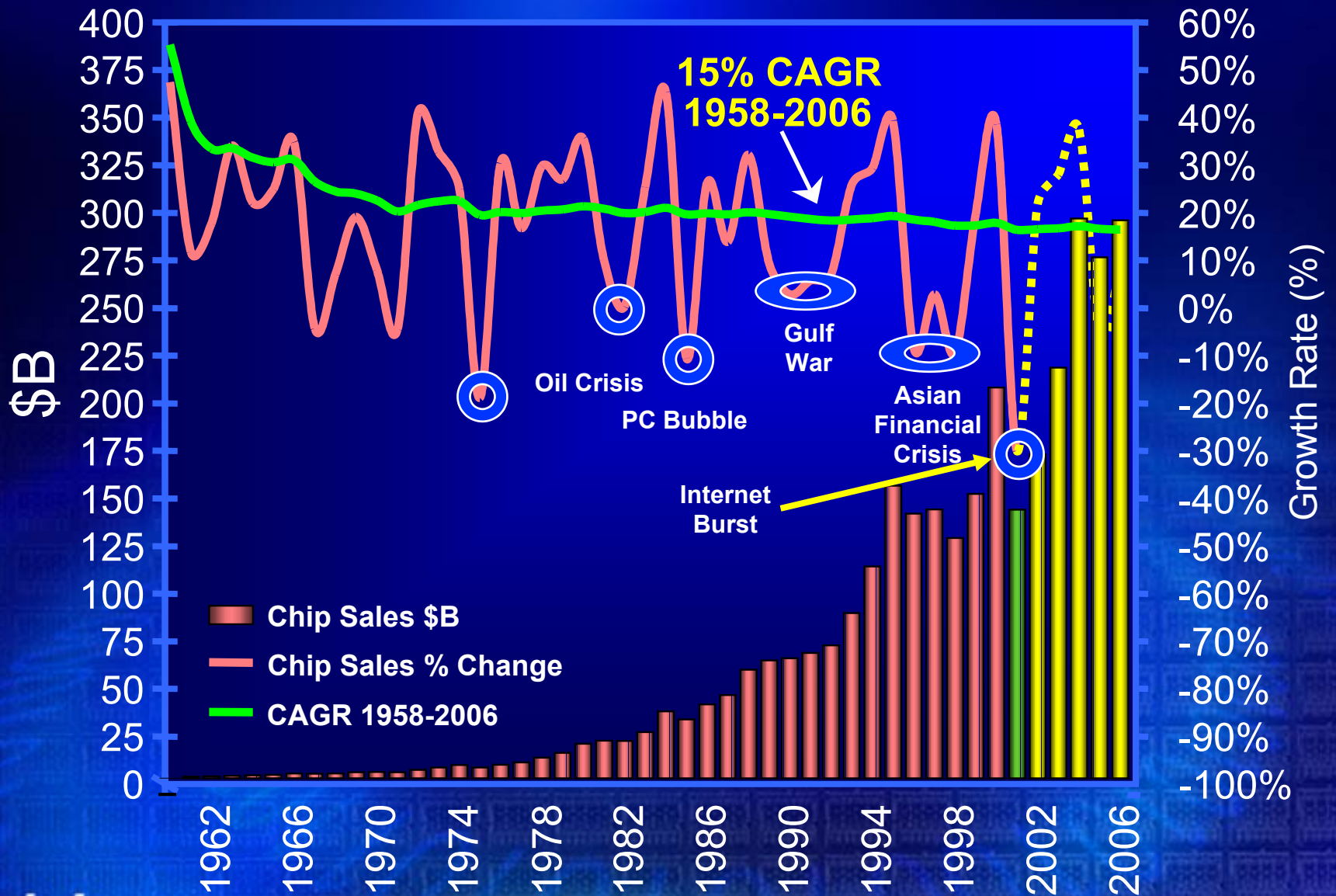
Intel Test Tooling Operation Manager  
Chandler, Arizona



# Take Away:

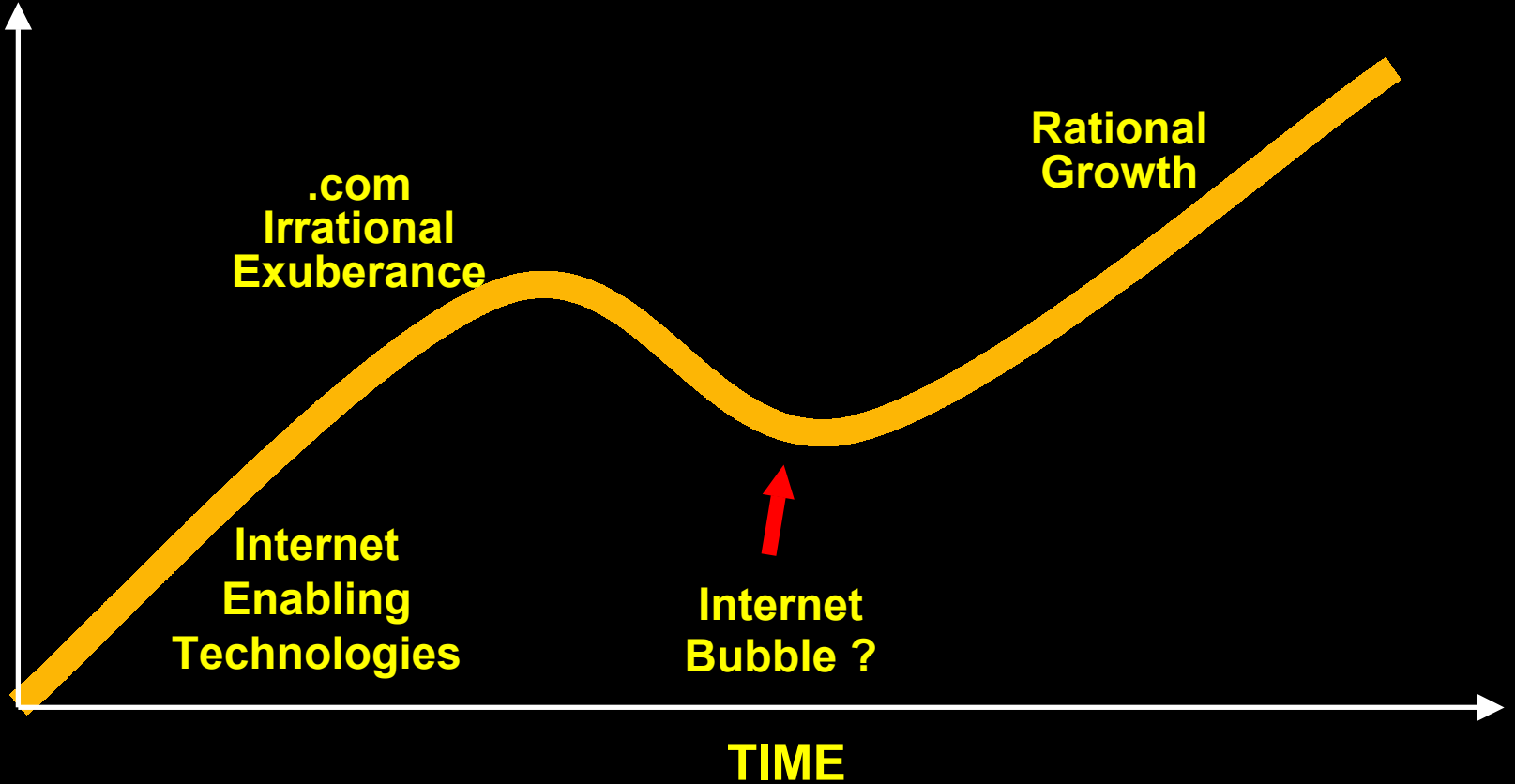
- Increasing costs have driven changes in Capital Equipment for Test
- A revolution is happening in Test Equipment to respond to these costs
- The Tooling Supply industry has not changed to meet customer needs
  - comprehensive solutions, cost, leadtime or capability
- It's time for a Revolution in Test Tooling

# Semiconductor Industry Cycles



# The Last Cycle

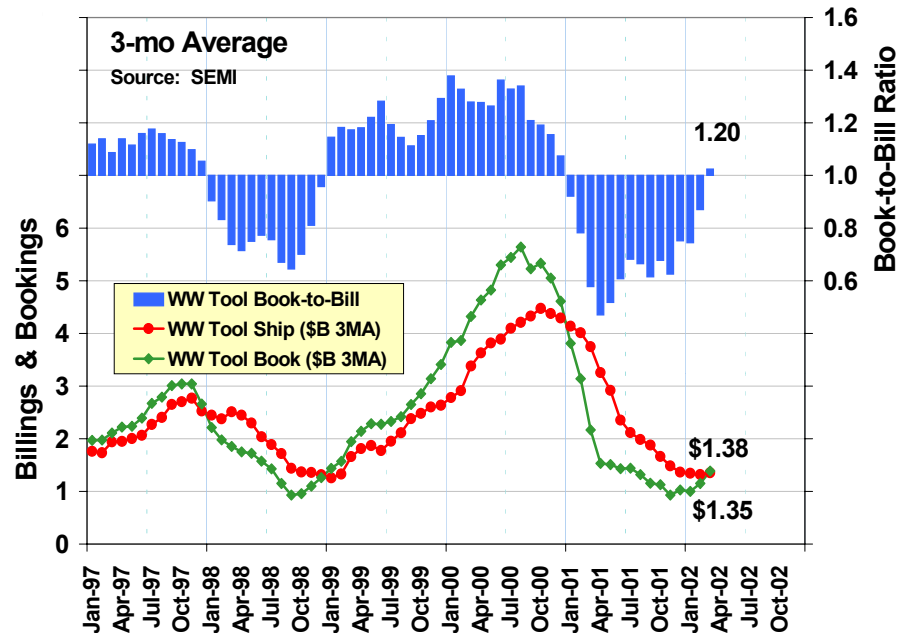
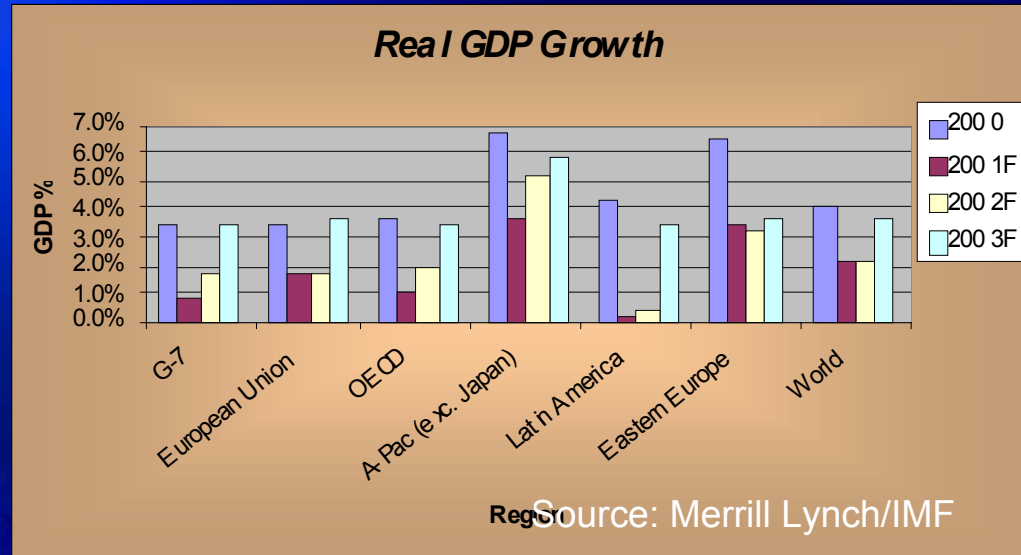
GROWTH



# Optimism for 2H'02 – '03

- Consumer confidence is up
- US economy predicted to grow 3.2% in 2002
- China, South Korea, and Eastern Europe are leading
- IT dependent countries (Singapore, Taiwan) will follow by latter half
- Some economies are stuck in reverse (Argentina, Japan) – will they follow in 2003 ?

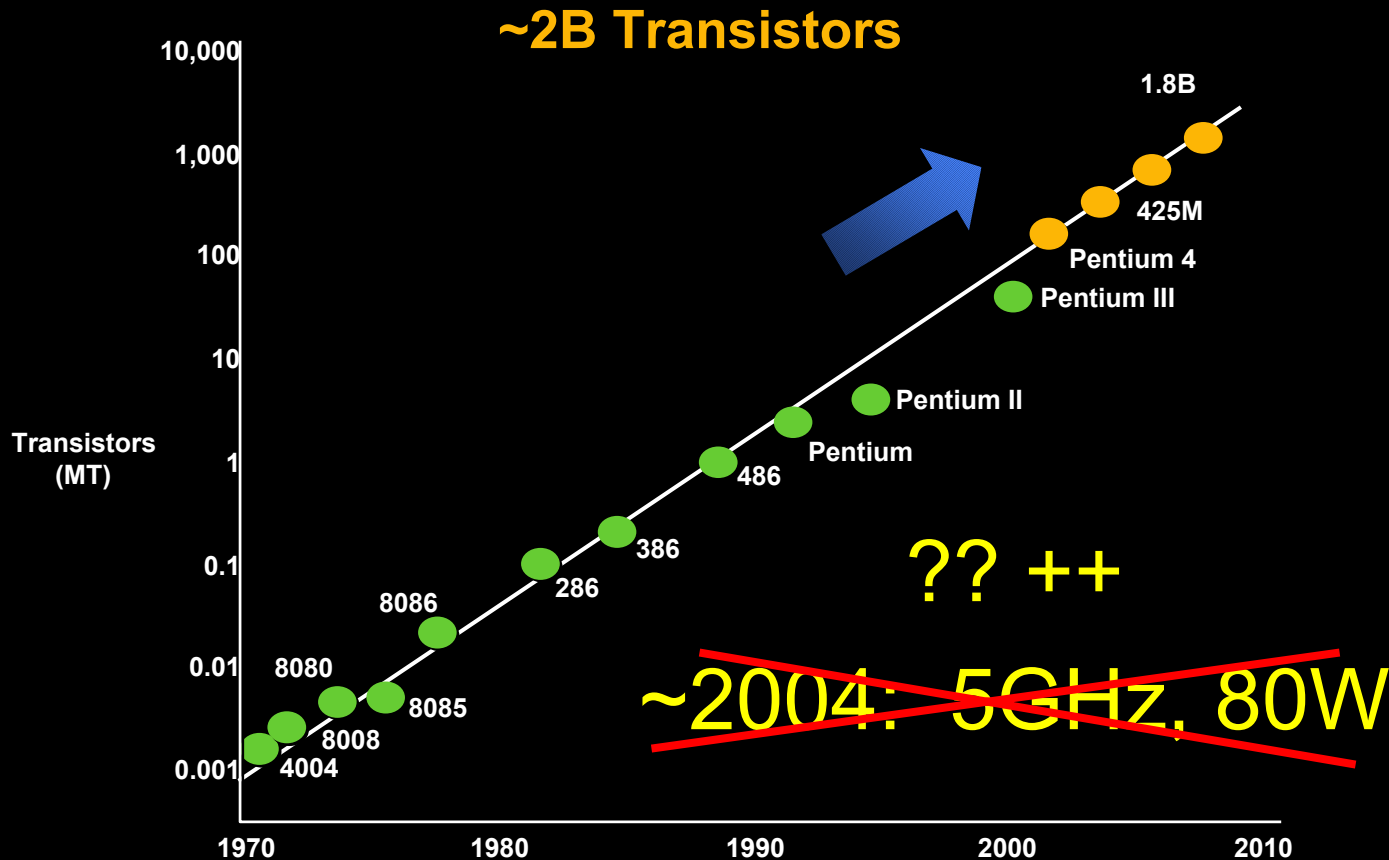
Will supplier improvement and responsiveness continue in the upturn?



**Worldwide Equipment Book-to-Bill**

# Technology Trends

Transistors doubling every 2 years toward a billion transistors



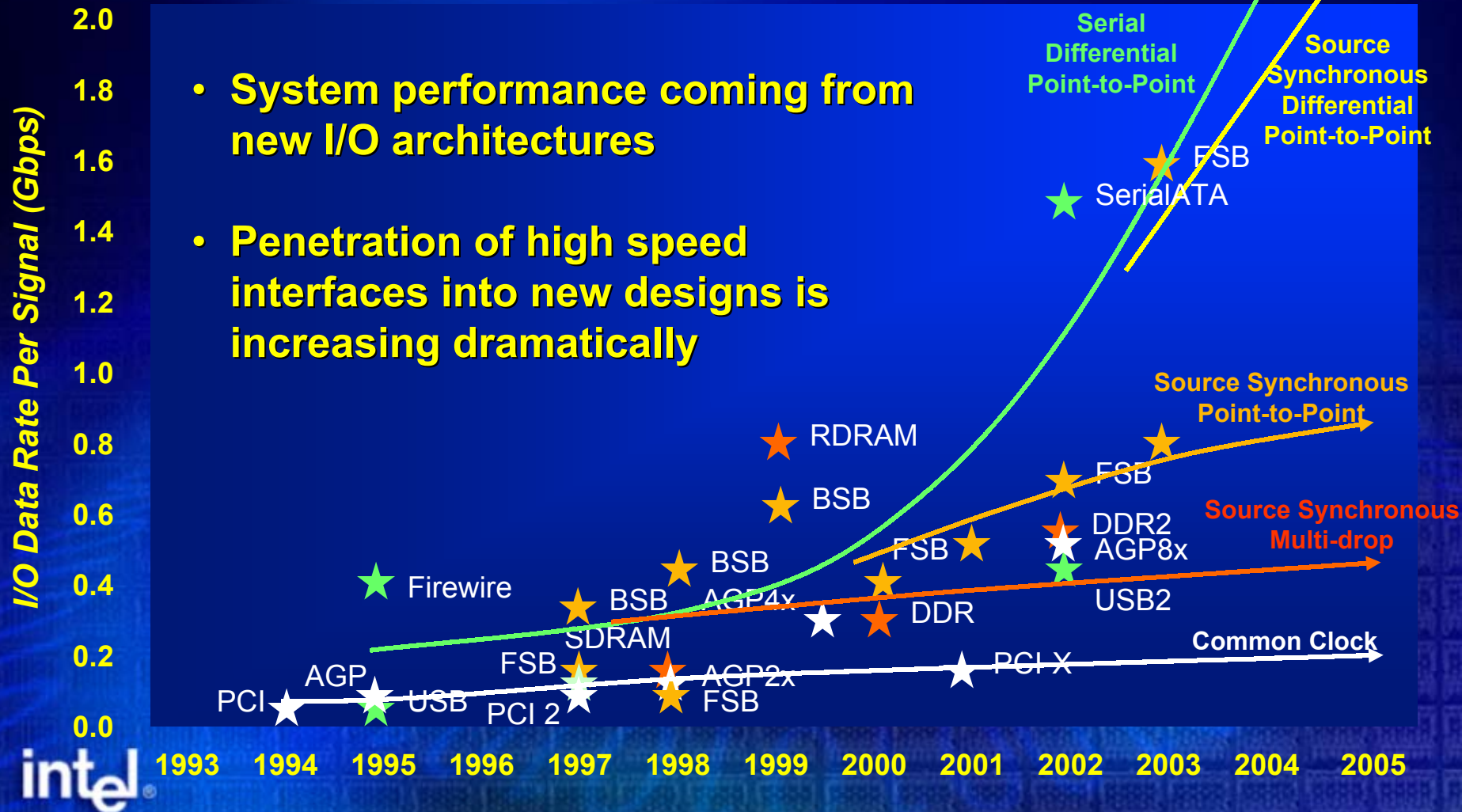
Q4'01 estimates for Q4'02 CPU top

intel frequency was 2.5Ghz, reality will be 3Ghz +

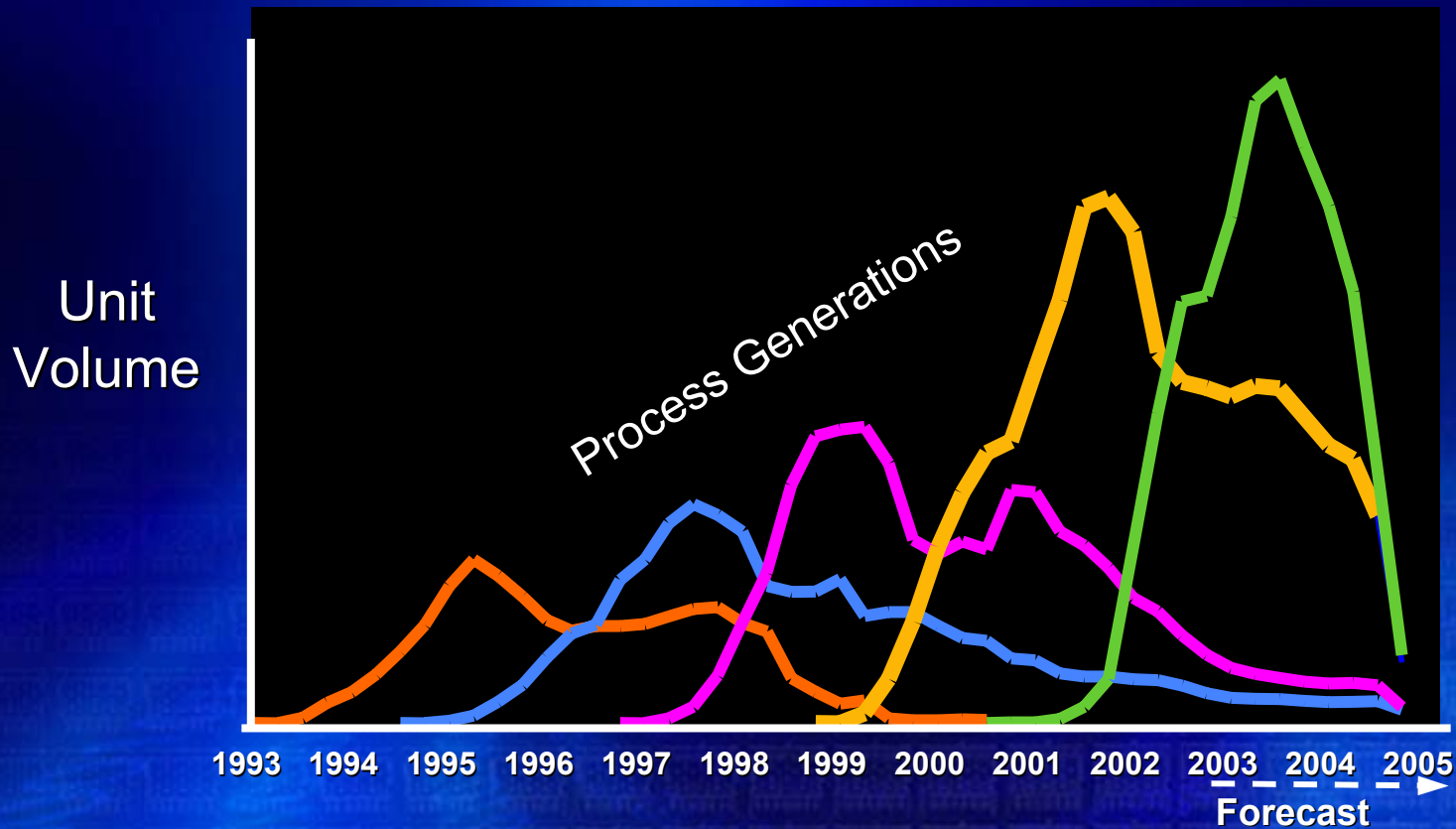
# Technology Trends

## Device I/O

- System performance coming from new I/O architectures
- Penetration of high speed interfaces into new designs is increasing dramatically



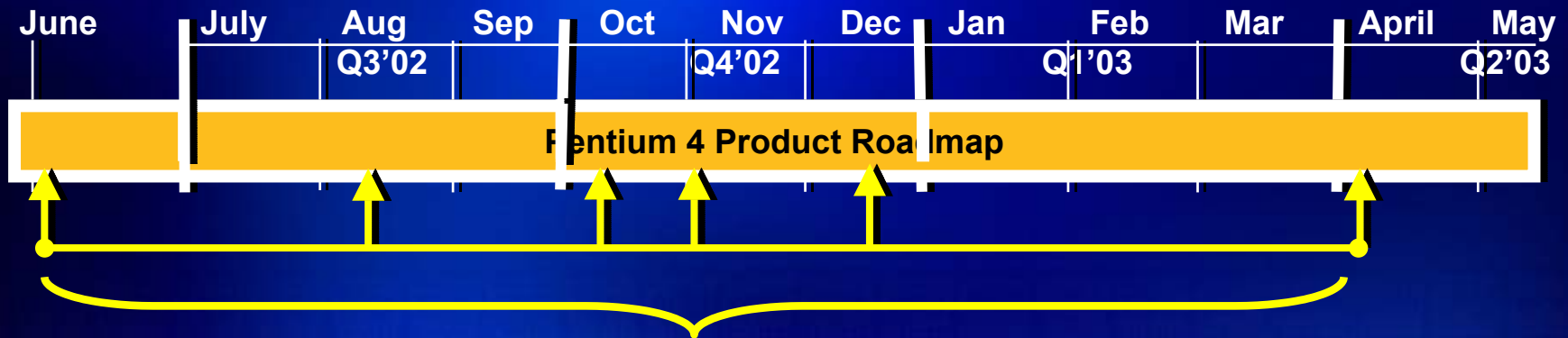
# The Process Lifecycle



**130nm – 4 quarters from development to HVM**  
**No time for Mistakes – HVM and Prototypes**  
**are one and the same**



# The Real Product Cycle



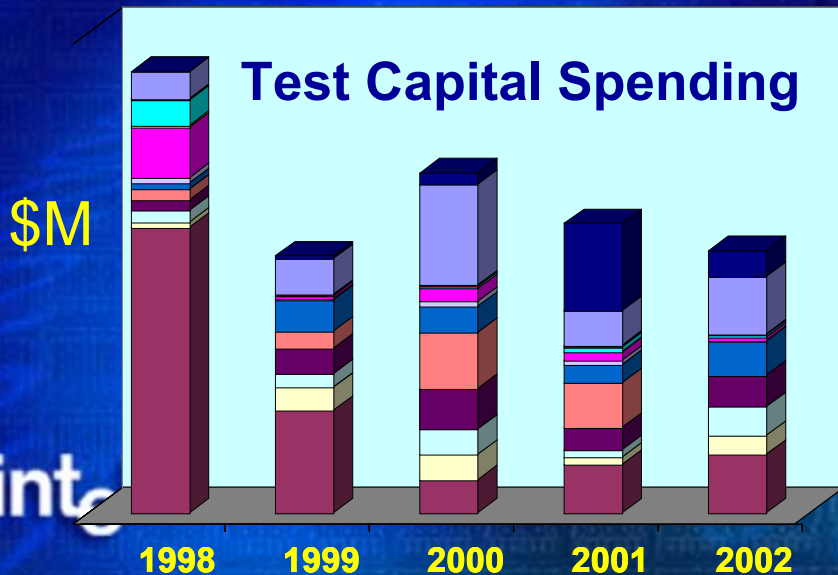
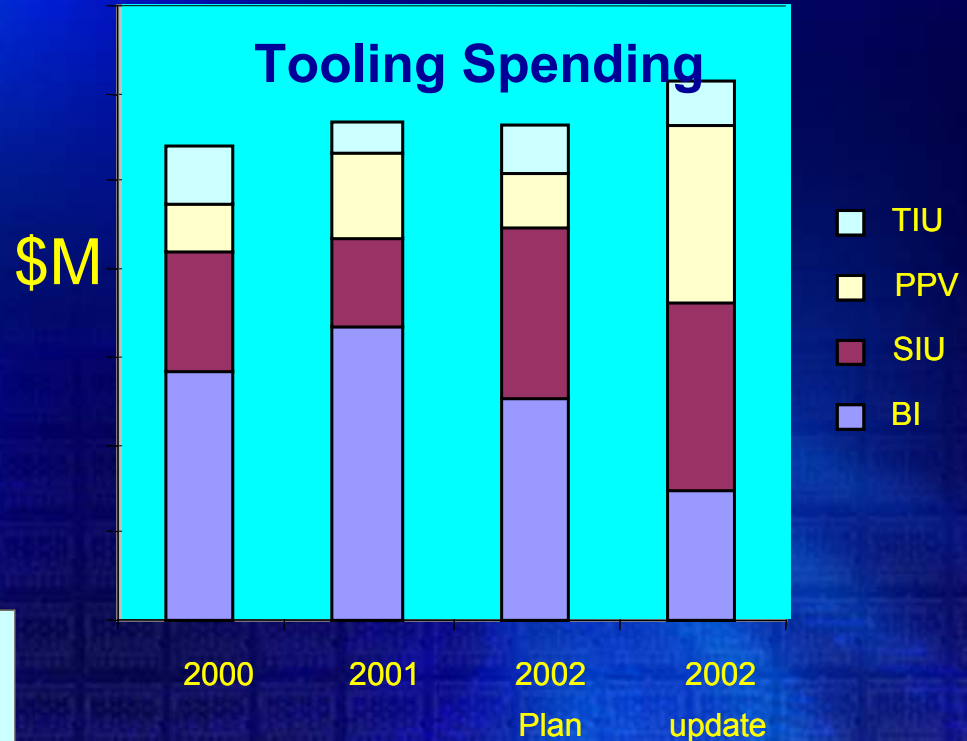
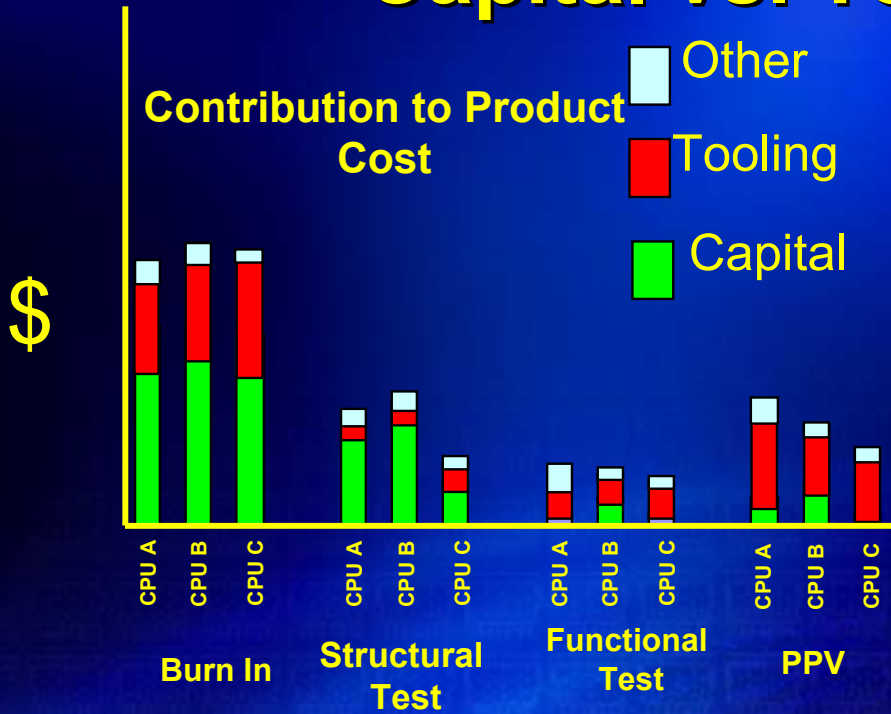
## Product Changes

Speed Improvements, Yield Improvements,  
Packaging and other changes yield an  
effective product cycle of 3 to 6 months

**Overlapping ramp up, peak, ramp down**

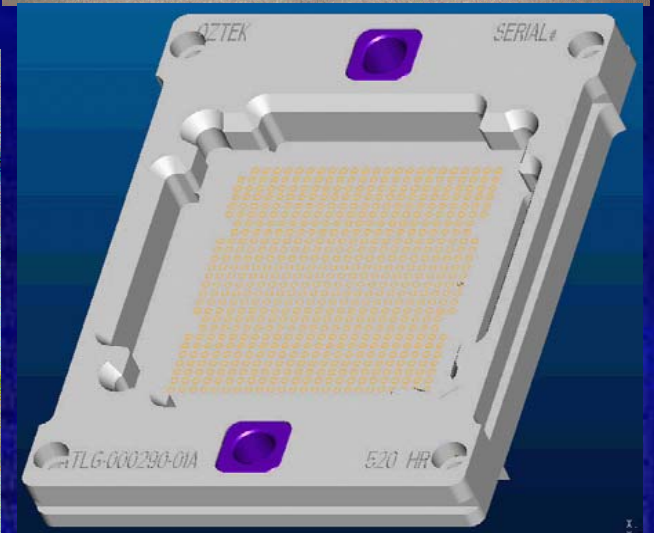
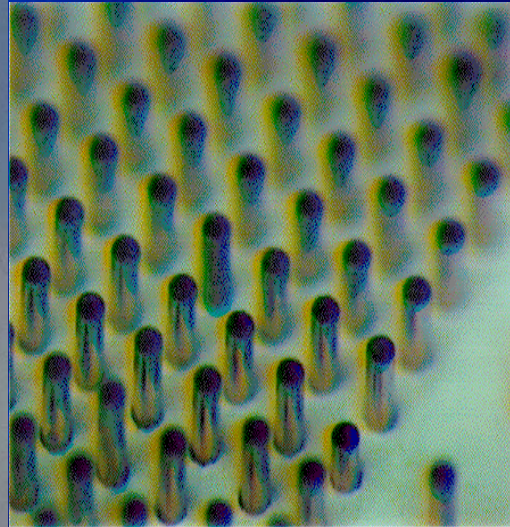
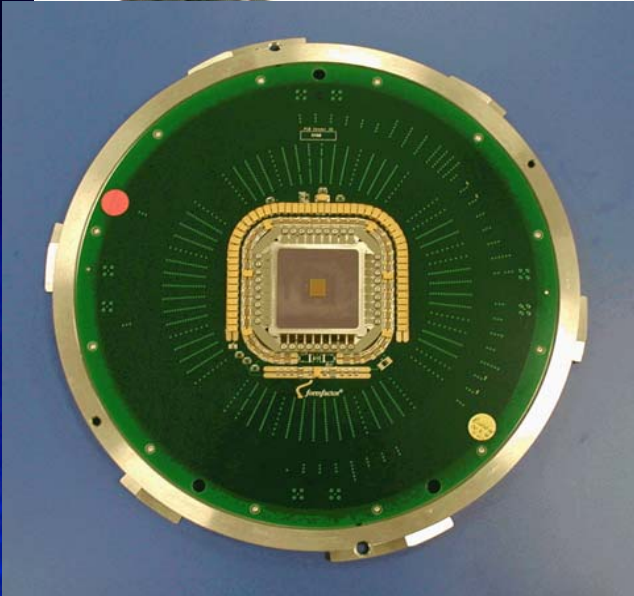
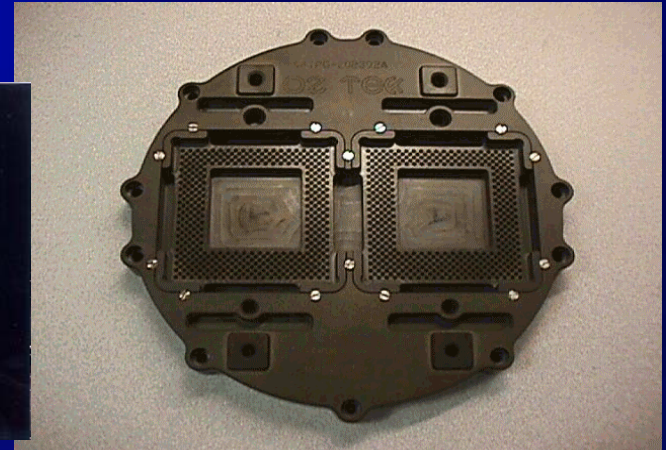
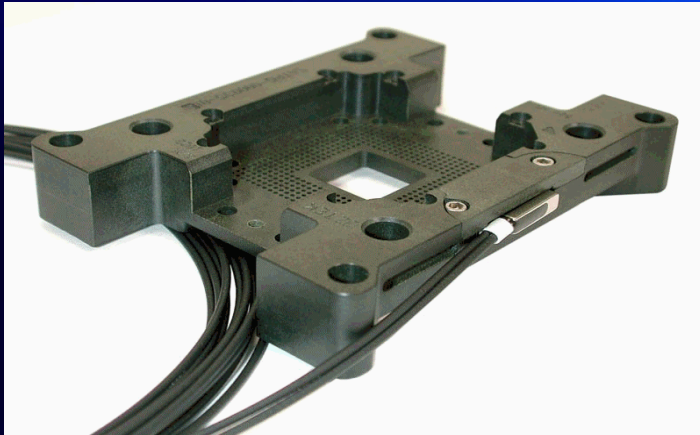
**No time for Mistakes – HVM and Prototypes  
are one and the same**

# Capital vs. Tooling Spending



- **We are buying less and less Test Capital**
- **And...Tooling is becoming a bigger and bigger % of product cost**

# Tooling



Probe Cards, Sockets, Test Boards, BIB's...

# The tooling challenge

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

Is custom to products

Customized to: Packaging form factors,  
Electrical and Thermal requirements and  
Device Function

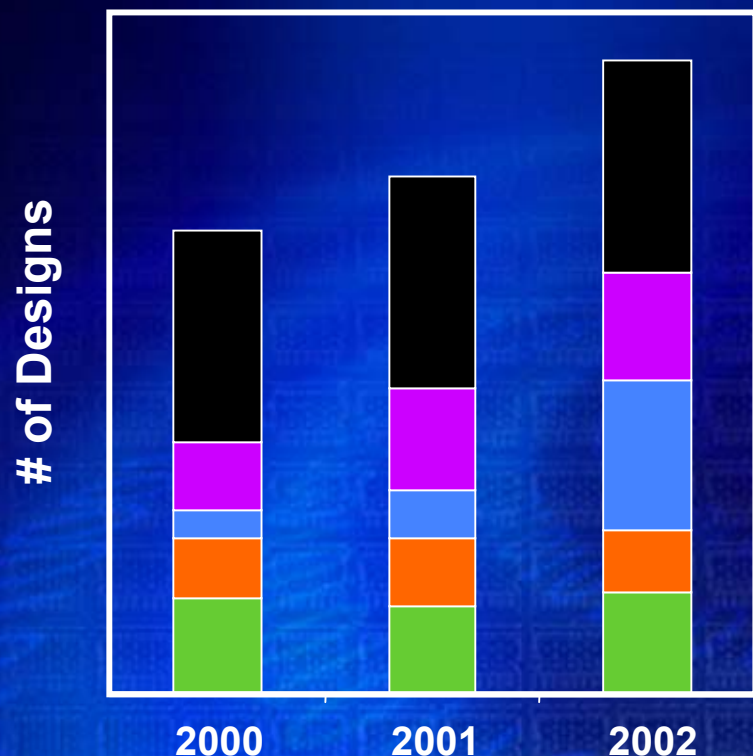
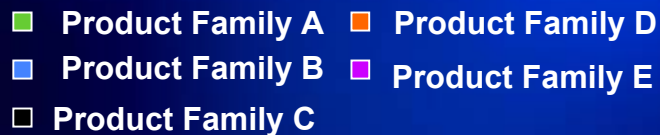
Demand driven by product ramp cycles

Complex supplier and supply chain logistics

**And is a technology, development and  
HVM enabler!**

Tooling Suppliers are not  
fully enabling their customers

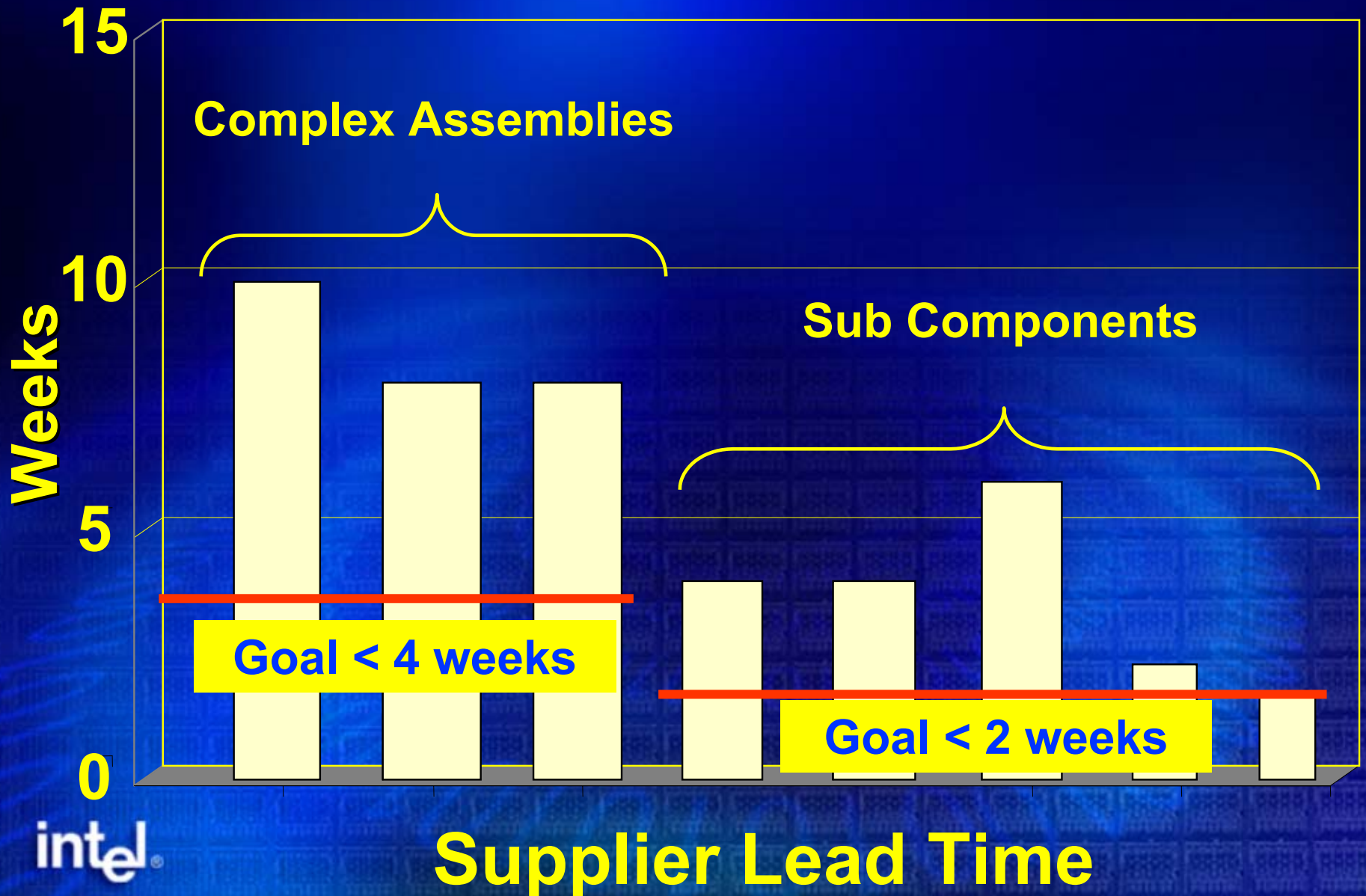
# Example: Probe Card Design Outsourcing



- NPI numbers increasing
- 2001- All SIU's designed in-house
- Probe Card Design Growth:
  - 22% 2000 to 2001, 38% 2001 to 2002
- Strategy changed in 2001 to enable outsourced designs
  - >1/3 outsourced designs planned in 2002

- Intel had to enable suppliers to be able to do these designs
- These same suppliers could not provide total solutions – only designs

# Example: Lead time reduction Only marginal improvement in 2 years



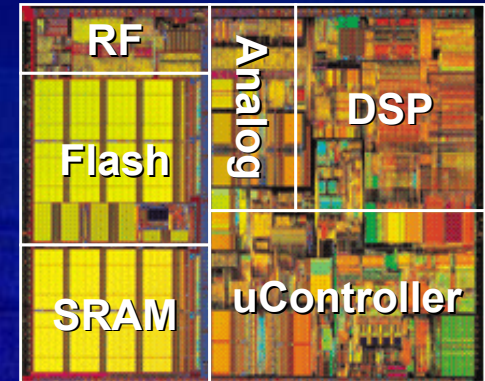
**What does a revolution look like?**

**A Tester Example**

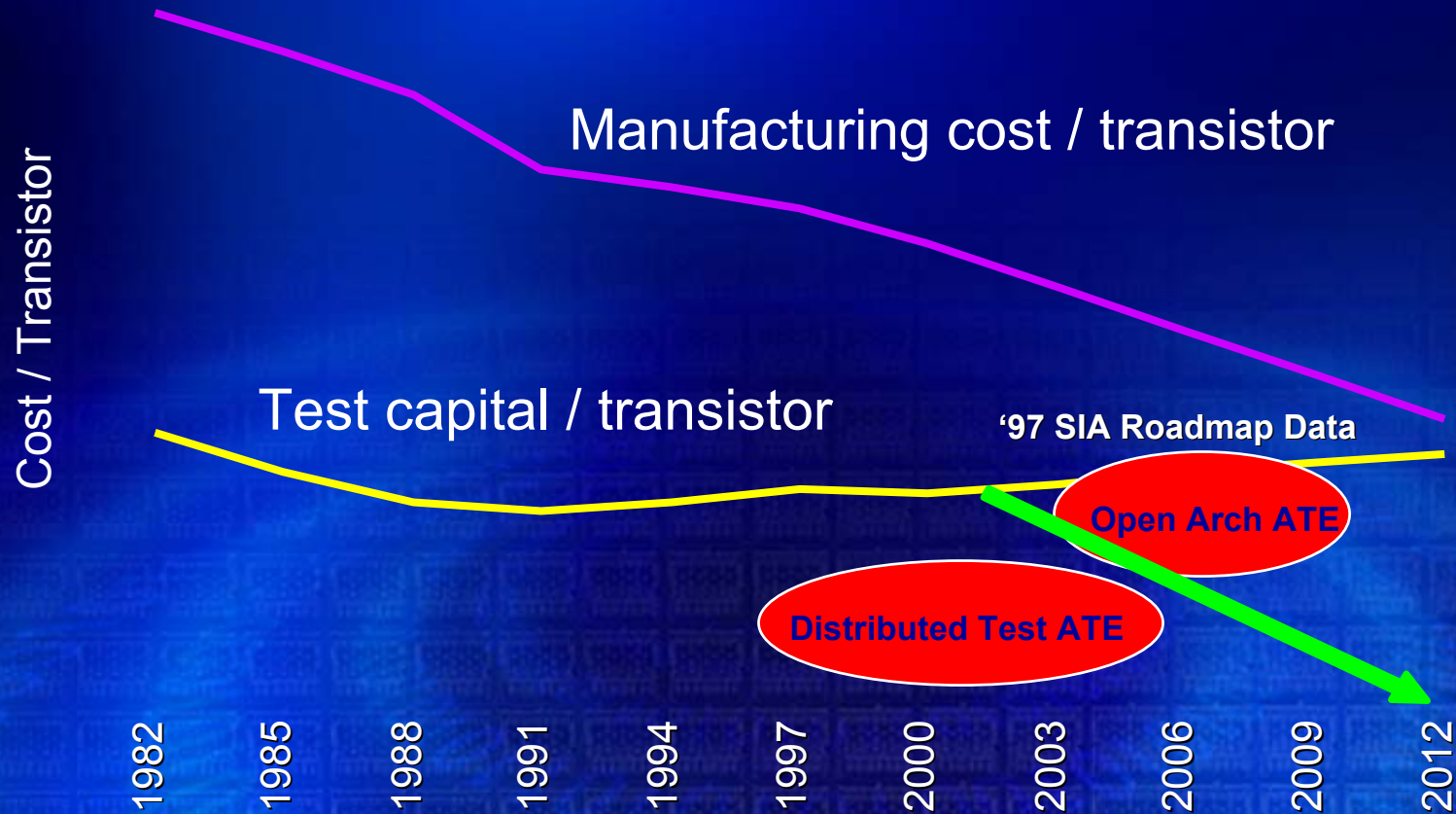


# Example Problem: SOC

- **Highly integrated device containing any combination or permutation of the following:**
  - **Processor Core**
  - **DSP Core**
  - **Memory Interface**
  - **Embedded Memory (SRAM, Flash)**
  - **Analog (ADCs, DACs, baseband, RF)**
  - **High Speed Serial**
  - **Peripheral Interfaces**



# Problem: Need to change the slope of the test curve

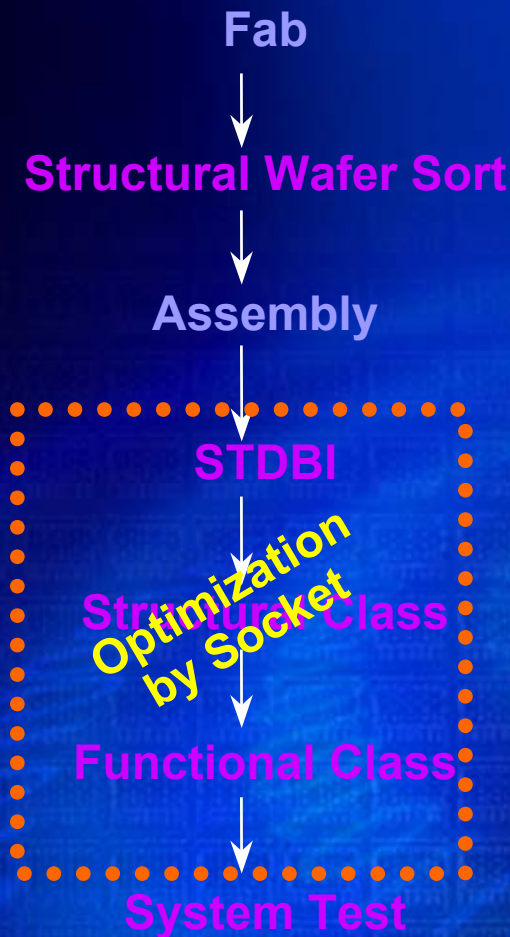


**Evolution: Distributed Test**  
**Revolution: Modular ATE**



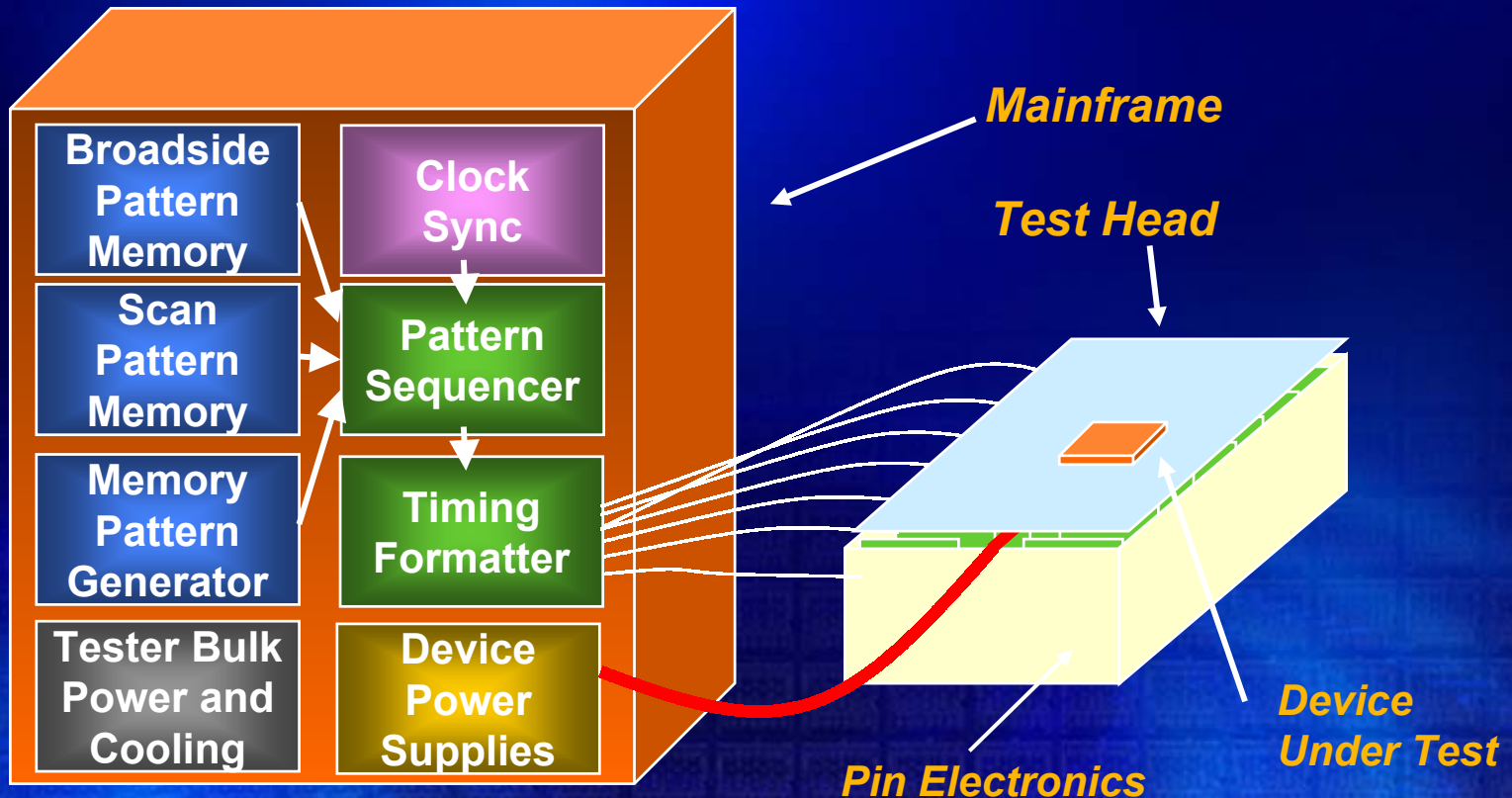
# Distributed Test

## Partition the test content by socket:



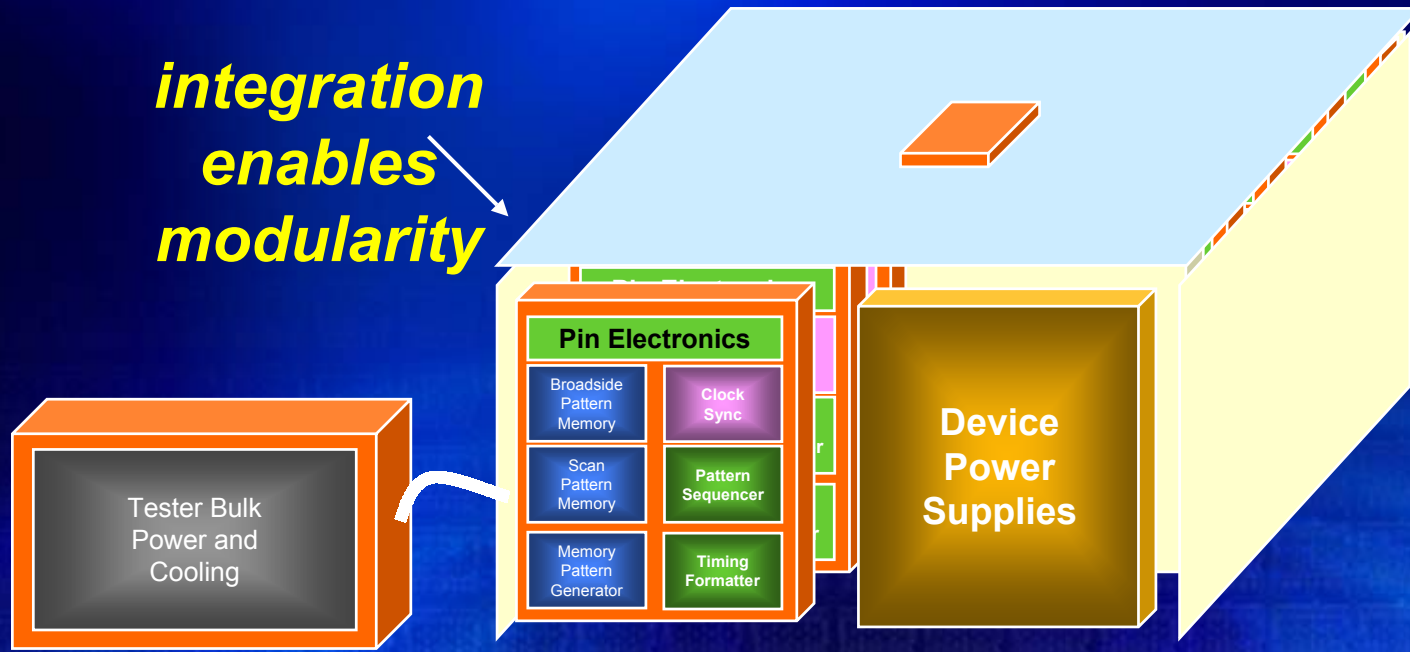
- The ATE industry has enabled this capability!
  - Implemented advanced DFT to manage test complexity
  - Reduce capability treadmill
  - Enable parallel test in complex designs
- Move a significant percentage of test content to less expensive DFT based structural testers
  - Enables capital cost reduction
  - Deliver state-of-the-art capabilities
  - Simplified tester hardware designs
  - Optimized content and flow

# Modular ATE: Current Tester Architecture



- **Closed architecture**
- **Custom infrastructure**
- **Difficult to support**
- **Improvements are 'generational' and difficult to incorporate**
- **Single supplier**

# Modular ATE: A small step forward



## Positives:

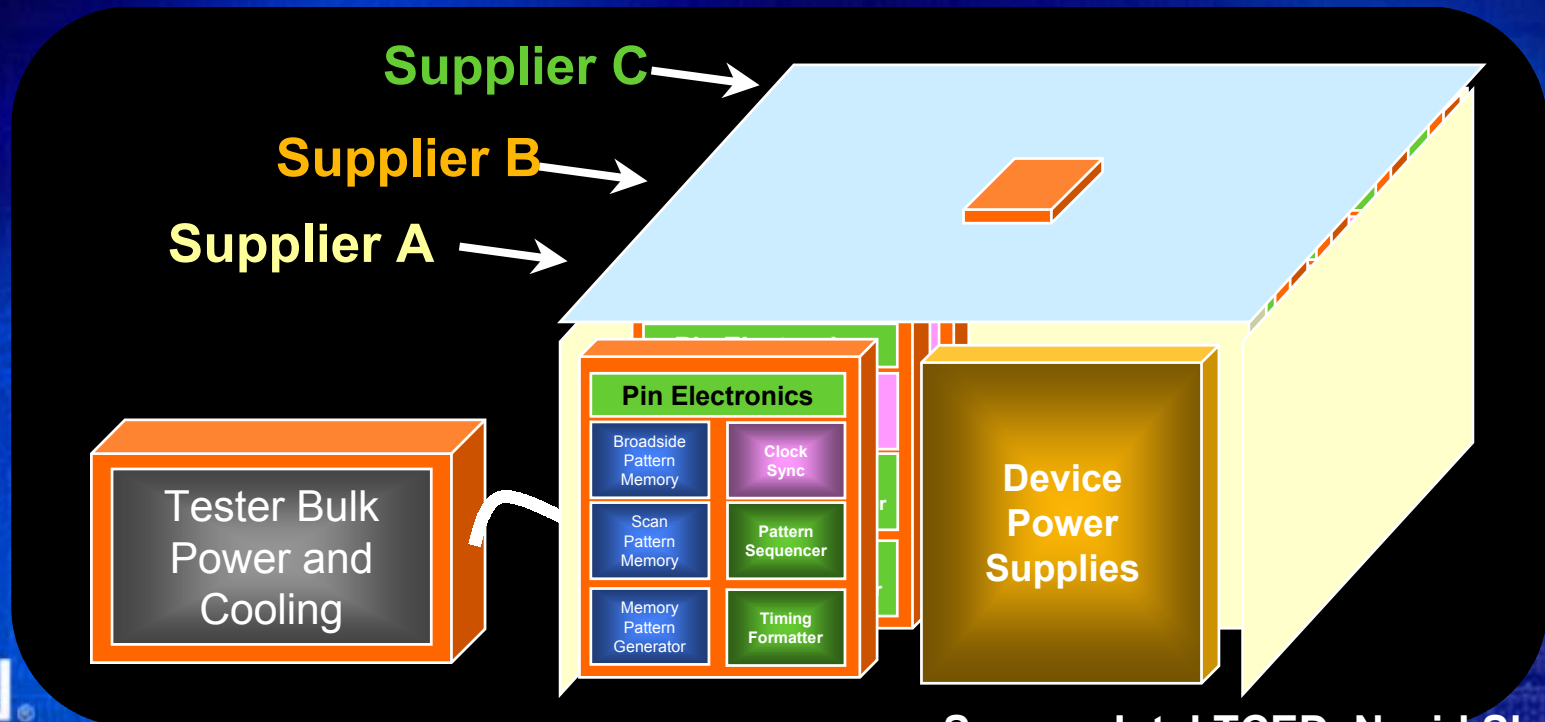
- Modules = “Tester on a board”
- Flexible configurations

## But....Still has negatives

- Single supplier
- Closed architecture

# Revolutionary Solution: Open Architecture VLSI ATE

- Multiple suppliers, industry specifications
- Scales across price, performance, pin counts, applications
- Reusable platforms & incremental CIP
- Standard operating system and equipment interface software
- Addresses high mix, low volume business need for “configure on the fly” capability



# Turn Key Tooling?

- **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 Vertical Probe Card**
  - 1 supplier for Design
  - 1 supplier for PCB / Space transformer manufacturing
  - 1 supplier for Probes / Integration
- **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 future products and processes**



# The Next Generation Tooling Supply Chain

- **Is proactively on the “treadmill”**
  - Technically
  - Economically
  - Logistically
- **Enables fungible designs that last multiple product generations**
- **Is synchronized with the specific technologies of the customers**
- **Provides complete turn key solutions**
- **Has 2 - 4 week lead times, and finds innovative ways to continue to drive it down**
- **Is low, low cost and continues to drive costs down**

# What it takes is Revolution

- 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!**

**Strauss's Prediction :**

**About ½ of you will be around in 2 years**

**Will you be one of them?**

“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*

# Q&A