2010 Distinguished Speaker

ARCHIVE 2010

TEST-IN-TRAY PERSPECTIVE

by

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ABSTRACT

Advances in Test-in-Tray technology have potential to improve greatly the productivity of burn-in and test for semiconductor electronics. With the growing complexity of IC devices, back end test operations consume an ever increasing portion of manufacturing cost. This trend cannot continue. Test-in-tray (TnT) enables full "lights-out" automation through all back-end processes where individual parts are not handled, manually or robotically, until pack and ship. The major wafer fabs have implemented full lights out automation years ago using the FOUP as a standard wafer carrier. A standard tray carrier serves the same role for back end processes. Automation equipment can be standardized around TnT for efficiency and a minimum of custom fixturing.

A recently announced FlexFrame carrier overcomes problems that have hindered testing in tray or strip format. Although strip testing greatly increases test throughput where applicable, the method is limited to certain specific devices that can be tested in strip format. Further, dimensional stability, part placement, and cost of complex strip handlers have stunted adoption. The FlexFrame carrier overcomes these problems by holding devices in a dimensionally stable tray that is CTE matched to its mating contactor socket. Now, the placement and number of devices in the tray may be matched to ATE test capacity. The FlexFrame carrier allows easy alignment and insertion/extraction from the mating contactor socket, greatly simplifying the process and reducing the cost of automation.

Test-in-Tray methods are applicable to a full range of semiconductor devices from WLP and TSV chips to complex BGA packages and MEMS sensors. TnT has the full potential to revolutionize the test industry – and the change is needed now. Open standards are essential to support a great opportunity for all.

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Test-in-Tray Perspective

Dr. Thomas Di Stefano
Centipede Systems

2010 BiTS Workshop
March 7 - 10, 2010

Advances in Testing Are Needed !

- Lessons from the Wafer Fab
- Previous Limitations
- FlexFrame Technology
- Broad Scope
- Future Prospects

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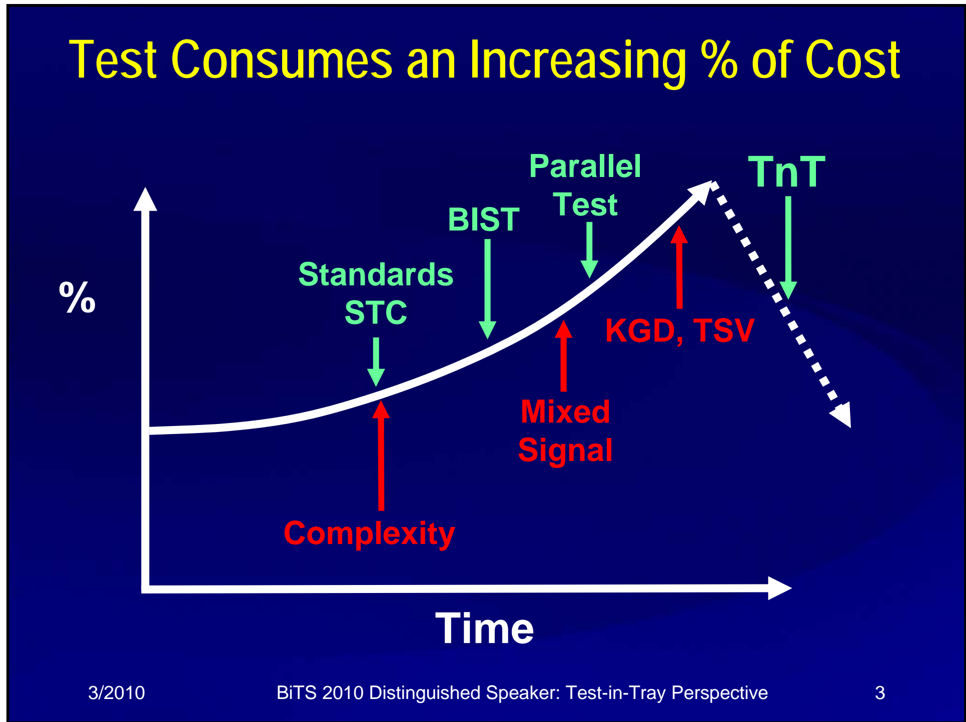

Move Test Offshore?

One Time "Pop" in Profitability but ...

- Learning Curve Stalls
- No incentive for technological advances

Continuing Race to the Lowest Wage Venue

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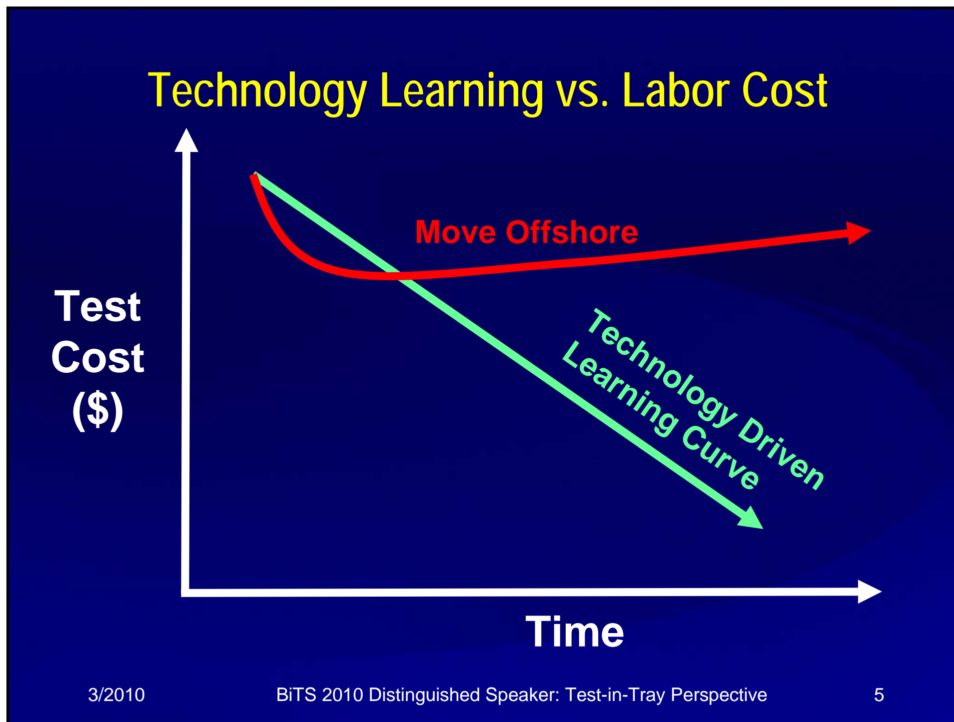

Or - Automate Using Intelligent Manufacturing

Automate Back End Processing
- Transport with Standard Carrier
- Never Handle a DUT

Drive Technology Learning
- Date Traceability
- Adaptive Test, . . .

Standards !

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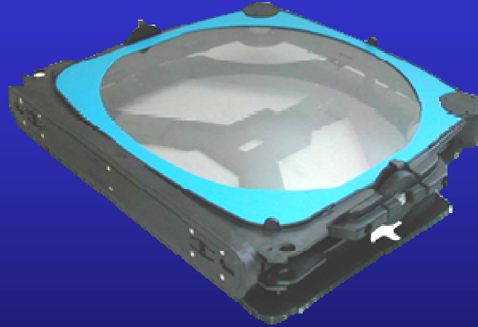
Lessons Learned from the Wafer Fab:



Transport Standardized on the FOUP Carrier*

*** Front Opening Unified Pod**

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Lessons Learned from the Wafer Fab:

Improved Cycle Time
- 50% improvement in two years*

Increased Tool Utilization
- 10-30% improvement in two years*
- Re-use of (standard) tools

Process Learning !
- Focus on tool and process instead of moving WIP*

- * From Tom Franz, VP and GM FAB/Sort Manufacturing, Intel Corp.

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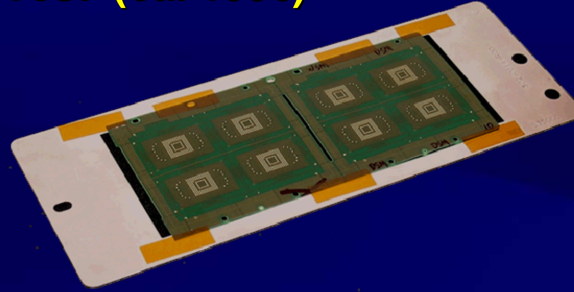
Strip Test (ca. 1996)



High Productivity … but Limited:

- Entangles Packaging & Test Processes
- Dimensional Stability Limits Array Size
- Handling is Complex/Expensive
- Applicable only to Parts Fabricated in Strip

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TnT FlexFrame™ Tray

Enables Full Automation

- Precise Registration of DUT
- DUT Remains in Tray Throughout
- Applicable from WLP to MEMS

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FlexFrame™ Carrier Simplifies Handling

Standardized Carrier Dimensions/Features
- Accommodates Custom Trays for All DUT Types
- Carrier is Independent of Tray and DUT

FlexFrame Springs Simplify Insertion
- No Expensive Insertion Mechanics Required
- Springs Guide Tray onto/off of Contactor

Tray is Made to Match Contactor
- Alignment Features on Contactor Match Features on Tray
- CTE Matched to Contactor

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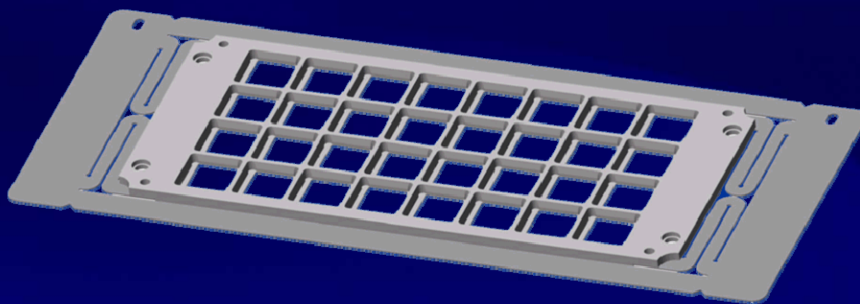
FlexFrame Tray (Retracted)



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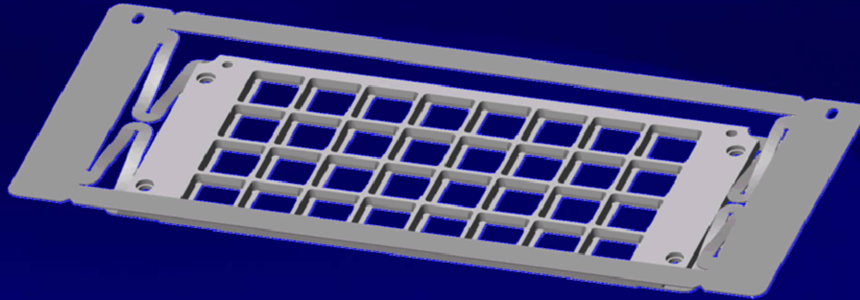
FlexFrame Tray (Extended)



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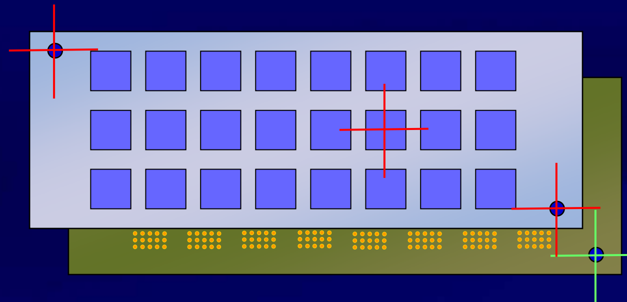
TnT Provides Dimensional Integrity



Device Position is Set

- CTE Matched to Socket
- DUTs Set on Standard Centers
- Accurate to +/- 5 µm for FlexFrame Carrier

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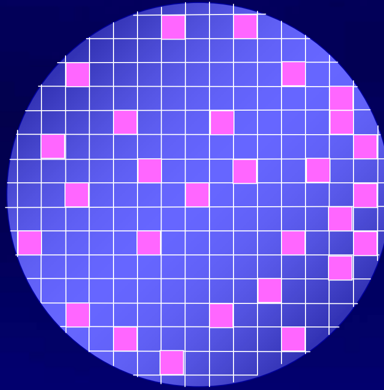
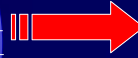
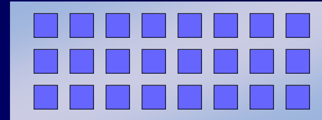
Eliminate "Dead Soldiers"

Test-in-Tray
- Test only good die
- Standardized handling
- Test and Burn-in on the same tray
- Cost !

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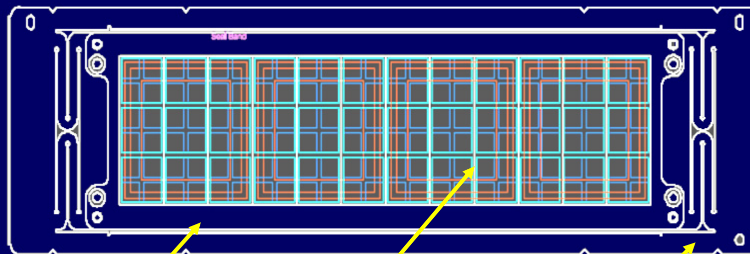
Standard FlexFrame Carriers

Lowers Cost of Automation Equipment



DUT Arrangements
- 45, 50, 55 mm (x4)
- 18 mm (x36)
- 9x18mm (x72)
- 9 mm (x144)

Configuration Shown is One of four proposed FlexFrame Standards

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TnT Segmented Contactor
(example layouts)

20x60mm segment
(x12 replaceable segments)

60x60mm segment
(x4 replaceable segments)

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Segmented Contactor

Replaceable Cartridge*
(Multiples of 20 mm)

* Centipede Systems

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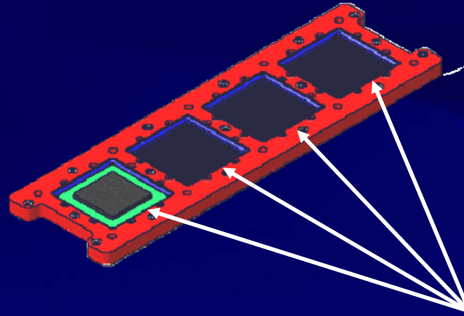
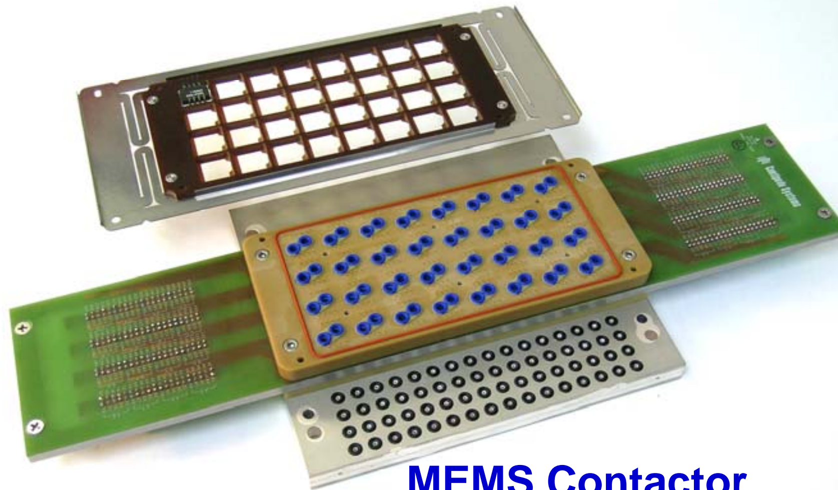
Segmented Contactor



* Contech Solutions



MEMS Contactor

- Independent Pressure Ports
- x32 of Pressure Sensors

* Centipede Systems

Broad Applicability of TnT

- BGA to 60mm x 60mm
- QFN, QFP,TSOP, ...
- CSP, WLCSP, ...
- MEMS – All Types
- WLP
- TSV
- Flip-chip
- Stacked dice
- . . .

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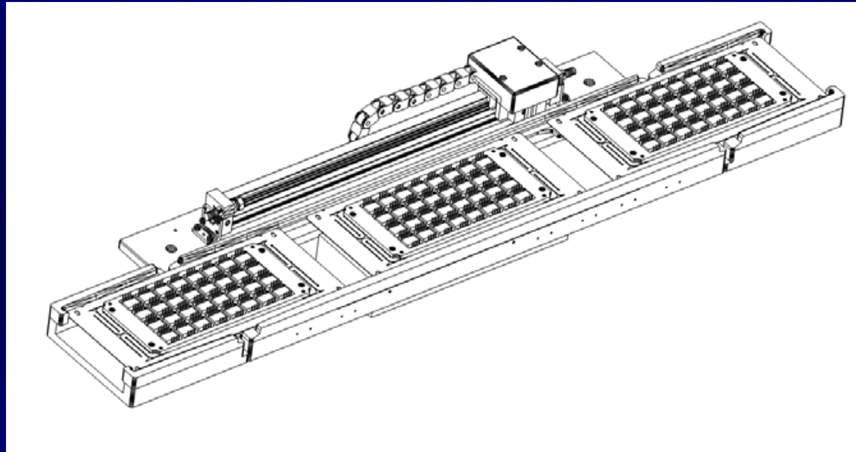

Standardized Transporter*

* Centipede Systems

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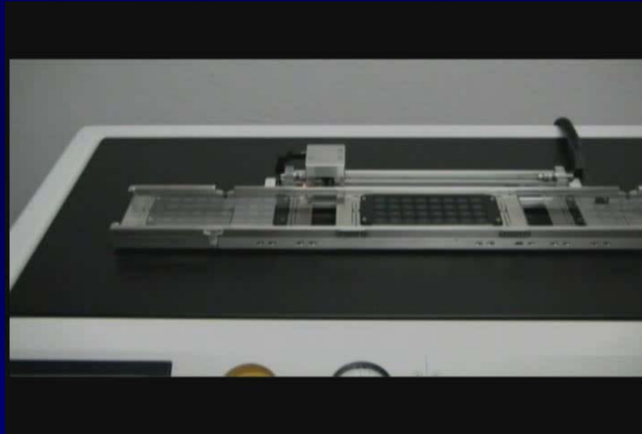
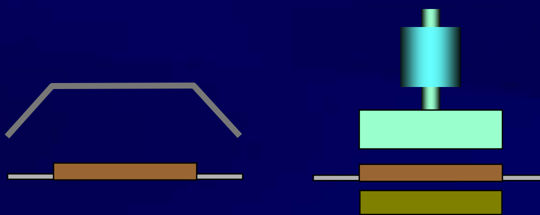
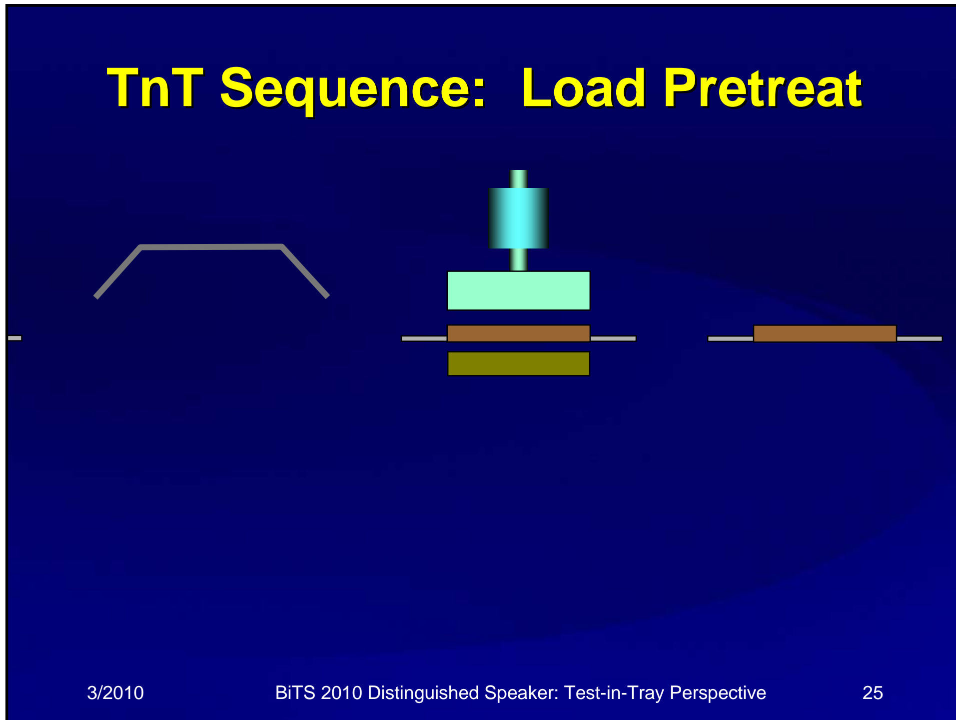
Carrier Transport on Load Board



TnT Sequence: Index Trays




TnT Sequence: Load Pretreat
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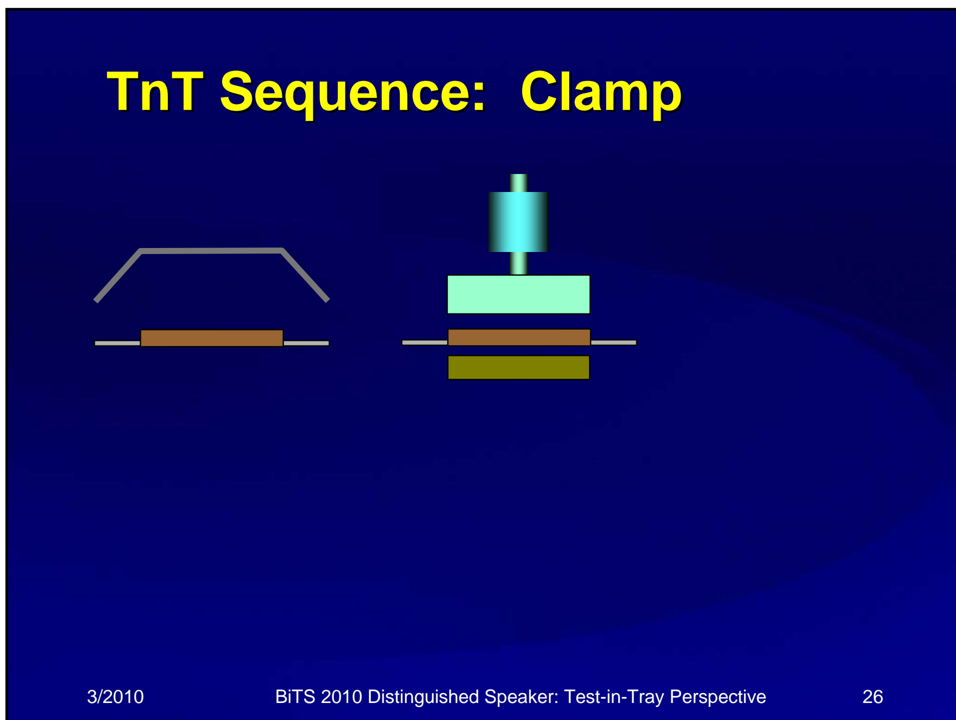
TnT Sequence: Clamp
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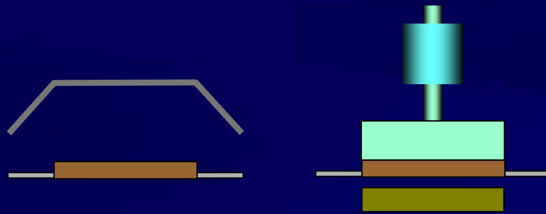
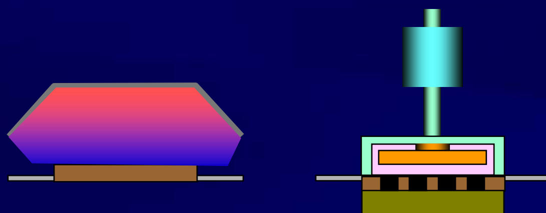
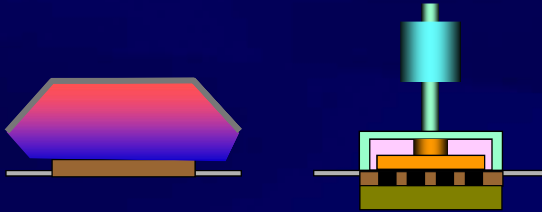
TnT Sequence: Seal & Backfill



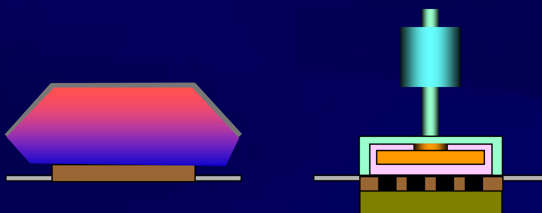
TnT Sequence: Thermode



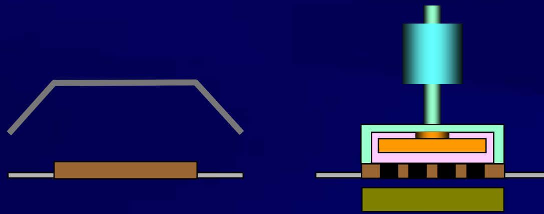
TnT Sequence: Release



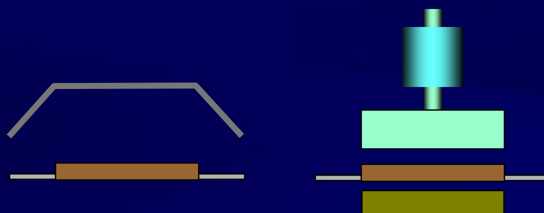
TnT Sequence: Open Chamber



TnT Sequence: Release Tray



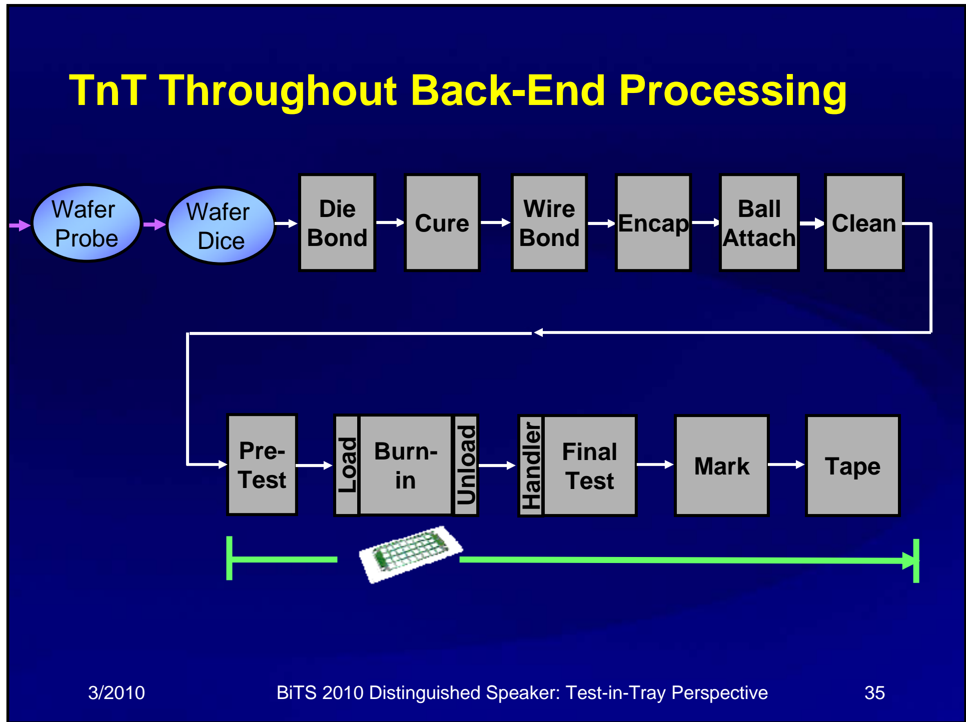
TnT Sequence: Index Trays



500 ms

Open Architecture ...

- Carrier Formats
  - Standardized Sizes
  - Alignment Features
- Automation
  - Modular Elements "Plug and Play"
  - Interface Standards
- Design Points
  - CTE
  - Materials and Handling


TnT Throughout Back-End Processing
Wafer Probe
Wafer Dice
Die Bond
Cure
Wire Bond
Encap
Ball Attach
Clean
Pre-Test
Load
Burn-in
Unload
Handler
Final Test
Mark
Tape
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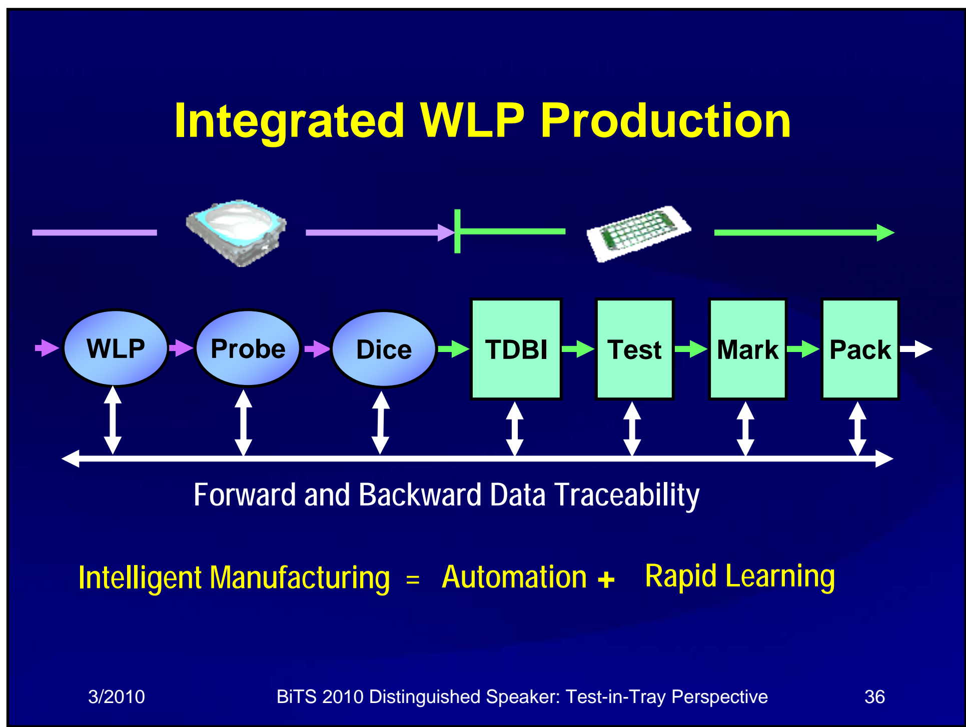
Integrated WLP Production
WLP
Probe
Dice
TDBI
Test
Mark
Pack
Forward and Backward Data Traceability
Intelligent Manufacturing = Automation + Rapid Learning
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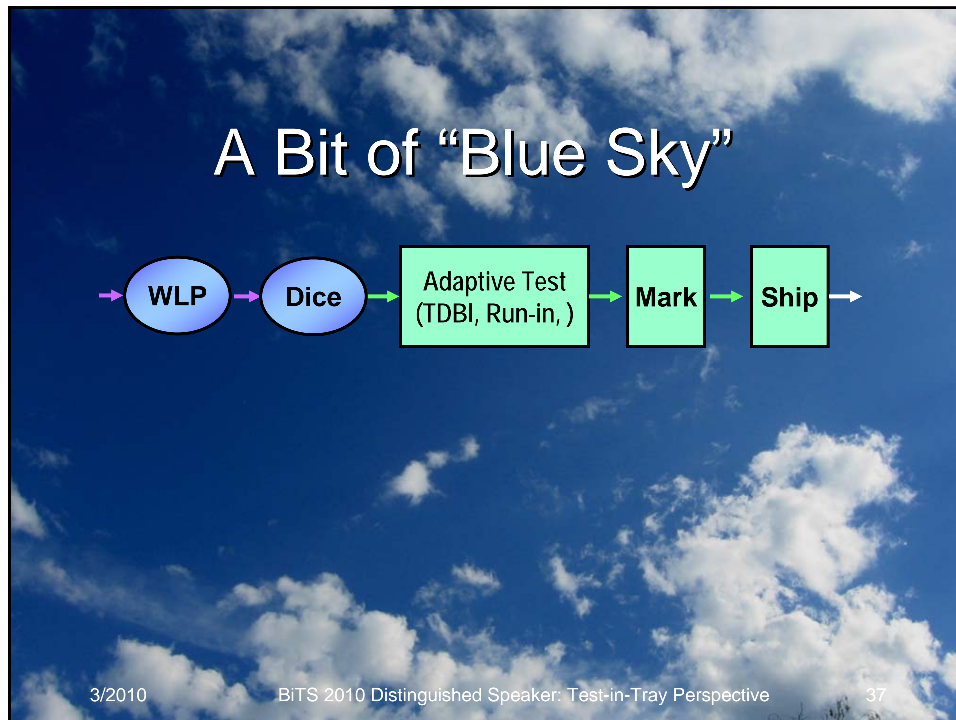

TnT Provides a Path to the Future

- High Throughput
  - Parallelism limited by only by ATE
- Full Automation
  - Lights-out Production
  - Forward & Backward Traceability
- Standards !
  - Reduce or Eliminate custom fixtures
  - All DUT types

TnT will revolutionize semiconductor test !

- Intelligent Manufacturing
- Data Integration Throughout
- Standardized Fixtures and Transport
- Opportunities for Innovation
- *ACCELERATED LEARNING* !

Or … ??????

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