

Factory Integration

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International Technology Roadmap for Semiconductors

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ITRS Factory Integration Attendees

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Agenda

- Needs, Scope, Difficult Challenges
- Changes in potential solutions
- Issues: Participation
- Summary



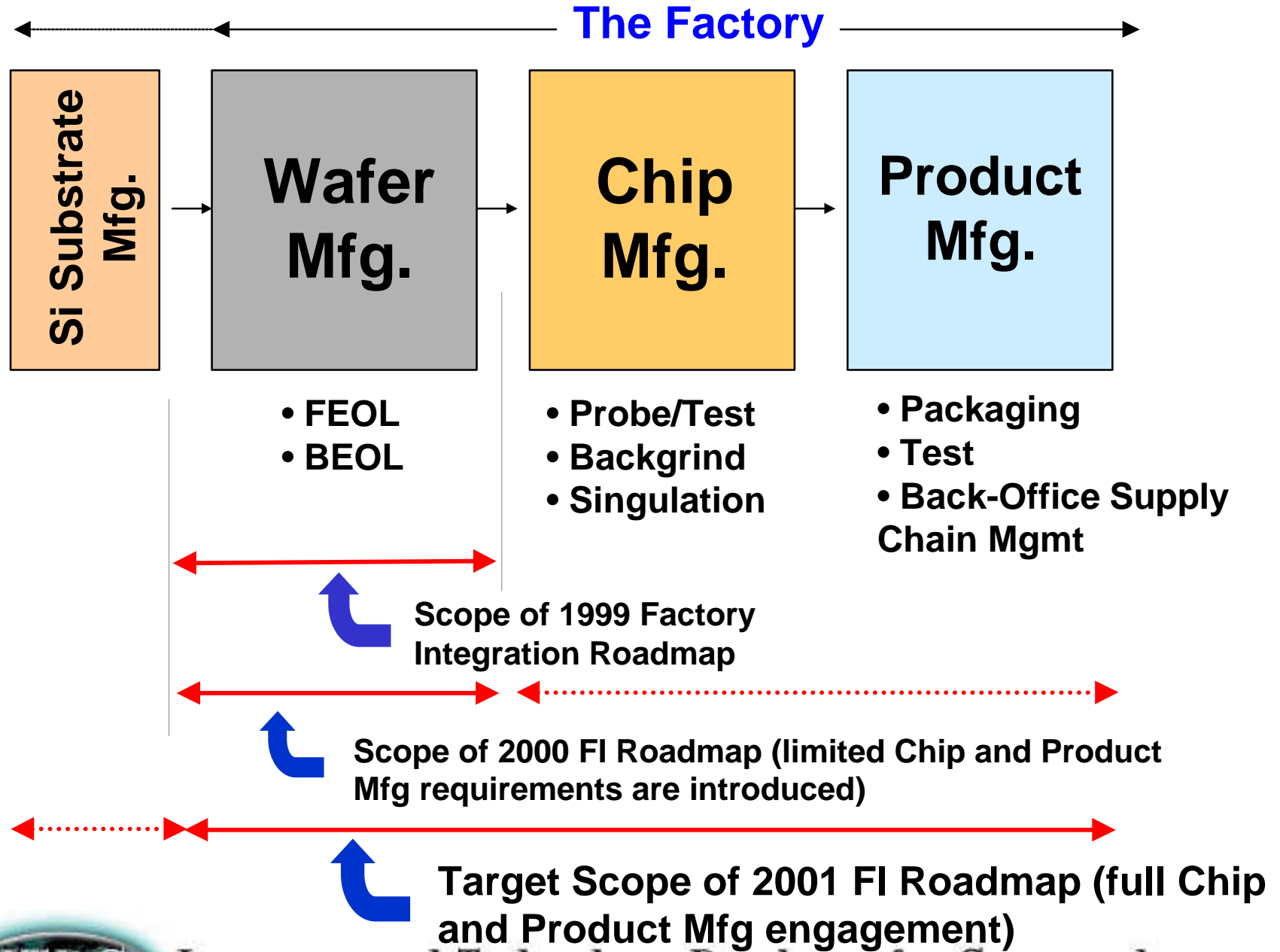
Factory needs have not changed

◆ Cost & productivity expectations drive the need to:

- ① Reduce factory capital and operating costs per function
- ② Improve factory optimization for different business models (high-volume/high-product mix and high-volume/low-product mix)
- ③ Increase factory life via extendibility, flexibility, and scalability
- ④ Increase equipment reliability and availability
- ⑤ Reduce ramp time for both new and retrofit factories



Factory Integration Scope for 2000/2001



Improve Equipment Productivity

1999 ITRS Excerpt

<i>Year</i> <i>Technology Node</i> <i>Wafer Diameter</i>	<i>1999</i> <i>180 nm</i> <i>200 mm</i>	<i>2002</i> <i>130 nm</i> <i>300 mm</i>	<i>2005</i> <i>100 nm</i> <i>300 mm</i>	<i>2008</i> <i>70 nm</i> <i>300 mm</i>	<i>2011</i> <i>50 nm</i> <i>300 mm</i>	<i>2014</i> <i>35 nm</i> <i>450 mm</i>
Bottleneck production equipment OEE [3] (SEMI E79)	75%	87%	89%	91%	92%	92%
Average production equipment OEE [3] (SEMI E79)	55%	65%	71%	78%	80%	82%
% Capital equipment reused from one process node to next	> 70%	> 0%	> 80%	> 80%	> 80%	>20%
Production equipment lead time (months from order to full throughput capability) [5]	< 9 months	< 8 months	< 7 months	< 6 months	< 5 months	<5 months
Process equipment availability [6] (SEMI E10)	> 85%	> 90%	> 93%	> 95%	> 95%	> 95%
Metrology equipment availability [6] (SEMI E10)	> 90%	>95%	>95%	>98%	>98%	>98%
% of equipment to factory systems interface standards defined [2]	75% 300 mm	100% 300 mm	100% 300 mm	100% 300 mm	80% 450 mm	100% 450 mm
% conformance: equipment to factory systems interface standards [2]	100% 200 mm	100% 300 mm	100% 300 mm	100% 300 mm	100% 300 mm	100% 450 mm

- Equipment productivity (availability and overall effectiveness) are not meeting roadmap targets. Need to update tables with actuals + gaps and drive improvements through potential solutions
- 300mm software interface standards are defined, but industry implementation is not meeting expectations



New potential solutions for 2000/1

❶ Reducing cycle/ramp times with Agile Manufacturing principles

❷ e-Manufacturing, e.g. Remote diagnostics of factory equipment

❸ Standardization to reduce complexity of Assembly/Test equipment

Common Component: Adopting mainstream network and communication protocols for semiconductor manufacturing



Agile Manufacturing



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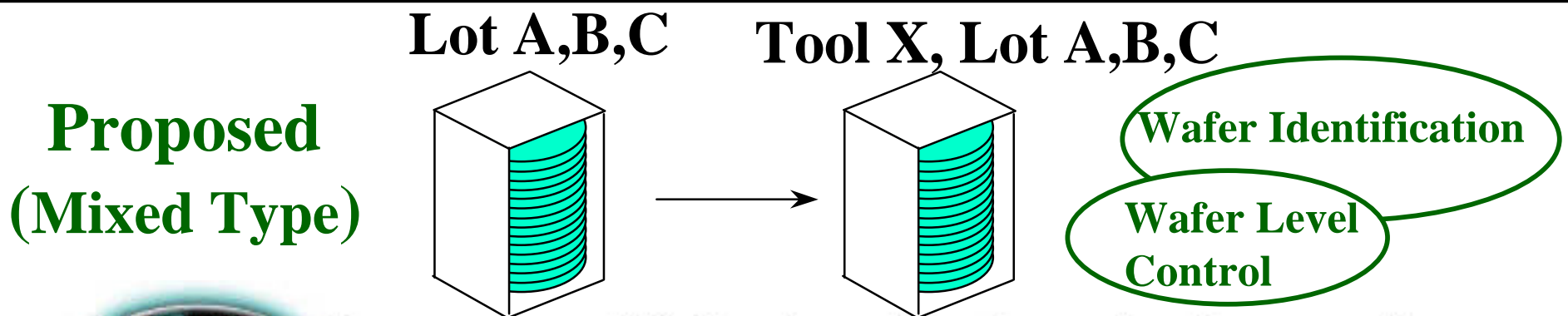
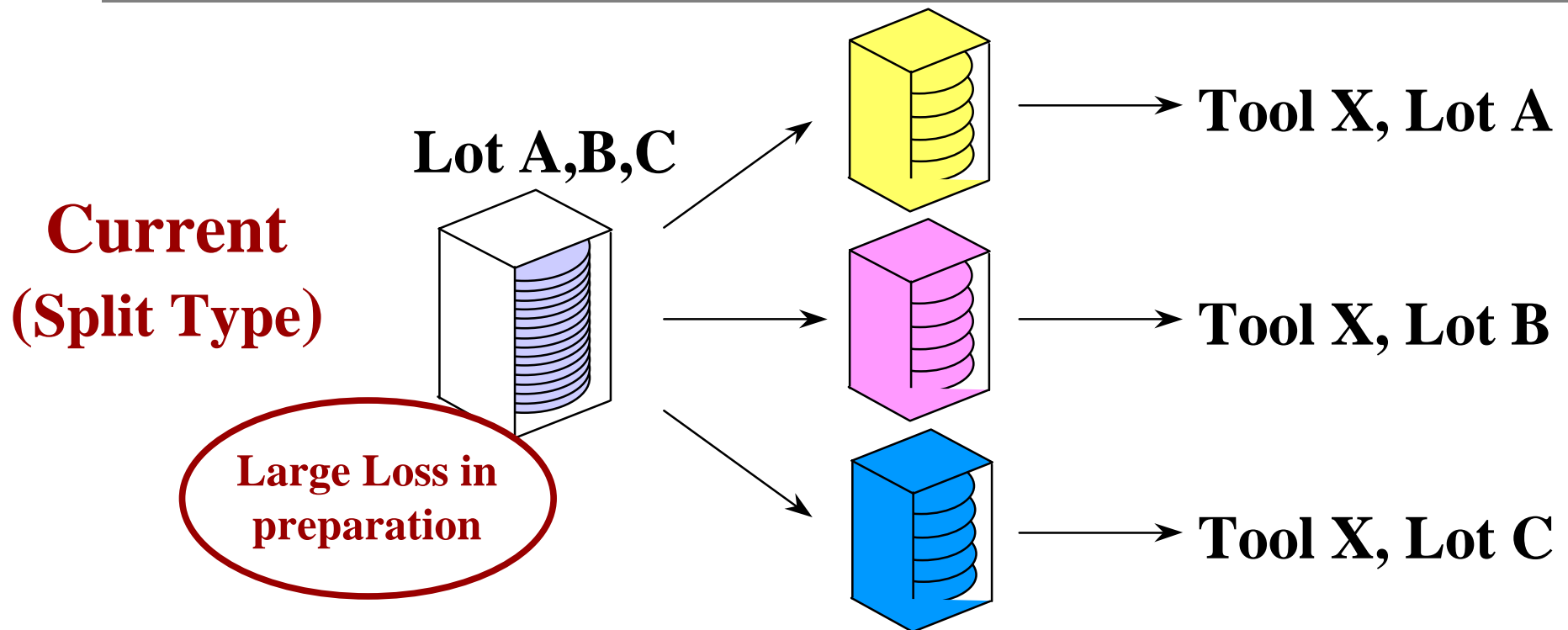
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Extension of FITWG technical requirements for Agile Manufacturing

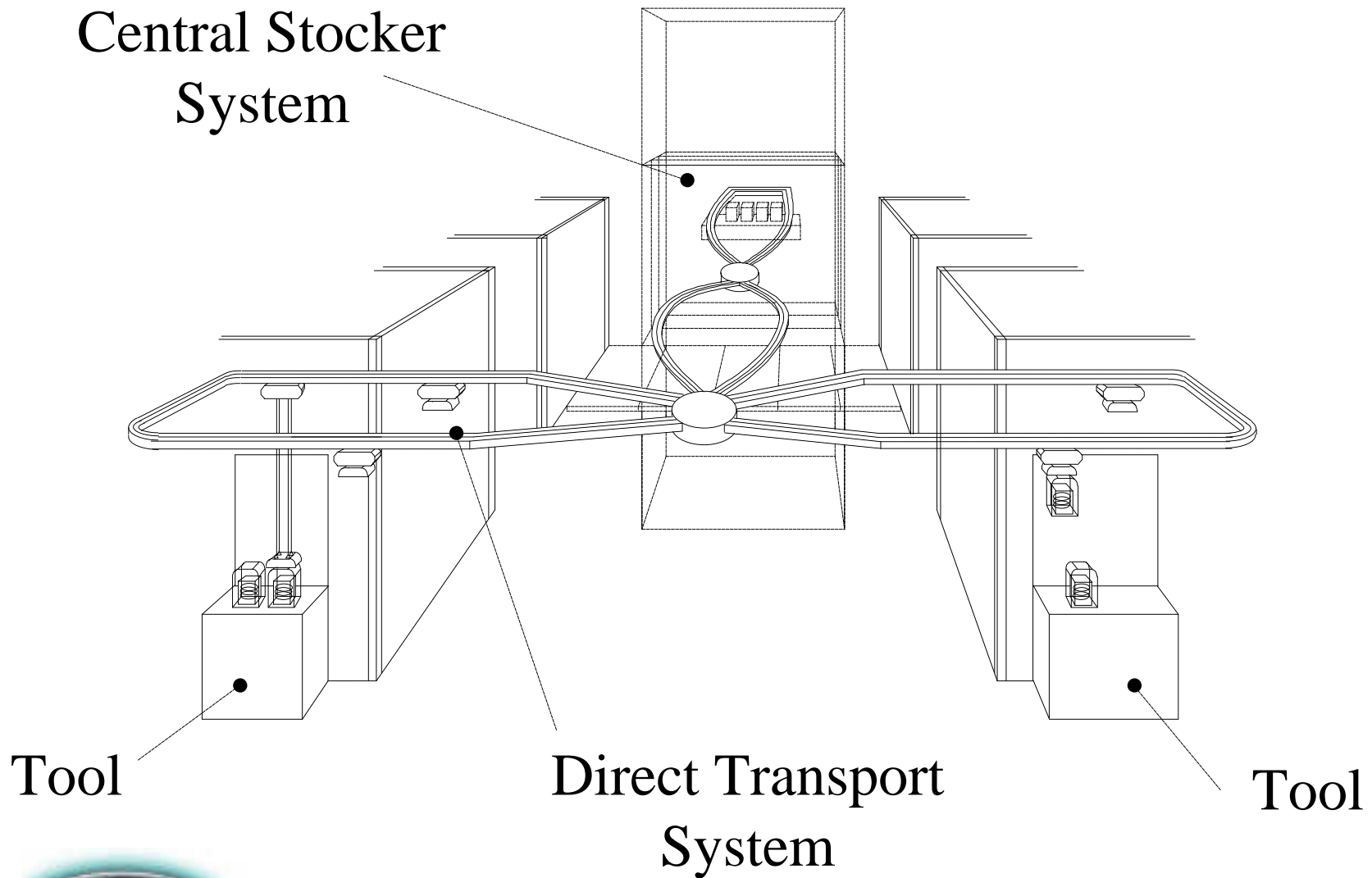
- Wafer level control to achieve
 - Precision process control, cycle time reduction, equipment productivity with small lot sizes.
- Direct transportation system to achieve
 - Cycle time reduction, WIP reduction, material handling cost reduction



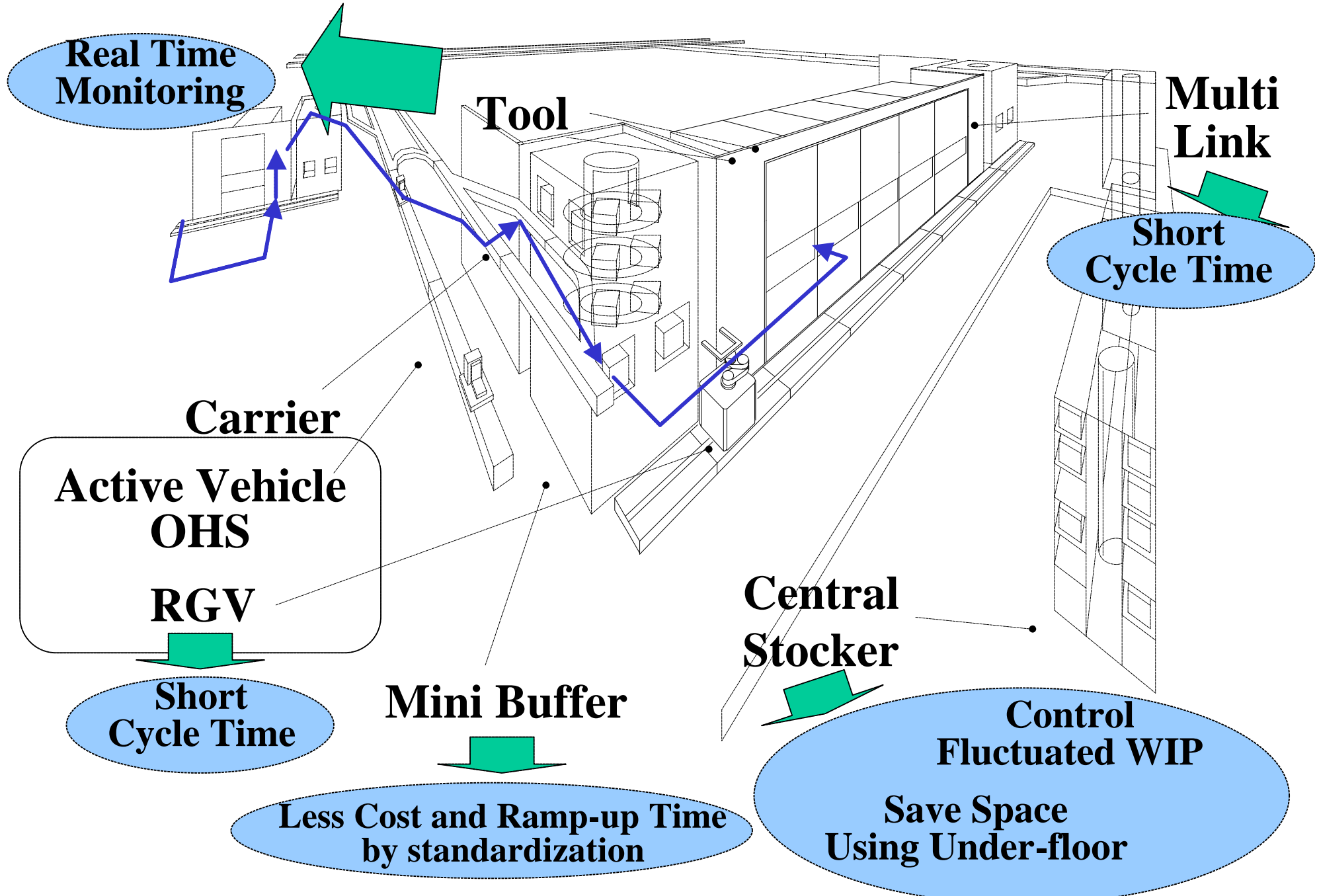
Wafer Level Control (Multiple Lots in a Carrier)



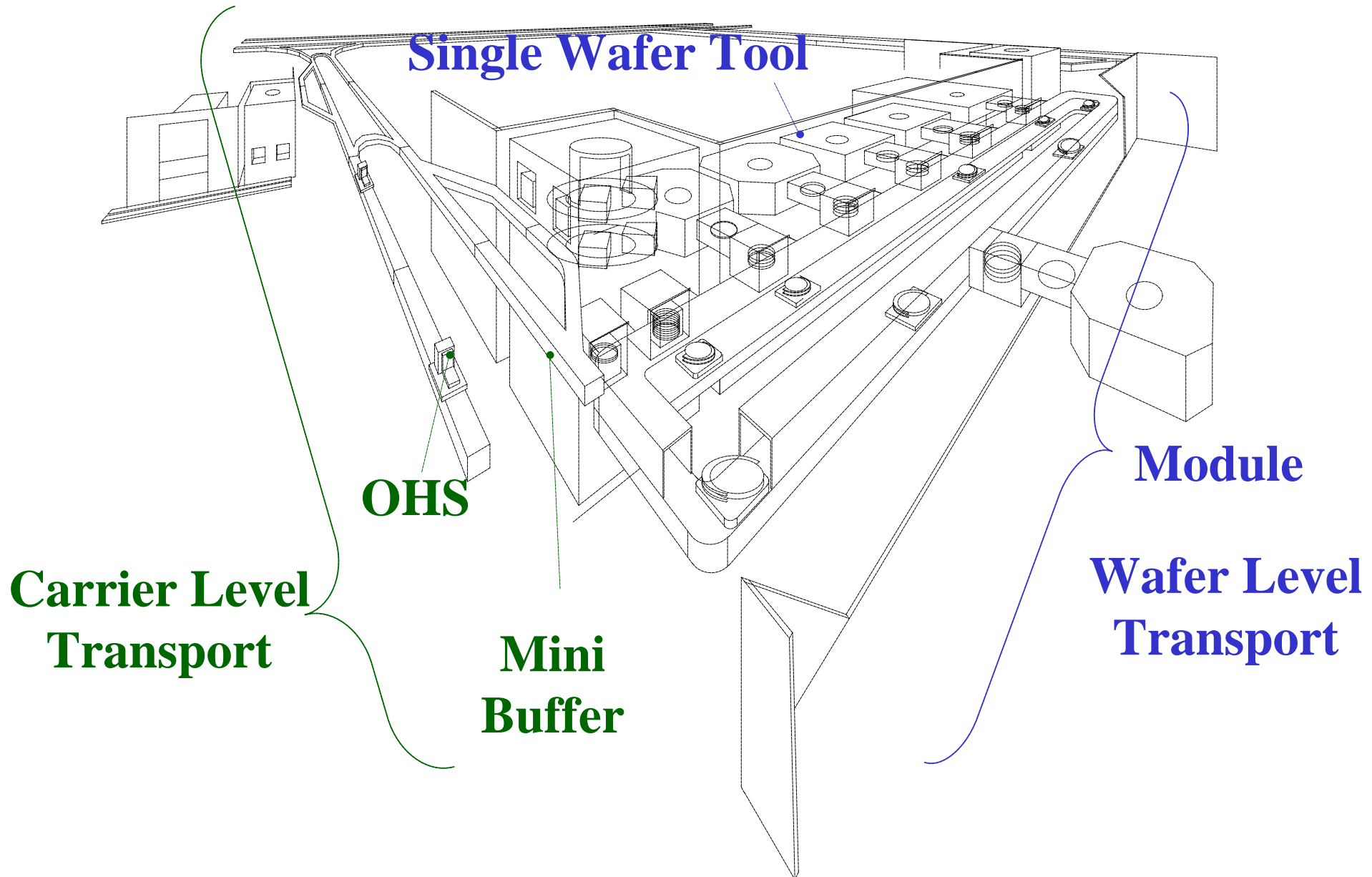
Direct Transportation Vision



Direct Transportation First Step



Direct Transportation and Wafer Level Control



e-Manufacturing

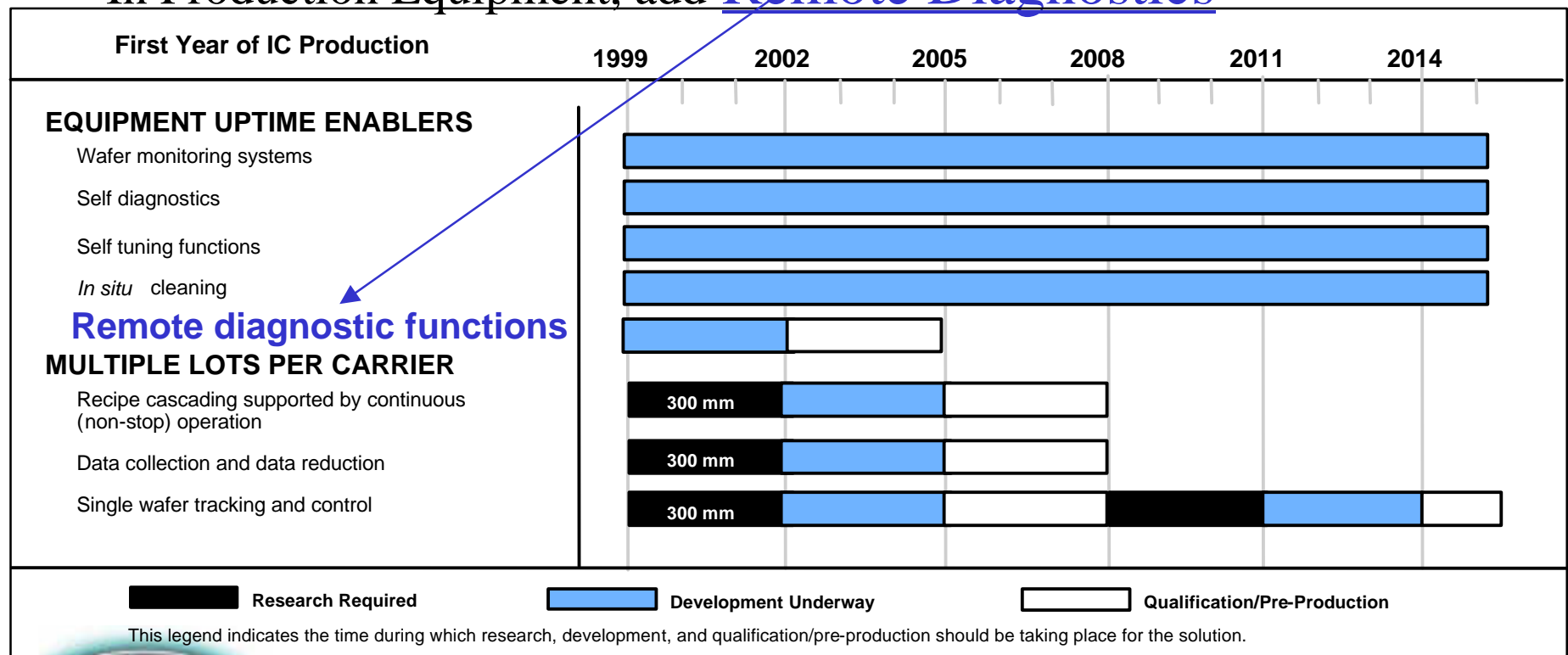


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Production Equipment Potential Solution Proposed Change

- Technology Requirements tables:
 - No Change for 2000, but possible significant equipment support cost and MTTR reduction targets for the 2001 roadmap
- Potential Solutions tables:
 - In Production Equipment, add Remote Diagnostics



e-Diagnostics

Why e-Diagnostics?

Goal is 66% reduction in equipment support dollars.

Significant reduction in Repair Time = higher Availability = Increased Output.

Anticipate problems before they occur.

Provide data to support continuous improvement and new product development

Internet

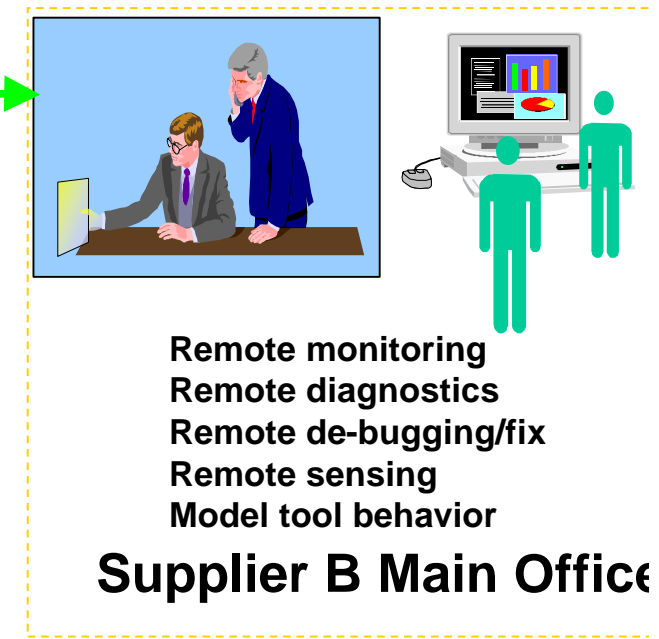
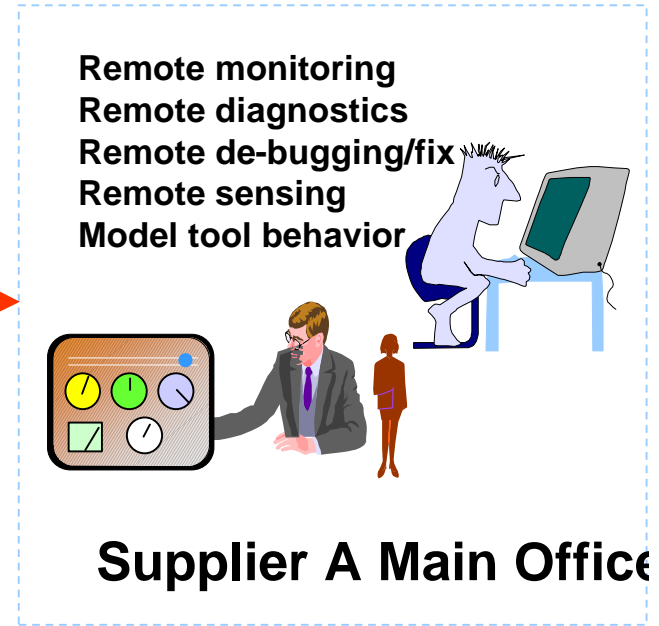
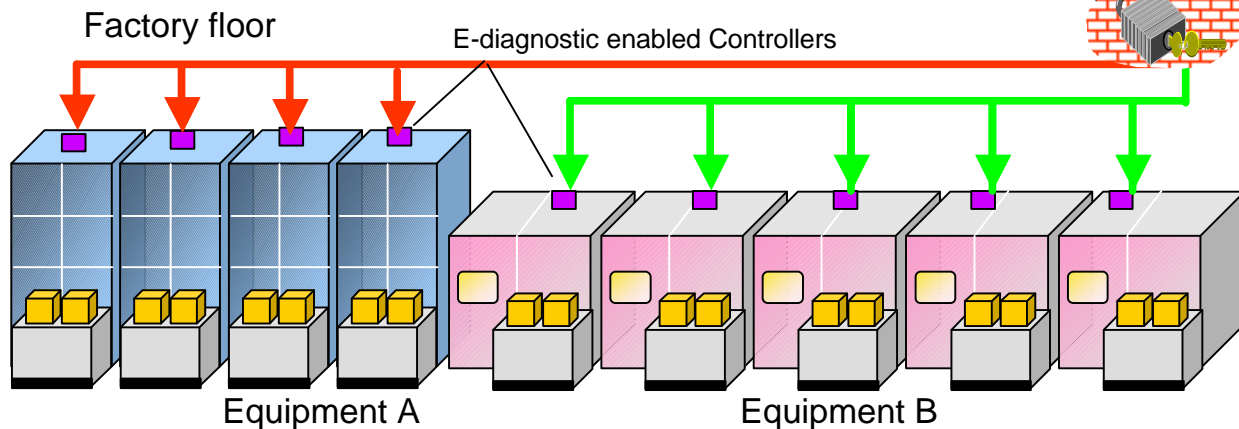
- Mainstream Computing Technologies
- Open Architectures

Protocol Options

- Serial line IP
- Remote Cntl
- Telnet
- Ethernet IP
- VPN

Firewall & Authentication

- Data Security
- Safety Infrastructure



Assembly / Test Standardization



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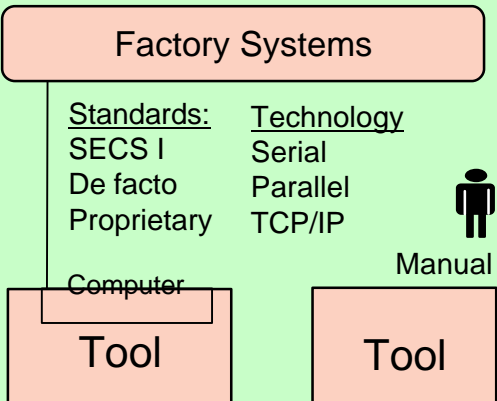
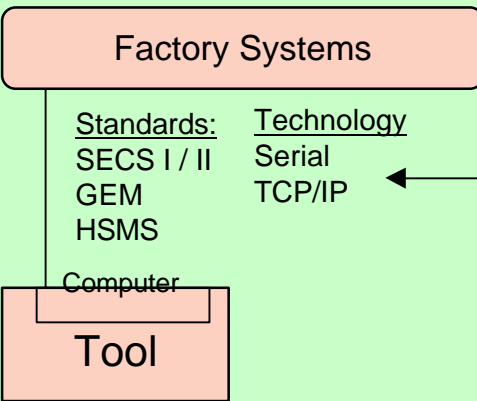
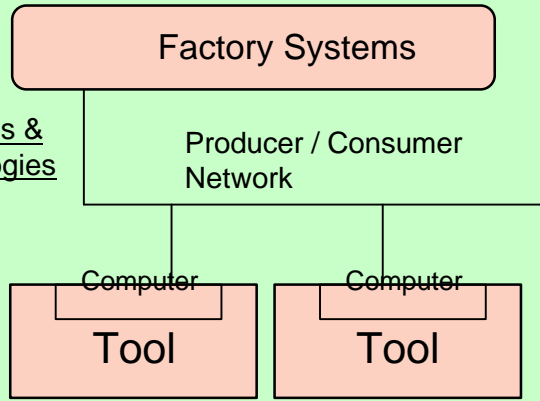
Standardization to reduce the complexity of Assembly and Test equipment

Table XX Assembly, Packaging, and Test Potential Solutions

KEY ISSUES	POTENTIAL SOLUTIONS
Material Handling Cost Reduction	<ul style="list-style-type: none">• Carrier standards• Media standards• Production equipment load/unload interface standards
Equipment Communication Cost Reduction	<ul style="list-style-type: none">• Adherence to existing proven standards• Improved Equipment <-> Host communications standards• Standard behavioral models across equipment types• Tester <-> Prober/Handler interface standards



Roadmap for Semiconductor Equipment Interface Standards in Assembly/Test Manufacturing

Current State	Immediate Need	Roadmap
<p>Characteristics:</p> <ul style="list-style-type: none"> •Some recipe management •Some Equipment Performance Metrics •Low or no standardization  <p>Factory Systems</p> <p>Standards: SECS I, De facto, Proprietary</p> <p>Technology: Serial, Parallel, TCP/IP</p> <p>Computer Manual</p> <p>Tool Tool</p>	<p>Characteristics:</p> <ul style="list-style-type: none"> •Full recipe management •Equipment Performance Metrics •Anomaly Management •SEMI standards  <p>Factory Systems</p> <p>Standards: SECS I / II, GEM, HSMS</p> <p>Technology: Serial, TCP/IP</p> <p>Computer</p> <p>Tool</p>	<p>Characteristics:</p> <ul style="list-style-type: none"> •Intelligent control •Remote Diagnostics / Monitoring •Mainstream computing standards  <p>Factory Systems</p> <p>Standards & Technologies: TBD</p> <p>Producer / Consumer Network</p> <p>Computer Computer</p> <p>Tool Tool</p>
<p>Issues:</p> <ul style="list-style-type: none"> • Limited extension opportunities • High integration cost • Long development 	<p>Issues:</p> <ul style="list-style-type: none"> • High integration cost • Long lead time • Semiconductor specific interfaces 	<p>Strategy: Use</p> <ul style="list-style-type: none"> • Standard communication protocols <ul style="list-style-type: none"> • Lower integration costs • Leverage computing industry investment • Standard equipment • Standard behavior models across tool types



Issues: Participation

- Not enough participation from the supplier community. We do need their input for Factory Integration in particular.
- No participation from Taiwan

FI TWG actions to increase participation:

- Assigned a driver for Taiwan participation, support needed from the IRC
- Future ISSM and ASMC synched public workshops and face to face meetings for FI TWG



Summary

- New potential solutions added:
 - Agile Manufacturing
 - e-Manufacturing
 - Assembly / Test Standardization
- Leverage potential solutions from other industries
- Supplier participation *is critical* in defining as well as implementing the roadmap for factory integration
 - Also need Taiwan and Korea participation

