• iNEMI Overview

• Emerging Markets

• Emerging Technology

• Conclusions and Summary
The iNEMI Mission:
Advancing Manufacturing Technology

iNEMI PROCESS FUNNEL
Identify and close technology gaps, which includes the development and integration of the electronics industry supply infrastructure.

Accelerated deployment of new technologies
Dissemination of efficient business practices
Development of industry infrastructure
Stimulation of standards
Customer Deliverables
Headquarters in the United States
Regional Center in China

• iNEMI Chinese Collaboration has been active for three years.
  – Member forums
  – Project support

• Made decision in 2006 to proceed with China center:
  – Signed lease for Office in March.
  – Occupied the office June 25, 2007
  – Manager will be: Dr. Haley Fu
    • Starting Date July 23, 2007
    • PhD from Shanghai Jiao Tung University with studies at TU Berlin
Supplier Members

3M
Ciba
ALBEMARLE
UniversaL Instruments
Vitronics Soltec
ERSA
ITW Kester
ENOVIA
Matrix One
3D Systems
supresTA
Speedline technologies
UGS
Advancing manufacturing technology

NanoDynamics
KLA Tencor
PCN ALERT
NIHON SUPERIOR CO., LTD.
PTC
Senju Comtek
RAM-CHEM
STATS ChipPAC
TERADYNE
Texas Instruments

Advancing manufacturing technology
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- Jim McElroy, CEO, iNEMI
- Dr. Robert Pfahl, VP of Operations, iNEMI
The Changing Industry

- Consumers are concerned about the impacts that electronics products may exert regarding safety, energy usage, and environmental impact.
- There has been a dramatic movement of manufacturing and manufacturing support to China from North America, Europe, and other Asian countries because of:
  - A low-cost, highly skilled workforce
  - A massive market opportunity.
- The increasing scope of outsourced operations requires loosely coupled business processes spanning multiple companies and continents.
- Business models in the electronics industry have changed - leading to significant shifts in roles and responsibilities across the supply chain.
## Strategic Concerns

### Value Creation in the Supply Chain

<table>
<thead>
<tr>
<th>Electronic Materials</th>
<th>Active Components</th>
<th>IC Assembly Services</th>
<th>Passive Components</th>
<th>EMS Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$81Bn</strong></td>
<td><strong>$228Bn</strong></td>
<td><strong>$8.8Bn</strong></td>
<td><strong>$197Bn</strong></td>
<td><strong>$127Bn</strong></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Typical Companies
- **Sumitomo Bakelite**, DuPont, Ablestik
- Intel, STMicro, LSI Logic
- Amkor, ASE, SPIL
- Tyco, Molex, AVX, Sharp
- Solectron, Sanmina-SCI, Flextronics
- Dell, HP, Cisco, Nokia, Teradyne, Visteon, Siemens

### Financial Metrics

<table>
<thead>
<tr>
<th>Gross Margin</th>
<th>Operating Margin</th>
<th>R&amp;D Margin</th>
<th>R&amp;D Value</th>
<th>%Total R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>10%</td>
<td>7%</td>
<td><strong>$8Bn</strong></td>
<td>4%</td>
</tr>
<tr>
<td>45%</td>
<td>15%</td>
<td>15%</td>
<td><strong>$34Bn</strong></td>
<td>24%</td>
</tr>
<tr>
<td>17%</td>
<td>8%</td>
<td>2%</td>
<td><strong>$0.7Bn</strong></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>8%</td>
<td>5%</td>
<td><strong>$16Bn</strong></td>
<td></td>
</tr>
<tr>
<td>6%</td>
<td>2%</td>
<td>&lt;1%</td>
<td><strong>$3Bn</strong></td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td>8%</td>
<td>8%</td>
<td><strong>$90Bn</strong></td>
<td></td>
</tr>
</tbody>
</table>

### R&D Value
- **$8Bn**
- **$34Bn**
- **$0.7Bn**
- **$16Bn**
- **$3Bn**
- **$90Bn**

### Source: Prismark Partners
Changing Regulations

- Environmental legislation in various product segments requires the electronics industry to share detailed material content data of their products and components.
- To meet regional legislative requirements, manufacturers must remove environmental “Materials of Concern,” such as lead.
- A number of “High Reliability” product manufacturers are taking Pb exemptions under the EU RoHS, and requiring a dual supply chain for components.
- The electronics industry is facing end-of-life or producer responsibility legislation.
Market Growth

- Worldwide production of computers and office equipment is expected to reach $431Bn in 2006, and grow at an average rate of 5.4% per year to reach $532Bn in 2010.
- Global production of communications equipment is expected to reach $176Bn in 2006, representing about 15% of the electronics industry.
- Portable and consumer electronics production will reach $267Bn in 2006, following several years of exceptional growth.
- Medical electronics equipment production will be $53Bn in 2006, accounting for about 4% of the global electronics industry.
- In 2006, over 3Bn SiPs were assembled. By 2010, this number is expected to reach 6.65Bn, growing at an average rate of about 17% per year.
Converging Markets

- Medical-Consumer
- Automotive-Entertainment
- Communication-Entertainment
- Computing-Entertainment
• Established A Top Down Vision of the Industry as the foundation for the Roadmap:
  • Innovation driven by Consumer: killer experience
  • Innovation links Invention to the Market, must have social value
  • Concept of “Open Innovation” thru collaboration, partnering
  • Collaboration takes various forms, new business models
  • Interoperability, Open source/standards
  • On-demand, flexible: what/when/where you need it
  • Consumer Electronics demands shorter cycle times
A research vision with three major thrusts:
- Energy & the Environment
- Miniaturization
- Medical Electronics
Emerging Technologies
Emerging Technology

- The end of traditional semiconductor scaling.
- Reduction of emphasis on the microprocessor frequency metric, and the corresponding increase in importance of the system’s throughput metric.
- Higher bandwidth to and from the microprocessor.
- Increased need for improved cooling & reduced power.
- Minaturization including 3D Packaging.
- Disruptive technology offers opportunity for innovation. In order to ensure success, the supply chain must be willing to invest with a long-term perspective in mind.
- The 2007 roadmap did not identify a major need for optical transmission within high performance printed wiring boards during the next decade.
- Growth in silicon device size is slowing.
Research Priorities

- 2007 Gap analysis being completed
- 10 year priorities being created
- Available late July 2007 at www.inemi.org

Contents:
- Technology Research Needs by Product Sector
- Priorities Summarized by Research Area
  - Manufacturing Processes
  - System Integration
  - Materials & Reliability
  - Energy and the Environment
  - Design
- Significant Gaps and Issues from Roadmap
- Options for Innovation
Key Gaps by Roadmap Area

• Board Assembly
  – Low cost fine line/via PCB Technology
  – Inspection and test capability
  – Board flex standards
  – Design for Manufacturing standards
• Environmentally Conscious Electronics
  – Alternatives to Cd, Hg, CrVI, PBB, and PBDEs
  – Industry involvement in policy making on material restrictions
  – Scientific methodologies to assess environmental impact of materials
  – Effective basic energy efficiency metrics
• Substrates
  – Low cost, fine line/via PCB Technology
  – Moisture reliability
  – High Tg
  – Low cost, low loss tangent materials
Key Gaps by Roadmap Area

• Medical
  – Component reliability standards and standard test methods
  – Standardized characterization process for RoHS-compliant components
  – Development of advanced printed circuit board and flexible printed circuit technologies
  – Safety study of clinical and home-health wireless environment.

• Thermal Management
  – Closed Loop, Liquid Cooling Solutions
  – Cooling of 3-D Stacked Dies
  – Data Center cooling strategies
  – Reliable low-cost pumps

• Board & System Test
  – Test access for miniaturized products
  – Increased adoption of boundary scan in digital and analog devices
  – Tools to determine defect coverage.
  – Standards for board flexure of lead-free BGAs
  – Test solutions for High Density Interconnect
Projects to address Strategic Thrusts
Emerging Scenario for iNEMI Projects

• Meet needs of members (both users & suppliers) in key segments:
  – Medical electronics
  – High reliability (Telecom, Computing)
  – High volume/portable
• Complete initial Medical Electronics Project & build momentum for this segment.
• Establish “End Game” for High Reliability segments for Pb-free conversion:
  – Close remaining knowledge gaps
  – Work source of supply issues (BGAs) in the interim
• Expand & strengthen miniaturization projects.
Energy & the Environment

• Established Projects
  – Tin Whisker Phase II Project
  – Lead-Free Rework Optimization Project
  – Pb-free Wave Soldering Assembly Process Project
  – Lead-Free Rework Optimization Project
  – Pb-free BGAs in SnPb Assemblies Project
• New Project
  – Halogen-Free Project Phase II – Launch June 2007
• New Initiative
  – BGA Metallurgy Proliferation
Miniaturization

• Established Projects
  – Nano Attach Project
  – Pb-free Nano-solder Project

• New Project
  – Functional Test Coverage Assessment Project – Launch July 2007

• Initiative
  – High Temperature Co-planarity Requirements for Components and PWBs
Medical Electronics

- Established Project
  - Medical Grade Component Reliability Specifications

- Initiative
  - iNEMI Substrates for Medical Devices
Summary

• iNEMI is a Global Organization:
  • We are starting a center in China
  • We have strong participation in Europe
  • We are well established in North America
• iNEMI is the leader in roadmapping and identifying technology gaps for the electronics industry.
• Industry must continue to close gaps to ensure ongoing growth and prosperity.
• A number of challenges have been identified for the research community to address.
Conclusions

• Consumer Electronics has become the major driving force for our industry:
  – New Technology to enable miniaturization
  – Relentless cost reduction
  – Volume manufacturing capability

• The high reliability market must develop a viable scenario to take advantage of consumer components and still meet their reliability requirements.

• Disruptive technology offers opportunity for innovation. To ensure success, the supply chain must invest with a long-term perspective in mind.
www.inemi.org

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