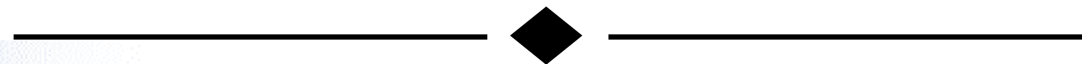
INNOVATION PRIORITIES for 2015



Dr. Robert C. Pfahl, Jr.
VP of Operations, iNEMI

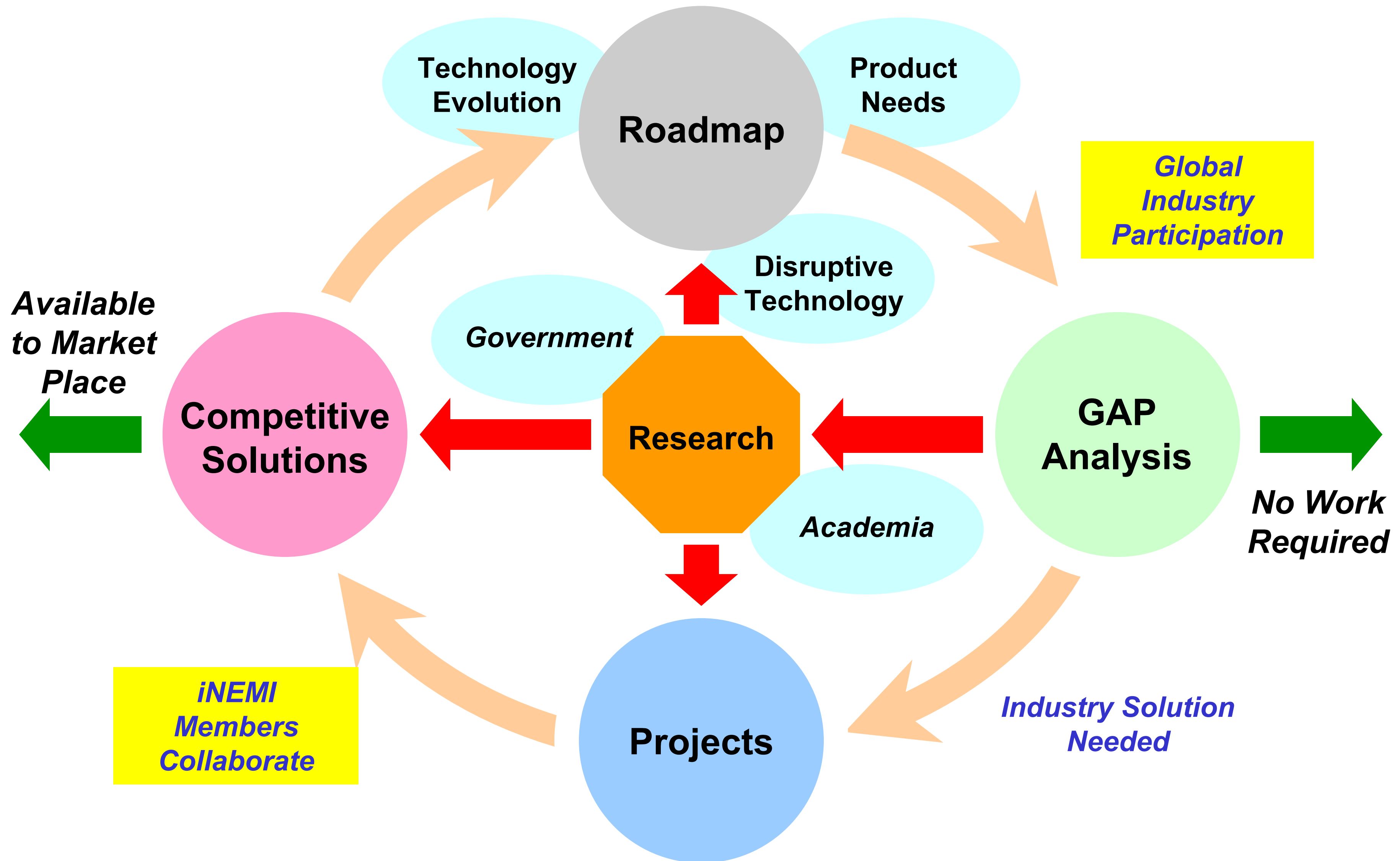
Outline

- iNEMI Process for Determining Needs
  - iNEMI Roadmapping Process
  - Highlights from the 2004 Roadmap
- 2005 iNEMI Innovation Priorities
  - Identified Strategic Gaps from the 2004 Roadmap
  - Potential Innovative Solutions for the Identified Gaps
- Highlights from the iNEMI Innovation Leadership Forum
- The Challenges for the Next Decade

What Does iNEMI Do?

- iNEMI roadmaps the global needs of the electronics industry
  - Evolution of existing technologies
  - Prediction of emerging/innovative technologies
- iNEMI identifies gaps (both business & technical) in the electronics infrastructure
- iNEMI stimulates research/innovation to fill gaps
- iNEMI establishes implementation projects to eliminate gaps
- iNEMI stimulates worldwide standards to speed the introduction of new technology & business practices

Methodology



Statistics for the 2004 Roadmap

- > 470 Participants
- > 220 Companies/organizations
- 11 Countries on 3 Continents
- 19 Technology Working Groups (TWGs)
- 7 Product Emulator Groups (PEGs)
- Over 1200 Pages of Information
- Roadmaps the needs for 2005-2015

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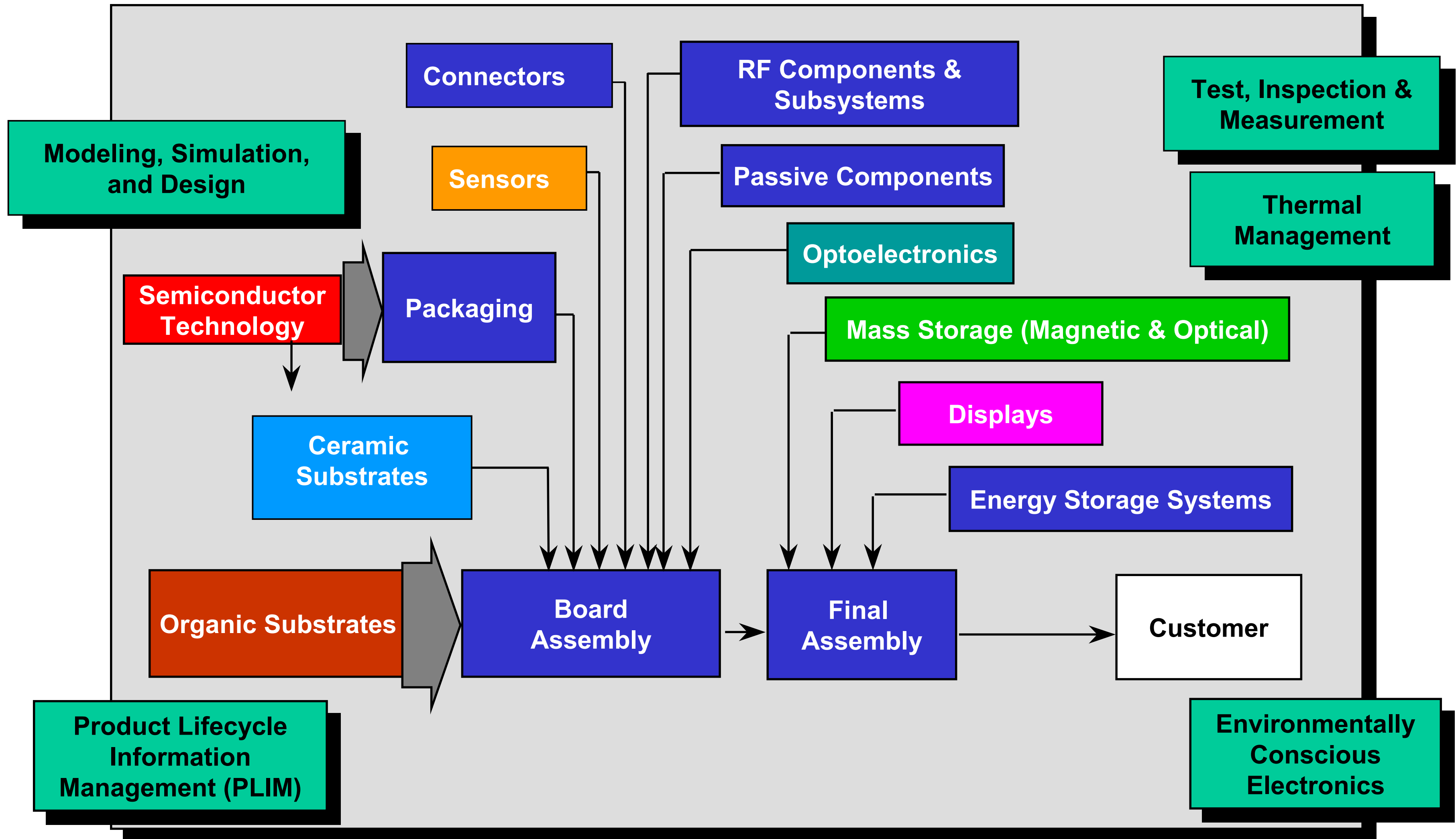
7 Product Emulator Groups (PEGs)

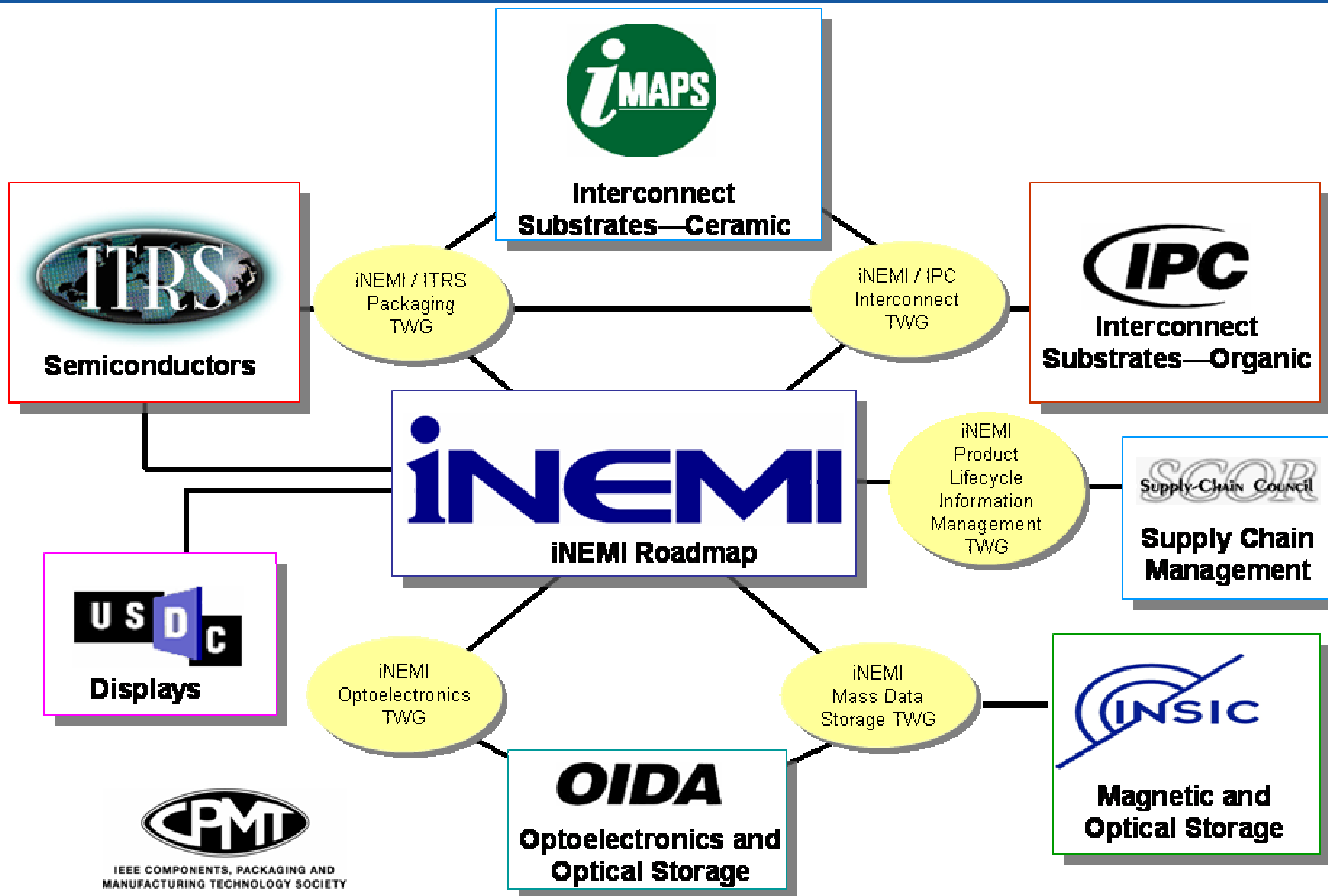
Emulators	Characteristics
Portable / Consumer	High volume Consumer Products for which cost is the primary driver including Hand held, battery-powered products driven by size and weight reduction
System in a Package	Complete function provided in a package to system manufacturer
Office Systems / Large Business Systems	Products which seek maximum performance from a few thousand dollar cost limit to literally no cost limit
Network / Datacom / Telecom Products	Products that serve the networking, datacom and telecom markets and cover a wide range of cost and performance targets
Medical Products	Products which must operate within a highly reliable environment
Automotive	Products which must operate in an automotive environment
Defense and Aerospace	Products which must operate in extreme environments

Yellow = Completely new Emulator Green = Broadened focus

19 Technology Working Groups (TWGs)



8 Contributing Organizations



Highlights from the 2004 Roadmap

The End of Semiconductor Scaling

- **The anticipated end to semiconductor scaling c. 2015 will create a major technology shift in the industry:**
  - **Implementation of advanced, non-classical CMOS devices with enhanced drive current**
  - **Identification, selection, and implementation of advanced devices (beyond-CMOS)**
  - **Increased need for improved cooling**
  - **Potential need for high speed optical communications**
  - **Innovative Packaging for:**
    - **Nano size devices**
    - **Hetro systems**
- **Innovation must begin today to meet these needs**

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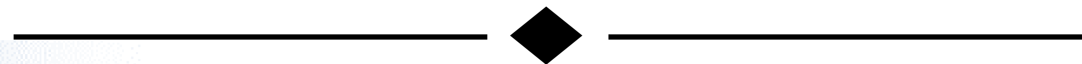
Potential Disruptive Technology

- New energy technologies that may cause disruptive opportunities:
  - Fuel cells
  - High power batteries for hybrid electric vehicles

- Nanotechnology has the potential to be a very disruptive technology during the period covered by the roadmap

2005 iNEMI Innovation Priorities



Based on 2004 Roadmap

2005 Research Priorities

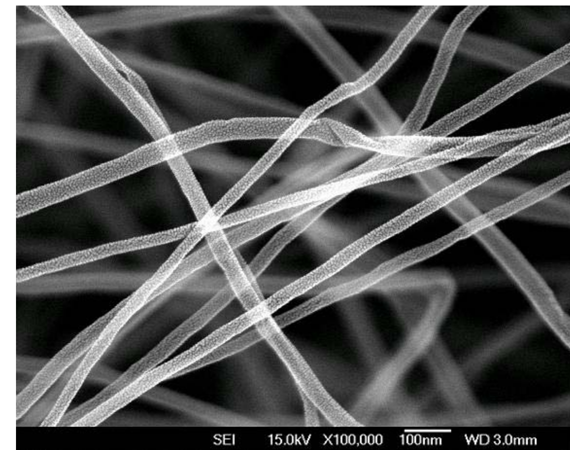
- Gap analysis completed
- 10 year priorities created
- Ready for distribution
- Contents:
  - Technology Research Needs by Product Sector
  - Priorities Summarized by Research Area
    - *Manufacturing Processes*
    - *System Integration*
    - *Materials & Reliability*
    - *Energy and the Environment*
    - *Design*
  - Significant Gaps and Issues from Roadmap
  - Options for Innovation

Identified Strategic Gaps

- Active Device Technology
- Thermal Management
- Increased Serial Communications Bandwidth
- Next Generation Packaging Technology
- Design and Simulation Tools
- Sustainability Metrics

Active Device Technology

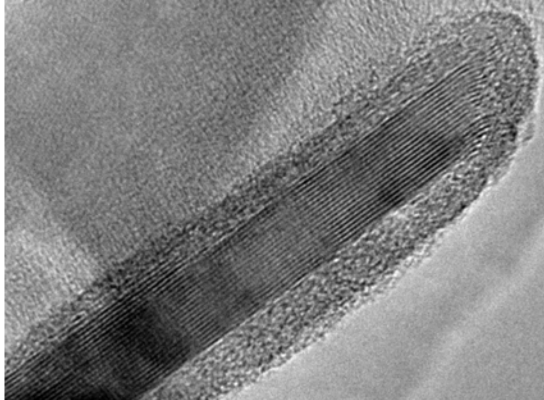
- **Implementation of advanced, non-classical CMOS devices with enhanced drive current**
- **Identification, selection, and implementation of advanced devices (beyond-CMOS)**
- **Drives following three strategic system gaps**



Multi-wall carbon nanotubes (NanoDynamics Inc.)

Thermal Management

- Increased need for improved cooling
- Improved materials and design concepts
- Focus is on local hot spots
- Must design from device to system level.



BN coated with Al203 (ALD Nanosolutions Inc)

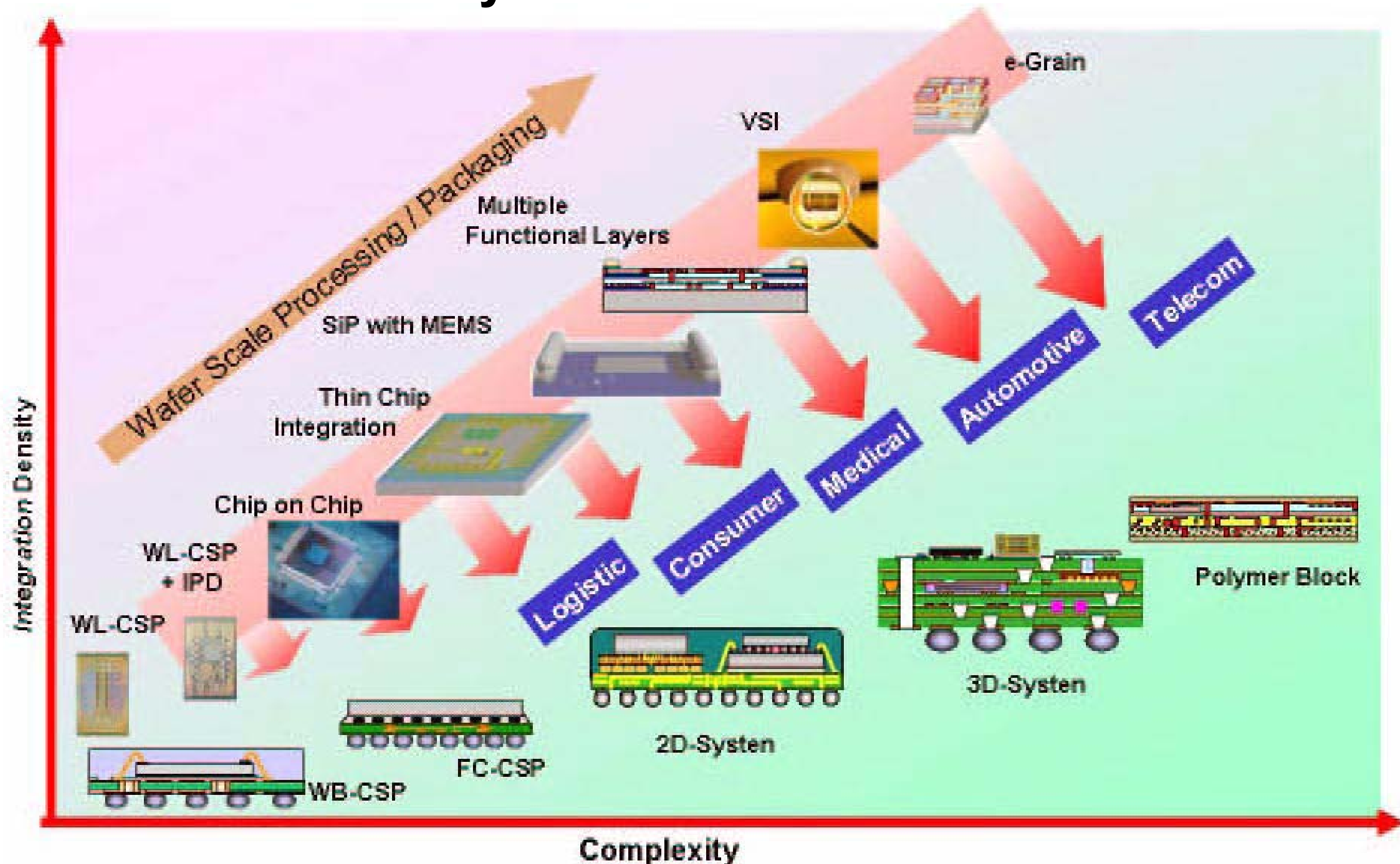
Increased Serial Communications Bandwidth

- Copper
- RF
- Optical

- Where?
- When?
- How Fast?
- At what cost?

Innovative Packaging for:

- Nano size devices
- Hetero systems



Source: Professor Dr. Reichl, Fraunhofer IZM, Berlin Germany

Design and Simulation Tools

Design & simulation tools are main roadblocks to more rapid introduction of new technologies:

– Mechanical & reliability modeling

– Thermal & thermo-fluid simulation

– Co-design of mechanical, thermal & electrical performance of the entire chip, package & associated heat removal structures

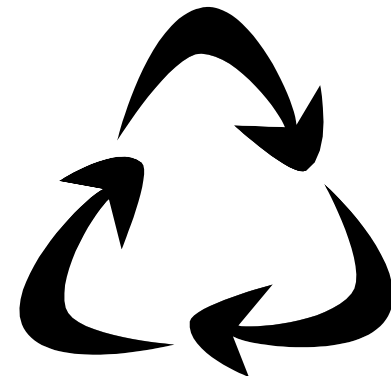
– Simulation tools for nano devices & materials

– Improved design tools for emerging technologies like embedded passives & optoelectronic PWBs

– Integrated design & simulation tools (circuit, EM, thermal, mechanical, manufacturing, etc.) for higher functionality in mixed-mode wireless chips & modules.

Sustainability Metrics

- Development & implementation of scientific methodologies:
  - Assess true environmental impacts of materials
  - Potential trade-offs for alternatives
- Develop a common, straightforward definition of sustainability



Nanotechnology- A Potential Solution for some of the Identified Gaps:

Active Device Technology
Thermal Management
Increased Serial Communications Bandwidth
Next Generation Packaging Technology
Design and Simulation Tools
Sustainability Metrics

Some applications & benefits of Nanotechnology

Nano Composites: stronger, tougher, stiffer, lighter materials (adhesives, structural,thermal, electronic, optical functionality)

Nano displays: Large, lower cost and brighter displays based on embedded carbon nanotubes

Nano sensors: smaller, more sensitive Nano scale sensors for bio, optical, chemical and physical sensing

Nano antennas: Nano scale fractal antennas for multiple spectra and broadband

Nano power: High capacity power sources (storage, conversion, advanced fuel cells, photonic energy), parasitic energy harvesting, nanobiotech related functionality

Source: Dr. Iwona Turlik, Motorola, Schaumburg IL

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Possible Time Line for applications of Nano Technology in Electronics

- **Advanced fillers that are reinforcing, thermally conductive, electrically conductive, TCE modifying for mold compounds, underfills, adhesives and board materials; short term**
- Mixed Nano and MEMS sensor technology; medium term
- Display technology based on CNT emitters; medium term.
- Quantum computing
- Transistors based on CNT or spintronics; long term
- DNA strand self-assembly of electronic structures; long term

iNEMI Innovation Leadership Forum September 2005

- Convened key industry, government, university and business leaders
- Discuss issues and outlined a research vision strategy to focus investments

Innovation Forum Results

Major Accomplishments:

1. Identification and participation of leaders in electronics manufacturing innovation.

   Innovation is not Invention

2. Strong descriptions of requirements to drive innovation:

   Identification of "next big things“

   Sources for strategic R&D funding

   Changed innovation model

Next steps:

1. Create Innovation/Research Vision
2. Communicate to Research Stakeholders

Wake Up Call: Vision Focus Areas

- Need 2005 Sputnik equivalent of "Wake up" or rallying call.
  Must have social value. Could it be:
  - Energy: reduce imports by P% in N years…..
  - Health Care: ex. 30min of paperwork for every hour of patient care, 98K avoidable deaths/yr
  - Security/Safety: post 9/11….
    - Data/Telecom: from New Orleans breakdown
- Define goals with specific timelines.
- Rallying call with a face.
- Must convince the public.

VALUE CREATION IN THE SUPPLY CHAIN

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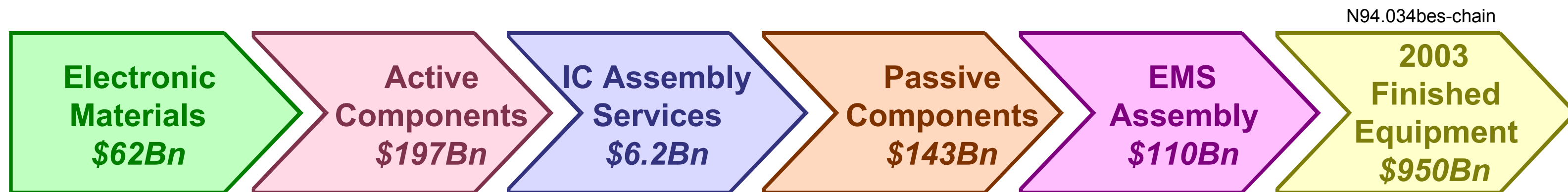

	Electronic Materials	Active Components	IC Assembly Services	Passive Components	EMS Assembly	Finished Equipment
Typical Companies	Sumitomo Bakelite, DuPont, Ablestik	Intel, STMicro, LSI Logic	Amkor, ASE, SPIL	Tyco, Molex, AVX, Sharp	Solectron, Sanmina-SCI, Flextronics	Dell, HP, Cisco, Nokia, Teradyne, Visteon, Siemens
Gross Margin	30%	40%	12%	25%	7%	30%
Operating Margin	10%	15%	8%	8%	2.5%	8%
R&D	7%	15%	2%	5%	<1%	8%
Margin Value	$6Bn	$30Bn	$0.5Bn	$11Bn	$3Bn	$76Bn
R&D Value	$4Bn	$30Bn	$0.1Bn	$7Bn	<$1Bn	$76Bn
%Total R&D	3%	25%				64%

Prismark

Guiding principles in the new innovation model

	Monolithic Product Development	Global Product development networks
Governance	Top-down control	Symbiotic partnerships
Corporate ethos	Not invented here	Best from anywhere
Attitude toward IP	Own and protect	Share and expand
Innovation processes	Rigid	Flexible
Success metrics	Patents	Customer experience
Role of customers	Passive users	Active co-innovators

Source: Forrester Research-Navi Radjou

The Challenges for the Next Decade

The Challenges for the Next Decade

- Electronic Packaging
  - Technology Driver will be multifunctional system in packages (SiPs)
    - Needs must be addressed through innovation using new processes and new materials
    - Made possible through emerging efforts such as nano-technology
- Green Electronics
  - As we recover from implementing RoHS and WEEE, the electronics industry needs to develop a strategic vision of sustainable electronics

www.inemi.org

Bob Pfahl

bob.pfahl@inemi.org

Tuesday, 15 November

Innovation Priorities for 2015 Vision

Productronica Forum, Hall A6, 13:00-13:30

Bob Pfahl, iNEMI will present highlights from the September 2005 iNEMI Innovation Leadership Forum and the iNEMI Roadmap.

iNEMI/IPC Standard for Exchanging RoHS Composition Data

Productronica Forum with ZVEI-Podium, Hall B3, 14:20-14:50

Richard Kubin, E2open, will provide the status of materials data composition exchange standards and urge global standardization.

Implementing the iNEMI/IPC Composition Data Exchange Standards

iNEMI Conference Room A 61, 9:00 - 12:00

(Co-sponsored by IPC)

This meeting will encourage industry to adopt the IPC-1752 standard

2007 iNEMI Roadmap/European Kick-Off Meeting

iNEMI Conference Room A 61, 13:00 - 17:00

(Co-sponsored by IEEE's CPMT Society, Fraunhofer IZM, IMAPS Europe)

Thursday, 17 November

Implementing the iNEMI System-in-Package Technical Plan

iNEMI Conference Room A 61, 9:00 - 12:00

This meeting will review and prioritize gaps identified in the iNEMI Technical Plan and develop projects to close the gaps.

Update on Pb-Free Soldering Optimization

Productronica Forum, Hall A6, 13:00-13:30

Denis Barbini, Vitronics Soltec will provide the latest update on three ongoing iNEMI projects to optimize Pb-free soldering:

System in Package Technology

Productronica Forum with ZVEI-Podium, Hall B3, 13:30-14:00

Bob Pfahl, iNEMI will discuss identified SiP technology needs and the iNEMI action plan