

2017 iNEMI Roadmap - Highlights

Steve Payne,
iNEMI

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Highlights of the iNEMI Roadmap

➤ iNEMI

➤ iNEMI 2017 Roadmap

- Key Trends

- IoT

- Medical

- A&D

➤ iNEMI Collaborative Projects

➤ Summary

iNEMI

International Electronics Manufacturing Initiative (iNEMI) is an industry-led consortium of over 90 global manufacturers, suppliers, industry associations, government agencies and universities. A Non Profit Fully Funded by Member Dues; All Funding is Returned to the Members in High Value Programs and Services; In Operation Since 1994.

www.inemi.org



iNEMI Industry Value



Roadmap

- Anticipate technology requirements
- Identify gaps
- Focus R&D priorities

Collaborative Projects

- Eliminate gaps
- Deliver learning & critical data
- Leverage efforts & resources of participants

Forums & Workshops

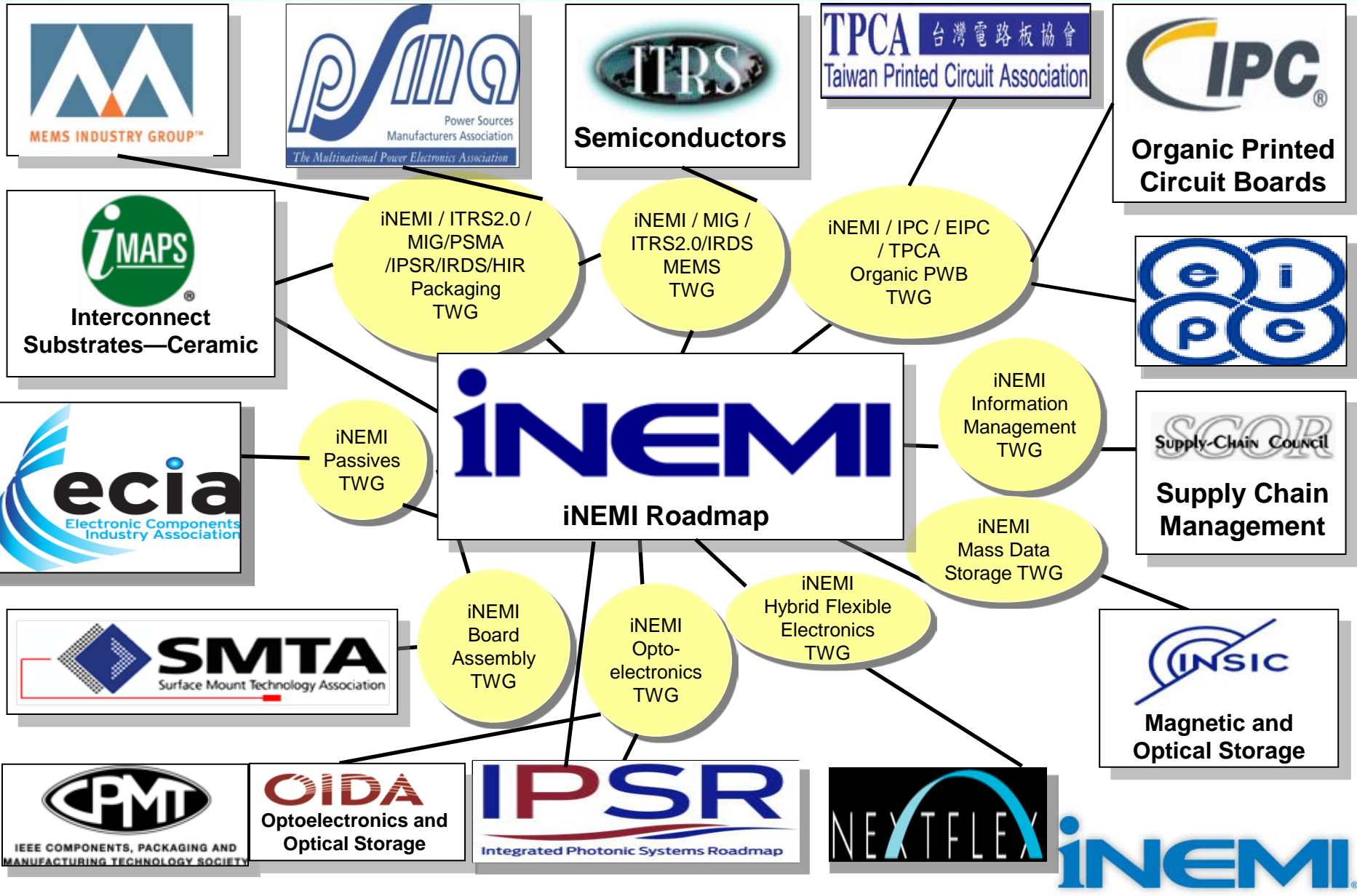
- Share solutions & best practices
- Prioritize key challenges
- Network with customers & suppliers

2017 iNEMI Roadmap

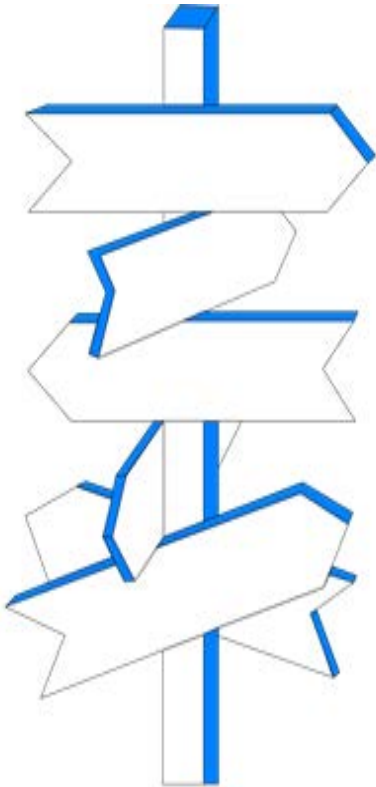
<http://www.inemi.org/inemi-roadmap>



Contributing Organizations



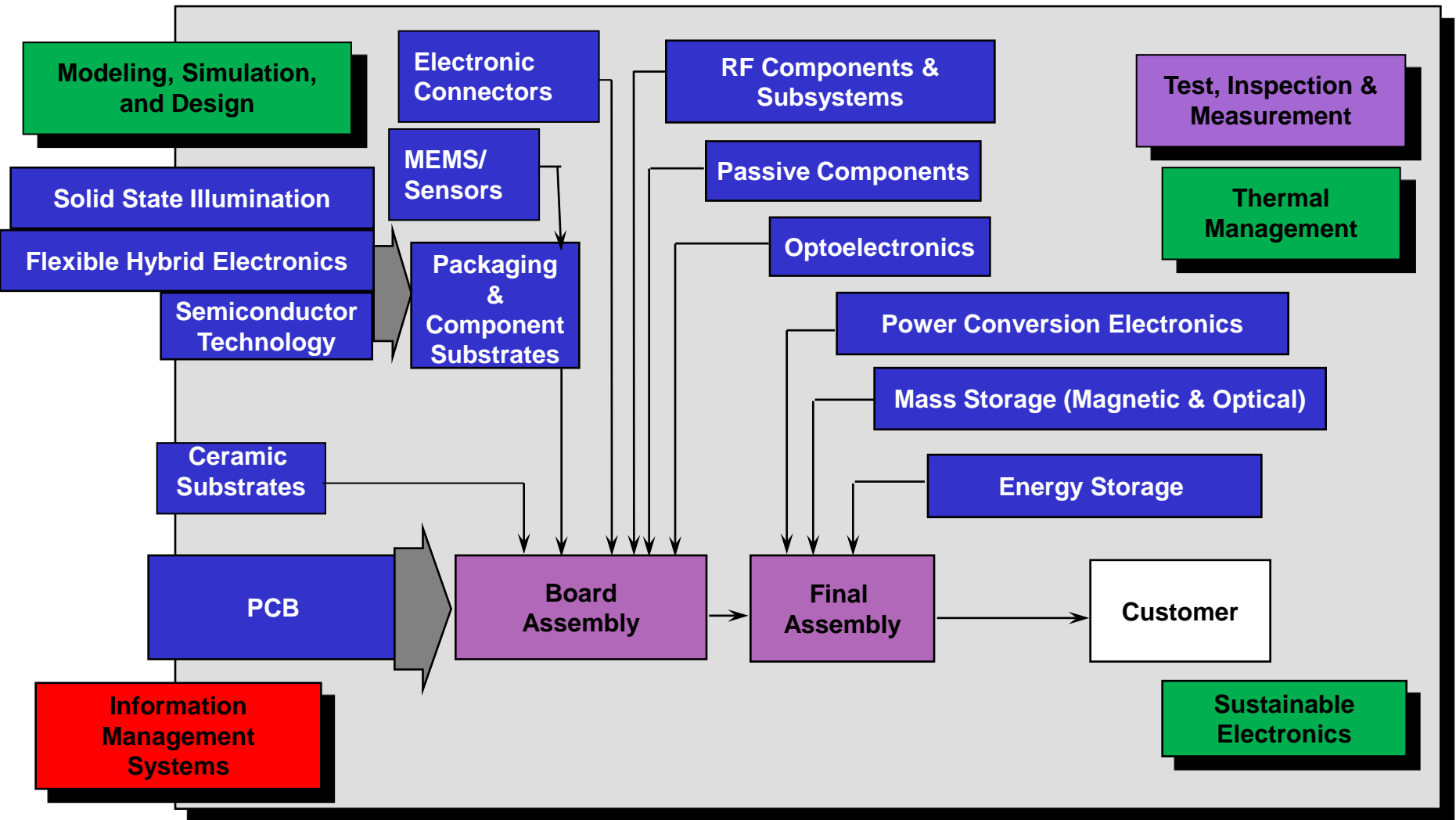
iNEMI Roadmap Process



Product Emulator Groups (PEGS)

- **Aerospace & Defense**
- **Automotive**
- **High-end Systems**
- **IOT**
- **Medical**
- **Consumer & Office**
- **Portable & Wireless**

2017 Technology Working Groups (TWGs)



Key Trends for Future

- **The end of Moore's Law scaling**
- **Rise of the Internet of Things**
- **Migration of data, logic and applications to the Cloud**
- **Consumerization of data and data access**

2017 Roadmap IoT/Wearables Product Sector Highlights

Chairs:

Satish Parupalli, Intel

Barbara Goldstein, NIST

Presenter:

Eric Simmon, NIST



What is the IoT?

IoT infrastructure

An infrastructure of **networked objects** (cyber-physical devices, information resources, and people) that interact with the physical world through **sensors and actuators**.

IoT system

A system built from networked objects that can interact with the physical world to achieve a goal.



IoT/Wearables PEG Chapter TOC

INTERNET OF THINGS PRODUCT EMULATOR GROUP

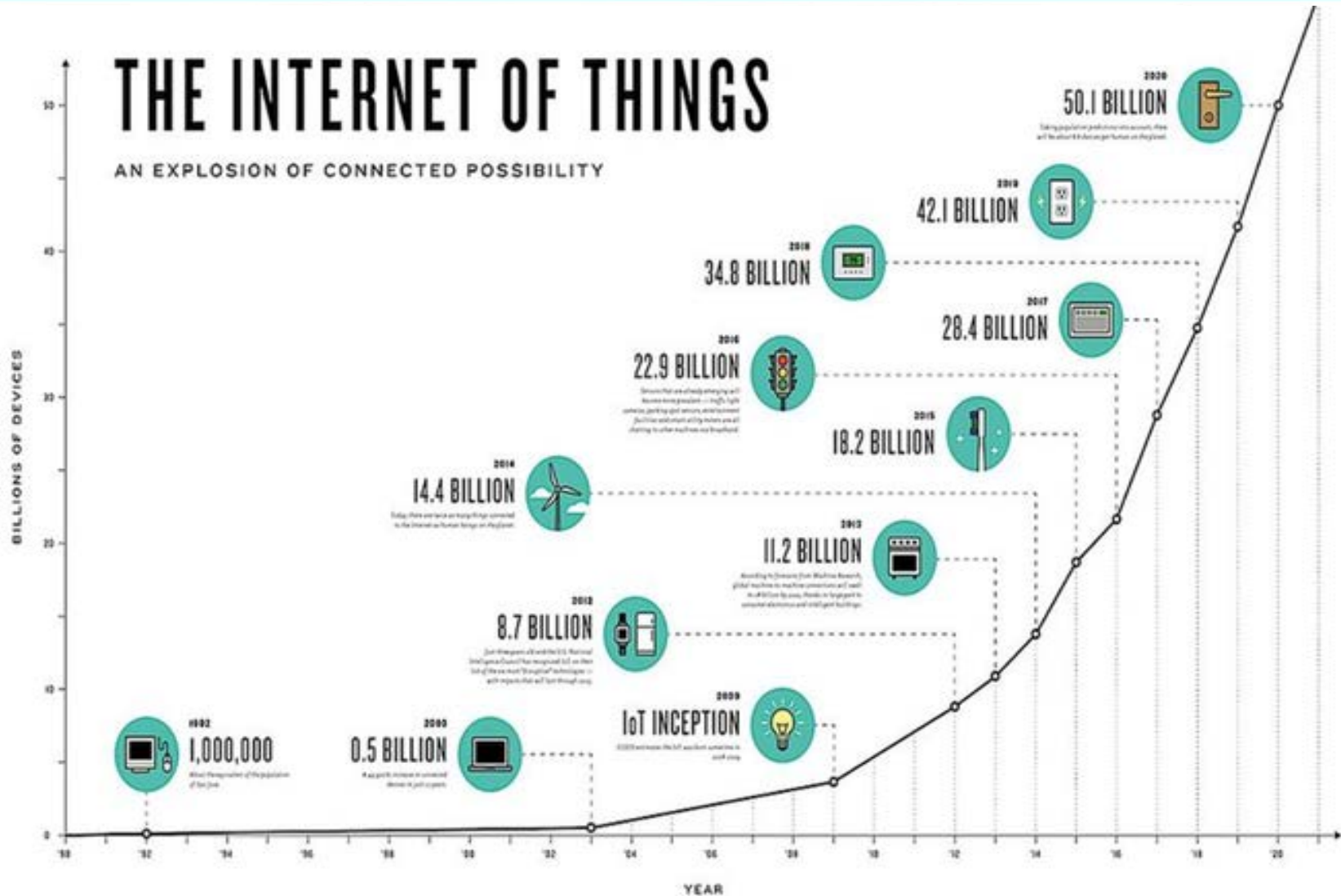
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Chronological Evolution of IoT Concept With Device Examples

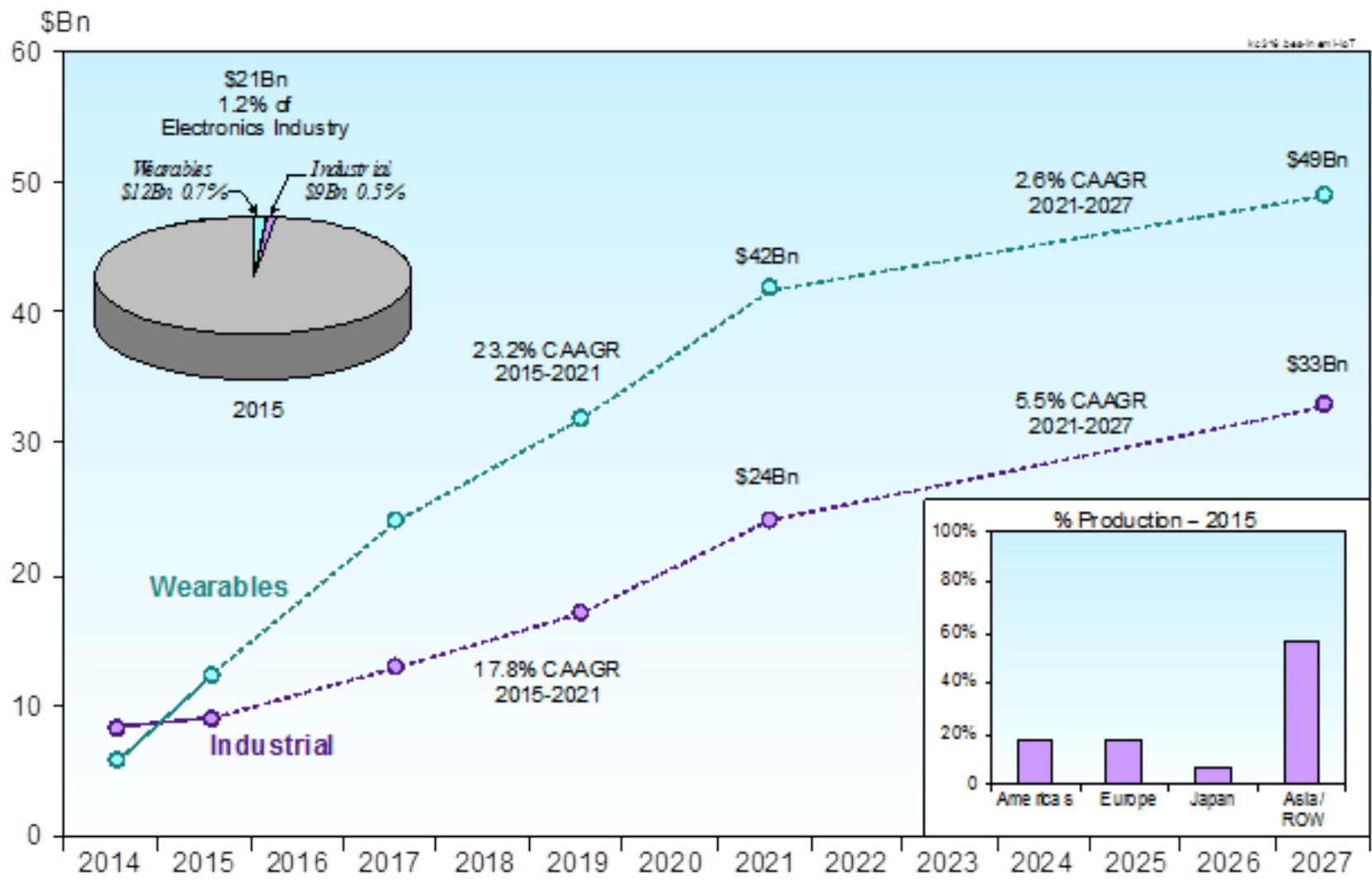


Source: 2017 iNEMI Roadmap

IoT Application Domains

- Two principal market segments of interest are **wearables** and **industrial**
- **The wearables market is one of the most visible segments of the IoT market:**
 - Devices that are worn directly on the body
 - The total world population is expected to grow to 7.6Bn by 2019
 - 7.6Bn bodies times many locations per body calculates to a very large market opportunity
- **Industrial is pervasive**
 - Smart cities (smart grid/infrastructure, transportation, etc.)
 - Commercial (building management, industrial control, supply logistics, etc)
 - Heavy industry (trains & boats & planes etc.)

INTERNET OF THINGS ELECTRONICS MARKET FORECAST (Prismark Partners LLC)



IoT Wearables

➤ **Smartbands**

- Focused on activity tracking, identification (access, payment) and gesture control functions

➤ **Smartwatches**

- Larger market will be as accessories for smartphones
- Have an important role in tracking children and disabled adults

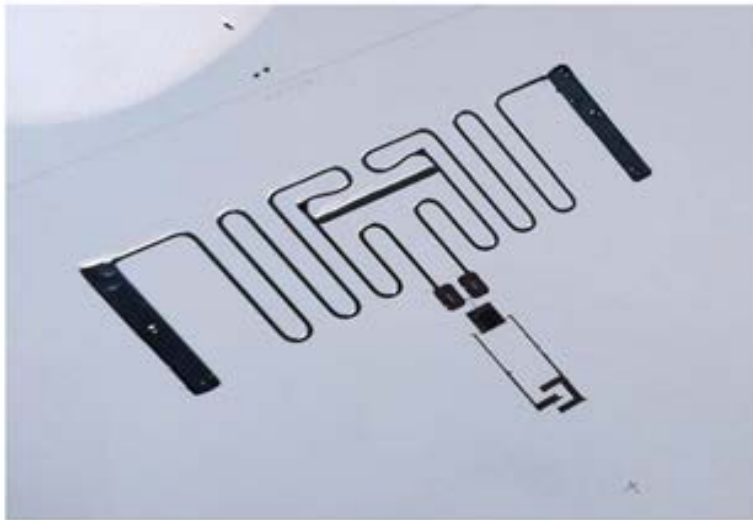
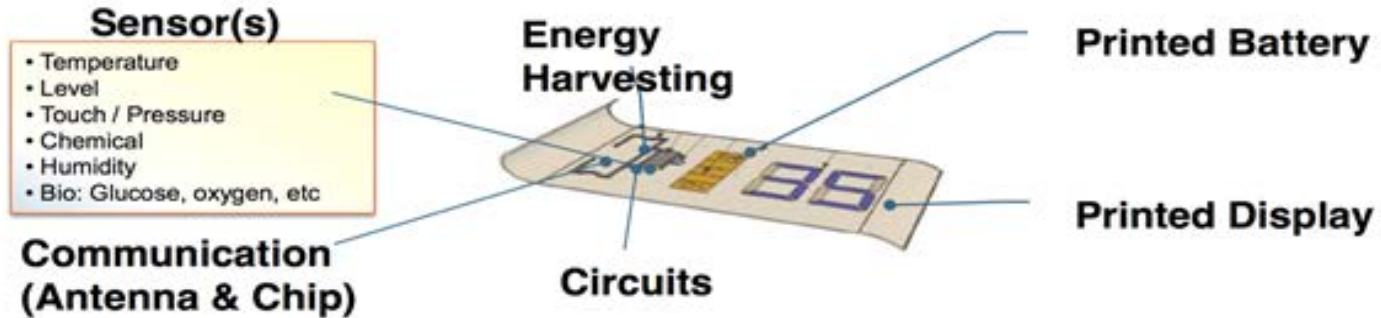
➤ **Smart glasses**

- Devices enabling virtual or augmented reality
- Industrial/occupational applications
- Bulk of the market will be driven by entertainment – gaming

➤ **Wearables have relatively short lifecycle**

bolstering the market through repeat purchases

Wearables Technology Example



Commercial/Industrial Connected Devices

- **Companies use connected devices for**
 - Energy management systems including lighting and HVAC control
 - Industrial control systems
 - Supply logistics
 - Safety
 - Quality control
- **Efficiency**
 - Supply logistics
 - Improved manufacturing control systems
- **Innovation**
 - Beacons - can be used for proximity sensing - a shoe store may alert a smartphone user when the user passes by

Critical Gaps

Many gaps to address including:

➤ **Confidence/assurance**

- Security, reliability, safety, privacy ...

➤ **Interoperability between IoT components**

- Particularly across domains (ex. Wearable-automotive, consumer-smart grid, etc.)

➤ **Synchronization across components**

➤ **Supporting standards far behind applications**

➤ **Technology challenges**

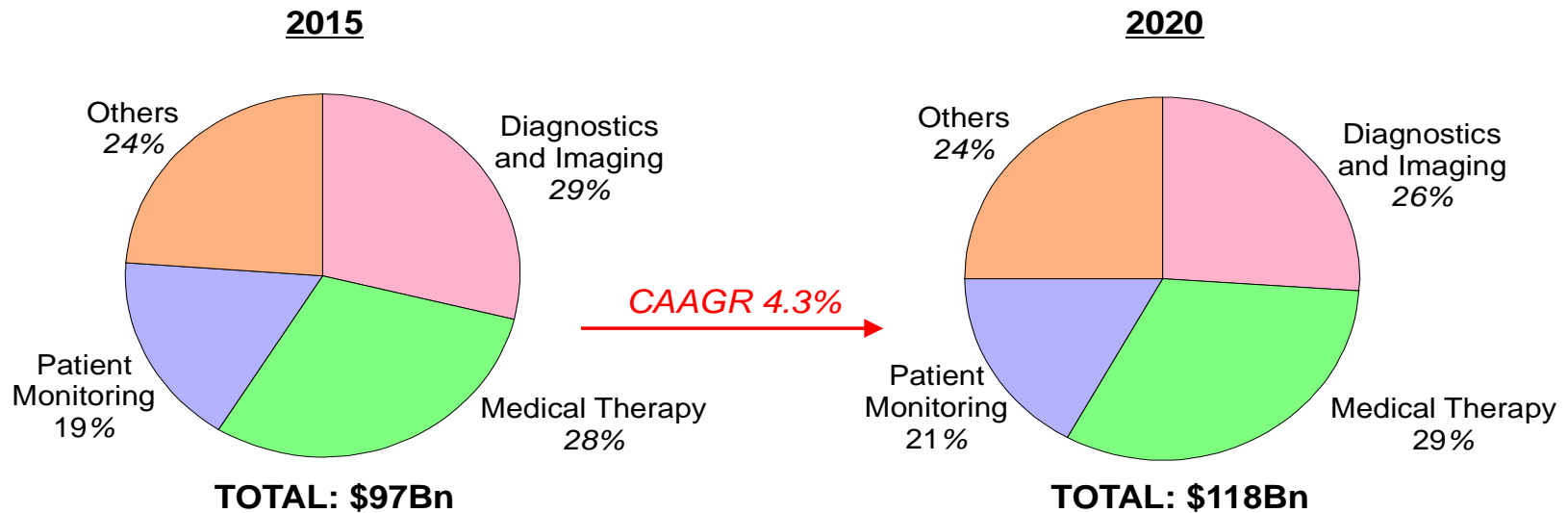
- Flexible electronics
- Battery technology
- Low power high performance processing

Medical Chapter Highlights

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MEDICAL ELECTRONICS MARKET- 2016 Prismark Update



Diagnostics and Imaging

Diagnostic instruments that provide high resolution pictures of structures inside the body.

Example: MRI, X-ray, ultrasound

Medical Therapy

Equipment used in the treatment of specific medical conditions

Example: defibrillator, hearing aid

Patient Monitoring

Instruments used to measure and monitor a patients' vital signs and other functions.

Example: blood glucose, ECG

Others

All other electronics used for medical applications

Example: surgical tools, test & analytical, medical IT, biochips, RFID

N316.169bes-med summary



Areas of Focus for 2017 Chapter

➤ New for 2017:

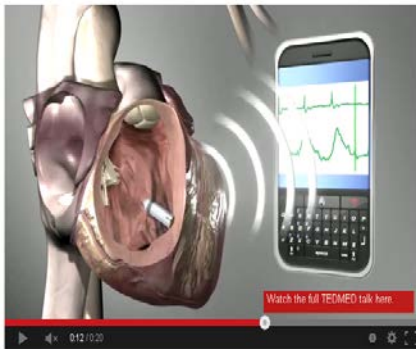
- Addition of stretchable substrates

➤ Business Issues:

- Increased globalization- Rise of Asia
- RoHS impact on Class III supply chains ->Mixed Assembly challenges
- Refreshed market forecasts

➤ Technical Issues:

- Miniaturization- 3D packaging, Wired/Wireless connectivity
- Alternative discrete technologies (e.g. Capacitors)
- Flexible/wearable medical applications



Roadmap Executive Summary

Market:

- Medical electronics demand increasing due to worldwide demographic and lifestyle changes.
- The market is forecast to exceed 100B\$ in the forecast timeframe.

Technology front – Tactical:

- Introduction of stretchable electronics substrates is a paradigm shift in the business.

Technology front – Strategic:

- Materials for electrodes used in Neurostimulation devices is a major need, with demonstrations of electrode arrays on flexible/expandable substrates.
- Research efforts in Nanomaterials or systems that can be configured for diagnostic or therapy purposes is expected to potentially be game-changing.
- In the implant product arena, opportunities for miniaturization exist with more research into methods by which electronic modules can be made fully biocompatible while reducing the volume overhead associated with large interconnect blocks to a can.

iNEMI Collaborative Projects

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iNEMI Projects - Quick Facts

- **iNEMI organizes and facilitates projects**
- **Members define and execute projects**
- **Projects are aligned with member interest and roadmap identified needs**
- **15+ ongoing projects; 8+ members participating per project**
- **Projects typically last 12-18 months**
- **Currently running projects in following areas:**

- **Packaging & Component Substrates**
- **Test, Inspection & Measurement**
- **Environmentally Sustainable Electronics**
- **Optoelectronics**

- **Board Assembly**
- **Interconnect PCB - Organic**
- **Connectors**
- **MEMS/Sensors**
- **Medical**
- **Automotive**
- **Power conversion**

10 Active Initiatives May 2017

Initiative Project Name	iNEMI PM	TIG	Initiative - Start Date
Approaches to Minimize PCB Warpage to Improve SMT Assembly Yield	Haley Fu	Board Assembly	3/15/2017
Ultra low loss laminate/PCB phase 2	TBD	Board Assembly	
Value Recovery from Use Electronics Phase 2 (Fast Turn Project)	Mark Schaffer	ECE	5/13/2017
Eco-Design Best Practices	Mark Schaffer	ECE	4/7/2017
Warpage Characteristics of Organic Packages Phase 4	Haley Fu	Packaging	4/4/2017
Wafer and Panel Level Package: Warpage and Flowability	Haley Fu	Packaging	5/4/2017
Solder Joint Fracture as a Function of Warpage	Haley Fu	Packaging	4/1/2017
Methodology for Qualifying New Packaging Technology	Masahiro Tsuruya	Packaging	3/21/2017
Wafer/Panel Level Package Fine Pitch Pattern Substrate Inspection/Metrology Project Phase 2	Masahiro Tsuruya	Packaging	3/7/2017
High Temperature, Pb-free Die Attach Material Phase 2	Masahiro Tsuruya	Packaging	4/6/2017

Approaches to minimize Printed Circuit Board (PCB) warpage in Board Assembly Process to improve SMT Yield

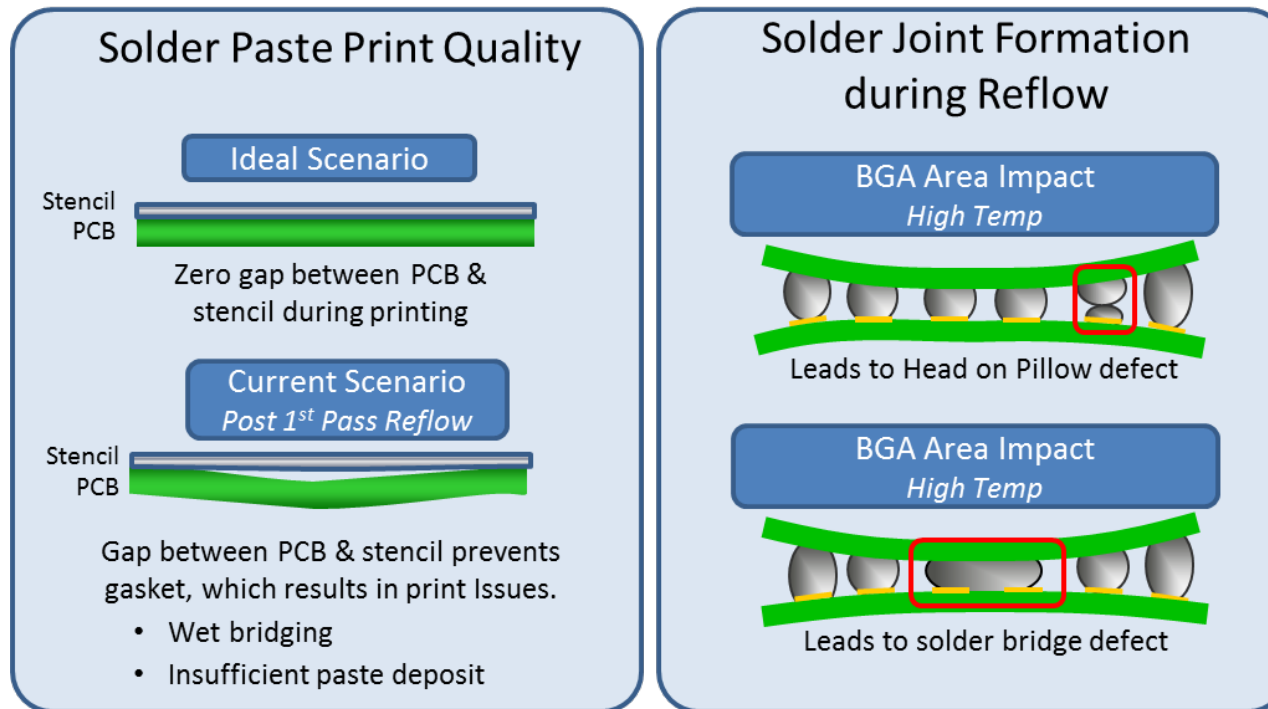
*Initiative Leaders: Srini
Aravamudhan & Chris Combs, Intel;
iNEMI Staff: Haley Fu*



Background

PCB with thickness $\leq 1.0\text{mm}$ are driving higher PCB warpage in board assembly process leading to lower assembly yields and higher rework for some components

- SMT yield depends on many factors including package warpage, PCB warpage, SMT materials, process, etc.



Uncontrolled PCB Warpage leads to Print and SMT defects

Challenges and Proposed Mitigation

Challenges

- PCB warpage at room temperature and elevated temperature impacts board assembly
- IPC-A-610E specification for incoming PCB warpage may not be sufficient to address PCB warpage at elevated assembly temperature
- Need to identify factors and guidelines to minimize PCB warpage during the SMT assembly process

Proposed Mitigation through Project

- Guidelines for PCB design on
 - Copper balancing across PCB layers within the board area
 - Panel and Board area copper balancing and infill
 - PCB location impact within panel during PCB fabrication
- Guidelines on Reflow pallet design
 - Design features & Pallet materials
- Other uncovered factors / solutions to minimize PCB warpage in SMT assembly process

Summary

- **iNEMI Roadmap is an essential tool for strategic decisions for businesses in the electronics sector; it looks over 10 years at technology requirements for all market sectors and technologies relevant PCB Fabricators, suppliers and users. Available to purchase : <http://www.inemi.org/inemi-roadmap>**
- **iNEMI Roadmap leads to a gap analysis to identify where research is needed and iNEMI Collaborative projects are directed to address some of these gaps**
- **iNEMI Membership provides free Roadmap and access to collaborative projects. Members can initiative projects supported by iNEMI staff.
<http://www.inemi.org/membership>**
- **iNEMI membership provides unique global networking opportunities and collaboration with key customers (at multiple levels) and key suppliers and access to iNEMI project reports and papers.**

Steve Payne
steve.payne@inemi.org
www.inemi.org

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