

Roadmapping for Advanced Packaging & Heterogenous Integration: iNEMI's Perspective



Francis Mullany, Director of Roadmapping

ASME InterPACK 2022
25 October 2022

iNEMI[®]
Advancing manufacturing technology

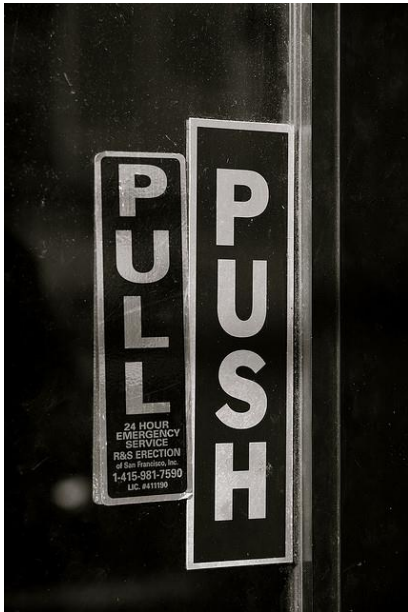
“Mind the Gap!”

Technology roadmapping
navigates the gap between
today’s technology capability &
tomorrow’s needs



Will McC, Wikipedia

Why Technology Roadmapping? It's Not About the Technology...



© Robert S. Donovan

- Create a consensus view of gaps and challenges.
- Guide ecosystem collaboration to unblock competitive markets
- Ensure that technology push addresses real societal pull.

Why Technology Roadmapping? A Historical View

Early 1990s saw the emergence of major technology roadmaps to guide US industry:

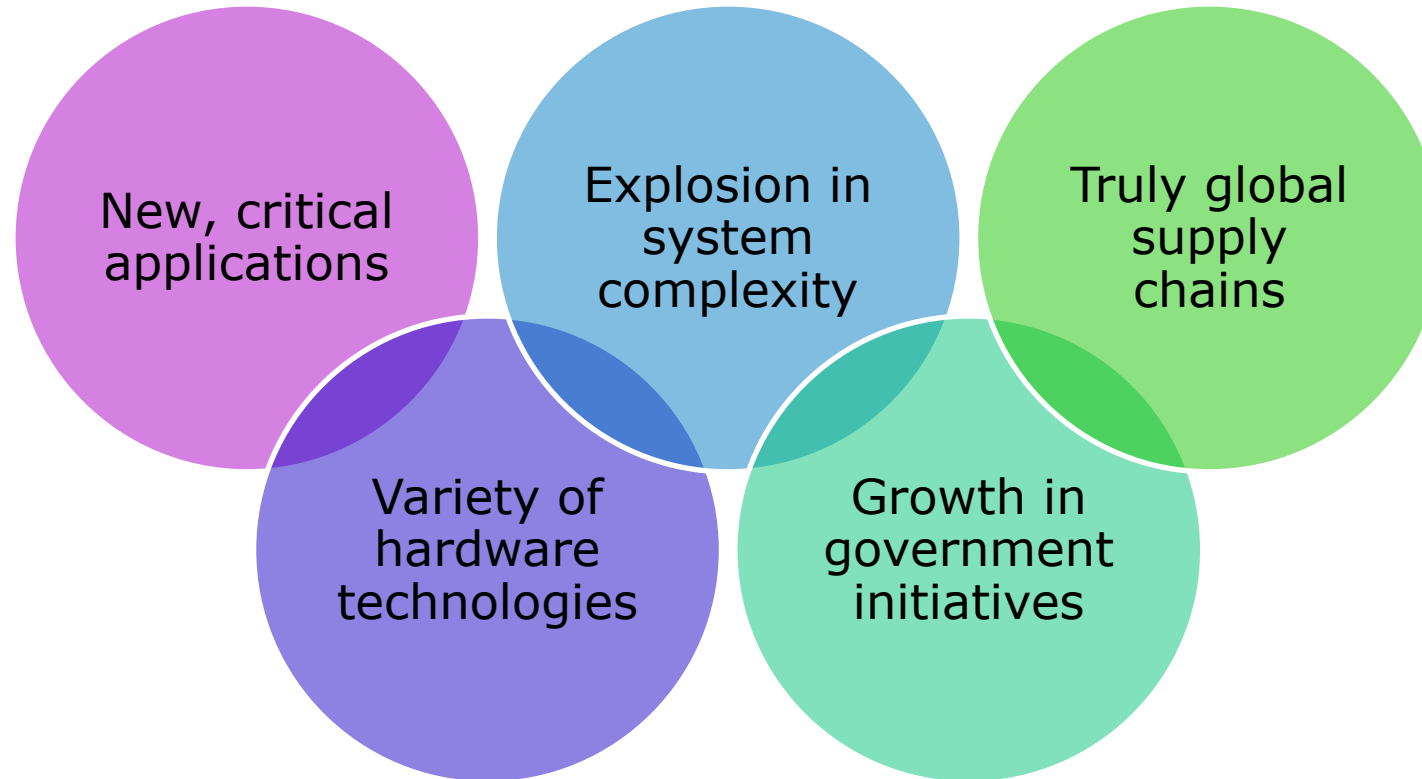
- NTRS – National Technology Roadmap for Semiconductors
- NEMI – National Electronics Manufacturing Initiative’s roadmap

1994 NTRS Roadmap prediction

| <i>Year of First DRAM Shipment</i> | <i>1995</i> | <i>1998</i> | <i>2001</i> | <i>2004</i> | <i>2007</i> | <i>2010</i> |
|---|--------------|--------------|--------------|--------------|---------------|---------------|
| <i>Minimum Feature Size (μm)</i> | <i>0.35</i> | <i>0.25</i> | <i>0.18</i> | <i>0.13</i> | <i>0.10</i> | <i>0.07</i> |
| <i>Memory</i> | | | | | | |
| <i>Bits/Chip (DRAM/Flash)</i> | <i>64M</i> | <i>256M</i> | <i>1G</i> | <i>4G</i> | <i>16G</i> | <i>64G</i> |
| <i>Cost/Bit @ volume (millicents)</i> | <i>0.017</i> | <i>0.007</i> | <i>0.003</i> | <i>0.001</i> | <i>0.0005</i> | <i>0.0002</i> |
| <i>Logic (High-Volume: Microprocessor)</i> | | | | | | |
| <i>Logic Transistors/cm² (packed)</i> | <i>4M</i> | <i>7M</i> | <i>13M</i> | <i>25M</i> | <i>50M</i> | <i>90M</i> |
| <i>Bits/cm² (cache SRAM)</i> | <i>2M</i> | <i>6M</i> | <i>20M</i> | <i>50M</i> | <i>100M</i> | <i>300M</i> |
| <i>Cost/Transistor @ volume (millicents)</i> | <i>1</i> | <i>0.5</i> | <i>0.2</i> | <i>0.1</i> | <i>0.05</i> | <i>0.02</i> |
| <i>Logic (Low-Volume: ASIC)</i> | | | | | | |
| <i>Transistors/cm² (auto layout)</i> | <i>2M</i> | <i>4M</i> | <i>7M</i> | <i>12M</i> | <i>25M</i> | <i>40M</i> |
| <i>Non-recurring engineering cost/transistor (millicents)</i> | <i>0.3</i> | <i>0.1</i> | <i>0.05</i> | <i>0.03</i> | <i>0.02</i> | <i>0.01</i> |

Figure 7. Overall Roadmap Technology Characteristics, Major Markets

Increasing Relevancy of Technology Roadmaps for Packaging



The iNEMI Roadmap: Seeing Both the Wood and the Trees

Vision for a shared future in electronics manufacturing



10-year time horizon

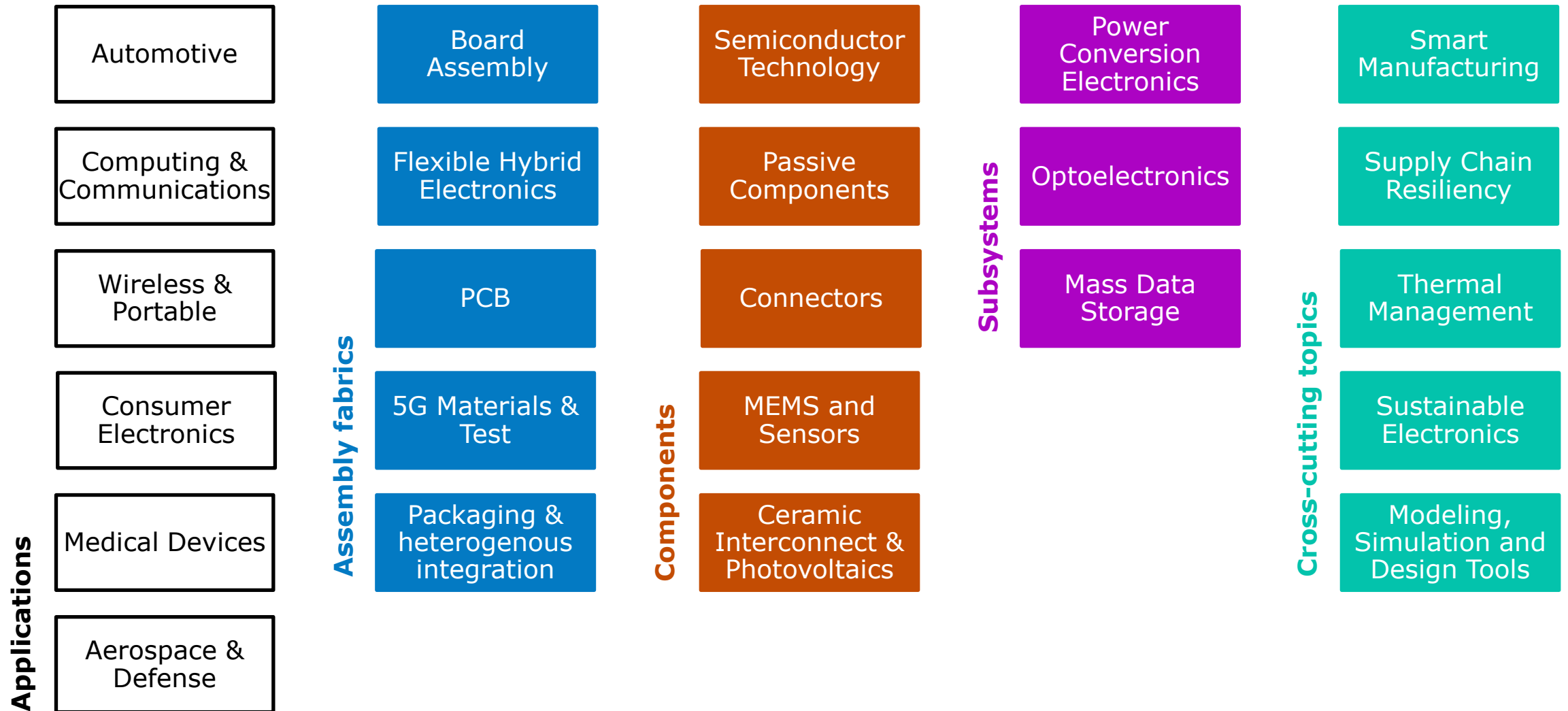


Full supply chain & lifecycle perspective

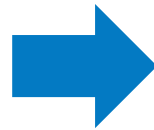


Focus on technical barriers to meeting real-world needs

iNEMI Roadmap: Technical Scope



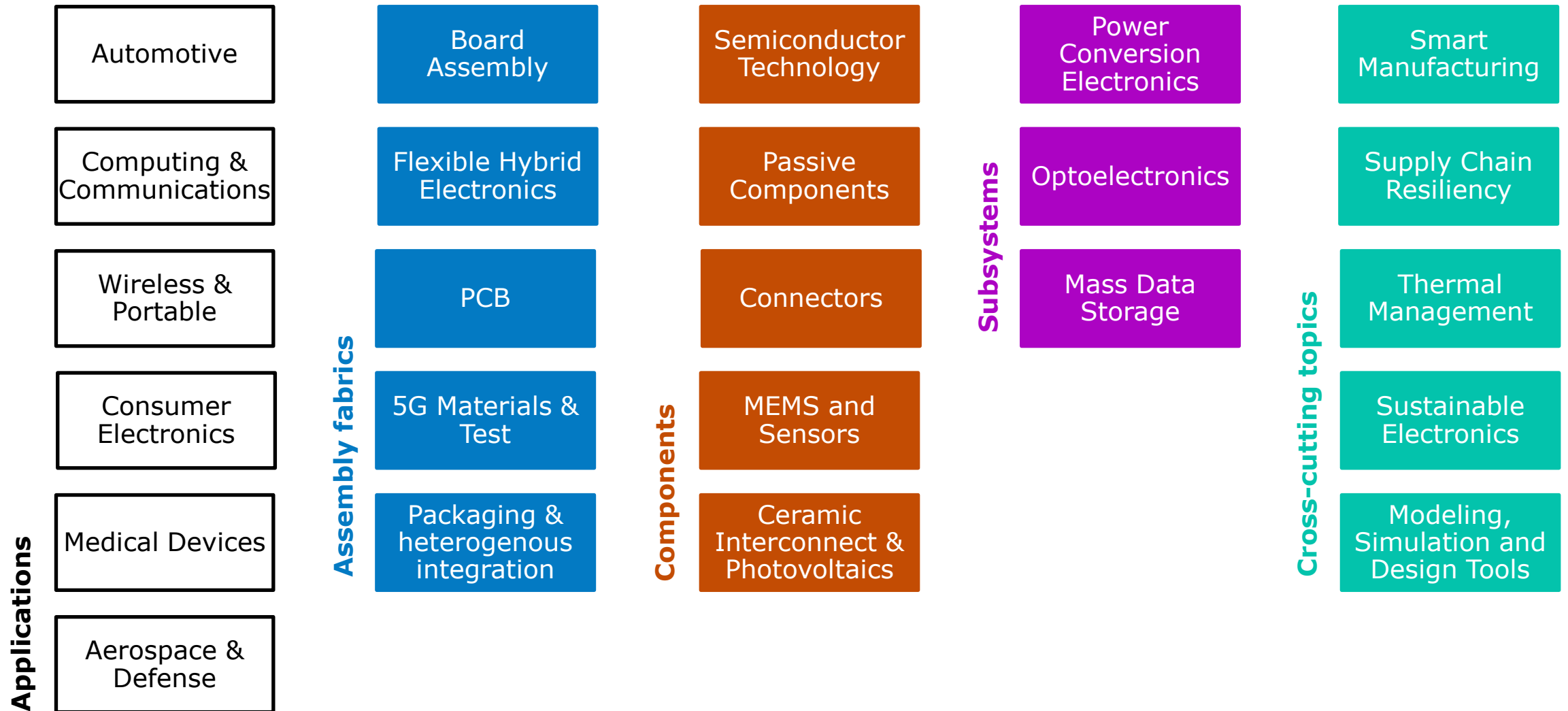
2022 iNEMI Roadmap Refresh: A New Approach to Roadmapping



A screenshot of the Wikipedia article for Jupiter. The article title is 'Jupiter' and it includes a sub-header 'From Wikipedia, the free encyclopedia'. The main text describes Jupiter as the fifth planet from the Sun and the largest in the Solar System. It mentions that Jupiter is a gas giant with a mass one-thousandth that of the Sun, but two and a half times that of all the other planets in the Solar System combined. The article also notes that Jupiter is the third-brightest natural object in the Earth's night sky after the Moon and Venus. A large image of Jupiter is shown on the right side of the page, with a caption: 'Full disk view in natural color, taken by the Hubble Space Telescope in April 2014'. Below the image, there are sections for 'Designations', 'Pronunciation', 'Named after', 'Adjectives', and 'Orbital characteristics'. The page also features a sidebar with navigation links like 'Main page', 'Contents', 'Current events', and 'Tools'.

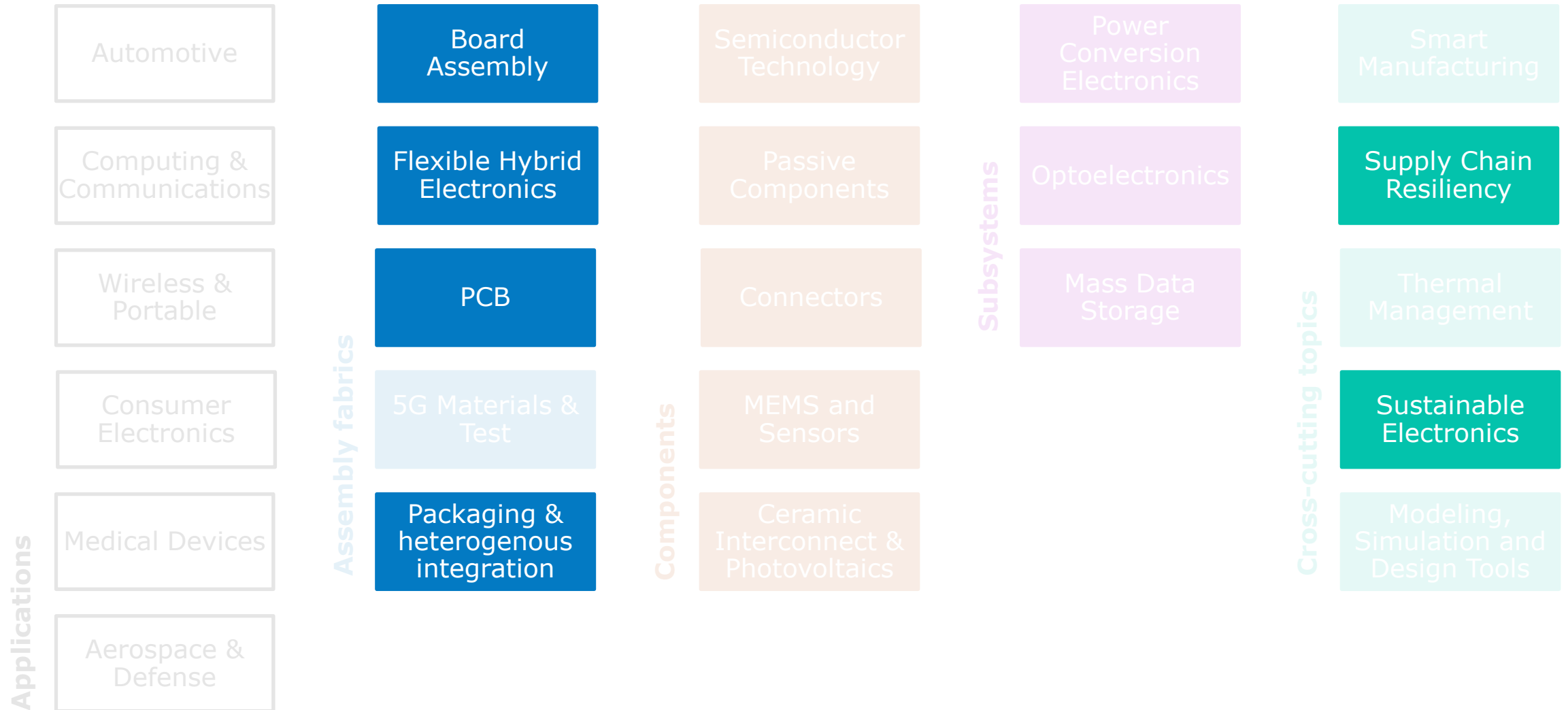
Vision: Influence technology investment decisions by moving to shorter, on-line documentation, updated in real time by a diverse community of experts

iNEMI Roadmap: Technical Scope



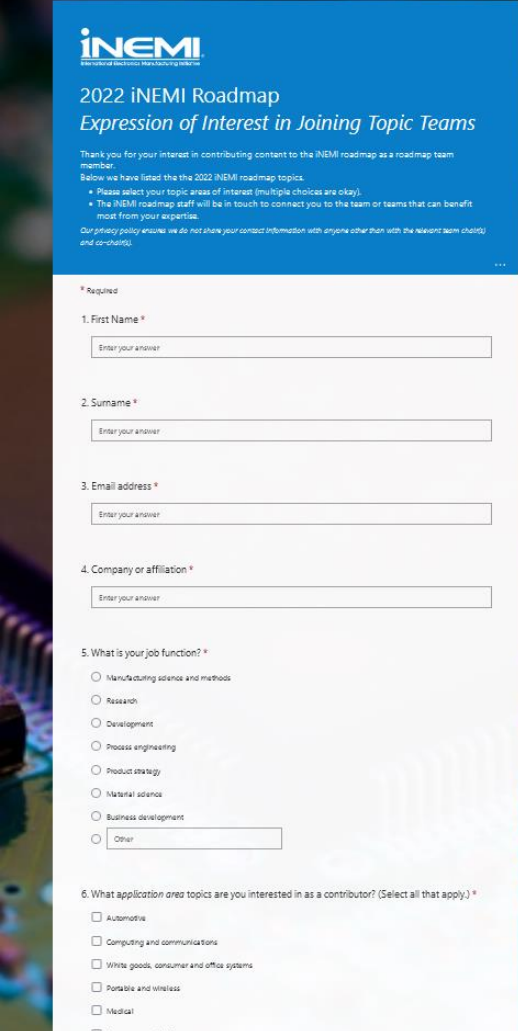
iNEMI Roadmap: Schedule

Priority topics – available 1Q23



How To Get Involved In The iNEMI Roadmap

Please fill out a short expression-of-interest form at <https://forms.office.com/r/4mt747vhUD>



The screenshot shows a web form titled "2022 iNEMI Roadmap Expression of Interest in Joining Topic Teams". The form includes the iNEMI logo and a thank-you message. It contains several required fields: First Name, Surname, Email address, and Company or affiliation. There is also a section for job function with radio button options: Manufacturing science and methods, Research, Development, Process engineering, Product strategy, Material science, Business development, and Other. The final section asks for application area topics of interest with checkboxes for Automotive, Computing and communications, White goods, consumer and office systems, Portable and wireless, Medical, and Aeronautics and defence.

iNEMI
International Electronics Manufacturing Institute

2022 iNEMI Roadmap

Expression of Interest in Joining Topic Teams

Thank you for your interest in contributing content to the iNEMI roadmap as a roadmap team member.
Below we have listed the the 2022 iNEMI roadmap topics.

- Please select your topic areas of interest (multiple choices are okay).
- The iNEMI roadmap staff will be in touch to connect you to the team or teams that can benefit most from your expertise.

Our privacy policy ensures we do not share your contact information with anyone other than with the relevant team (subject and scope).

* Required

1. First Name *

2. Surname *

3. Email address *

4. Company or affiliation *

5. What is your job function? *

Manufacturing science and methods

Research

Development

Process engineering

Product strategy

Material science

Business development

Other

6. What application area topics are you interested in as a contributor? (Select all that apply) *

Automotive

Computing and communications

White goods, consumer and office systems

Portable and wireless

Medical

Aeronautics and defence

Value of the iNEMI Roadmap

