Product Emulator Group Chair Role & Responsibilities
iNEMI Roadmap

Summary

The objective of the iNEMI product emulator groups (PEGs) is to update iNEMI roadmap key attributes for product emulators; identify gaps with product needs and available technology, and revise the latest trend and business information for the emulator to guide the iNEMI technology working groups.

There are several benefits for those serving as PEG Chairs, such as:

- An early look at the results of the 2019 Roadmap as it is being finalized.
- A free copy of the entire iNEMI 2019 Roadmap ($3500.00 value)
- Experience leading an international group of contributors that also builds a network of valuable contacts.
- The opportunity to help drive the industry over the 10-year horizon of the iNEMI Roadmap and insure your company's needs are represented.

Timeframe: PEG roadmap development cycle is October 2017–May 2018

Primary PEG Chair and Co-Chair Roles:
- Lead working group teams of subject matter experts during team calls
- Present team updates during Roadmap workshops and webinars
- Interface directly with Roadmap manager
- Serve as team editor to collect content for the PEG report
- Serve as consultant for PEG information and content for the Roadmap Executive Summary

Chair and Co-Chair Tasks	Time Commitment

• Produce the PEG roadmap chapter:
  o Review and revise Key Attributes for the PEG
  o Gather data that represents the class of products for the PEG
  o Provide tables of information on representative metrics
  o Identify technology gaps between product needs and technology evolution
  o Engage or delegate a PEG-member(s) to engage with other related-topic PEG or TWG teams as needed for roadmap content consistency
	2-3 hours per month

• Attend face-to-face (F2F) workshops	2-3 times/year, 2-day duration
• Attend virtual PEG progress check workshops	2-3 times/year, ½ day duration
• Lead monthly team teleconferences*	1-2 hours
• Edit final PEG report*	16-24 hours over one-month

*Time commitment during the chapter writing and editing phase will be higher

PEG Team Deliverables:
- Key attribute spreadsheet update
- PEG presentation materials of roadmap revisions for workshops and progress check webinars
- PEG final report.
    - Interim due May 22, 2018 for TWG input
    - Final due September 24, 2018

PEG Team Meeting Calendar:

Q4'17	Q1'18	Q2'18	Q3'18
• Date: Oct. 19, 2017 • Event: PEG/TC Emulator development meeting (emulator trends presentation for iNEMI Technical Committee) • Location: WebEx	• Date: Feb. 25-26, 2018 • Event: Roadmap TWG kick-off meeting/ PEG workshop • Meeting type: Face-to-face, with WebEx • Location APEX, San Diego, CA (Updated emulator presentation for TWG Chairs)	• Date: April TBD, 2018 • Event: PEG Chapter Technical Committee (TC) review • Location WebEx	• Date: August TBD, 2018 • Event: PEG Chapter Technical Committee review meeting • Location: TBD

PEG Chair Roles and Responsibilities Description

The iNEMI Roadmaps encompass more than just a projection of the evolution of manufacturing technology. Large end user companies provide an outlook on what their technology *Product Needs* are going to be over the time frame of the roadmap. This is accomplished by providing information on *Product Emulators* to the Technology Working Groups. These product emulators are not specific products but are representative of the technology needs of a class of products. iNEMI has defined seven emulator product classes: Portable/Wireless Products; Consumer/Office Systems; Automotive; Defense/Aerospace Products; Medical Products; IoT/Wearables and High-End Computing, Storage (Network, Datacom, Telecom Products).

The Product Emulator Group Chair is expected to gather data that represents the class of products to which he is assigned. The data should indicate the manufacturing technology and infrastructure needs of this class of products over the time frame of the Roadmap. This requires specialized knowledge on the product expectations, new product features that will be needed (related to technology rather than product function), market volumes (e.g. to analyze degree of automated tooling), and other manufacturing issues. The emulator chair will be asked to provide tables of information on representative metrics; for example, technology performance requirements, packaging sizes and volumes, normalized costs and anything else that his emulator will need or be dependent on in the 21 areas that are roadmapped.

The Product Emulators are key to the whole iNEMI Roadmapping exercise. The emulators help the TWG chairs to reflect real life needs against the evolution of technology. When this is done, we usually find mismatches or Gaps between product needs and the normal evolution of technology. These Gaps are where iNEMI projects are focused. In some cases, GAPs require inventions to resolve and become guides to University Research or Government funding. By focusing resources on the industry Gaps, the Global Supply chain is able to more rapidly close these gaps and move manufacturing competitiveness forward.

Ideally, representatives from several companies will pool their generic knowledge on emulators assigned. That way, an overall industry view is provided to the TWG chairs. If concern over sharing confidential information arises, the iNEMI staff can arrange for the data to be collected and pooled in a "blind study" where individual company information is not disclosed. Starting in 2011, we also asked knowledgeable

TWG participants to help populate the data tables in Q411 in partnership with the PEGs. We found in 2009 that they had better access to detailed knowledge in some areas than the PEGs. The PEGs are still relied upon as the primary group to provide the trend and business information for the emulators. Interactions with other related PEGS or TWGs throughout the process is encouraged, too, with the Chair/Co-chair serving as a primary point of contact with these engagements.

iNEMI contracts with a market forecast company to provide key market growth statistics and text around each of the 7 product sectors so that third party data can be shared from a number of sources and included in each of the PEG Chapters.

The typical product emulator group chair has a broad background that encompasses both technology development as well as product development. Ideal candidates are those that perform integration functions between product development groups and manufacturing technology or operations functions (both internal and external to the company).

Much of the work is done within the individual's normal work environment and "virtual" meetings. Two to three meetings are required over the nine-month roadmap development cycle for Product Emulator Chairs. In 2017/18, those meetings are expected to be as follows:

- PEG/TC Emulator development meeting – October 19, 2017– WebEx (emulator trends presentation for iNEMI Technical Committee)
- Roadmap TWG kick-off meeting/ PEG Workshop – Feb. 25-26, 2018 – Location APEX EXPO (Updated emulator presentation for TWG Chairs) Face-to-Face/WebEx
- PEG Chapter TC review – April TBD, 2018 – WebEx

   In addition to this time, effort will be required to conduct conference calls and edit the document/spreadsheet during the period from October through completion of chapter (preliminary chapter outline/spreadsheet is due by May 22, 2018). The final chapter is due September 24, 2018. While each group sets their own work patterns, the following is a reasonable estimate of time required:

PEG conference calls:
- 1-2 times per month for 1-2 hours.
- At end of cycle (last few weeks), times may be more frequent as chapter is assembled.

Effective PEG leaders will usually break up writing assignments and development of attributes to members of committee. Chair and Co-chair of committee can then focus on editing chapter and writing summary/conclusions.

Editing time estimate:
   - 16-24 hours over one-month period.

After chapter is submitted (working draft chapter/spreadsheet May 22, 2018), PEG Chairs/Co-chairs may be consulted from time to time as overall roadmap is integrated and overall executive summary is created. This is usually limited to a few phone calls and, potentially, small clarifications/additions to chapter.

Final chapter/spreadsheet is due September 24, 2018 for iNEMI Staff editing. Minor changes can be made by the PEG Chairs to their preliminary and working draft work between February and September while TWGs are using them to develop their chapters.

An example of a partial Medical Products Emulator (from the 2004 Roadmap) is attached as an illustration of the types of attributes that are forecasted.

Table 1. Key Parameters for Medical Product Sector

Parameter	Metric	2003	2005	2007	2009	2015
PWB Costs (FR4)						
2 layer flexible	$ per cm2					
4 layer flexible	$ per cm2					
4 layer conventional	$ per cm2	0.013	0.013			
6 layer conventional	$ per cm2	0.018	0.018			
12 layer conventional (Aramid) with buried and m-vias	$ per cm2	0.14	0.13			
14 layer, no blind/buried	$ per cm2	0.45	0.43			
28 layer, blind & buried vias	$ per cm2	1.17	1.1			
Assembly Costs						
Board Assembly Cost	¢ per I/O	0.28	0.25			
Final Product Assembly Cost	$/unit	12	10			
Package Costs						
Business Costs						
PLIM cost to add EMS	$	200,000	100,000	50,000	50,000	25,000
B2Bi Gateway cost	$	25,000	10,000	8,000	5,000	5,000
Cycle Time						
Time to add EMS	Weeks	12	8	6	6	4
NPI Cycle Time	Weeks	16	14	12	10	6
Reliability						
Temperature Range	Deg C - Deg C	"-40 to 85	"-40 to 85	"-40 to 85	"-40 to 85	"-40 to 85
Number of Cycles	Cycles to Pass	2500	2500	2500	2500	2500
Vibrational Environment (PWB level)	G²/Hz					
Use Shock Environment	Gs & ms to Pass	50G/various	50G/various	50G/various	50G/various	50G/various
Altitude	Feet					
Devices						
DRAM ½ Pitch (nm)	nm	90	65	45	30	10
MPU/ASIC ½ Pitch (nm)	nm	90	65	45	30	10
MPU Printed Gate Length (nm)	nm	180	130	90	60	20
MPU Physical Gate Length (nm)	nm	190	140	95	65	32
Number of stack die Max	#					
Number of Die in SiP max	#					
Passive Components						
Passive Devices:	Type/Size	0201 case	0201 case	0201 case	0201 case	0201 case
Embedded Passives	# per sq. cm	NA	NA	NA	NA	NA
Max. Ohms	ohms / sq.					
Max. Capacitance	µF / sq.					

Parameter	Metric	2003	2005	2007	2009	2015
Min. % tolerance	%	5%	5%	5%	5%	5%
RF Components						
Quality Factor	Q	20	125	400	1000	5000
Capacitance density	nF/sq. cm	0.3	1	10	100	500
Inductance req.	nH					
Insertion loss maximum	db/in/Ghz					
Display						
Resolution	Type	1600X1200	1800x1600	1800x1600	2000x1800	2400x2000
Technology	Type	LCD	LCD	LCD	LCD	LCD
Color	Type	UXGA	VXGA	VXGA	VXGA	VXGA
Cost	$ per unit	180	200			
Average Display Size	sq. mm	17	19			
Memory						
Main Memory Type	Type					
Main Memory Size	MB	256	512	1024	1024	2048
Storage Memory Type	Type	ATA	SATA	SATA	SATA	SATA
Storage Memory Size	MB	80,000	120,000	240000	360000	5120000
Components/ Package						
Max Component I/O density	I/O/sq.cm	240	400	630	630	630
Average Component I/O density	I/O/sq.cm	14	16	18	20	20
Average Component Density	#/sq.cm	2.1	2.4	2.8	2.8	2.8
Maximum I/O per package	I/O per part					
Average I/O per package	I/O per part					
Max Components/sq. cm.	#/sq.cm					
Max I/O for 50 mm square SCM w/ full area array	#					
Max I/O for 100 mm square MCM w/ full area array	#					
Interconnects						
Memory	Type	DIMM	DIMM	2 Pc	2 Pc	2 Pc
Printed Circuit	Type	Card Edge	CardEdge	CardEdge	BGA-Mez	BGA-Mez
IO	Type	Circ	Circ	Circ	Circ	Circ
IC Card	Type	PCMCIA	PCMCIA	PCMCIA	PCMCIA	PCMCIA
Connector Minimum Mated Ht. (Board-Board)	mm					
Minimum Connector Pin Pitch	mm					
Electrical						
Frequency on Board	MHz	2000	3000-4000	5000-6000	8000-10K	12000
Impedance Tolerance	%	10	7	7	5	5
Number of Voltages	#	10	10	10	10	10
Power						