An Update on AIM Photonics
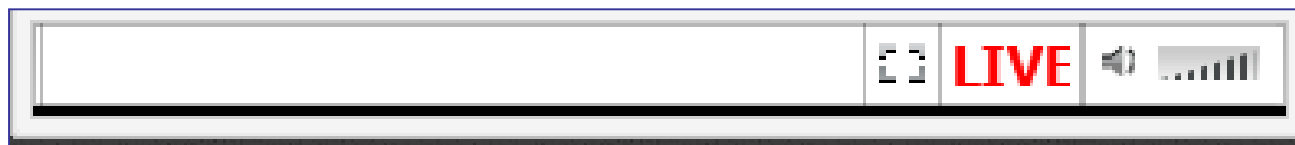## *November 17, 2015*

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An Update on AIM Photonics
November 17, 2015

Welcome

Dr. Alan Willner

Chair

NPI Steering Committee
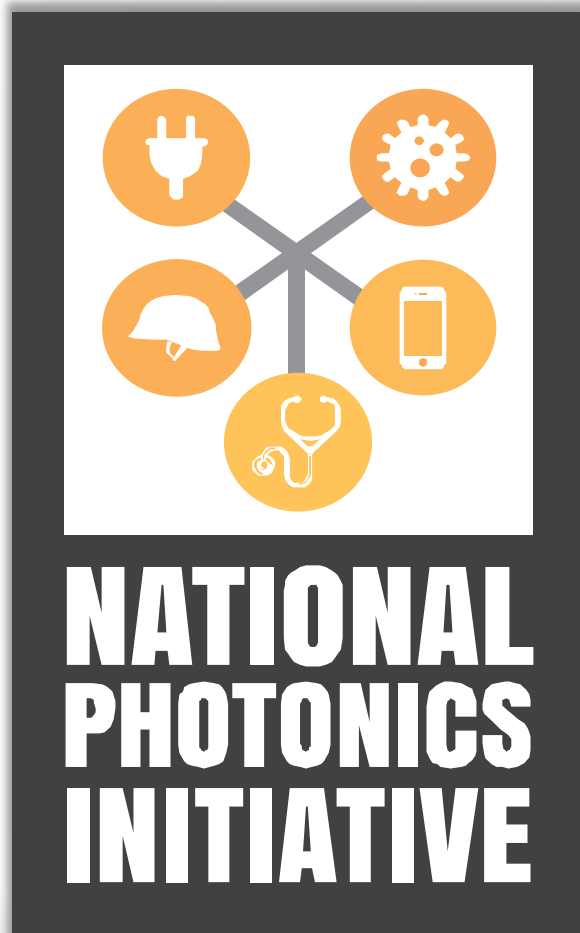
Agenda

NPI

Welcome & Introduction*: Dr. Alan Willner, chair, NPI Steering Committee*

AIM Photonics Update: *Dr. Thomas L. Koch, chair, Technical Review Board, AIM Photonics*

Closing Remarks*: Dr. Tom Baer, past chair, NPI Steering Committee*

Who We Are

NATIONAL PHOTONICS INITIATIVE

A collaborative alliance seeking to unite industry, academia and government to identify and advance areas of photonics critical to maintaining US competitiveness and national security.
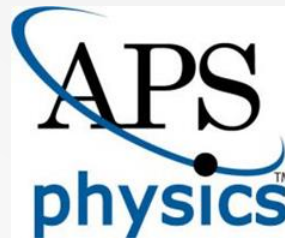
Partners

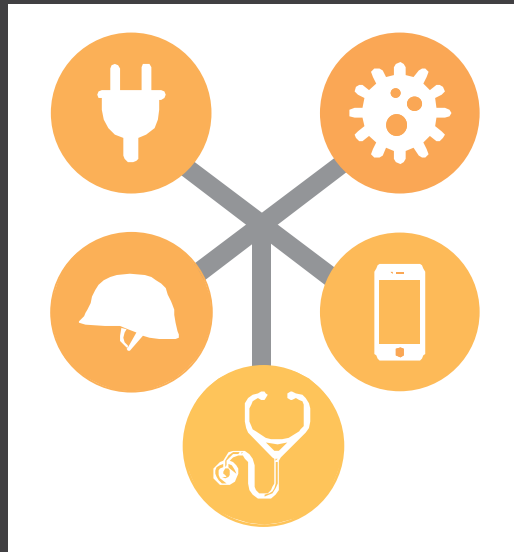**NPI**

Founding Sponsors:

Sponsors:

Collaborators & Supporters

National Photonics Initiative

NATIONAL PHOTONICS INITIATIVE

- Defense & Nat'l Security
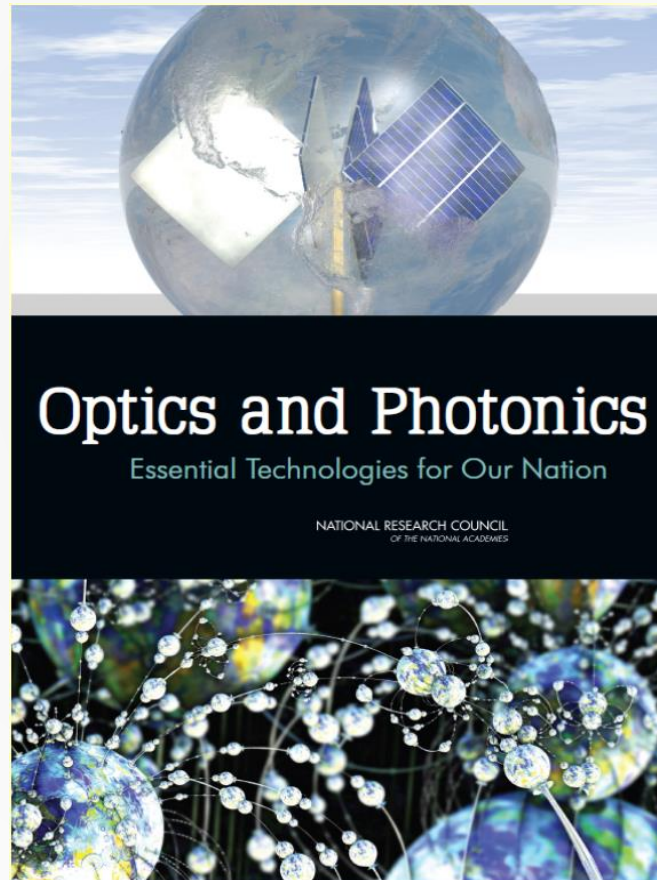- Energy
- Health Care & Medicine
- Communications & IT
- Manufacturing

National Research Council Report

NPI Advocacy Strategy

- Educate members of Congress
- Build champions
- Collaborate with the Administration
- Secure legislative language & funding

Educate Elected Officials & the Public In-District

Educate Elected Officials in Washington

NPI Greatest Successes: Congressional

NPI

- Secured optics and photonics report language in the National Defense Authorization Act (NDAA) for FY 2015

- Secured optics and photonics language in the Senate-introduced America COMPETES Reauthorization Act of 2014

- Supported optics and photonics language in the House-passed Reinvesting in American Manufacturing Innovation (RAMI) Act, which was included in the FY2015 omnibus bill

- Hosted numerous fly-ins, in-district visits and congressional meetings to demonstrate constituent support for NPI priorities in Congress and optics and photonics policy leadership: COMPETES, RAMI, NDAA, ITAR, Higher Education Act

NPI Greatest Successes: Administration

NPI

- **Advanced Manufacturing**: Mobilized and led photonics community to support and secure presidential endorsement for a DOD-led Integrated Photonics Institute for Manufacturing Innovation (IP-IMI).

- **Health Care and Medicine:** Created and launched the NPI Photonics Industry Neuroscience Group (PING) alongside White House and federal agency officials in support of BRAIN Initiative Grand Challenge; developed and published first-of-its-kind optics and photonics technology road map for White House and program managers across five agencies.

- **IT and Communications:** Secured seat at White House policymaking table to ensure optics and photonics are part of next generation High Performance Computing architectures.

NPI's Role in the IP-IMI Process

NPI

- Submitted a white paper to White House Office of Science and Technology Policy (OSTP) staff recommending a photonics prototyping and advanced manufacturing facility; opened the door to conversations between the NPI and DOD, and aided in the national push for a photonics IMI.

- Hosted webinars with DOD officials to educate the photonics community about the selection process.

- Coordinated responses to the FOA from dozens of experts, and matched industry with academia to submit proposals.

- Provided regular communication to the community as to relevant deadlines and information.

- Upon request, supplied a letter of support to include in proposal submissions.

- Engaged the media around the IP-IMI announcement.

AIM Photonics

The NPI is strongly committed to supporting the winning New York consortium through the platforms, programs and resources of the NPI's top scientific societies.

AIM Photonics Update

Dr. Thomas L. Koch, chair, Technical Review Board, AIM Photonics

AMERICAN INSTITUTE *for* MANUFACTURING INTEGRATED PHOTONICS

AIM *photonics*
AMERICAN INSTITUTE *for* MANUFACTURING INTEGRATED PHOTONICS

- 2012: National Academies Report:
  "Optics and Photonics: Essential Technologies for our Nation"

- 2013: Creation of National Photonics Initiative

- Outreach Events, Task Forces, White Papers ….

  - NPI Telecommunications Taskforce

  - NPI Sensors for Energy and Environment Taskforce

  - NPI Education and Workforce Development Taskforce

  - NPI Photonics Industry Neuroscience Group

  - NPI High-Powered Lasers Taskforce

Tom Baer, past NPI Steering Chair   **Alan Wiilner, current NPI Steering Chair**

- Focus on NNMI program, emerging interest in Photonic Integration

- June 2, 2014: NNMI RFI, Photonics one of six topics for down selection to two

- October 3, 2014: Integrated Photonics selected for IMI, >$220M

- November 5, 2014: FOA; Concept papers, down-select finalists for full proposals

US VICE PRESIDENT JOE BIDEN (CENTER) MEETS SUNY POLYTECHNIC INSTITUTE'S FOUNDING PRESIDENT AND CEO DR. ALAIN KALOYEROS (FAR LEFT) AND NEW YORK STATE GOVERNOR ANDREW CUOMO (RIGHT OF CENTER) DURING THE OFFICIAL ANNOUNCEMENT OF THE AIM PHOTONICS HUB IN ROCHESTER, NY, ON JULY 27, 2015.

- American Institute for Manufacturing Integrated Photonics (AIM Photonics)

- Sixth Institute in National Network of Manufacturing Innovation (NNMI) program.

- Largest institute to date, with $110M of federal funding and more than $500M of matching funding from state, industry, and academic partners

SUNY POLYTECHNIC INSTITUTE

- *Years of proven results in Si photonics*
- *300mm wafer tools provide unprecedented quality photonics*
- *Sematech partnerships drive continued investment to remain at state-of-the-art*
- *3D stacking w/CMOS*

SUNY Poly Albany NanoTech Complex – Albany, NY:

- 1.3 million Sq. Ft. facility with 300 and 450mm toolsets
- 135,000 Sq. Ft. of class 10K and better cleanroom
- Wet labs, metrology labs and 3D packaging
- 65nm low power CMOS base line; 7nm CMOS capable
- Leading edge lithography and dedicated eng. staff
- Multiple prior photonics DARPA projects

Institute Members

Government

Department of Defense
Department of the Army
Department of the Air Force
Department of the Navy

NSF   NIST

Department of Energy   NASA

New York State
California State
Massachusetts State

Industry

Tier 1

intel · United Technologies · GE · infinera · hp
ACACIA COMMUNICATIONS, INC. · IBM · GLOBAL FOUNDRIES · CISCO
LOCKHEED MARTIN · SYNOPSYS · cadence
Raytheon · Mentor Graphics

Tier 2

CORNING · aurrion · TE connectivity · IQE

Tier 3

4D · HARRIS · BOEING · Nistica · KEYSIGHT TECHNOLOGIES
NORTHROP GRUMMAN · samtec · AnalogPhotonics

Academic

Tier 1

SUNY POLYTECHNIC INSTITUTE · UCSB · MIT Massachusetts Institute of Technology · COLUMBIA UNIVERSITY
UCDAVIS · R·I·T · UNIVERSITY of ROCHESTER · THE UNIVERSITY OF ARIZONA

Tier 2

University of Delaware · Berkeley · UC San Diego
Caltech · BOSTON UNIVERSITY · University of Colorado
STANFORD UNIVERSITY · UNIVERSITY of VIRGINIA

Trade Associations

NEATEC · SPIE. · semi · OSA · Manufacturing Institute · OP-TEC

Committed Participants and Supporters

Photonics · Rockwell Collins · Adarza BioSystems · Honeywell · ficonTEC · RPC Photonics · Seagate · PROMEX INDUSTRIES · OPTIMAX · OPTIPRO · NEW YORK PHOTONICS
SYDOR OPTICS · JUNIPER NETWORKS · TEXAS INSTRUMENTS · NAVITAR · FREEDOM PHOTONICS · LaserMax · Micron · NEW SCALE TECHNOLOGIES Ingeniously small motion systems · Chiral Photonics

Manufacturing Institutes & AIM Photonics

AN AMERICA BUILT TO LAST

"Sparking this network of innovation across the country, it will…keep America leading in manufacturing..."
President Obama, March 9, 2012

NNMI

University Research

Commercial Investment

"Closing the Gap"

MRL   Manufacturing Readiness Level

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Mission

Create a national institute supporting the end-to-end integrated photonics manufacturing ecosystem in the U.S. by expanding upon a highly successful public-private partnership model with open-access to world-class shared-use resources and capabilities

Key Concepts for AIM Photonics:

- *Provide venue for US cooperative development of advanced manufacturing solutions*

- *Catalyze maturation and stratification of the integrated photonics ecosystem*

- *Provide world-leading photonic integration technology access/on-ramps to SME's, government, academic, and entrepreneurial communities*

Manufacturing Readiness Levels

MRL 1-3	**MRL 4**	**MRL 5**	**MRL 6**	**MRL 7**	**MRL 8**	**MRL 9**	**MRL 10**
Mfg Concepts Identified	Mfg Processes Identified Key Processes Identified Producibility assessment initiated	Mfg Processes Develop. Mfg equipment in relative environment Producibility assessment ongoing Cost drivers identified	Critical Mfg Processes Demo'd Mfg equipment in relevant environment Producibility assessment ongoing Cost drivers analyzed Long lead items identified	Prototype Mfg System Mfg processes in validation Producibility improvement underway Trade studies conducted Supply chain validated Long lead plans in place	Process Maturity Demo All materials ready for LRIP Mfg processes proven for LRIP Supply chain established	Mfg Processes Proven Overall Mfg Process Operates At target Quality, Cost and Lead times All key Processes Meet process Control Targets	Highest Production Readiness System in Production Or Meets Engineering Performance & Reliability Overall Mfg Process Operates At 6-Sigma Quality, and Meets Cost and Lead times Estimates

Primary Institute Focus MRL 4-7

A   B   C

Technology Push ✗   Market Pull ✓

This market is held back by a lack of common manufacturing technology platforms

market vehicles primarily used to drive manufacturing technology development

1. Industry sets the pace: exploring technology potentials, revolutionizing the data and sensing market

2. Scientific/defense market leverages industry pace: building on solid ground, adding uniquely required functionalities

	DataCom / Telecom	RF & Analog	Sensors	Phased Array
Industry	Internet / Datacenters	CATV / Cellular	Spectroscopy	LIDAR / 3D Displays
Increase ⬆	Capacity / Flexibility	Quality / Reliability	Sensitivity	Safety
Enable	Internet Scaling	Subcarrier Applications	Environmental / Proactive Healthcare	3D Augmented Reality
Decrease ⬇	Power / Cost	Cost	Healthcare Cost	Cost

Market

DataCom / Telecom: 2015 $138 M, 2020 $8.6 B, 2025 $108 B
RF & Analog: 2025 $57 B
Sensors: 2025 $5.1 B (value near $5.1 B shown)
Phased Array — values: $41.4 B and $4.5 B

	DataCom / Telecom	RF & Analog	Sensors	Phased Array
Scientific / Aero / Defense	Enterprise Networking / Supercomputing	Avionics / Signal Processing	Chemical / Bio Defense	Safety / Performance
Increase ⬆	Capacity / FLOPs	Bandwidth & Reliability	Safety & Health	Detection Accuracy
Enable	Reallocatable Bandwidth in Theater / Multiscale Modeling	Enhanced Capability	Warfighter	Augmented Reality
Decrease ⬇	Power / Cost	Weight / Cost / Power	Cost	Cost

AIM Photonics Leadership Council
Robert Duffy, Chair

CEO
Michael Liehr

Chief of Staff	Deputy CEO	Dir., Program Management
Ross Goodman	John Bowers	Amie Kaplin

CTO – Innovation
Michael Watts

- Technology Portfolio Manager

- Key Technology Manufacturing Areas (KTMA)
  - Datacom / Telecom
  - Analog RF Applications
  - PIC Sensors
  - PIC Array Technologies

COO – Operations
Douglas Coolbaugh

- Foundry Access Broker

- Chief Manufacturing Officer

- Manufacturing Innovation Centers of Excellence (MCE)
  - Electronic Photonic Design Automation (EPDA)
  - Multi Project Wafer and Assembly (MPWA)
  - Inline Control and Test (ICT)
  - Test, Assembly, and Optical Packaging (TAP)

Education and Workforce Exec. – Lionel Kimerling

- Knowledge, Technology and Work Force Interfaces
  - Integrated Photonics Roadmapping
  - MOOC Distribution on edX
  - Internships and Apprenticeships
  - Hands-on Training and Research
  - Employment Needs Assessment

Government and Industry Outreach Executives
Rod Alferness and Tino Treiber

- Initiate Growth and Sustainability
  - New Member & Customer Acquisition
  - Customer Satisfaction
  - Conference Organization

Technical Review Board Chair
Thomas Koch

- Coordinate Ind/Govt/Aca Technical Direction Across KTMAs and MCEs
  - Plan Inputs
  - TWG Coordination
  - New Projects
  - Project Sunset

Matrix Institute Business Operations – MCEs

Manufacturing innovation Centers of Excellent (MCEs)

Manufacturing Capability & Design Platform Roadmaps

TWG → PI &PM → **Electronic & Photonic Design Automation (EPDA)**

TWG → PI &PM → **MultiProject Wafer & Assembly (MPWA)**

TWG → PI &PM → **Inline Control & Test (ICT)**

TWG → PI &PM → **Test, Assembly & Packaging (TAP)**

Role of Manufacturing innovation Centers of Excellence (MCEs):

- *Function like manufacturing & design platforms in a corporation*

- *Drive stratification/maturation of photonic integration industry ecosystem*

- *Provide baseline capabilities in each manufacturing support area (i.e., for foundry services)*

- *Use Technical Working Groups (TWGs) comprised of institute partners for inputs & project proposals*

- *Select projects that maximize synergy across KTMAs and advance AIM Photonics manufacturing capacity*

- *Each MCE has industry, government, and academic co-leads*

Key Technology Manufacturing Areas (KTMAs)

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│         Product Feature/Market Roadmaps       │
└─────────────────────────────────────────────┘
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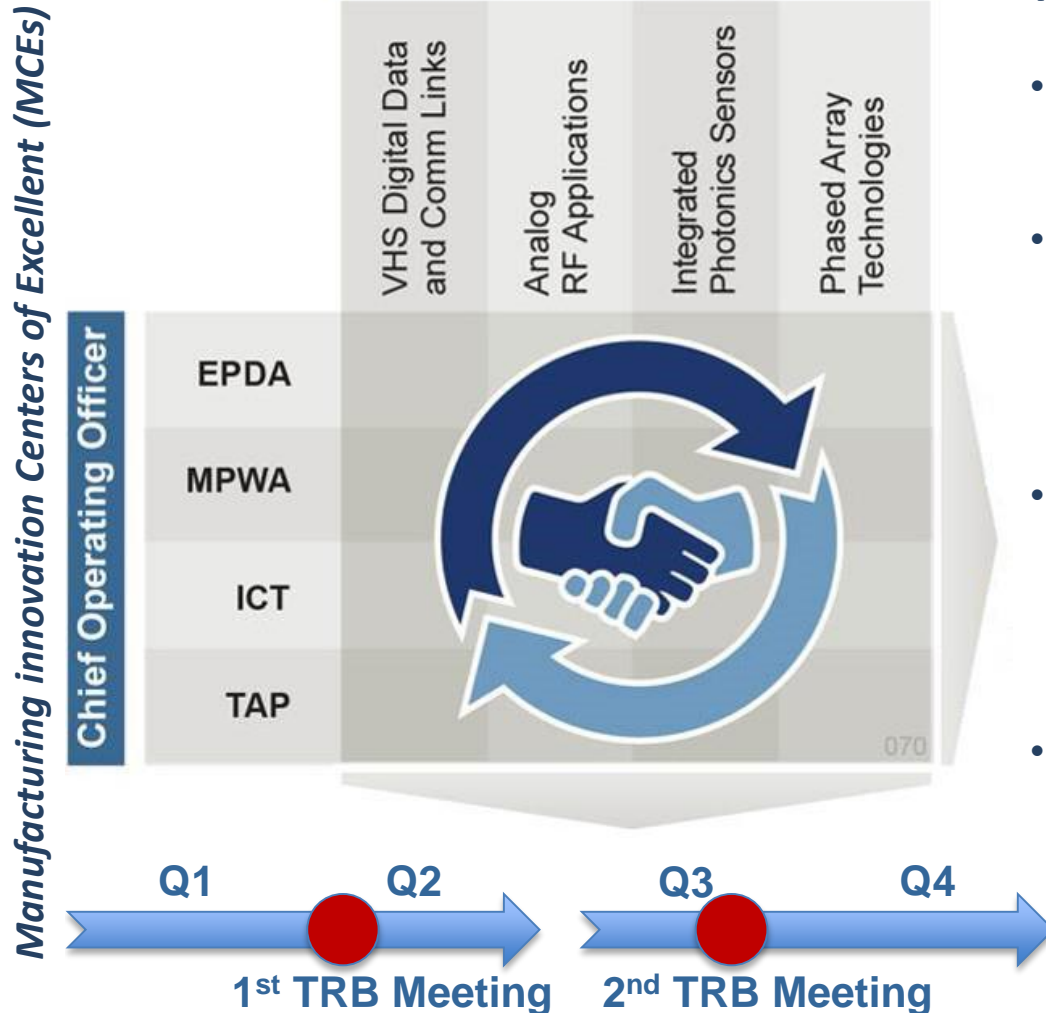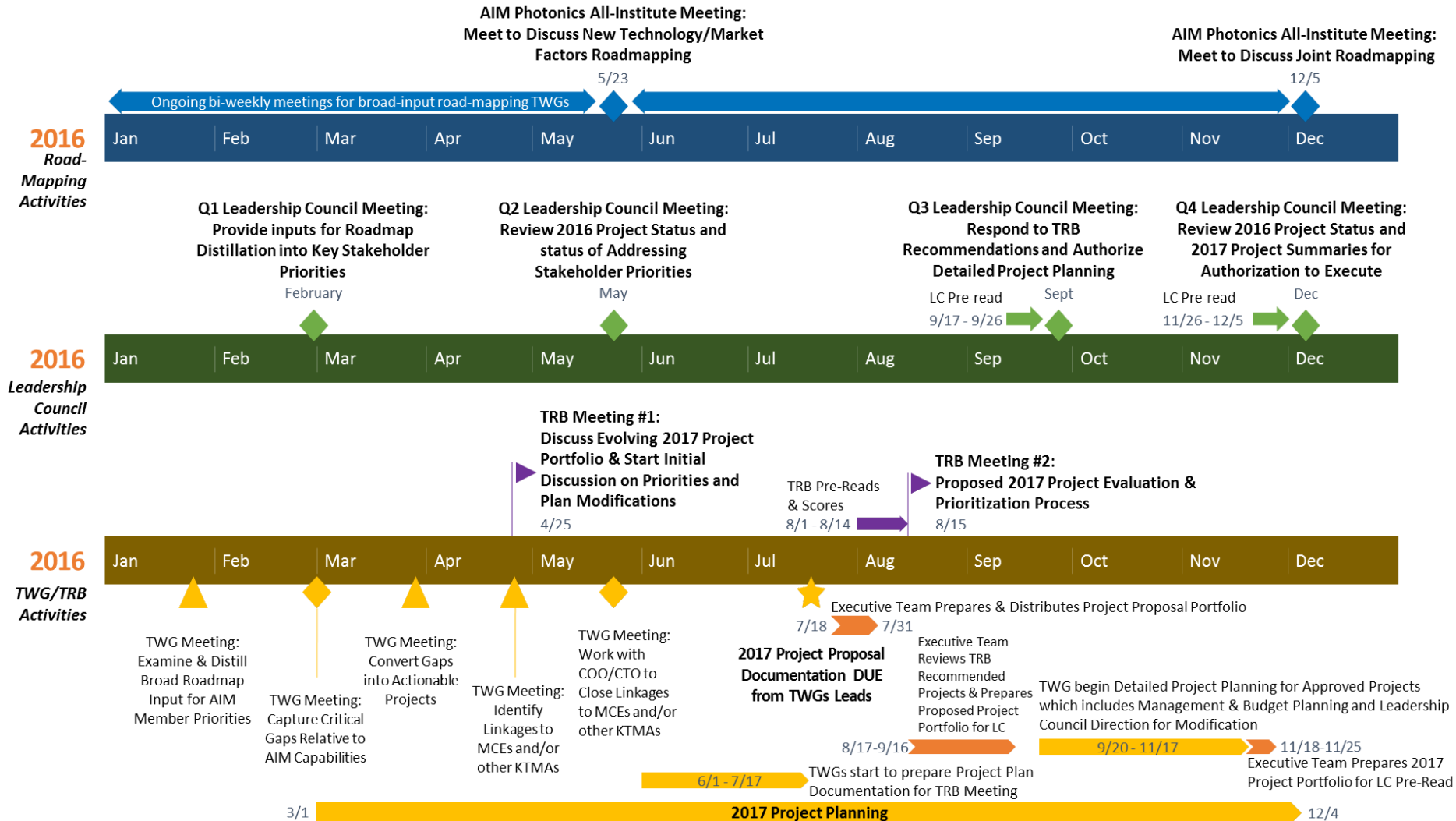
Role of KTMAs:

- *Function like "business units" in a corporation*
- *Bring photonic integration needs from different market application segments*
- *Use Technical Working Groups (TWGs) comprised of institute partners for inputs & project proposals*
- *Select projects that serve as drivers to advance AIM Photonics manufacturing capability*
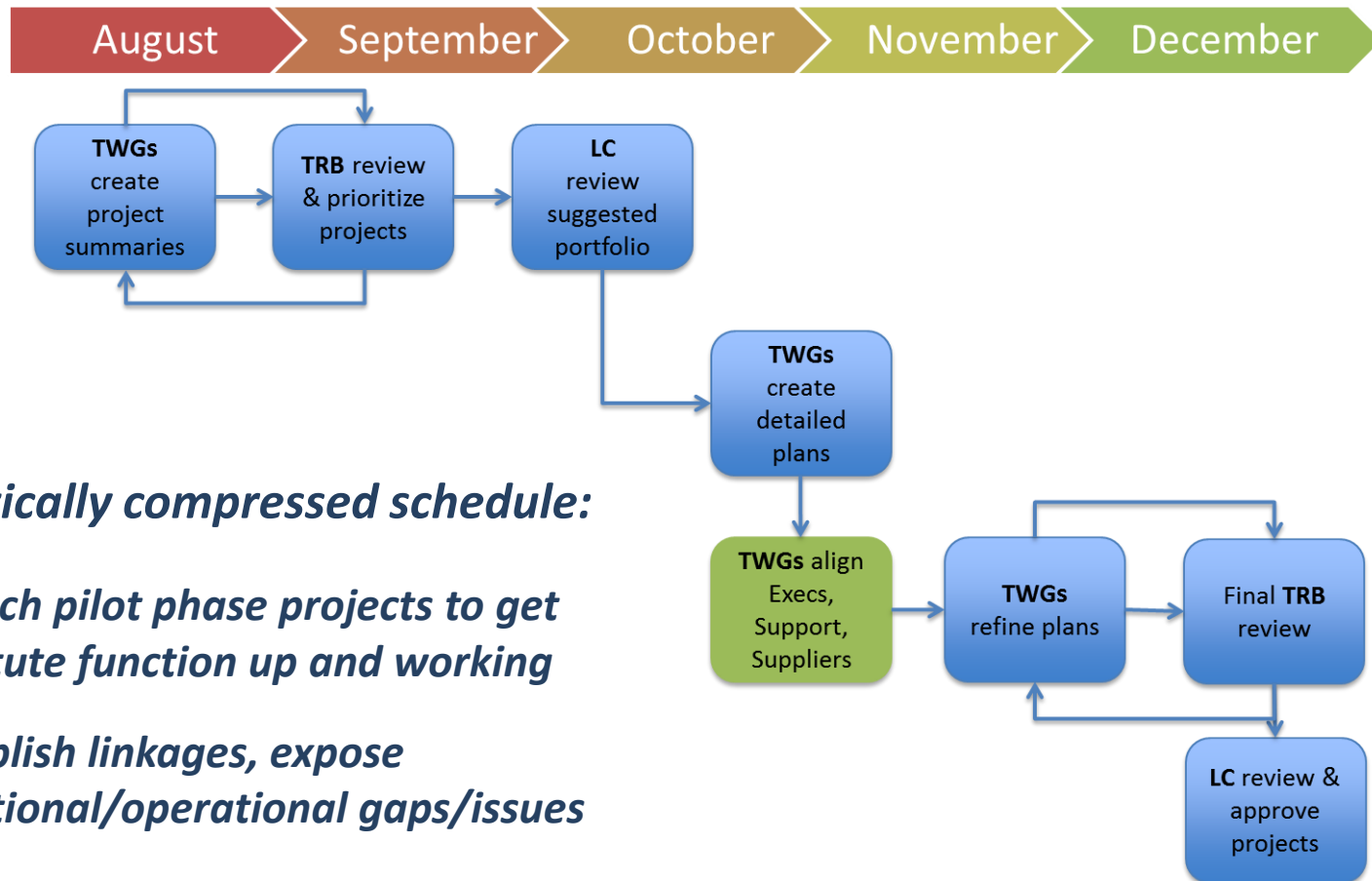- *Each KTMA has industry, government, and academic co-leads*

Institute Business Operations – TRB

Key Technology Manufacturing Areas (KTMAs)

Manufacturing innovation Centers of Excellent (MCEs)

Technical Review Board (TRB):

- *Cooperatively identify highest impact baseline and advanced capability projects*

- *Comprised of industry, government, and academic leads for each KTMA and MCE, together with AIM executive management and government oversight*

- *Provide prioritized recommendation of project portfolio (new projects, project sunsets) to AIM Photonics executive team and Leadership Council*

- *Provide visibility for Leadership Council and executive team to project status, linkages and project management issues on biannual basis*
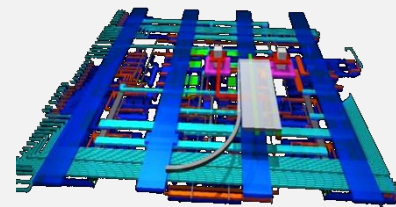
Q1   Q2   Q3   Q4

1st TRB Meeting   2nd TRB Meeting

AIM Photonics All-Institute Meeting: Meet to Discuss New Technology/Market Factors Roadmapping
5/23

AIM Photonics All-Institute Meeting: Meet to Discuss Joint Roadmapping
12/5

Ongoing bi-weekly meetings for broad-input road-mapping TWGs

2016 Road-Mapping Activities

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Q1 Leadership Council Meeting: Provide inputs for Roadmap Distillation into Key Stakeholder Priorities
February

Q2 Leadership Council Meeting: Review 2016 Project Status and status of Addressing Stakeholder Priorities
May

Q3 Leadership Council Meeting: Respond to TRB Recommendations and Authorize Detailed Project Planning
LC Pre-read 9/17 - 9/26
Sept

Q4 Leadership Council Meeting: Review 2016 Project Status and 2017 Project Summaries for Authorization to Execute
LC Pre-read 11/26 - 12/5
Dec

2016 Leadership Council Activities

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TRB Meeting #1: Discuss Evolving 2017 Project Portfolio & Start Initial Discussion on Priorities and Plan Modifications
4/25

TRB Pre-Reads & Scores
8/1 - 8/14

TRB Meeting #2: Proposed 2017 Project Evaluation & Prioritization Process
8/15

2016 TWG/TRB Activities

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Executive Team Prepares & Distributes Project Proposal Portfolio
7/18 - 7/31

TWG Meeting: Examine & Distill Broad Roadmap Input for AIM Member Priorities

TWG Meeting: Capture Critical Gaps Relative to AIM Capabilities

TWG Meeting: Convert Gaps into Actionable Projects

TWG Meeting: Identify Linkages to MCEs and/or other KTMAs

TWG Meeting: Work with COO/CTO to Close Linkages to MCEs and/or other KTMAs

2017 Project Proposal Documentation DUE from TWGs Leads

Executive Team Reviews TRB Recommended Projects & Prepares Proposed Project Portfolio for LC
8/17-9/16

TWG begin Detailed Project Planning for Approved Projects which includes Management & Budget Planning and Leadership Council Direction for Modification
9/20 - 11/17

Executive Team Prepares 2017 Project Portfolio for LC Pre-Read
11/18-11/25

TWGs start to prepare Project Plan Documentation for TRB Meeting
6/1 - 7/17

3/1 **2017 Project Planning** 12/4

August | September | October | November | December

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[TWGs create project summaries] → [TRB review & prioritize projects] → [LC review suggested portfolio]
                                                                              ↓
                                                              [TWGs create detailed plans]
                                                                              ↓
[TWGs align Execs, Support, Suppliers] → [TWGs refine plans] → [Final TRB review]
                                                                              ↓
                                                              [LC review & approve projects]
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Dramatically compressed schedule:

- *Launch pilot phase projects to get institute function up and working*

- *Establish linkages, expose functional/operational gaps/issues*

- *Most pilot projects based on projects identified during proposal phase*

- *Emphasis on MCE capabilities*

Institute MCE's Manufacturing Center of Excellences

EPDA — Electronic Photonic Design Automation

Lead Contacts			
Peter Goetz	NRL		Development of a set of integrated design tools for photonic and combined electronic-photonic components. Features: Models for Si and InP devices; Integrated electronic-photonic design environment; Design tools/PDK; and Intellectual Property protection.
Rob Scarmozzino	Synopsys		
Mike Watts	MIT		

MPWA — Multi Project Wafer / Assembly

Lead Contacts			
Atilla Szep	AFRL		Provision of full MPWA services including Foundry Broker and Foundry Operations for both Si and InP based photonic devices & components. Features: Availability of in-house 300mm Si and InP fabrication facilities; III-V laser integration; Interposer 2.5D/3D integration.
Darwin Enicks	Corning		
Jeremiah Hebding	SUNY Poly		

ICT — Inline Control & Test

Lead Contacts			
Nick Usechak	AFRL		Robust optical testing for photonics applications using inline and stand-alone approaches. Features: High-throughput, high-functionality wafer-scale optical probe test; On wafer photonic test cells for process control; and Multi-channel I/O fiber array test interfaces.
Wilfried Haensch	IBM		
Douglas La Tulipe	SUNY Poly		

TAP — Test , Assembly & Optical Packaging

Lead Contacts			
Justin Bickford	ARL		Development of standardized advanced automated, no-touch and accessible processes for PIC test, assembly & optical packaging. Features: Integration of 2D, 2.5D and 3D subassemblies into system-level package, fiber/WG attach, and pick and place capabilities; Sub-micron 3D inspection tools; and In-house prototype photonics optical packaging center.
Alan Evans	Corning		
Tom Brown	UR		

Institute KTMA's Key Technology Manufacturing Areas

DataCom / Telecom

Lead Contacts			
	Mike Gerhold	ARO	Initiative focuses on the challenges for manufacturing high volume, low cost Terabit-scale photonic interconnectivity technology for advanced high performance embedded computing and data centers. Initially focus is on ultra-high-speed, high quality multi-wavelength communications links exceeding Tb/s bandwidth densities; and multi-port (high-radix) spatial and wavelength selective, nanosecond-scale reconfigurable switches.
	Ray Beausoleil	HP	
	Srinath Kalluri	Intel	
	John Bowers	UCSB	

Analog RF Applications

Lead Contacts			
	Keith Williams	NRL	Initiative objective is to develop manufacturing technologies specifically targeted for producing high volume chip-scale microwave photonics for demanding applications requiring very high optical performance fidelity. The driving goal is to address the critical challenges for the mass manufacture capable integration of high-dynamic range ultra-low loss broadband PICs and microwave frequency electronic ICs for unprecedented analog RF transmission communication performance.
	Fred Kish	Infinera	
	Larry Coldren	UCSB	

PIC Sensors

Lead Contacts			
	Jason Guicheteau	ECBC	Initiative addresses the manufacturing challenges of chemical and biochemical sensors realized in glass/silicon materials, and demonstrates how the proposed solutions can facilitate high-volume production of embedded sensors connecting to, or integrated with, mobile platforms. Goals include development and demonstration of manufacturing methods enabling dramatic miniaturization of sensor systems based on glass/silicon integrated photonics and novel engineered glass surfaces.
	Jeff King	Corning	
	Benjamin Miller	UR	

PIC Array Technologies

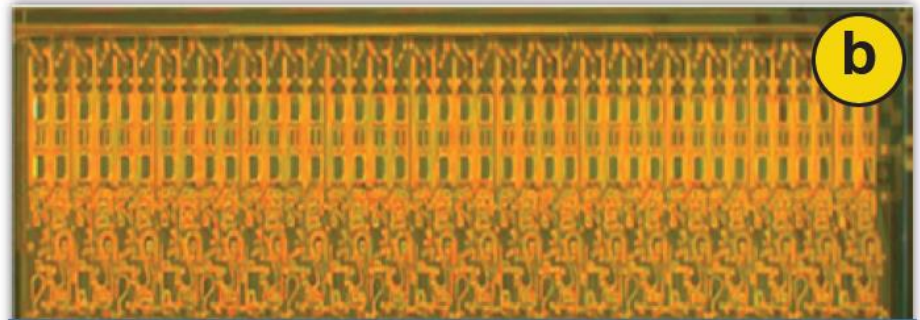| Lead Contacts			
	Tom Nelson	AFRL	Initiative addresses the manufacturing challenges associated with PIC Phased Arrays. Phased arrays enable high-speed steered projection and imaging without moving parts. Near-term focus will include Free-Space Communications, then extending to Light Distance And Ranging (LIDAR), Biomedical Imaging, and Display Technologies.
	Wel-Chiao Fang	Intel	
	Mike Watts	MIT	

a — High Q resonators (Caltech)

On chip lasers and photodetectors (UCSB)

b — Indium Phosphide Integration (Infinera)

c — InP & Si Integration (UCSB)

d — Through Oxide Vias (TOVs) (SUNY Poly) — TOV 2μm — Photonics Metal

300mm Bonded SiPhotonic-CMOS Wafer

Smallest, lowest Power Modulator

Largest FSR Modulators

e — C-Band Tunable Filters

Largest SiPhotonic Circuit

High-Speed Ge Detectors

Integrated Erbium Gain — 980 nm — 1550 nm

SiPhotonics (MIT / SUNY)

Examples of Team Technology Capabilities

Photonics
- ☐ Metal 1-2
- ☐ Body Si
- ☐ Ge

- ☐ TOV

CMOS
- ☐ Metal 1-5
- ☐ Si Handle
- ☐ Gate

Silicon Photonics Wafer

Oxide Bond

CMOS Wafer

Through-Oxide-Via

$2\mu m$

Photonics Metal 2

Oxide

CMOS Metal 5

3D Wafer Stack
(SiPhotonics & 65nm CMOS, TOVs with no voids)

TOV Electronic-Photonic Integration (MIT-CNSE-UCB)

- ❑ **Capacitance:** ~1-to-2fF/contact

- ❑ **Density:** ~3µm pitch

- ❑ **Yield:** CNSE has demo yields of >99.999%

- ❑ **Results:** Demonstrated the lowest power silicon photonic communication link to date (250fJ/bit)

Transmission — IL=1dB — ER=5dB — 12Gb/s

MIT-CNSE-UCB

Integrated Photonics MPWA Offering

- ❑ Shared reticle, targeted at SMEs, DoD and universities
- ❑ Aggregator offers turn-key services
    1. Designer-facing application engineer
    2. Logistics and fab execution

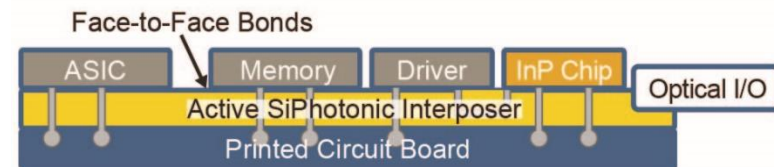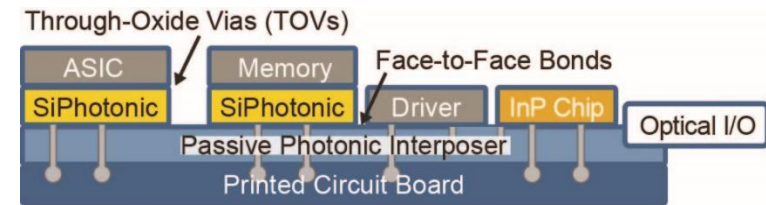| GDS Aggregation and DRC | Mask and Substrate Procurement | Wafer Build | Interposer Assembly | Package, Module Assembly | Functional Test | System Validation |

- ❑ Standardized process
    - ❑ Interposer with design-for-assembly and test
    - ❑ Pre-validated library of design elements
- ❑ Customization with NRE
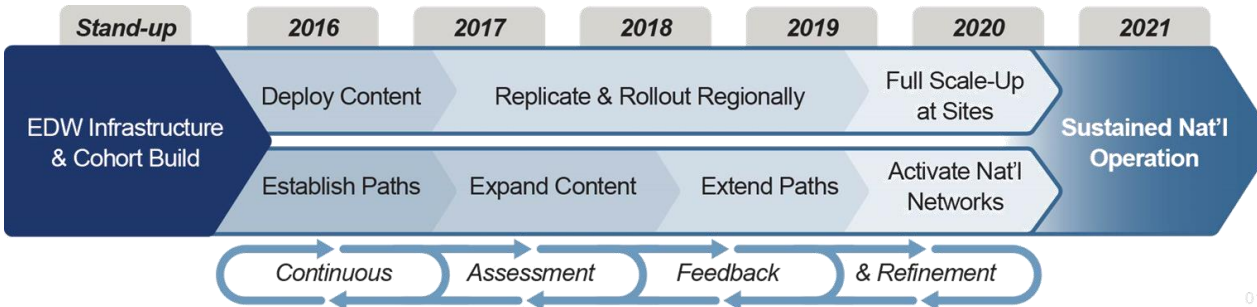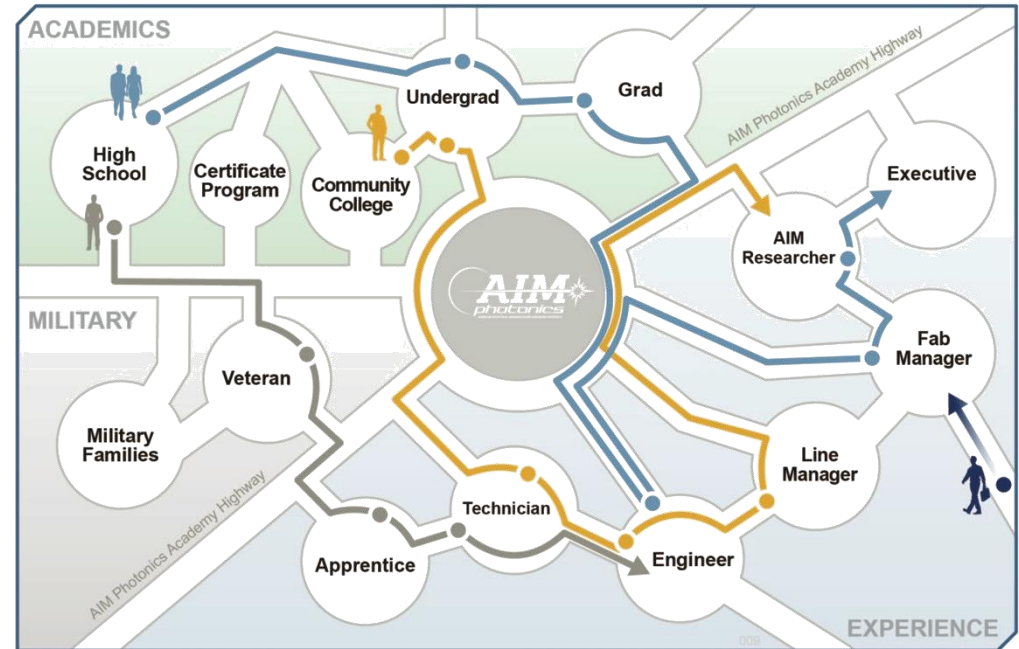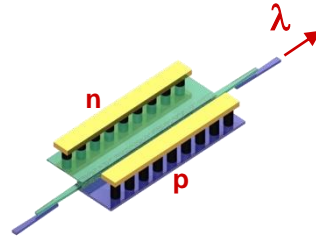   - ❑ Optimal for larger customers

Through-Oxide Vias (TOVs)
ASIC   Memory   Face-to-Face Bonds
SiPhotonic   SiPhotonic   Driver   InP Chip   Optical I/O
Passive Photonic Interposer
Printed Circuit Board

Face-to-Face Bonds
ASIC   Memory   Driver   InP Chip   Optical I/O
Active SiPhotonic Interposer
Printed Circuit Board

Education / Work Force Development: AIM Academy

Inspire, attract and retain community college, undergraduate, graduate students and veterans through career transition to the photonics industry

❑ **on/off-ramp career pathways for all supply chain skill levels**

❑ **transition paths between academic and industry sectors through internships, apprenticeships and hands-on training**

Basic educational courses:

➢ **photonic system modeling**
➢ **design automation**
➢ **materials and processing**
➢ **metrology and testing**
➢ **integrated photonics packaging**
➢ **integrated photonics applications**

Stand-up	2016	2017	2018	2019	2020	2021
EDW Infrastructure & Cohort Build	Deploy Content	Replicate & Rollout Regionally			Full Scale-Up at Sites	Sustained Nat'l Operation
	Establish Paths	Expand Content	Extend Paths	Activate Nat'l Networks		

Continuous → Assessment → Feedback → & Refinement

The AIM Photonics Academy will provide a unified learning, training, knowledge, technology and workforce deployment platform

Membership Agreement

- Membership Agreement
  - Exhibit
  - Exhibit
  - Membership Scope
  - Membership Fee

Membership Agreement

Consistent to all members, is negotiated once and contains Federal Government flow down terms from Cooperative Agreement and general terms and conditions, such as:

- Governance / Intellectual Property / Membership Tier Structure / Project Class Structure / Term and Termination
  - **Membership Scope Exhibit**
    Specific to each Member, reviewed annually, contains:
    - Tier selection / applicable Program Segments / specific Member proprietary projects
  - **Membership Fee Exhibit**
    Contains the financial obligation of the Member, cash and cash equivalent; reviewed annually

- Project Award Agreements

Project Award Agreements

Only Members with an executed Member Agreement may be a Participant under a Project Award Agreement

- Each Member who participates in at least one Project will have a Project Award Agreement which incorporates a Project Scope document for each Project
- Project Scope documents are common to all Participants in a given Project, and specify contributions including cash and cash equivalents (background IP, personnel, equipment, etc.), rights, obligations, proprietary project IP terms, milestones and deliverables

- Tier Structure

Member Tiers

Contributions, Benefits & Rights define Tier level of Industrial / Academic Member

- Tier 1 / Tier 2 / Tier 3 / Observer
- IP rights and project planning/participation vary with Tier level

- Project Classes

Project Categories

Classes define Rights in IP

- Class A – Consortium / Primarily Institute funded, Projects to be central to Institute Mission
  - IP ownership is sole/joint according to inventorship among Participants, licenses as per Membership Agreement
- Class B – Corporate or Government Interest / Partially Institute funded; Projects require positive ROI for Institute
  - Proprietary Projects, IP ownership & license rights negotiated among Participants & Institute, IP is shielded from others
- Class C – Services / Completely Participant funded, Projects to be profitable for Institute
  - Work for Hire, negotiated by the Participant & Institute, IP is shielded from others

Contributions	Benefits and Rights of Membership
Industry Membership Tiers	
Tier 1 – Industrial member pays annual membership fee of at least $1 million with a 5 year commitment. Opt-out period is 2 years. In years 1-5, a mix of cash and cash-equivalent (with a minimum of $100k in cash in year 1 ramping to full cash in year 6), with continued participation requiring an all cash contribution.	▪ One Seat on Leadership Council, which among other things provides company the right to steer overall direction of the Institute and provide application space direction. ▪ Access to participate in and to IP generated from all collaborative programs. ▪ As long as membership fee is paid in at least partially in cash, AIM will reimburse company for up to three (3) company assignees up to $150,000 each, limited to the amount of membership fee paid in cash above the pre-determined cash minimum. ▪ Ability to submit a proprietary project.
Tier 2 – Industrial member pays annual membership fee of at least $500,000 and a 3 year commitment. Opt-out period is 1 year. In years 1-5, a mix of cash and cash-equivalent (with a minimum of $100k in cash in year 1 ramping to full cash in year 6),with continued participation requiring an all cash contribution.	▪ Access to participate in and to IP generated from three (3) collaborative programs of company choosing. ▪ As long as membership fee is paid in at least partially in cash, AIM will reimburse company for up to one (1) company assignee up to $150,000, limited to the amount of membership fee paid in cash above the pre-determined cash minimum. ▪ Ability to submit a proprietary project.
Tier 3 – Industrial member pays annual membership fee with a target of $100,000 in cash-equivalent form and a 2 year commitment. Opt-out period is 1 year.	▪ Access to participate in and to IP generated from one (1) collaborative program of company choosing.
Industry Observer – Observer pays annual membership fee of $2,500.	▪ Receive access to an annual Institute newsletter and participate in the annual meeting.
University and Non-Profit Membership Tiers	
Tier 1 – Member must provide a greater than 1:1 cost match for project(s) the university actively participates, can be cash or cash equivalent; must be meaningful and critical to success of AIM. Total 5 year contribution must be equal to or greater than $5 million over the course of 5 years.	▪ Allowed access to participate in one or more KTMA, MCE, ED-WFD, Roadmap Technical Working Groups. ▪ Ability to participate in and access to results and IP generated from all collaborative programs. ▪ Right to submit proposals to perform work on projects. ▪ Ability to submit proprietary projects.
Tier 2 – Member must provide an at least 1:2 cost match, can be cash or cash equivalent; must be meaningful and critical to success of AIM. Contribution is only required should university project be chosen.	▪ Allowed access to participate in one or more KTMA, MCE, ED-WFD, Roadmap Technical Working Groups, however, not in a leadership role, unless executive team deems it necessary. ▪ Access to participate in and to IP generated from collaborative projects, where they provide 1:2 cost match.
Observer – No fee expected.	▪ Receive access to annual meeting and receive Institute's quarterly newsletter; no rights to participate in projects other than educational support (meant mostly for community colleges).

Institute Project Classes

Classes | Funding	Active Participation · assumes that the Member providing the facility (eg. SUNY Poly for wafer processing) is always named as a Participant in the respective Project	Intellectual Property
Class A – Consortium · Primarily Institute Funded (subject to Leadership Council determination of centrality to Mission and SIP and alignment to KTMAs and MCEs) · May include US Government funds	· Primarily executed by Participants · Tier 1 Assignees allowed. Non-Tier 1 Assignees allowed only if home company is Participant · US Government participation allowed	· Project IP ownership is sole/joint according to inventorship among Participants. · All Tier 1 Members, Tier 2 Members participating in the relevant KTMA/MCE and Project Participants have rights to use Project IP internally. Sublicensing is allowed only to the extent necessary for customers to use Member's products based on the Project IP. · US Government has Government use rights. · Background IP remains property of contributing Participant and is licensed to the extent necessary to practice the Project IP, unless otherwise specified in the Project IP Plan.
Class B – Corporate Interest or Government Interest · Partially Institute funded (subject to Leadership Council determination of positive ROI to Institute) · Corporate Interest - no US Government funds and primarily Participant funded · Government Interest – at least partially funded by Government in addition to Cooperative Agreement funding and primarily Participant funded	· Executed by Participants · Assignees allowed only if home company is Participant	· Ownership of Project IP and license rights negotiated among Participants and Institute and documented in the Project Award Agreement. · Background IP remains property of contributing Participant . If provided for use in the Project, license rights are to be negotiated among Participants and Institute and documented in the Project Award Agreement.
Class C – Services · Completely Participant funded on a profitable basis to Institute	· Executed by Participants · Assignees allowed only if home company is Participant · Institute human and physical resources provided only on an as-available basis	· Work for Hire/Negotiated by the Participant and Institute.

- **AIM Photonics website:**

  - **www.aimphotonics.com**

- **AIM Photonics contacts:**

  - **Government and Industry Outreach Executives**
    - **Rod Alferness -- alferness@engineering.ucsb.edu**
    - **Tino Treiber -- tino.treiber@sematech.org**

  - **Department of Defense IP-IMI Program Management**
    - **Neil Supola -- neil.d.supola.civ@mail.mil**
    - **Nicholas Usechak -- nicholas.usechak@us.af.mil**

- **AIM Photonics aims to:**
  - **Provide venue for US cooperative development of advanced manufacturing solutions;**
    - **pathway for integrated photonics to leverage the market-supported continuing investments into VLSI manufacturing technologies**
  - **Drive maturation and stratification of the integrated photonics ecosystem**
    - **EPDA, MPWA, ICT, TAP**
    - **workforce development to support manufacturing & market growth**
  - **Provide world-leading photonic integration technology access/on-ramps to SME's, government, academic, and entrepreneurial communities**
  - ***Become self-sustainable within 5 years***

- **How to benefit from AIM Photonics:**
  - **Exercise capabilities as user (MPWA, etc.)**
  - **Influence the direction/capability, leverage the investment to meet your needs:**
    - **Join AIM Photonics!**
    - ***Participate in MCE and KTMA Technical Working Groups (TWGs)***

Stay Involved

NPI

www.lightourfuture.org

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