

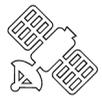
MMEC Digital and Physical Infrastructure

MMEC Human, Physical, and Digital Environment



EDA Tools/IP/MPWs

Access to EDA tools, IP and application engineering support for project execution ensuring timely onboarding of hub members, execution of agreements and strong collaboration for continuity and successful capability transition.



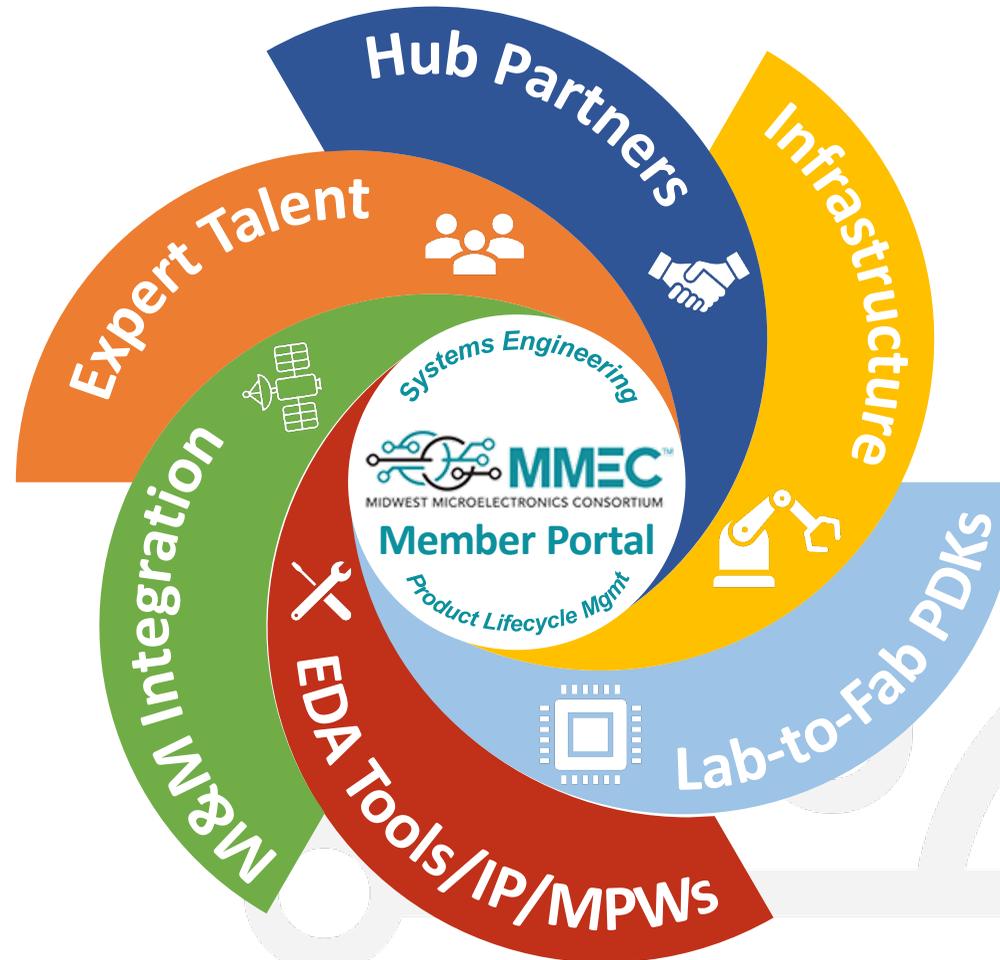
M&M Integration

Independent compliance reviews, digital models, meticulous data capture and characterization demonstrating at scale cost, performance, yield, reliability and assurance goals for expedited integration to support Mission and Market transition



Expert Talent

Provide robust expert talent to support member engagement and human, digital and physical environment to execute projects efficiently and quickly. World class research team across academia, industry, and government. Organic legal and business professionals and support.



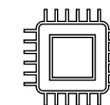
Hub Partners

Leveraging strengths of our hub members and clearly define roles and responsibilities in every aspect of technology transition to create a bridge of opportunity over the infamous valley of death.



Infrastructure

Lower/remove barrier at member interfaces through established and professionally managed access models to existing infrastructure, facilities, design tools and IP frameworks. Address gaps for investment.



Lab-to-Fab PDKs

Use of robust modeling and simulation and development and delivery of PDKs, compact models and process monitors for design and manufacturing proof point validation. Accelerating lab to fab transition. 2

Propelling Sustainable Microelectronics Innovation

Tactical Investments – Building an Ecosystem



Infrastructure

- Member clean room facilities
- Materials growth and device test facilities
- TRL/MRL relevant characterization
- Foundational/Core foundry access
 - 200mm and 300mm CMOS
 - 150mm for compound



Expertise

- Multidisciplinary skills and knowledge of membership team
- World class research team across academia, industry, and government
- Organic legal and business professionals and support



Investment

- Strategically invest in Prototype Pipeline:
 - Equipment supporting ramp lines and on and off-wafer test
 - Infrastructure supporting curation of system relevant data enabling early systems engineering trade off analysis and assurance



Initial Commons Targets

- Lab Facility Upgrades
- Member Access Models
- EDA/IP, MPWs
- BEOL/Full-stack Integration

- Process engineers
- Technicians
- Modeling
- Patent/Licensing

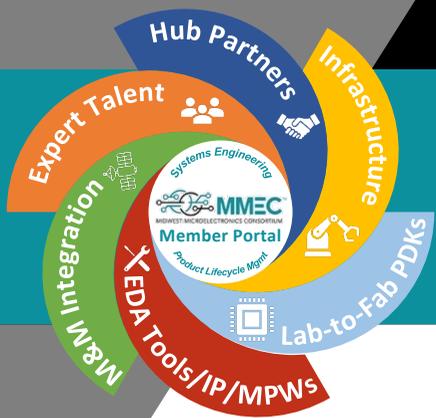
- Ramp line growth tools
 - MOCVD, MBE, HVPE, ALD
- Direct write lithography
- Test and Measurement (DC-Light)

Factors

- Cost share commitment
- Consortium commitment/need
- Transition target (buy-in)

- Stakeholder support
- Ecosystem alignment
- Sustainability

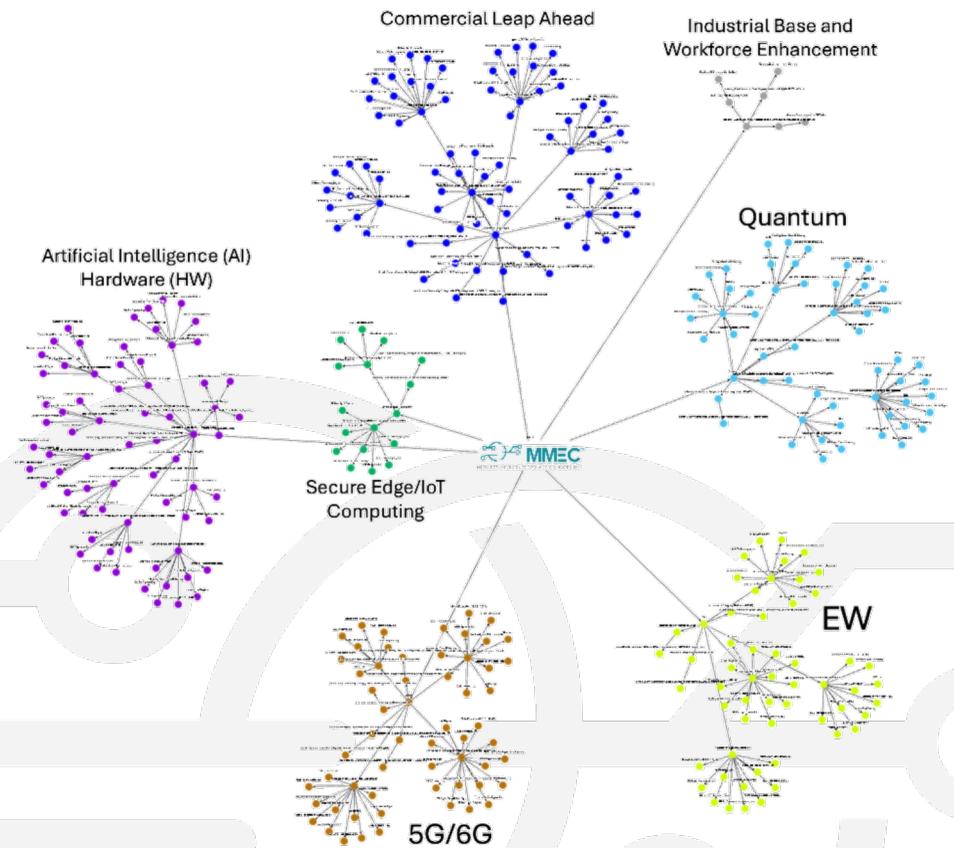
- Project alignment
- Workforce enablement
- Cost and schedule



MMEC Member Portal Status

- Capability Mapping, Initial Member Survey Completed
- Q2: Phase I of Member Portal in Testing, Phase II in Process of Programming:
 - Member Forms, NDA, Member Agreement, Resource Requests, etc...
- Q3: Phase III Features:
 - Capability and Knowledge Management
 - Ontological Mapping
 - Scheduling of Access to Digital and Infrastructure Resources
 - Marketplace for Member Resources on Pre-Negotiated Basis to Provide Access to other Members and The Commons Ecosystem
 - Member Teaming and other Resources

- Linking Requirements/Needs and Opportunities to Member/Stakeholder Capabilities and Resources





MMEC Ramp Lines

Key Status Updates

- Completed Agreements with OSU and Penn State
- MITEC Facility Co-Location
 - 2,000 Square Feet of Space allocated in Nanotech West Lab, CUI and ITAR Compliant (Part of 28,000 lab)
- Material and Equipment on Order (See table)
- 30% Cost Share Secured from OSU and Penn State
- Final Construction and Renovation Plans at OSU and PSU will be approved this month
- 75% of Characterization Equipment Installed in Q3

Major Equipment List Status



Equipment	Vendor	Lead-Time	Status	Where
IIII-Sb MBE	Veeco	13-16 Months	On Order	OSU
III-N MOCVD	Aixtron	12 Months	On Order	OSU
Ga2O3 MOCVD	Aixtron	12 Months	On Order	OSU
Ga2O3 HVPE	Matheson	14 Months	On Order	OSU
Plasma Atomic Layer Deposition	Applied Materials	32 Weeks	On Order	OSU
E-beam Metal Evaporator	CHA Industries	34 Weeks	On Order	OSU
Direct Write, Maskless Photolithography	Heidelberg Instruments	10-14 Months	On Order	OSU
2D/III-N MOCVD, Multi-wafer	Aixtron	12 Months	On Order	PSU

MMEC Characterization Lab: OSU



Pending final vendor proposals and quotes

DC Testbench Capabilities

- All basic semiconductor characterization under 200V
- Including testing capability for ferroelectrics/low voltage pulsed IV

New Equipment acquisition

- Manual Probe Station (4-probes)
- Semi. Char. Sys. (SCS) – DC/Pulsed/C-V/C-f

Epitaxial Testbench Capability

- Mercury probe CV/IV – 20 Hz to 2 MHz
- Single Magnetic field Hall testing

New Equipment acquisition

- Mercury Probe
- Discrete SMU, LCR Meter
- Tabletop FastHall System (Lakeshore)

Cryogenic Testbench Capabilities

- Up to 4 terminal device characterization from 77K to 450K: IV/CV/C-f
- Defect spectroscopy techniques for diodes and MIS structures (capacitance based)
- Utilize SCS as needed for characterization

New Equipment acquisition

- Zurich Instruments Impedance Analyzer – CV/Cf/DLTS
- Discrete SMU

RF Testbench Capabilities

- Small Signal up to 43 or 67 GHz
- Ka-band Load pull f0 up to 43 GHz
- 3rd Harmonic Load pull with f0 up to 14 or 22 GHz – depending on VNA config
- Possible two-tone capability
- Pulsed S-parameters
- Pulsed IV -400V to +600V

New Equipment acquisition

- RF Manual Probe Station
- PNA/ZNA or MT2000 for RF small signal/load pull
- Auriga-5 or AMCAD Pulsed IV system
- Relevant amplifiers, couplers, bias Tees, etc.
- Structure to house all components and keep cables short\

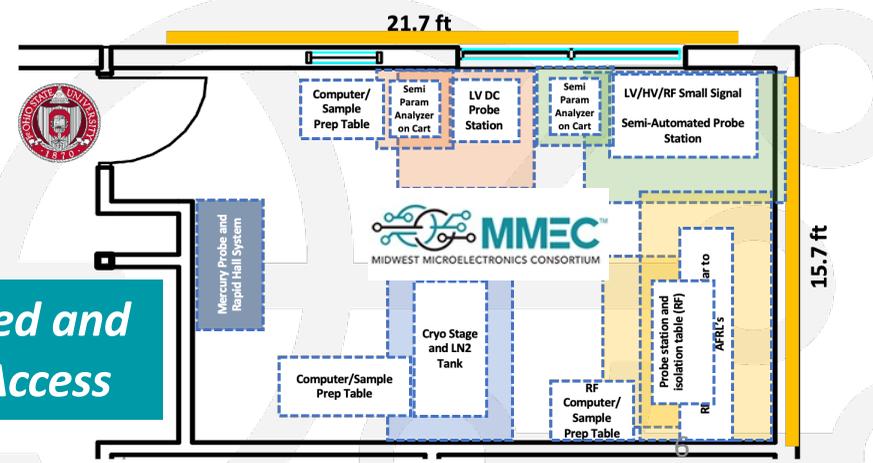
HV Testbench Capabilities

- Fully capable low voltage testing with high accuracy
- CV Testing up to 3kV
- DC IV Testing up to 10kV
- Small Signal up to 43 or 67 GHz (RF VNA)
- Pulsed IV system up to 220V or -400V to +600V
- Temperature dependent measurements (30C to 300C)

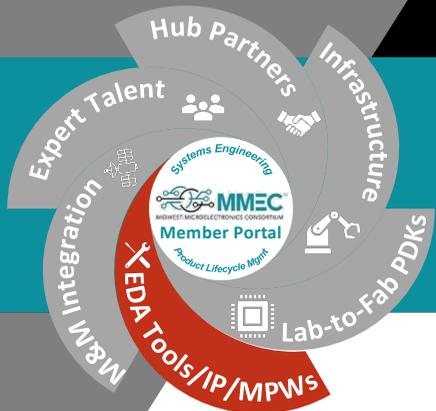
New Equipment acquisition

- Semi Automated probe station with environment control and temperature controlled stage
- B1505A with LV and HV testing capability including CV testing

Automated and Remote Access



EDA Tools and IP



The MMEC Digital Infrastructure provides a common hybrid-cloud MS&A environment for Members, reducing the burden on Project Teams and lowering the barriers to participation.

Through the Digital Infrastructure MMEC Members can access:

- A secure, cloud-based, virtual EDA and IP design center
- Secure cloud storage with data provenance and traceability for collaboration
- Commercial logic emulation providing cycle-accurate accelerated design verification
- High-performance computing for large-scale simulation and environment/effects analysis
- SoTA accelerated multiphysics MS&A digital twin capability used by DoD programs.

The Digital Infrastructure supports activities and projects spanning Workforce Development, Commercial, ITAR, and DoD requirements up to Controlled Unclassified Information (CUI) allowing for collaboration across academia, industry, and the government and supporting transition to DoD programs.

Members can access the Digital Infrastructure through the secure Member Portal via an Infrastructure Allocation Request.

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