MUSE SEMICONDUCTOR

AGENDA

1. Muse overview (30 s)
2. MPW prices (1 m)
3. MPW schedules (1 m)
4. Technology access (30 s)
5. Current educational support (1 m)
6. Muse VLSI tapeout class (6 m)
    a. Stakeholders
    b. Requirements
    c. Overview
    d. Benefits
7. Q & A (5 m)

MUSE SEMICONDUCTOR

MUSe = **M**PW **U**niversity **Se**rvice

Focused on serving the Multi-Project Wafer (MPW) needs of University circuit researchers.

Support for industry customers when referred by a Professor.

Leading TSMC MPW aggregator in the world.

MUSE HAS SOLVED THE MPW PRICE ISSUE

180nm minimum price: $5,750/5mm2

65nm minimum price: $5,500/1mm2

28nm minimum price: $13,000/1mm2

Workshop issue: Cost of fabrication

MUSE HAS SOLVED THE MPW SCHEDULE ISSUE

180nm frequency: every other month
180nm cycle-time: 7 weeks

65nm frequency: monthly
65nm cycle-time: 10 weeks

28nm frequency: every other month
28nm cycle-time: 11 weeks

Workshop issue: MPW shuttles

MUSE HAS SOLVED THE TECHNOLOGY ACCESS ISSUE

Access to foundry PDKs

Access to foundry provided standard cell libraries, I/O libraries and memory compilers

Workshop issues:
What process nodes are adequate?
Predictive technologies and PDKs
Availability of design collateral for research and fabrication
Can fabrication companies make models and PDKs available to a broad set of universities under NDA?
What design collateral can be made open/freely available to participating universities?

MUSE EDUCATIONAL TAPEOUTS

Muse is the supplier for educational tapeouts at 3 universities

Muse is the supplier for educational tapeouts funded by a consumer electronics company

Workshop issue: What is missing from VLSI education?

MUSE AND A COMMERCIAL COMPANY ARE CREATING A VLSI TAPEOUT CLASS

VLSI TAPEOUT CLASS STAKEHOLDERS

- Students
  - Hands on IC design, tapeout, and characterization experience with tools and technology used by industry
- Universities
  - Increase the value of the student's education
- Government
  - Increase in number of Universities offering practical IC design education
- Industry / Employers
  - New hires will productive from start, minimize on job training
- Industry / MPW Service Suppliers
  - Increase in revenue
- Industry / EDA Suppliers
  - Familiarize next generation of engineers with tools
- Industry / IP Suppliers
  - Familiarize next generation of engineers with IP
- Industry / Course Suppliers
  - Ongoing revenue stream from supplying, maintaining, and revising the VLSI tapeout course

VLSI TAPEOUT CLASS REQUIREMENTS

✓ Students ✓ Prerequisite courses ✓ Course professor ✓ EDA tools	Provided by University
✓ PDK/IP Access ✓ Affordable MPW tapeout service ✓ Timely MPW tapeout service	Provided by Muse
❑ Syllabus ❑ Tutorials ❑ Circuit and IP ❑ Test hardware for IC verification	In development to be provided by Muse
✓ Funding	Provided by NSF, Industry or University

MUSE VLSI TAPEOUT CLASS (1 of 2)

Muse is developing, in collaboration with a commercial company, a VLSI tapeout class.

Two semester class. Spring semester: Circuit design and tapeout. Circuit fabrication over summer. Fall semester: Circuit measurement and characterization.

The class includes a syllabus, tutorials, microprocessor IP, peripheral IP, tapeout, fabrication, package assembly and test hardware for circuit characterization and measurement.

MUSE VLSI TAPEOUT CLASS (2 of 2)

Muse will license the class to Universities.

All class fees will be embedded in the tapeout price.

The class will be updated and revised based on Professor feedback.

Pilot class is underway now.

Expectation is for the Muse VLSI tapeout class to be broadly adopted by over 100 universities on an annual basis including many universities without current microelectronics circuit research.

MUSE VLSI TAPEOUT CLASS BENEFITS

- Broad adoption possible
  - Class available from Muse
  - Low cost

- Sustainable
  - Commercial company course developer incentivized to maintain and revise course
  - Not dependent on a unique faculty member to develop and maintain

Workshop issues:
How can we increase hiring pools?
How can we increase undergraduate enrollments?
How can we increase graduate enrollments?
How can we broaden recruitment to improve diversity?
How can the community be made more inclusive?
Access to fabrication for universities:
How should the available technologies be updated over time?
How should it be funded and managed?

MUSE SEMICONDUCTOR

It's not just an MPW.