2012 Litho ITRS Update

Lithography TWG

December 2012

Outline

- Lithography Potential Solutions
- Major Challenges
- Some table updates
- Expectations for 2013 Roadmap

Litho Team

(2012 Meeting attendees shown – there are many other contributors)

Mark Neisser	SEMATECH
Naoya Hayashi	Dai Nippon Printing Co.
Tatsuo Chijimatsu	Fujitsu Semiconductor
Anthony Yen	TSMC
Reiner Garreis	Zeiss
Michael Lercel	SEMATECH
Bob Gleason	Luminescent
YC Ku	TSMC
Mauro Vasconi	Micron
T.S. Gau	TSMC

Updated MPU/DRAM Options

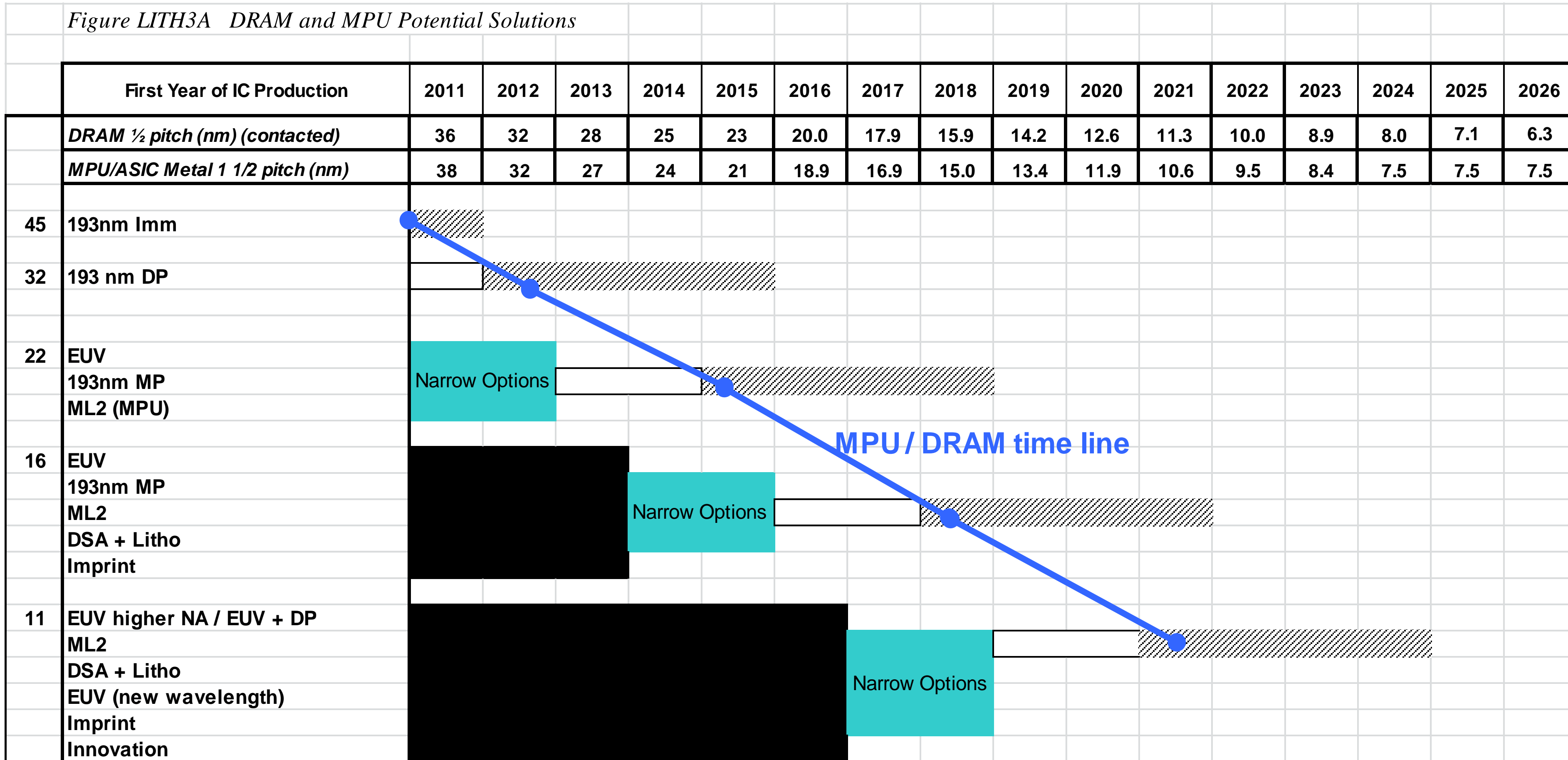
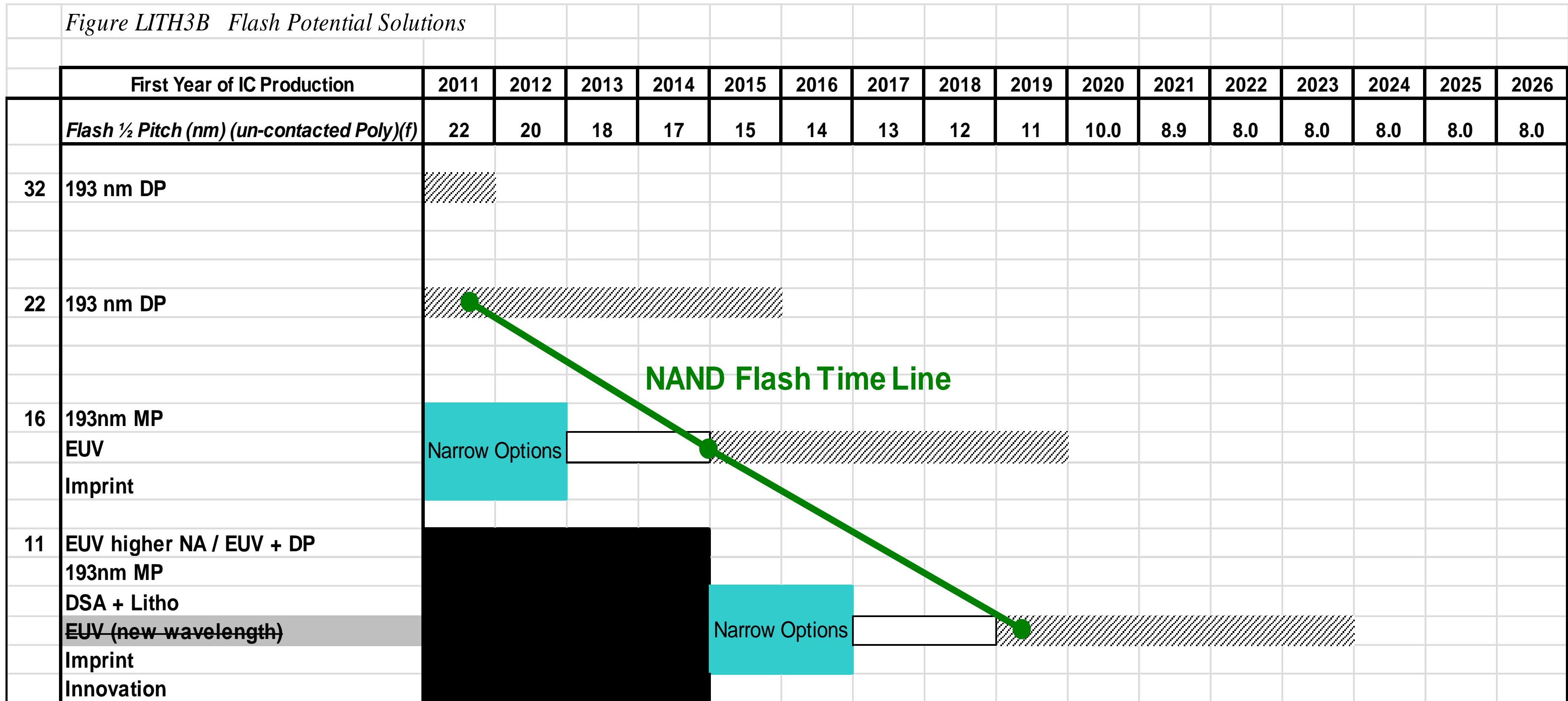


Figure LITH3A DRAM and MPU Potential Solutions

First Year of IC Production	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DRAM ½ pitch (nm) (contacted)	36	32	28	25	23	20.0	17.9	15.9	14.2	12.6	11.3	10.0	8.9	8.0	7.1	6.3
MPU/ASIC Metal 1 1/2 pitch (nm)	38	32	27	24	21	18.9	16.9	15.0	13.4	11.9	10.6	9.5	8.4	7.5	7.5	7.5

We will narrow options for 22nm hp in 2013.

Updated Flash Options



This table shows the requirements for 2-D flash development. The potential introduction of 3-D flash does not drive lithography.

Updated Challenges

	Table LITH1 Lithography Difficult Challenges
	Near Term Challenges (2013-2018) (16nm Logic/DRAM @ HVM; Flash 11nm @ optical narrowing with 16nm in HVM)
1	Cost and cycle time of multiple patterning - especially for more than 2x
2	Optical mask complexity
3	EUV source power Defect "free" EUV masks availability mask infrastructure availability
4	EUV Resist that meets sensitivity, resolution, LER requirements
~~5~~	Process control on key parameters such as overlay, CD control, exposure focus control, LWR with multiple patterning
6	Retooling requirements for 450mm transition (Economic & Technology Challenges)
	Long Term Challenges (2019 - 2025) (11nm hp@HVM)
1	Higher source power, increase in NA, chief ray angle change on EUV; Different Mask magnification and size, Mask material and thickness optimization
2	EUV with multiple exposures for 2D patterns
3	Defect free DSA processing
4	DSA compatible design rules
5	Selection of new EUV wavelength taking resist, mask, source and tool technology into account
6	Metrology tool availability to key parameters such as CDU, thickness control, overlay, defect

Summary of Challenges

- Multiple patterning extensions and making EUV work drive the near term challenges
  - These are the two prime options for the near term decision points
  - Process control is a major issue as shown by the number red cells in the litho tables in next years
- Extension of EUV and making DSA successful drive the longer term challenges.
  - EUV source power will have to continue to increase.
  - Higher NAs and/or a new wavelength will be needed long term to continue EUV capability improvement
  - DSA issues are driven by need for new design rules and needs to understand and minimize defects

2012 Table Changes

- There is now a lithographic materials challenges table.
  - This will provide input to industry and the ITRS ERM group on these needs without specifying chemical solutions
- Multiple patterning table was changed to reflect typical industry pitch splitting practice.

2013 Plans

- Update potential solutions chart in line with new node timing information
- Update mask number estimates
- Add DSA tables. The tables will show DSA capabilities and limitations by year.
  - We expect different problems and capabilities than the other alternative lithographic techniques that already have tables
  - There will be a table for line and space pitch replication by chemoepitaxy
  - There will be a table for contact hole rectification by graphoepitaxy
  - We are considering separate tables for guide pattern requirements.