



Fabless Specialty Memory

A Growing Sector with a Vibrant Eco-System

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Total Memory Market

Total Memory Market: ~\$80B

Main Stream DRAM Market:
Mobile
PC
Server
Graphic

Main Stream NAND Flash Market:
Mobile
Storage(SSD, Storage Card)

NOR
Flash

SRAM

SLC/SPI
NAND

Specialty
DRAM

Other

About a quarter of
the total
semiconductor
market

Specialty Memory Market

Total Specialty Memory Market: ~\$7B

Exclude:

Main Stream DRAM Market:
Mobile
PC
Server
Graphic

Exclude:

Main Stream NAND Flash Market:
Mobile
Storage(SSD, Storage Card)

About 10% of
total memory
market

NOR
Flash

SRAM

SLC/SPI
NAND

Specialty
DRAM

Other

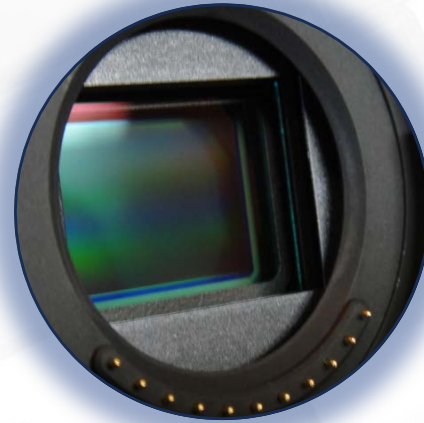
Relative Size and Significance



Total
FPGA Market
~\$6B



Specialty
Memory Market
~\$7B

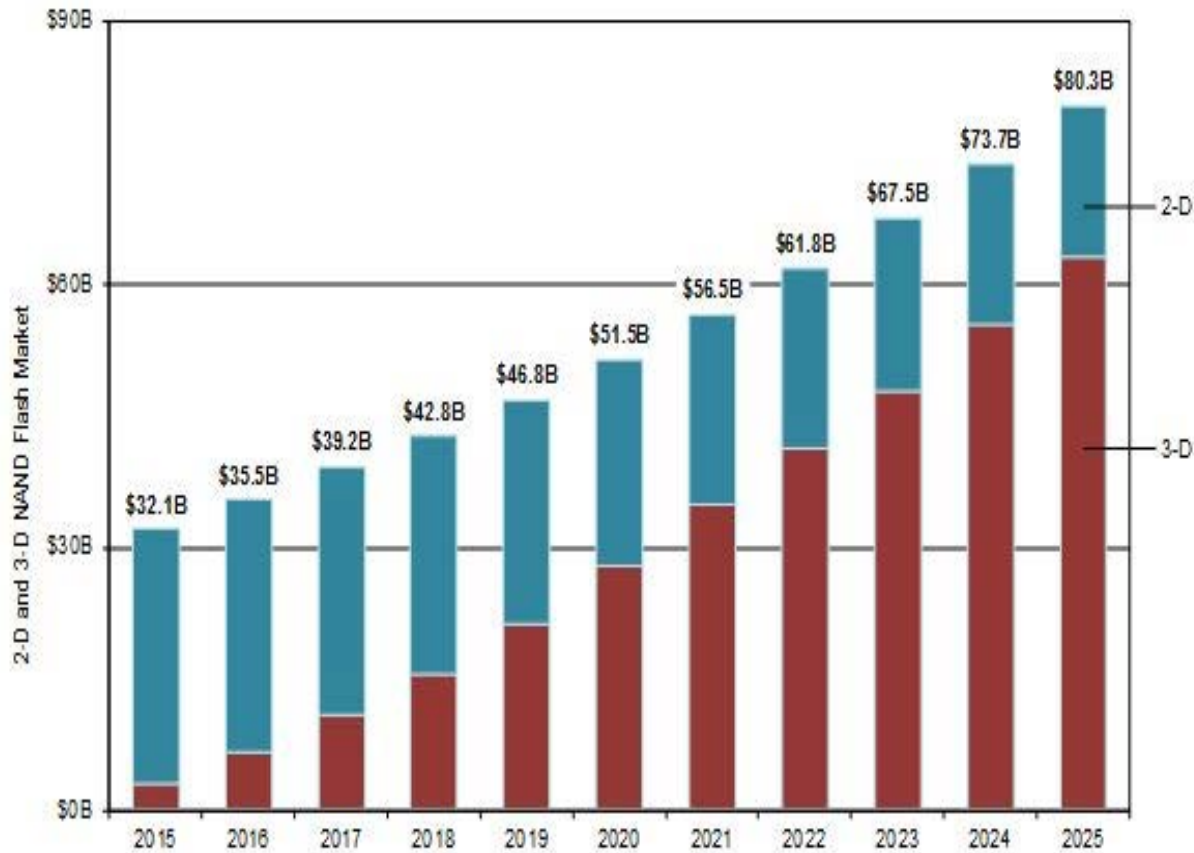


Total
CIS Market
~\$12B

Significant in size,
but growth potential?

Future Growth of Specialty Memory

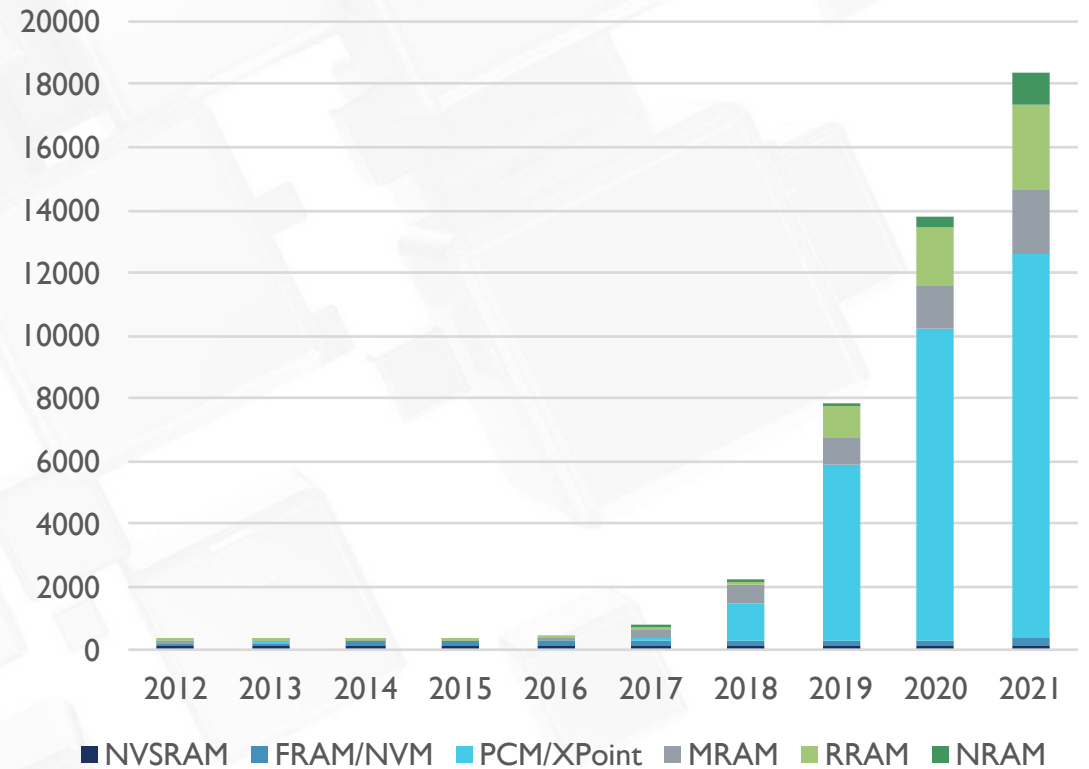
2D NAND Flash Becoming Specialty Memory



Source: SEMI, 2015

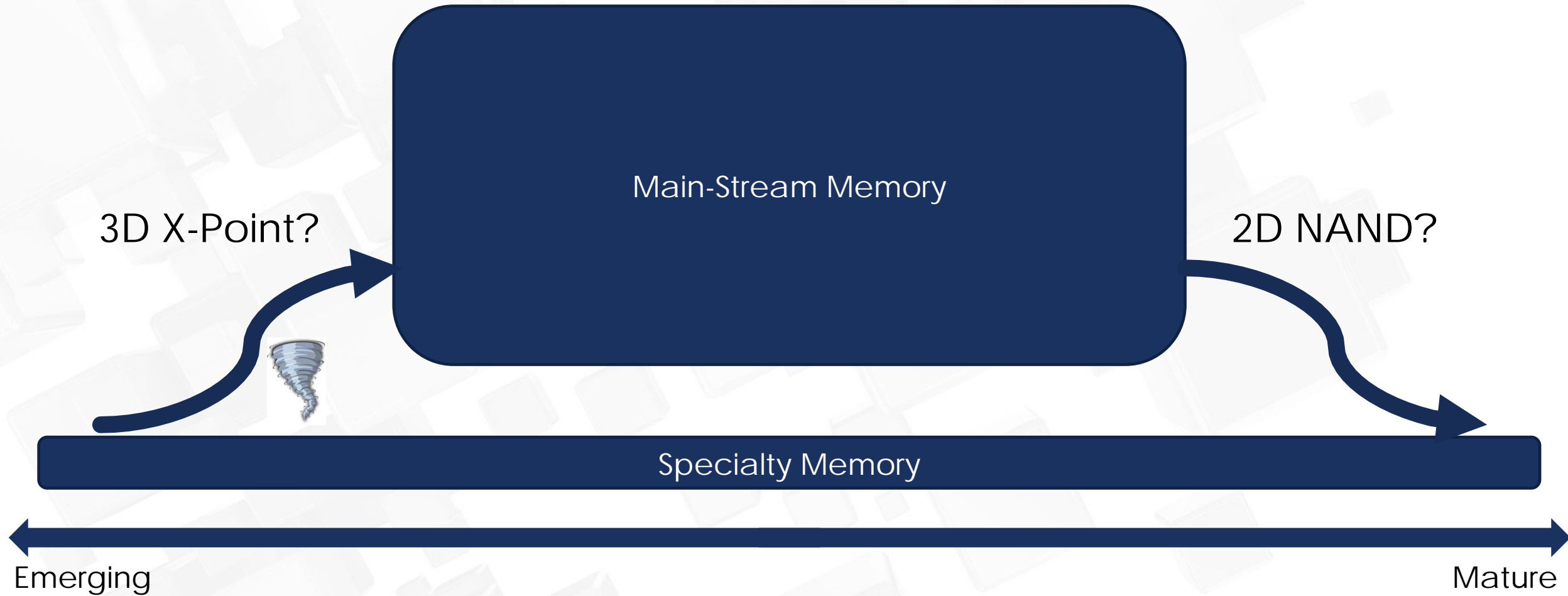
Emerging Memory Technologies Becoming Main-Stream

NVRAM Market Growth (\$M)

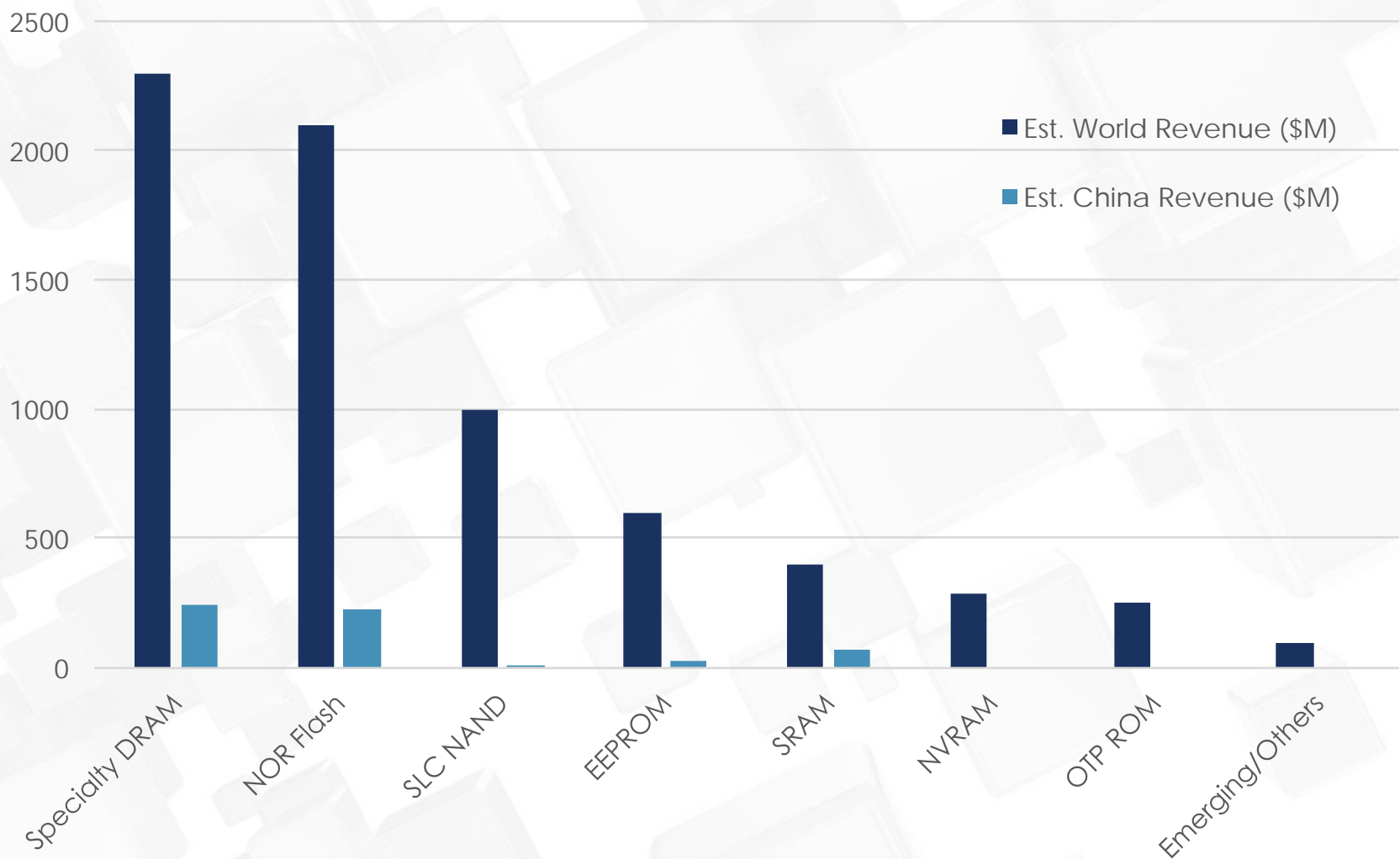


Source: Webfeet Research, 2016

Dynamics of the Specialty Memory Market



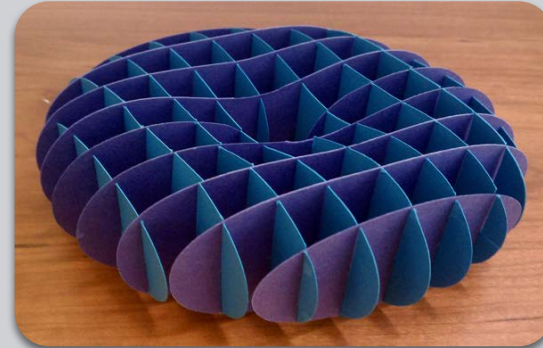
Specialty Memory Market Sectors



Source: Web Feet Research, GD internal



Characteristics of the Specialty Memory Market



Growth

- Grow with the total memory market
- Increased adoption of emerging memory
- Maturity of main-stream technology

Dynamic

- Constantly going through transitions
- Provides occasional entry into main stream memory market
- Frequently influenced by entry/exit of main players

Segmented

- Legacy segment TAM settles to below \$3B
- Many different products specs
- Many different applications
- Many different process/cell technologies
- Typical long-tail market

Vibrant Eco-System

- No monopoly/oligarchy
- Various business models (IDM/Fabless)
- KGD opportunities
- Function/feature rich
- Wide variety of technologies

Advantages of Fabless Business Model for the Specialty Memory Market



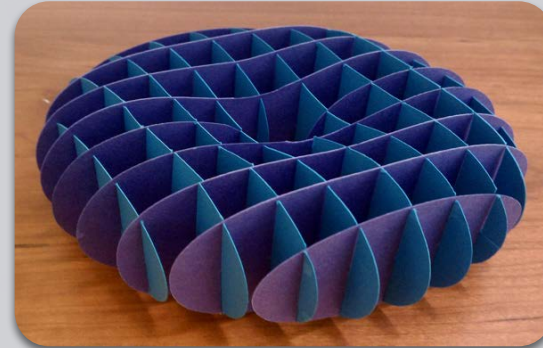
Growth

- Scalability of Foundry/Fabless model
- Access to more advanced manufacturing tools



Dynamic

- Flexibility of Foundry/Fabless model
- High capital efficiency



Segmented

- Foundries are optimized for simultaneous production of many products



Vibrant Eco-System

- Fabless specialty memory vendors offer unique market value as well as IDMs

Specialty Memory Landscape in Mainland China

Business Model	Specialty DRAM	Specialty NAND Flash	NOR Flash	EEPROM	SRAM	NVRAM	Emerging Memory
Fabless	ISSI	GigaDevice ISSI DoSilicon	GigaDevice ISSI DoSilicon	Fudan	ISSI	NA	Ciyu HikStor Xinchu AMT
Foundry/ IDM	Jinhua	SMIC	SMIC XMC HLMC	SMIC Huahong	SMIC HLMC	NA	SMIC

New Opportunities in China Brought by Emerging Memory Technologies

Challenges	Opportunities
Limited market size	More suitable for small-mid sized companies
Higher development cost and risks	International technology companies are more open for collaborations with Chinese partners
Fabless model for startups	Local foundries has more leverage in technology adoption
Need help on fundamental research	Chinese research institutes and universities are very active in this area
A solution trying to find the problem	China has one of the most diversified markets in the world

Main Threats to the Healthy Development of the Chinese Memory Sector



Irrational Expectations

Effects of government factors are over-exaggerated

Everything takes much longer time and more resource than many would think

Elevated risks of low ROI investments



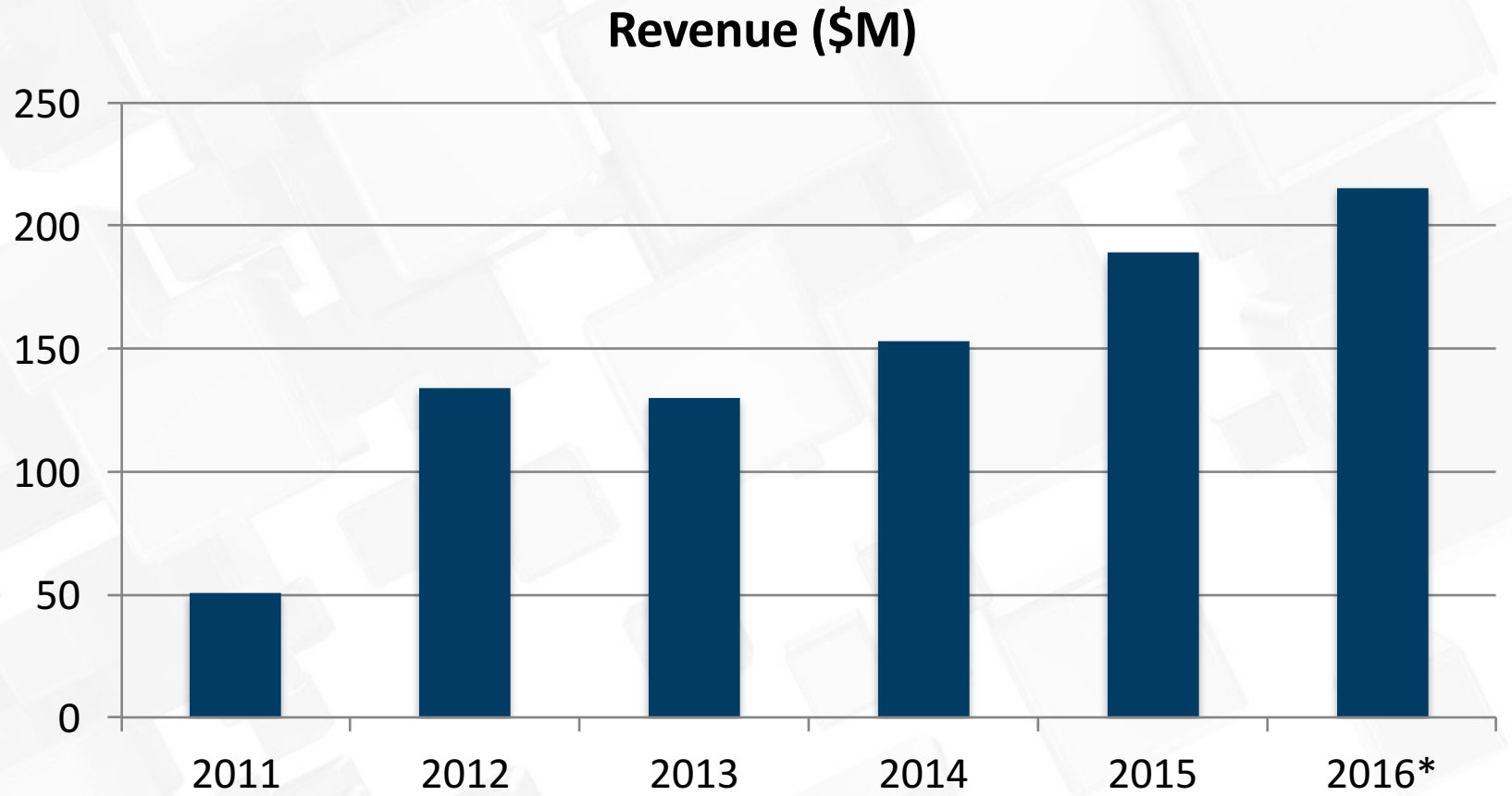
Falsely Alarmed

China's memory industry still supplies less than **1%** of the total world memory revenue, and does not have advanced mainstream memory technology.

Global memory sector is over-consolidated, and China could be the solution

Caused huge barrier for local companies in normal international collaborations

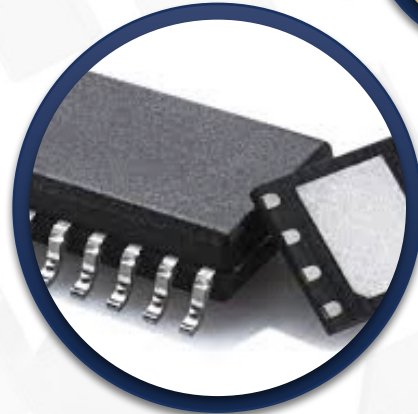
GigaDevice Revenue Growth



*: Estimated

GigaDevice Product Families

SPI NOR Flash



eMMC/eMCP



32-Bit ARM Cortex-M
MCU



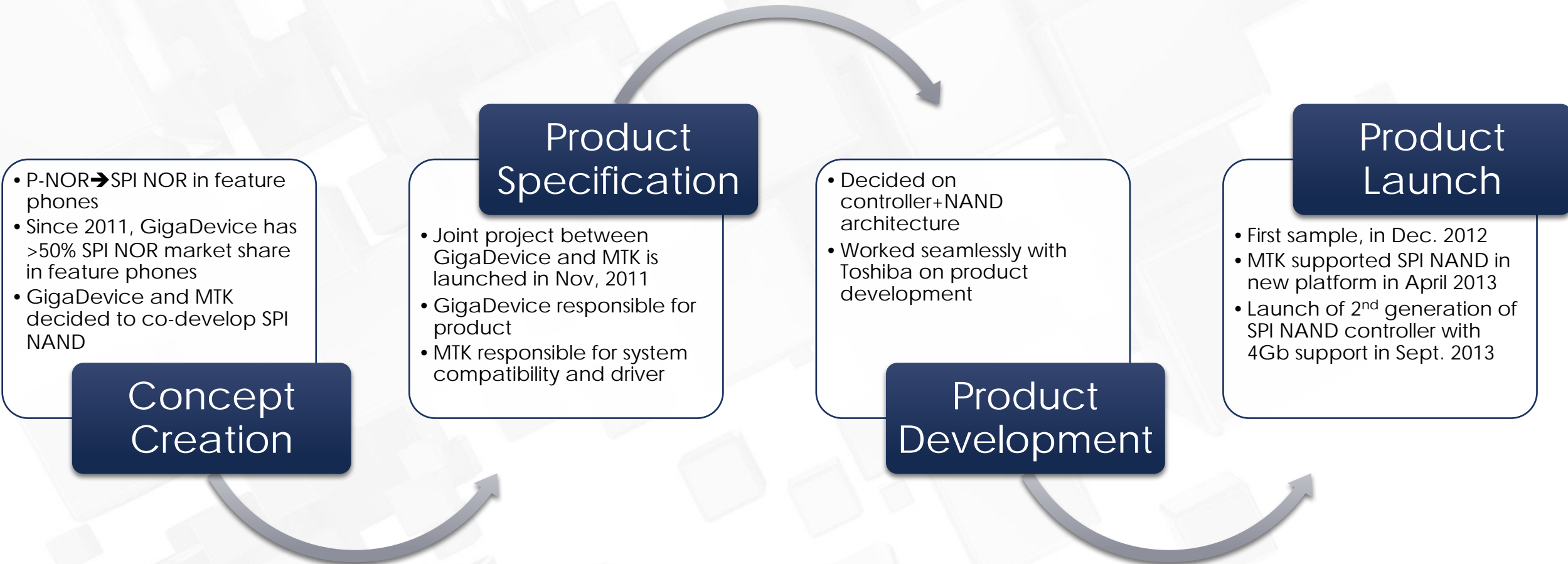
SPI NAND Flash

SPI NAND: An Example of Innovation in the Specialty Memory Market



Same SPI Interface
Same ROM code for system boot
ECC support internal
Much lower \$/bit

From Concept to Product



SPI NAND Market Promotion

IHS Electronics & Media Flash Memory Market Brief

Flash Dynamics

Volume 1 Issue 12 | July 3, 2013 ihs.com

The time is right for SPI NAND
By Ryan Chien, Analyst, and Michael Yang, Senior Principal Analyst

Introduction
 In this issue of Flash Dynamics, IHS discusses the status of SPI NAND, which is poised to follow SPI NOR and capitalize on an ideal opportunity in the embedded device market.

Findings and analysis
 In the last few years the biggest new memory technology besides TLC NAND has been SPINOR, which—with its reduced die size, cost, and power characteristics—has represented over half of annual NOR shipments since 2010. This has helped effect a major upheaval in the manufacturer hierarchy, as leaders Spansion and Micron have lost share to Asian rivals Winbond, Macronix, Eon Silicon Solution, and lately GigaDevice and Fidelix. With little concern for legacy business, these insurgents have made aggressive cost plays in serial NOR, and have enjoyed great success

Near-term market rating: Positive			
974	1.4%	▲	Week
949	2.6%	▲	1 Month
756	28.9%	▲	6 Month

Source: IHS

Weekly NAND Index - June 2013: 974

Source: IHS © 2013 IHS

First SPI NAND Report by IHS

Analyst Coverage

Pin Count Advantage of SPI Interface

Smaller application processor / MCU pin count

Customer trainings on SPI NAND advantages

Market Education

Drive SoC system and programmer support

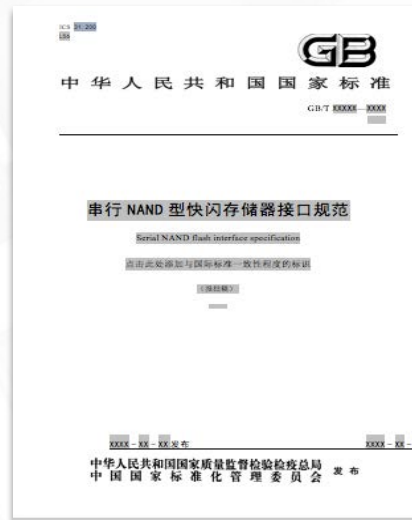
System Adoption

SPI NAND Standardization and Trademarking



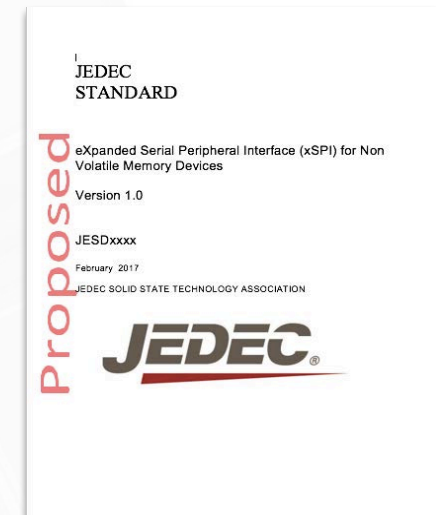
Won a trade mark dispute with Micron in 2014

Trade Mark



Lead China's SPI NAND Standardization in 2016

China Standard



Lead proposal in JEDEC xSPI TG for NVM

International Standard

SPI NAND Market Today: A Success Story

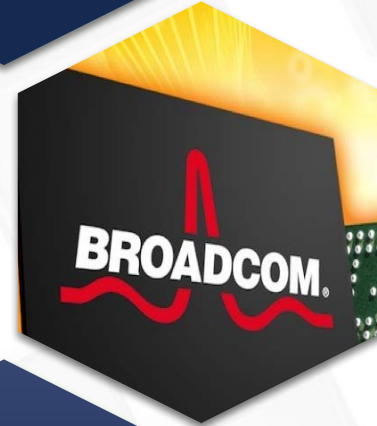


SPI NAND Vendors

Toshiba, GigaDevice, Micron, Macronix, Winbond, and many others

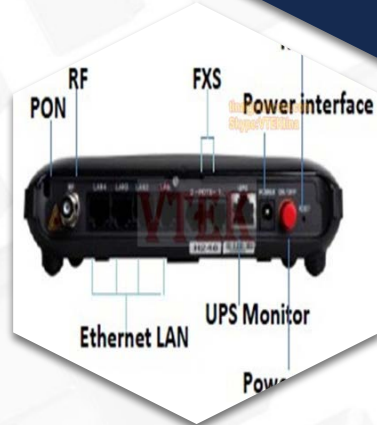
More than 70 SoC design wins at GigaDevice alone

SoC Vendors



Application Areas

NetCom, Surveillance, Set top Box, DV, Audio Toys, BMS, Metering, etc.



Summary

- Specialty memory is a growing sector with significant market potential
- Mainland China has developed an eco-system for specialty memory. However, it is still at an early stage of development
- There are plenty of room for innovations in specialty memory. SPI NAND is an example of international collaboration lead by a Chinese company.



G i g a D e v i c e