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2014 NAND Flash Market Update

-Supply, Demand and Beyond-

Memory and Storage Division
Sean Yang
June 5th , 2014

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Supply, Sufficiency and ASP

TAIPEI SHENZHEN SHANGHAI BEIJING

DRAMeXchange www.dramexchange.com
WitsView www.witsview.com
LEDinside www.ledinside.com
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NAND Market Revenue Trend

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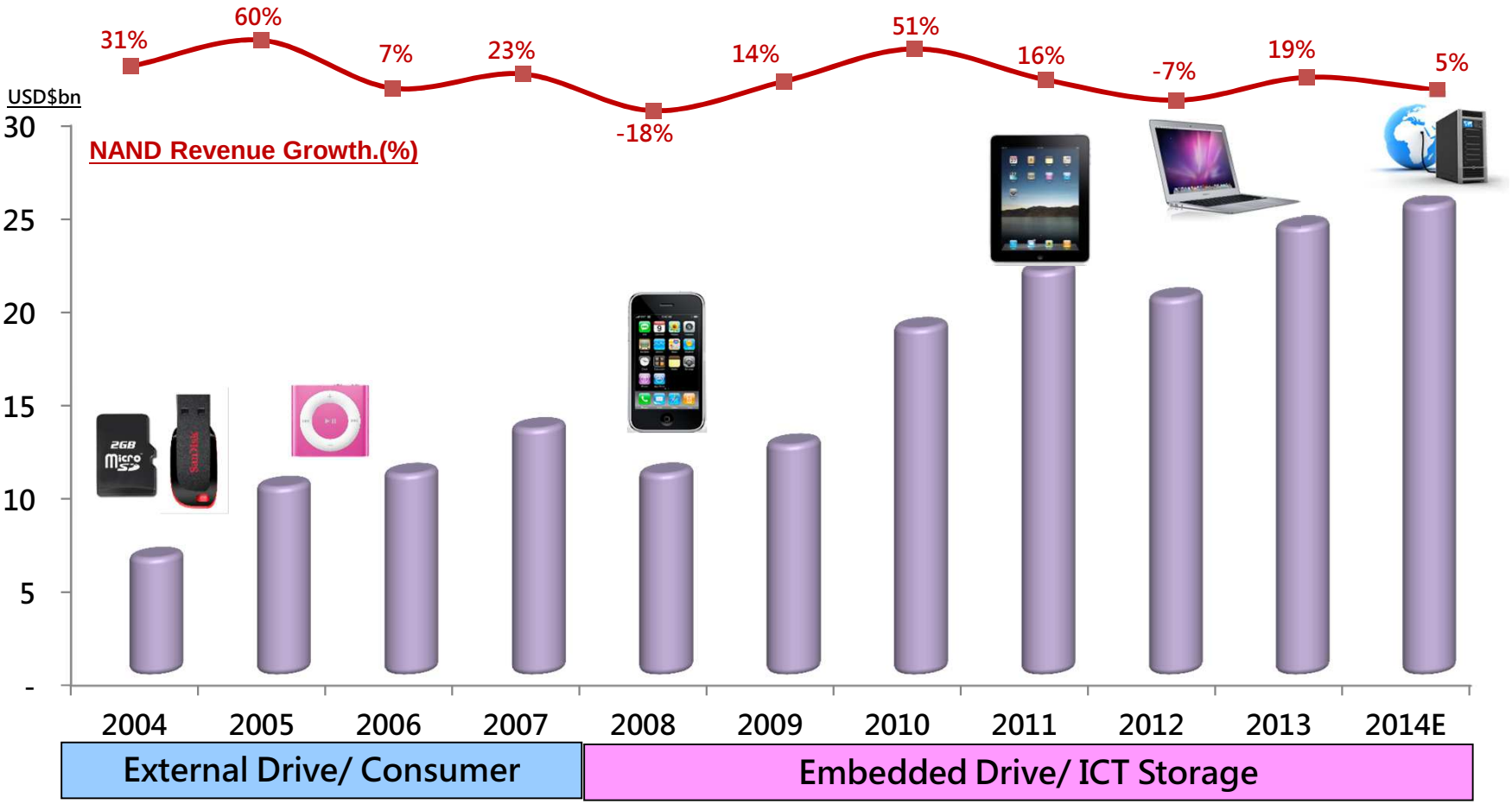
- 2014 NAND market revenue continues to grow with solid demand from diversified applications.

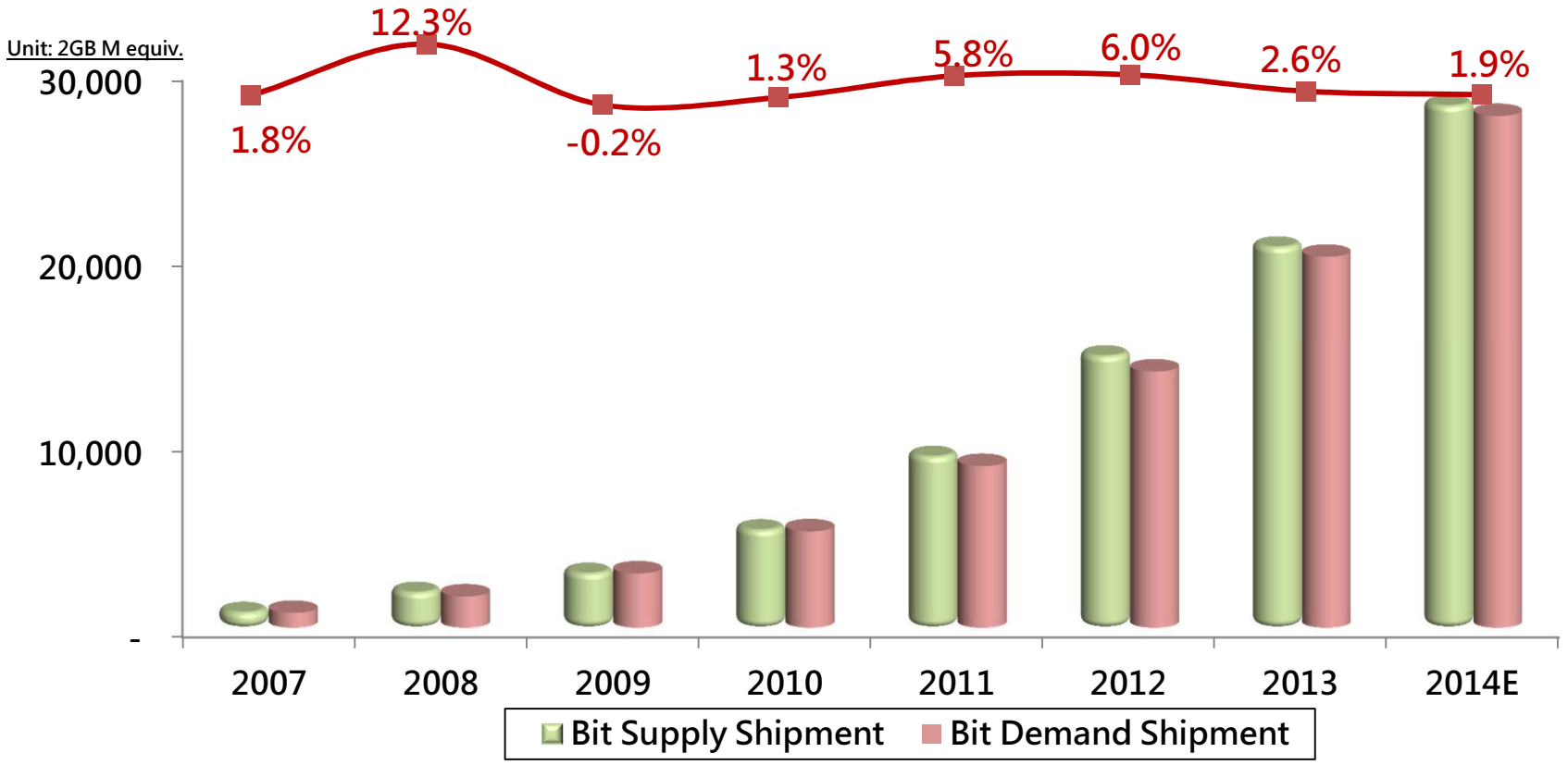


Source: DRAMeXchange,June2014

DRAMeXchange

2014 NAND Market: Balance is the Theme

- 2014: Supply growth @38% YoY, Demand grwoth@39% YoY.
- NAND makers are profit-oriented and conservative toward supply strategy.
- Supply & Demand balance is a new paradigm.

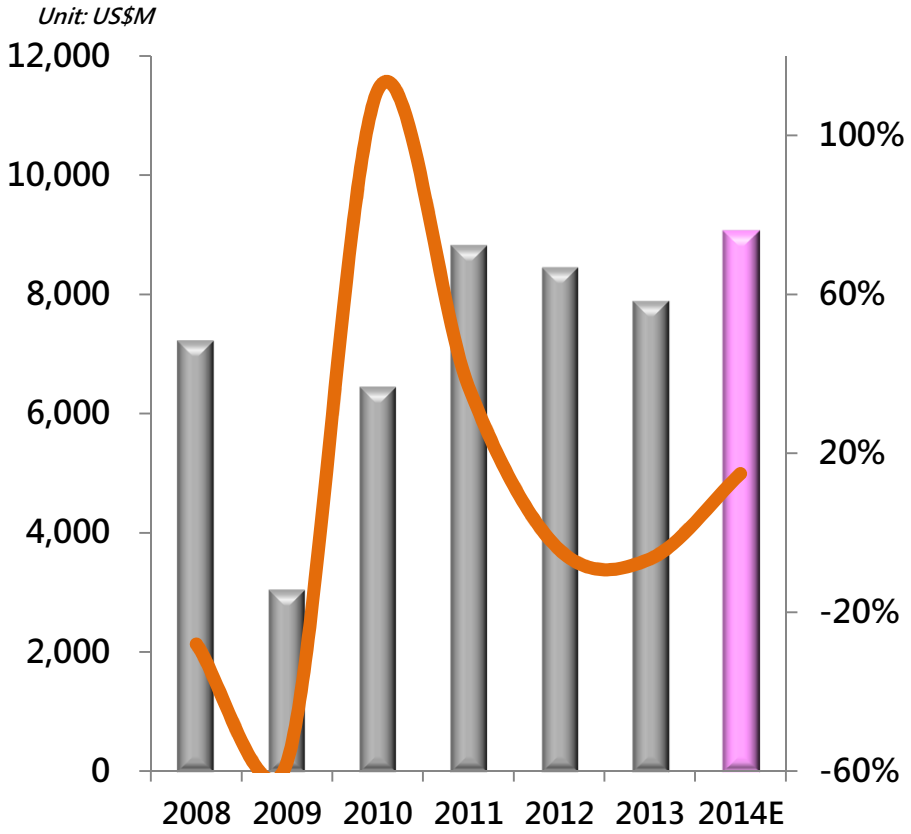


Source: DRAMeXchange,June2014

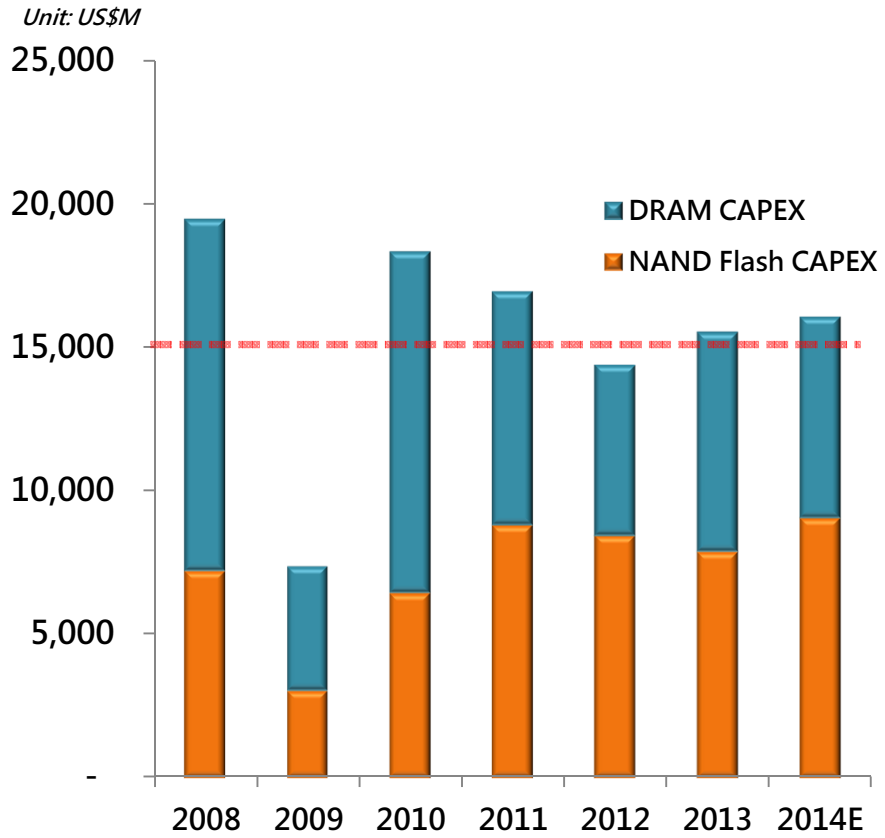
CAPEX: Preparation for 3D-NAND Era

- 2014 CAPEX : US$9.2 Bn with 15%yoy , mostly reserved for 3D-NAND in the future.
- Memory CAPEX is US$15-16 Bn level, allocation favor on NAND.

NAND Flash CAPEX



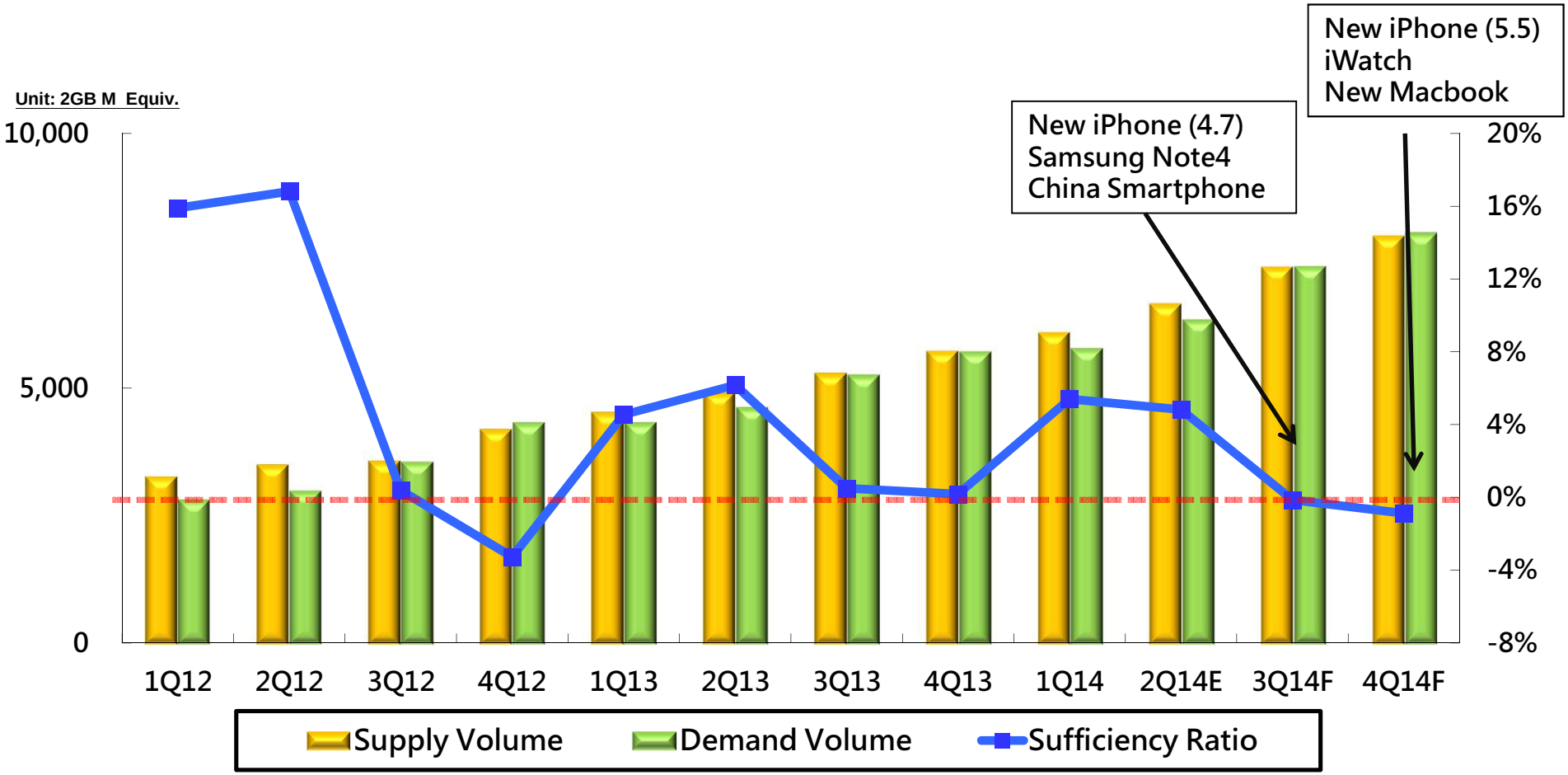
CAPEX: DRAM vs. NAND



Source: DRAMeXchange,June2014

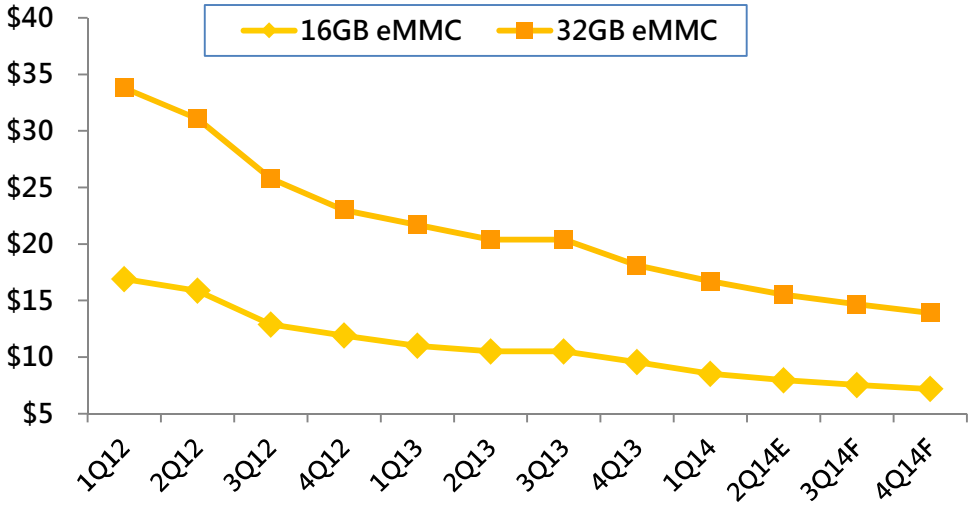
2014 Quarterly Sufficiency

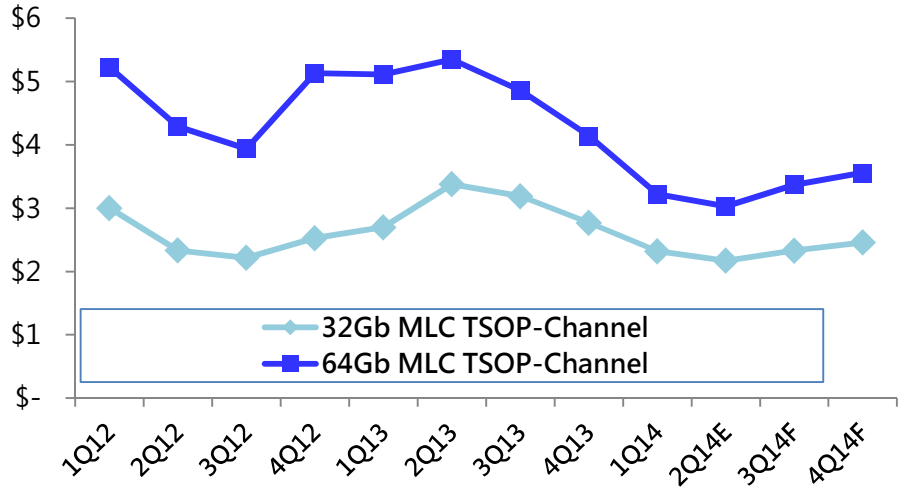
- 1H14 Weaker OEM and retail market results in over-supply pattern.
- Momentum from new OEM demand helps to ease S&D imbalance in 2H14.

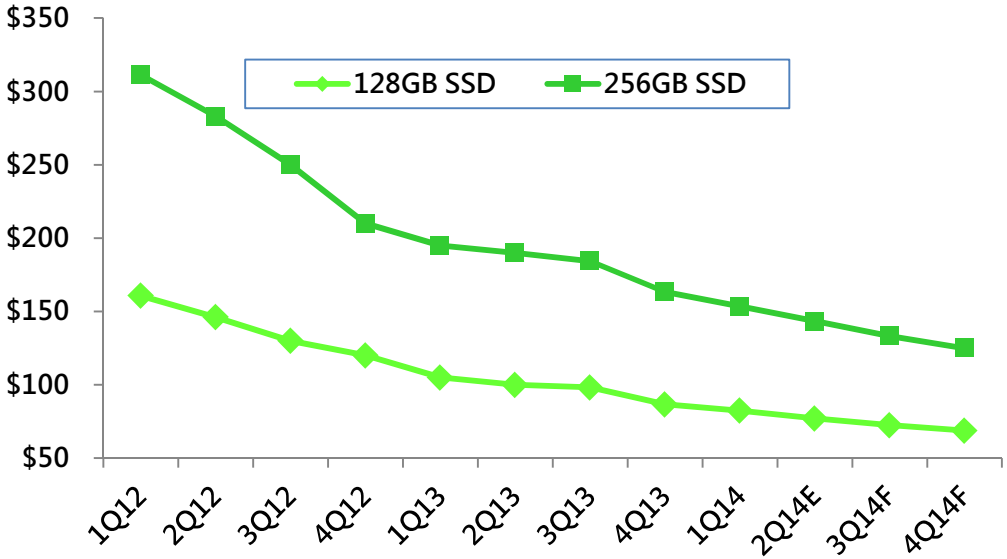


Source: DRAMeXchange,June2014

ASP Trend: Different Pattern for OEM and Channel







- Embedded (eMMC, SSD) price stably declined QoQ, mostly reflecting cost down from migration.
- Channel chip price is the mix of market supply and demand.

Source: DRAMeXchange,June2014

NAND Capacity: Added Slightly for 2014

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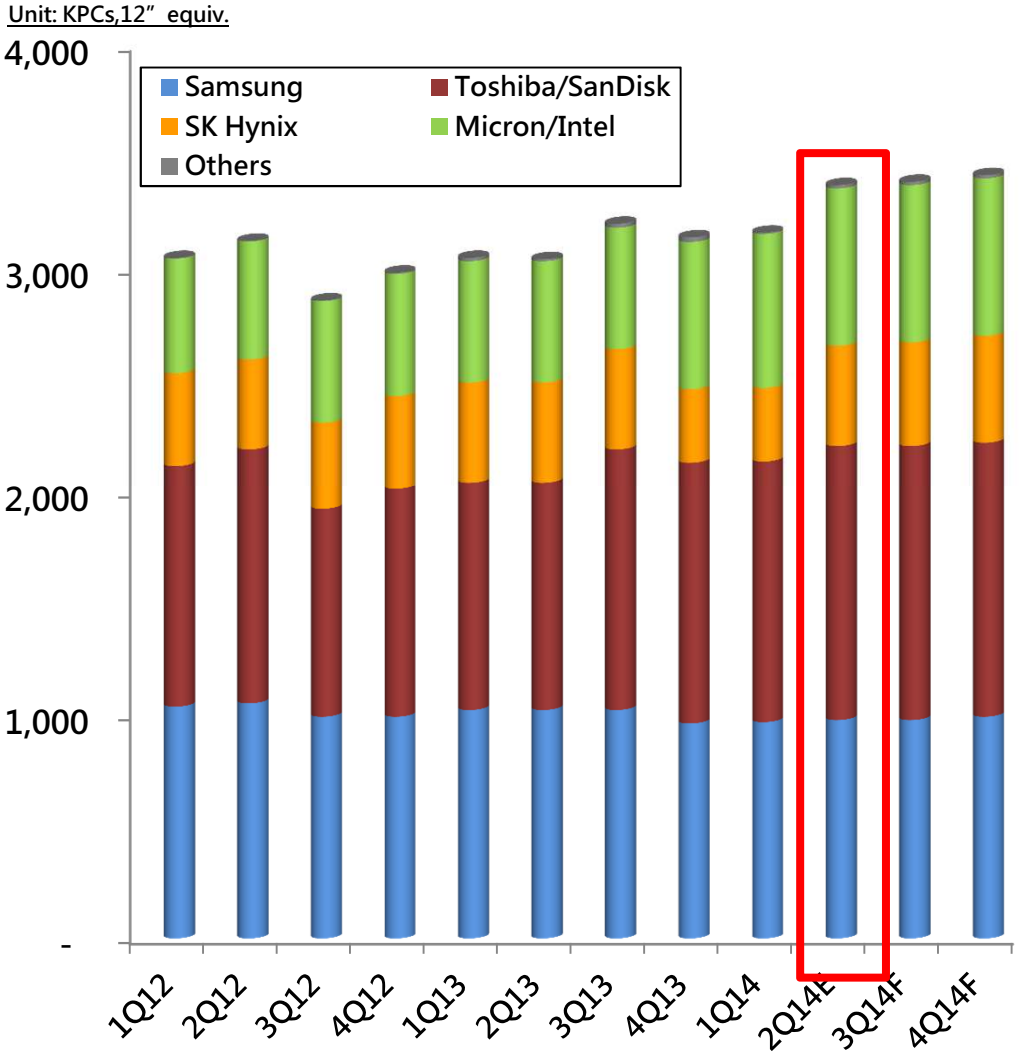

Source: DRAMeXchange,June2014

- 2014 NAND capacity +8% YoY.
- Hynix NAND capacity will be fully recovered from 142Q (150k/m).
- Micron Singapore fab transition will be completed, total Micron/Intel NAND capacity is up 235k/m from 142Q.
- Toshiba Fab5 Phase2 infrastructure is set from 14Q3, equipment installation from 14Q4.
- Samsung Xian fab and 3D-NAND schedules fall behind.

DRAMeXchange

2014 Bit Output: Derived from Node Migration more

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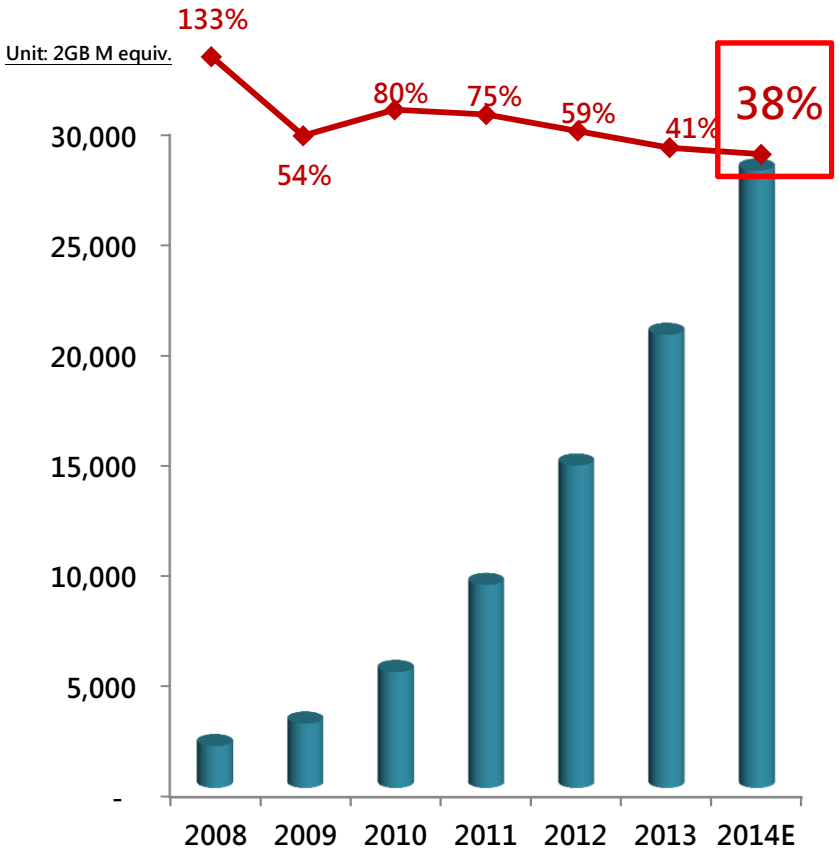
Source: DRAMeXchange,June2014

- Bit output is strongly driven by 1ynm embedded adoption and 1znm-class migration from 2H14.

Supply Dynamics: Limited Growth &Constant Share

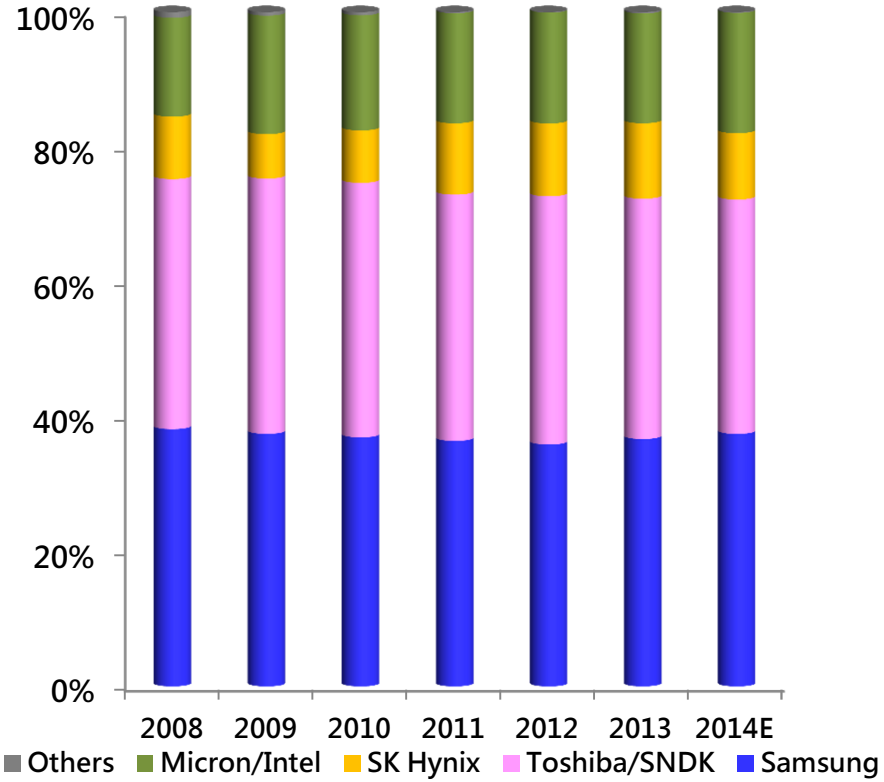
- Supply bit growth is 7-year-low level.
- Market Share: SEC@37%, TSB/SNDK@35%, MU/INTL:@17%, Hynix:@10%
- Rational supply strategy is predictable under game theory.

Bit Supply Trend



Source: DRAMeXchange,June2014

Market Share (Production Base)



NAND Financials : Profitability Remains but Squeezing

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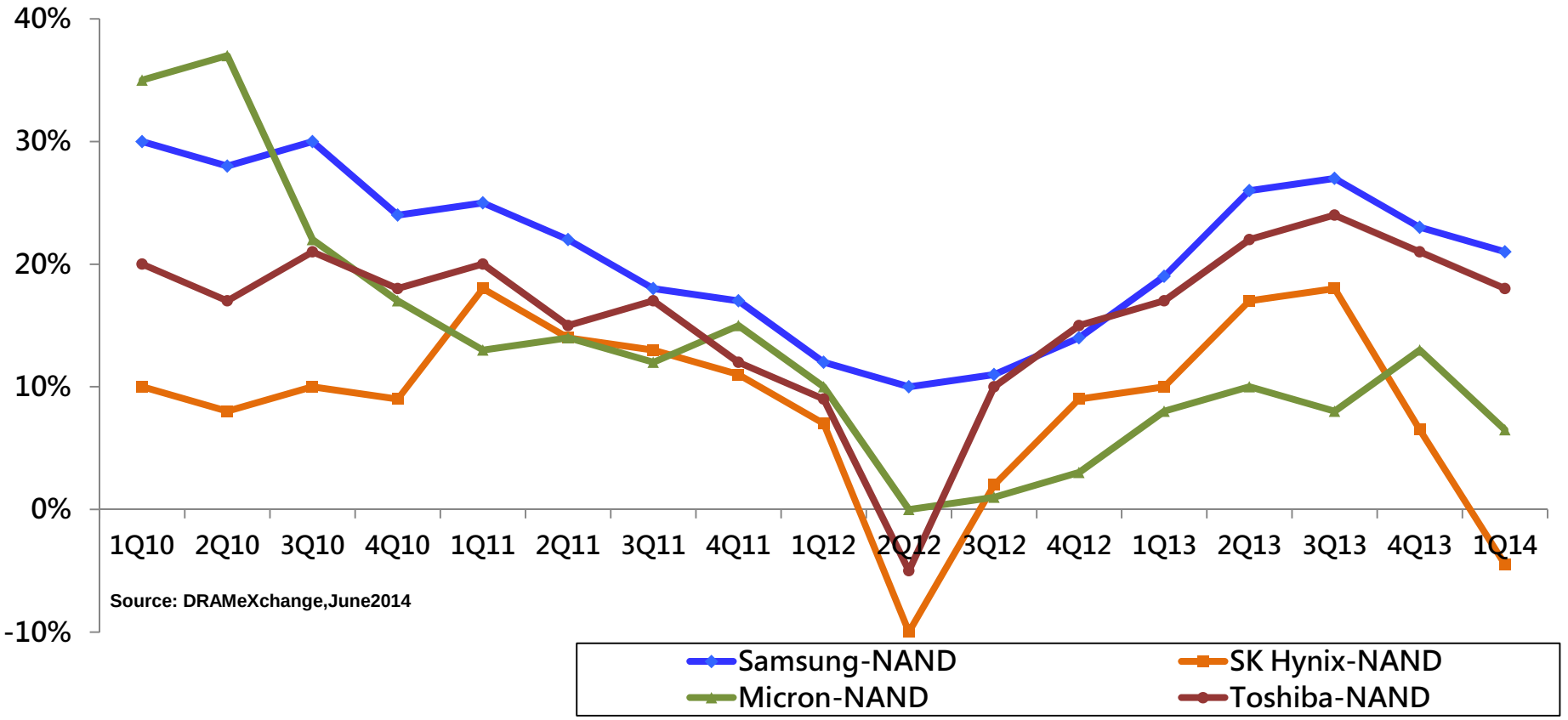
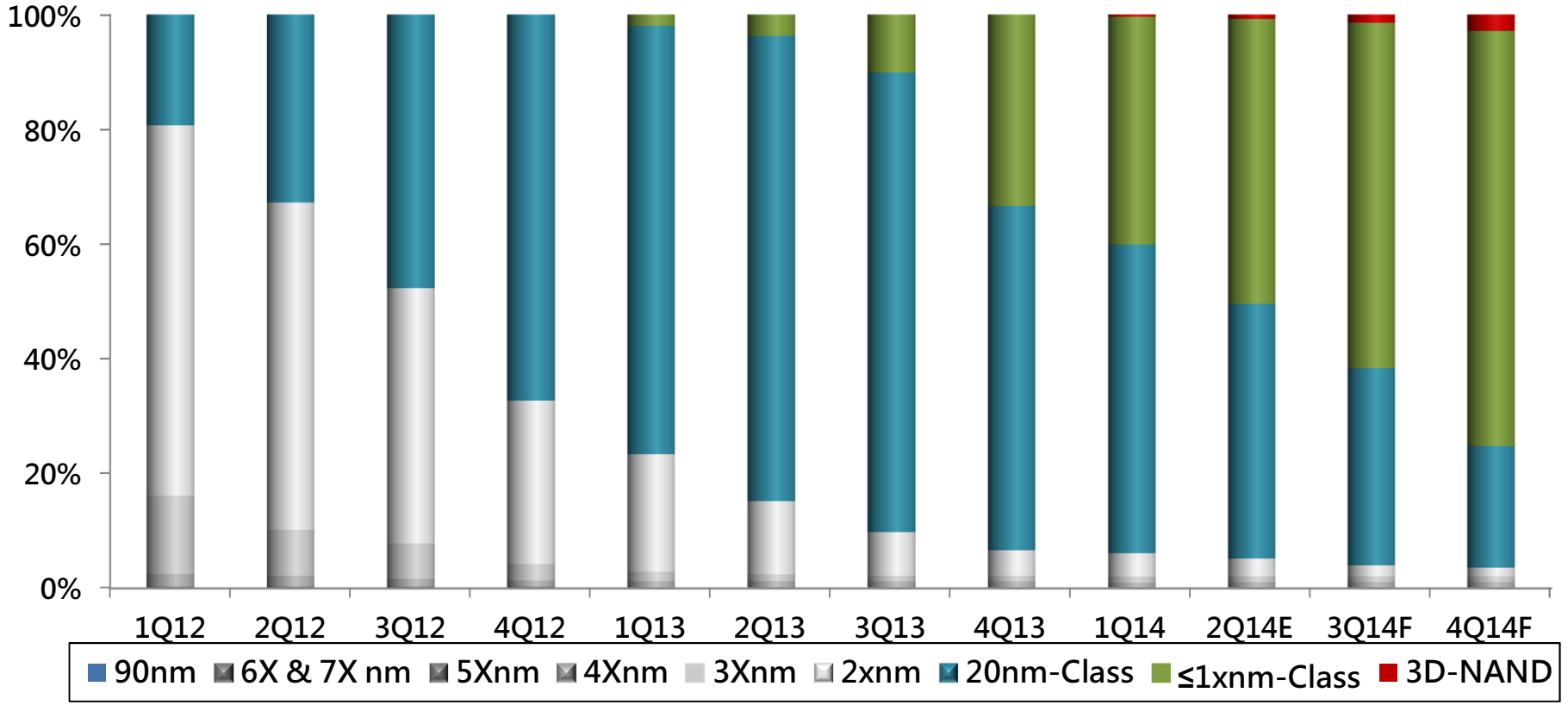
- Operating profit margin stabilization is challenging.
- SSD, eMMC and eMCP margin >card, UFD.
- Customer and product portfolio is the key to margin management.



Migration: 1xnm-class Embedded is through 2014, Limited Exposure for 3D-NAND



Source: DRAMeXchange,June2014

- Samsung full lineup for 19nm eMMC, eMCP and SSD is ready in from 1Q14.
- Toshiba & SanDisk 1ynm eMMC MP schedule is in 142Q.
- Hynix 16nm eMMC MP schedule is in 142Q.
- Mostly 1xnm-class SSD for PC schedule from 14Q13.
- 3D-NAND (%): <2% in 2014

3D-NAND is the Next Super Star

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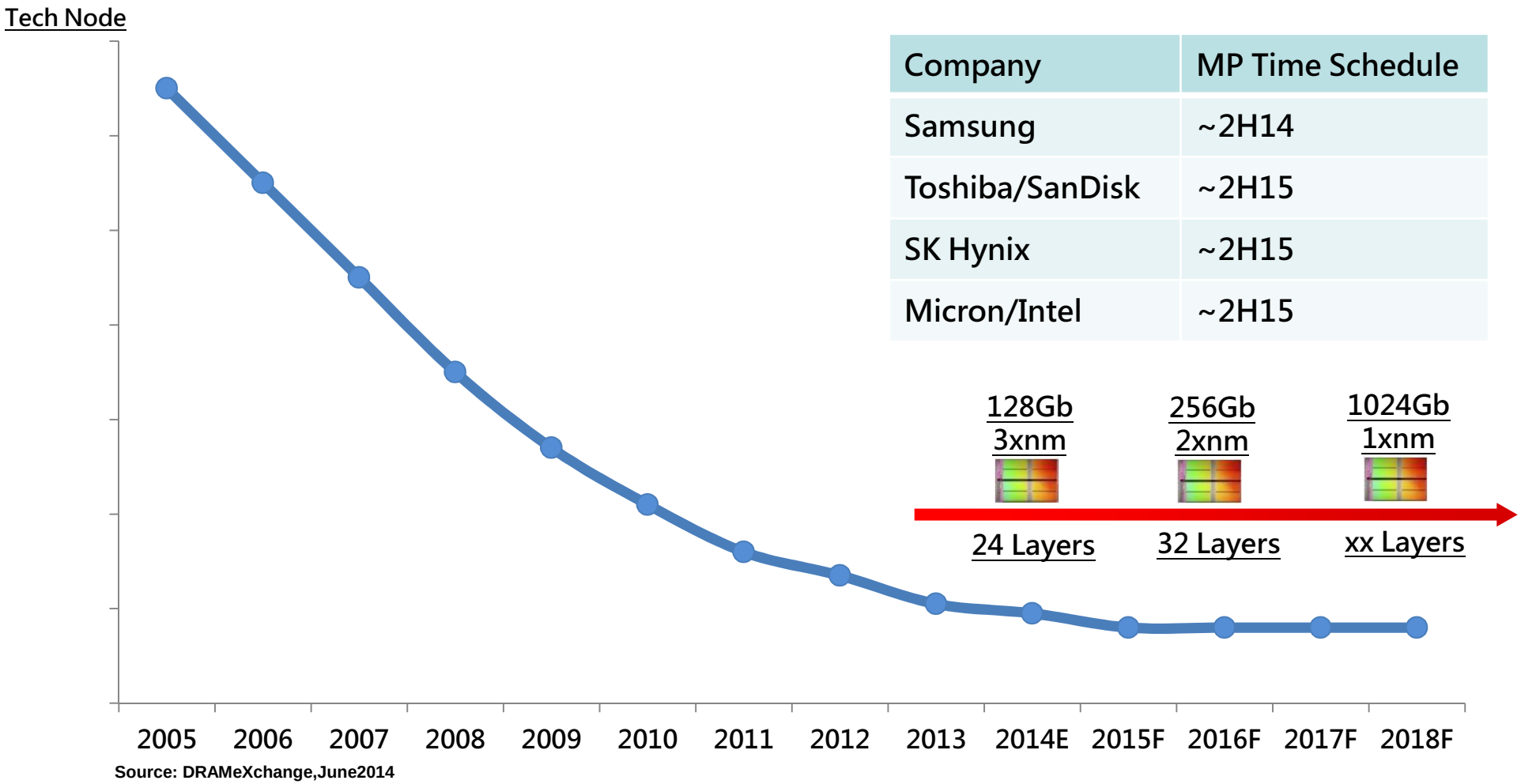
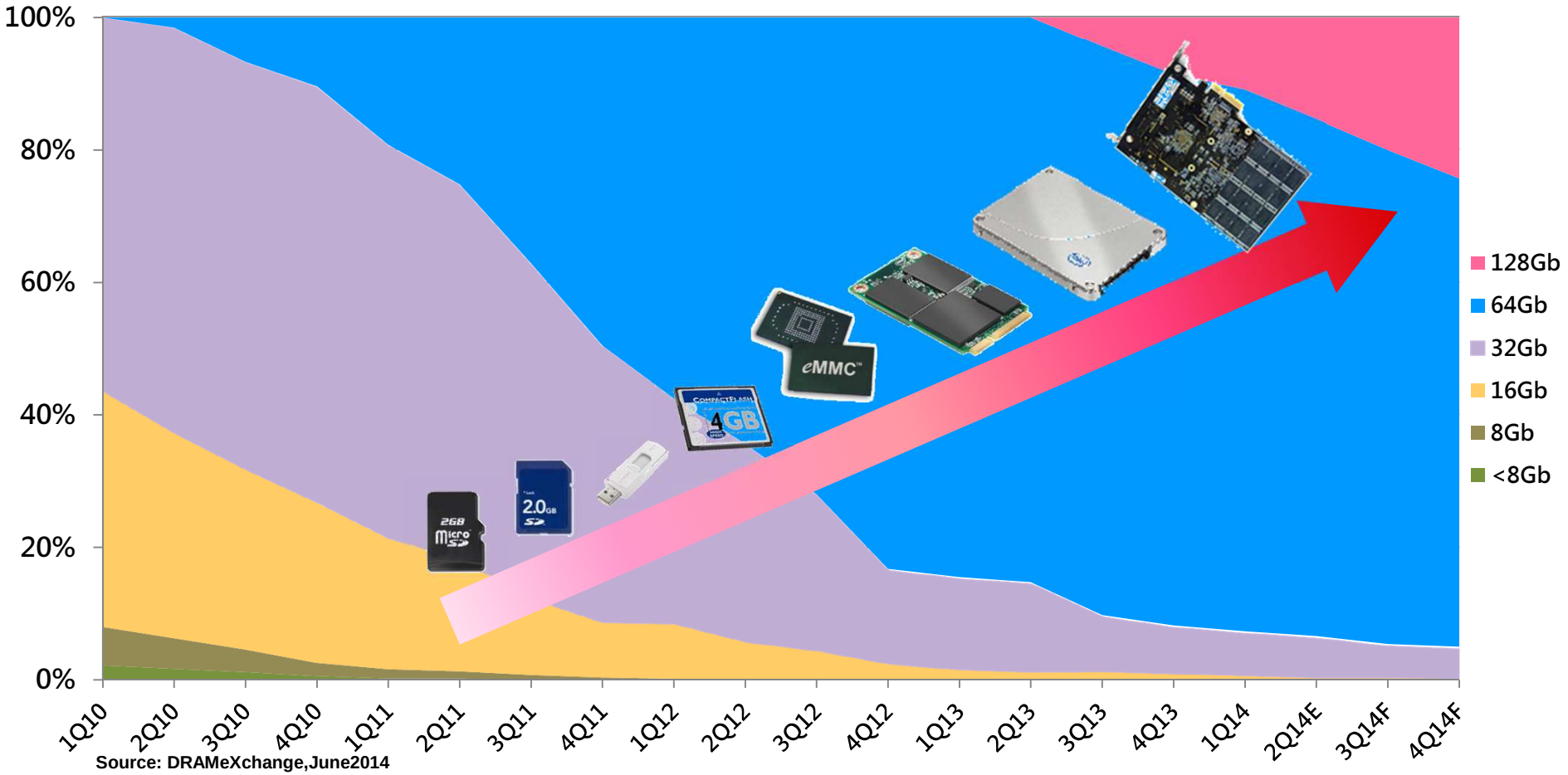
Company	MP Time Schedule
Samsung	~2H14
Toshiba/SanDisk	~2H15
SK Hynix	~2H15
Micron/Intel	~2H15



Source: DRAMeXchange,June2014

- 2D-NAND migration comes to bottleneck from 2015 (1znm is the last generation).
- 1znm node will be paralleled to 3D-NAND in 2015 and 2016.

Density: SSD and Node Migration Drives Density



Source: DRAMeXchange,June2014

- 128Gb portion is up to 25% in 4Q14 and cost-efficient in 1znm node production.
- SSD requires 128Gb or higher chip for larger capacity design.
- Enterprise-SSD content per box reaches ~600GB in 2014.

Technology: 3-Bits-Cell Embedded is the Key

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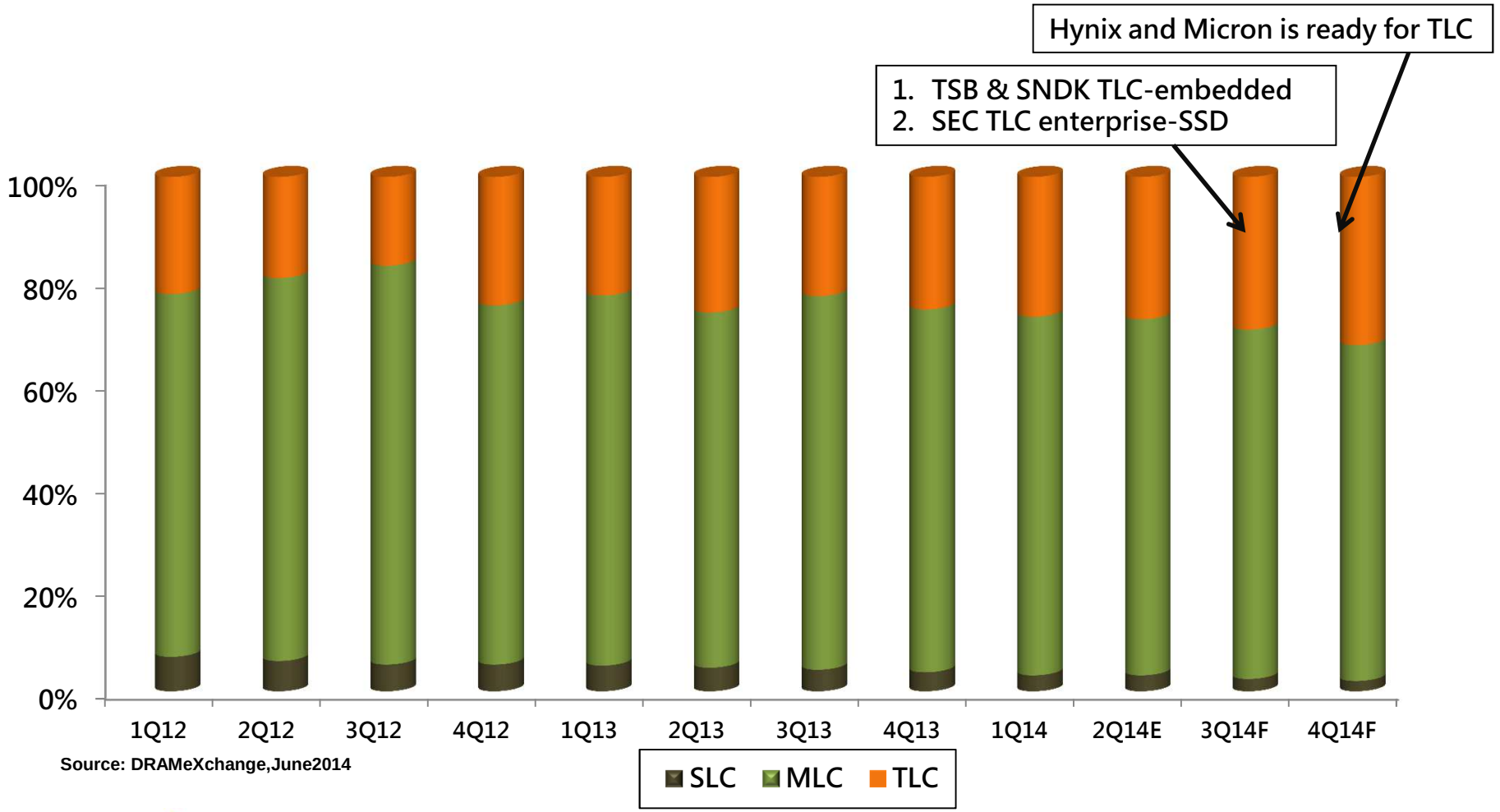
- 3-bits-Cell eMMC, eMCP and SSD are the next drivers for client OEMs.
- Samsung is pioneering 3-bits-cell SSD for enterprise market from 14Q3.

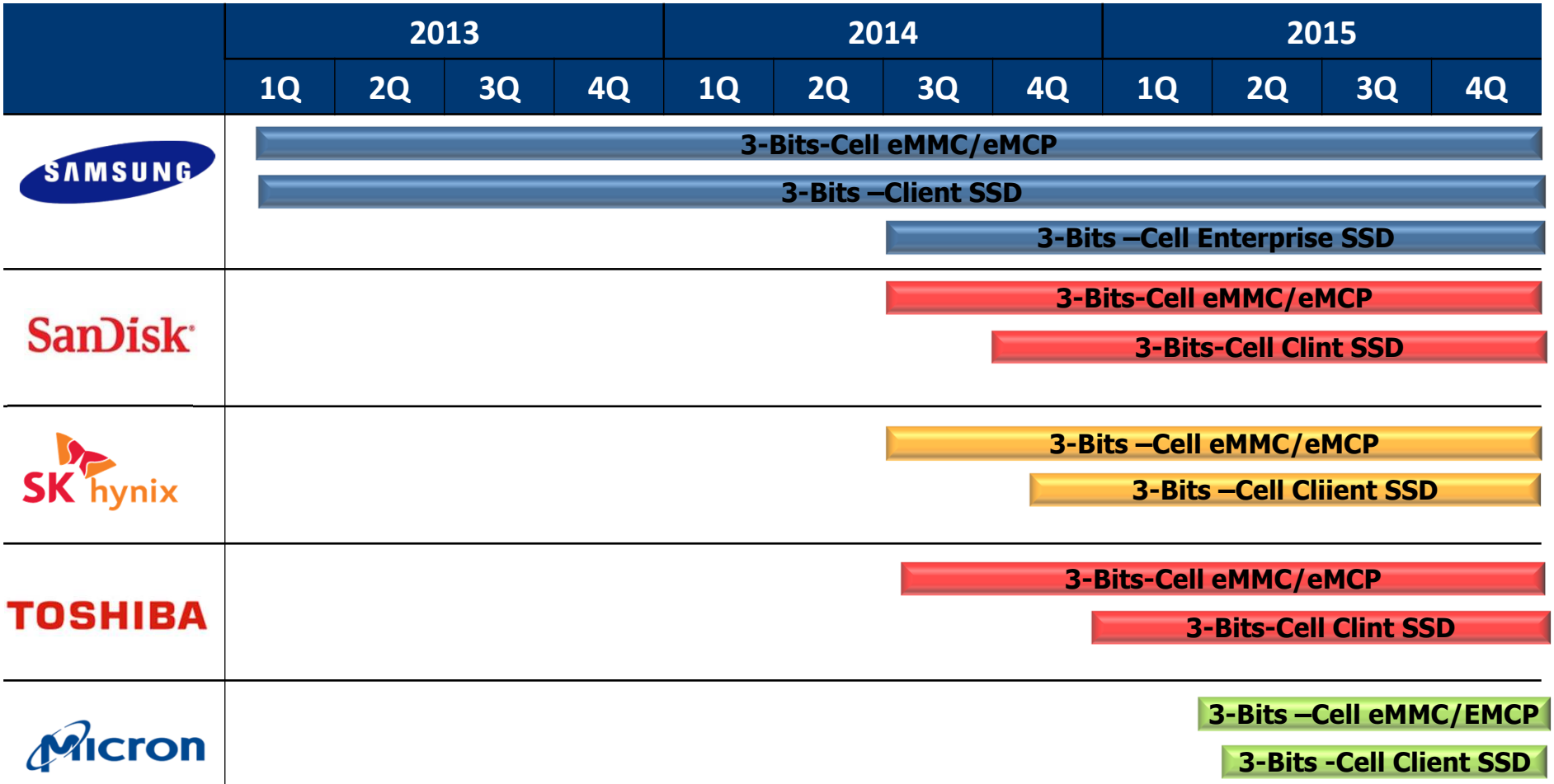


Source: DRAMeXchange,June2014

Roadmap for 3-Bits-Cell Schedule

- Samsung is introducing full lineups for 3-Bits-Cell embedded products from 14Q3.
- Other NAND makers 3-Bits-Cell products will be unveiled from 2Q14

Source: Company data, complied by DRAMeXchange,June2014



NAND Flash Vendor Review-Samsung

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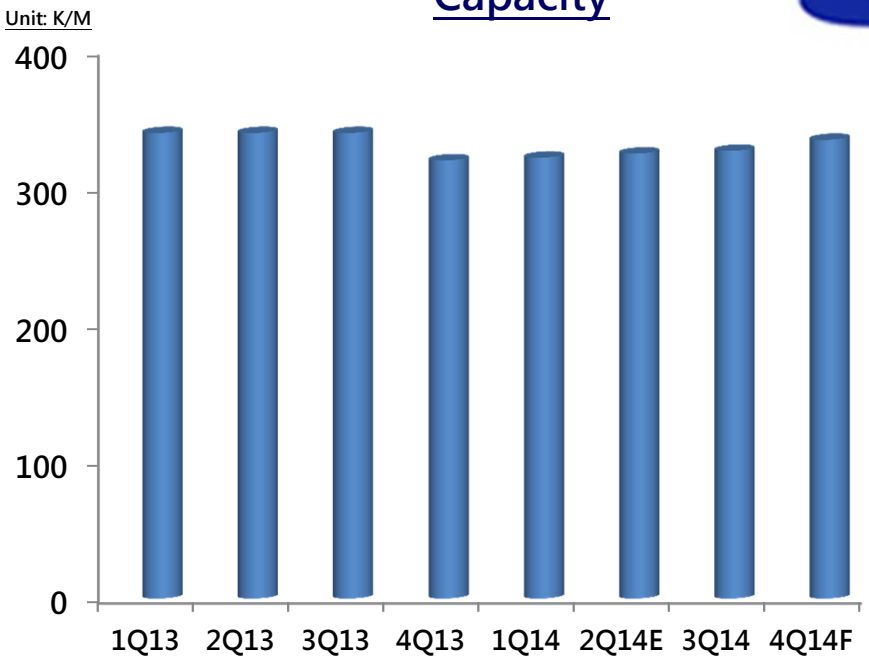
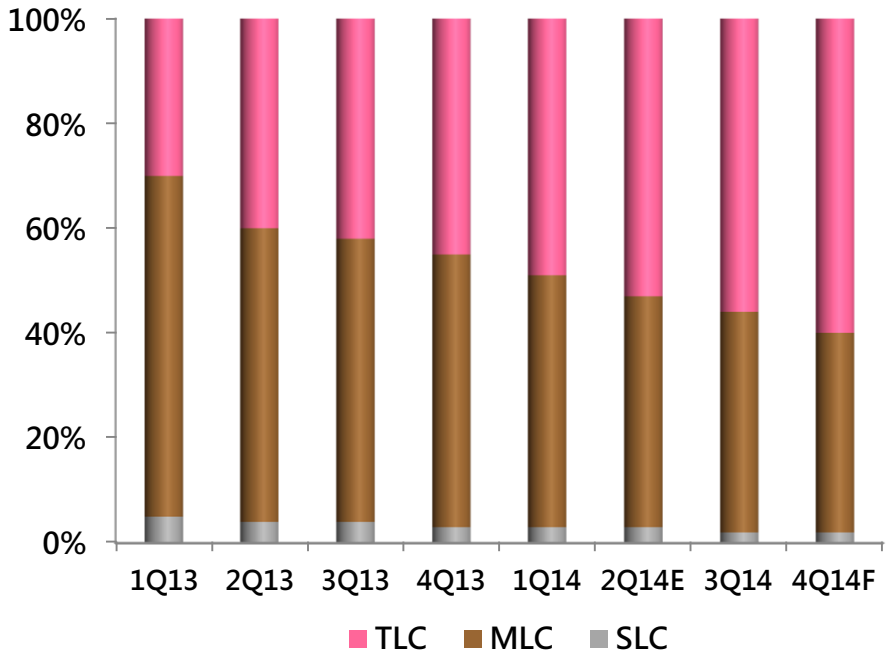
SAMSUNG

Capacity



Product Mix



Source: DRAMeXchange,June2014

- 2014 target bit growth:40%YoY
- Xian-An Fab production has been initiated from 1Q14 and dedicated on 3D-NAND.
- TLC-basis eMMC and SSD is the key in 2014.
- Strength: Strong leverage with Samsung smartphone and tablet.

NAND Flash Vendor Review-SanDisk/Toshiba

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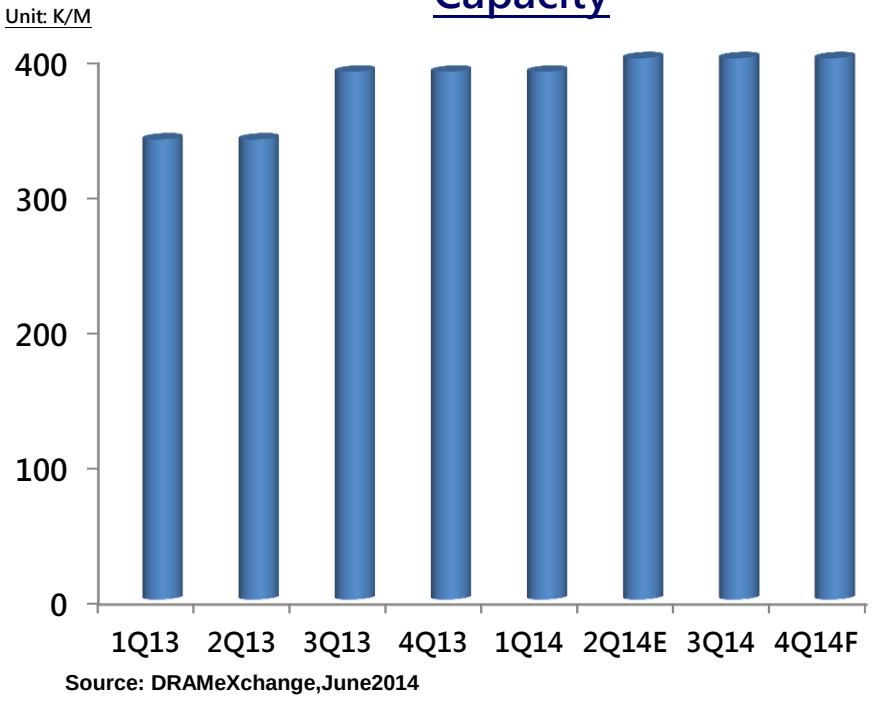
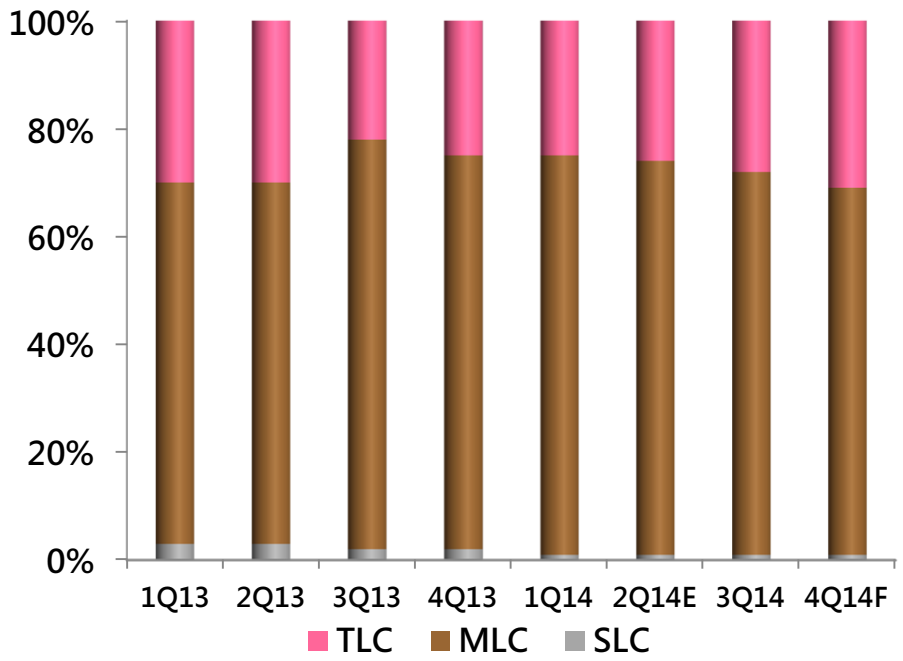
TOSHIBA SanDisk

Capacity



Source: DRAMeXchange,June2014

Product Mix



- 2014 target bit growth:35%YoY
- Fab5 Phase2 infrastructure will be completed in 3Q14 for 1znm and 3D-NAND.
- TLC-Basis embedded products are scheduled from 3Q14.
- Toshiba is seeking more engagement with more 1st-tier OEMs.
- SanDisk targets >25% SSD revenue contribution in 2014, strongly focus on enterprise-SSD.

NAND Flash Vendor Review-SK Hynix

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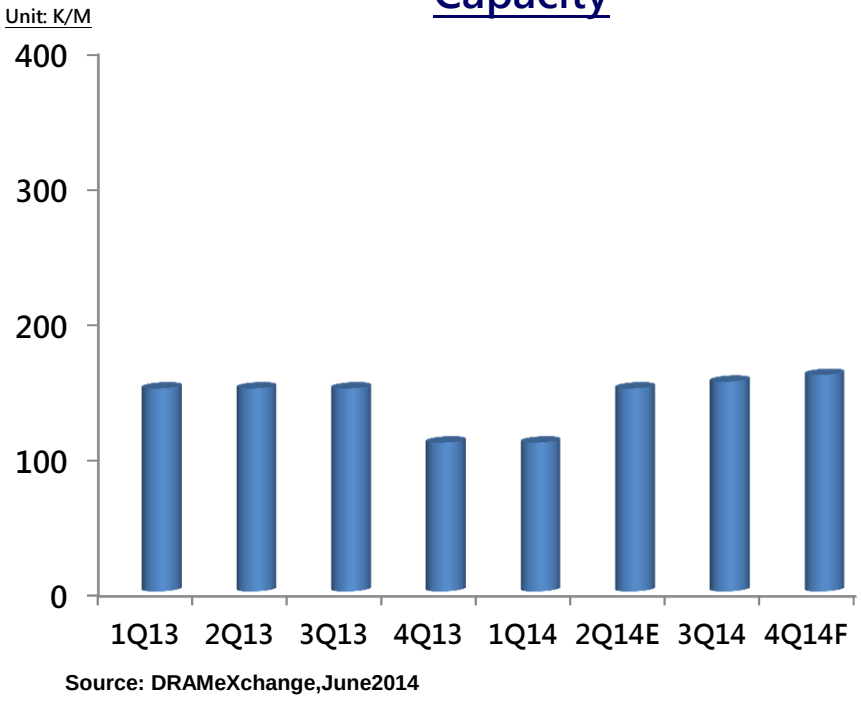
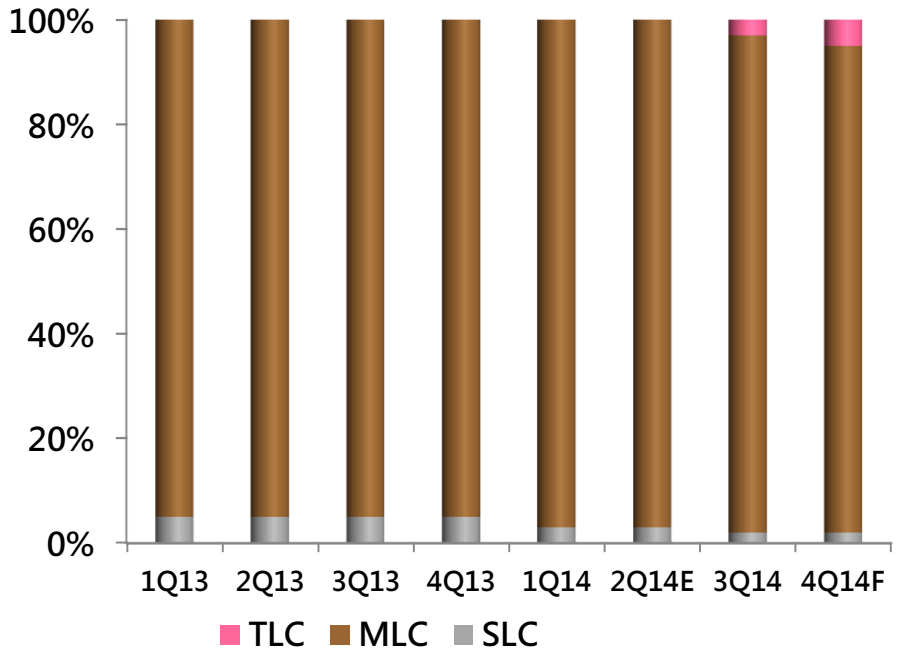
SK hynix

Capacity



Product Mix



Source: DRAMeXchange,June2014

- NAND capacity is recovered to normal level (150k/m) from late 1Q14.
- In-house eMMC and SSD controller is the key to embedded product success.
- TLC-basis eMMC and SSD schedule to ramp from 2H14.

NAND Flash Vendor Review-Micron/Intel

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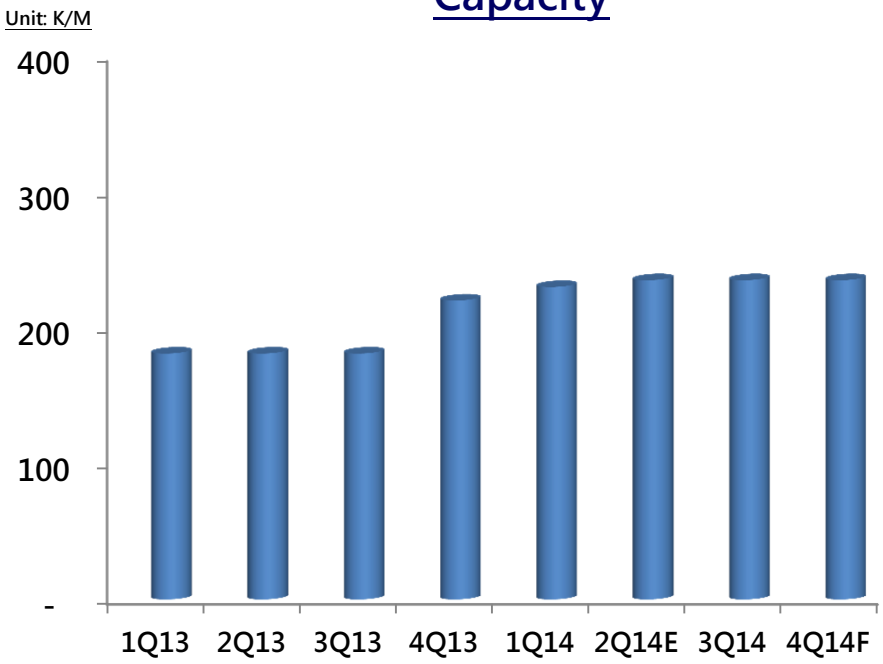
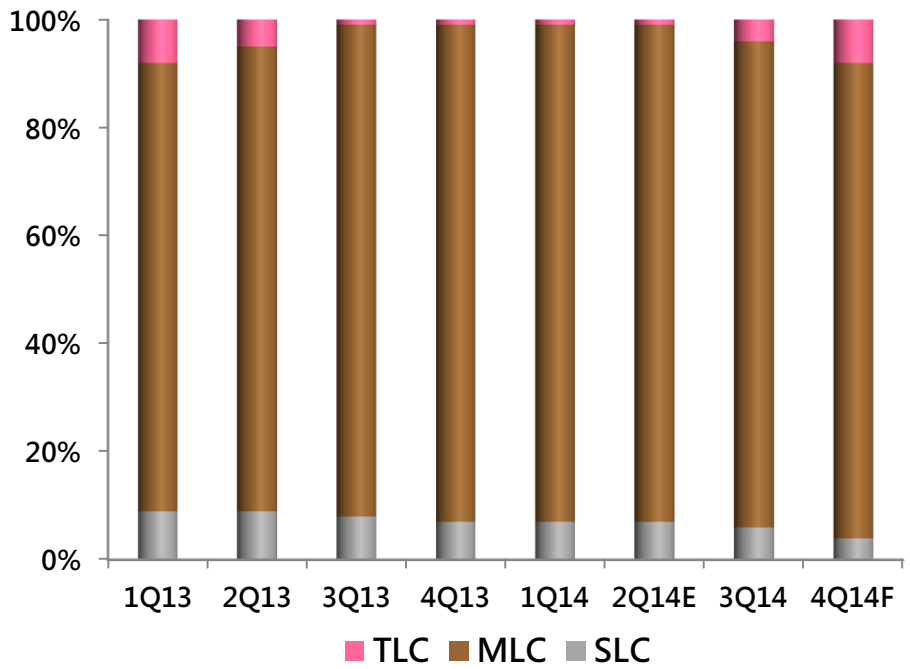
Micron intel

Capacity



Product Mix



Source: DRAMeXchange,June2014

- 2014 target bit growth:45-50%YoY.
- Singapore fab fabrication transition to NAND will be completed in 142Q.
- Next generation mobile embedded will catch up from 4Q14 when Elpida mDRAM and new controller is fully utilized.
- Intel positioned itself as a enterprise-SSD technology enabler in the field.

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Demand and Applications

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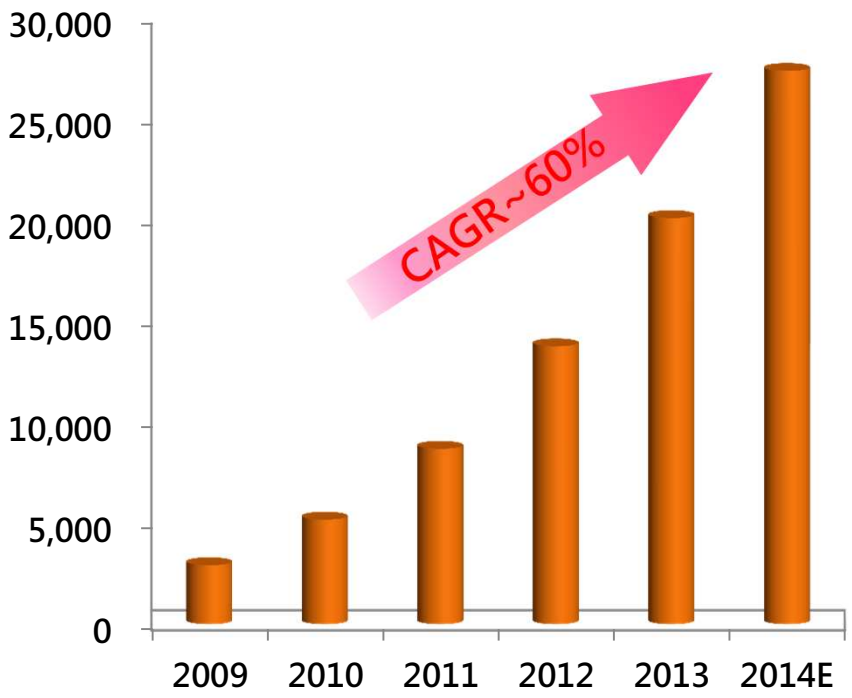
NAND Demand Outlook

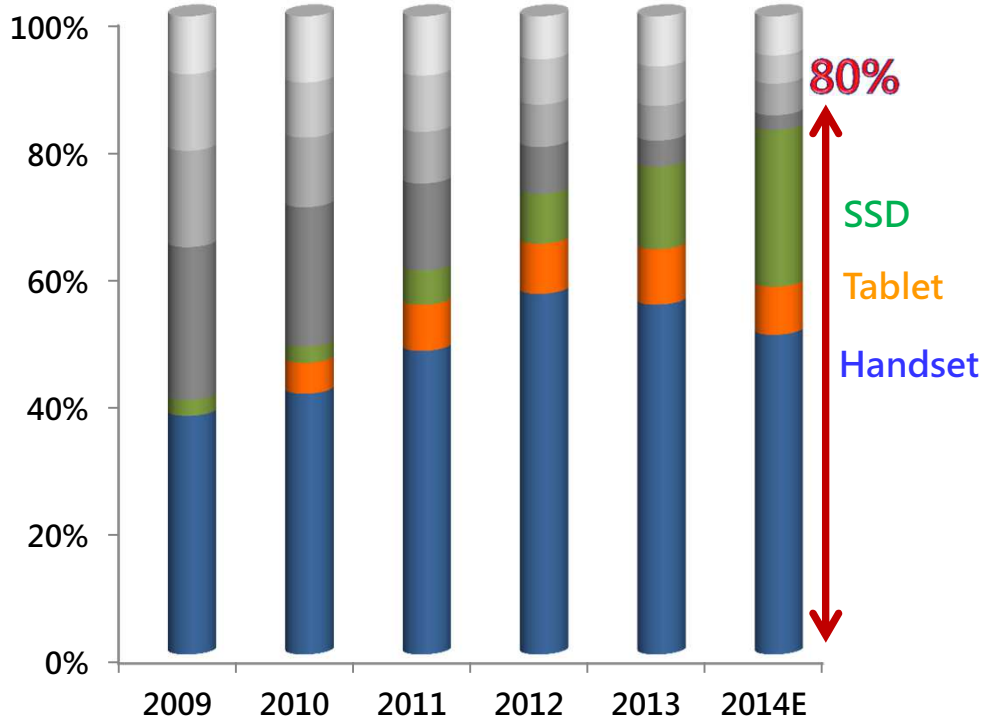
- Demand catalyst continues with strong mobile and enterprise applications.
- SSD is #No.1 growth driver in 2014.
- Smartphone+ Tablet+ SSD consumes ~80% of total NAND.

Unit: 2GB M equiv.

Demand Bit Volume



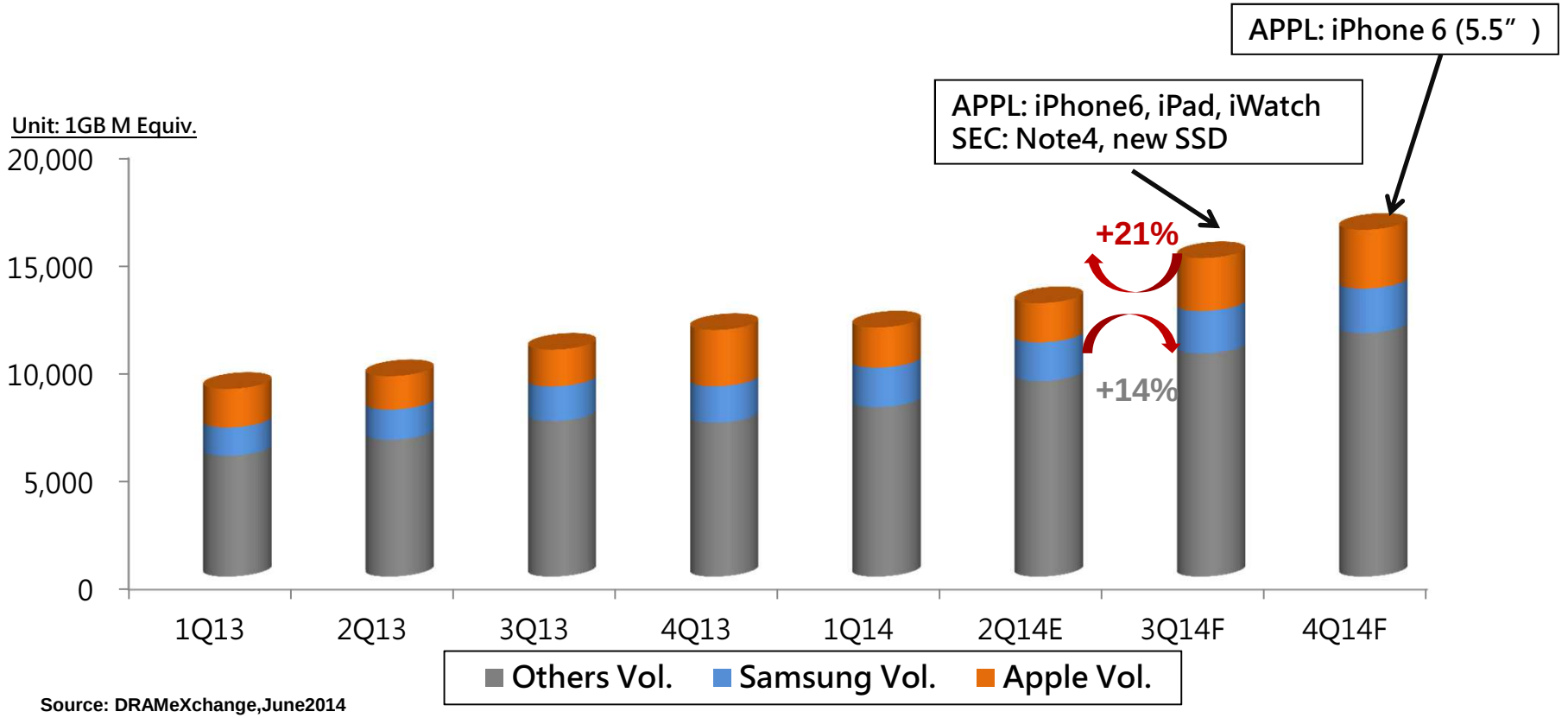
Demand by Application



Source: DRAMeXchange,June2014

NAND Demand: Apple and Samsung

- Apple and Samsung have series of new product launch at from143Q.
- Demand bit growth from Apple and Samsung outperforms market average in 3Q14, significantly helps to ease the market imbalance.
- Apple and Samsung steadily consume ~30% of total NAND.



Source: DRAMeXchange,June2014

eMMC Market Outlook

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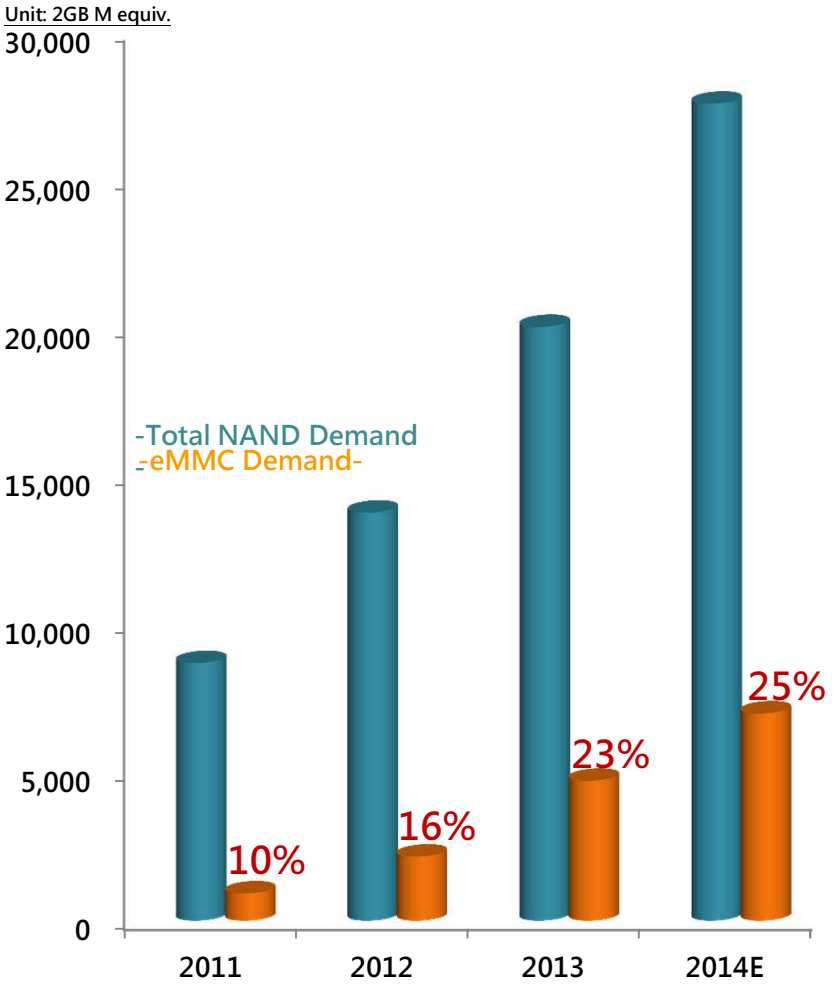
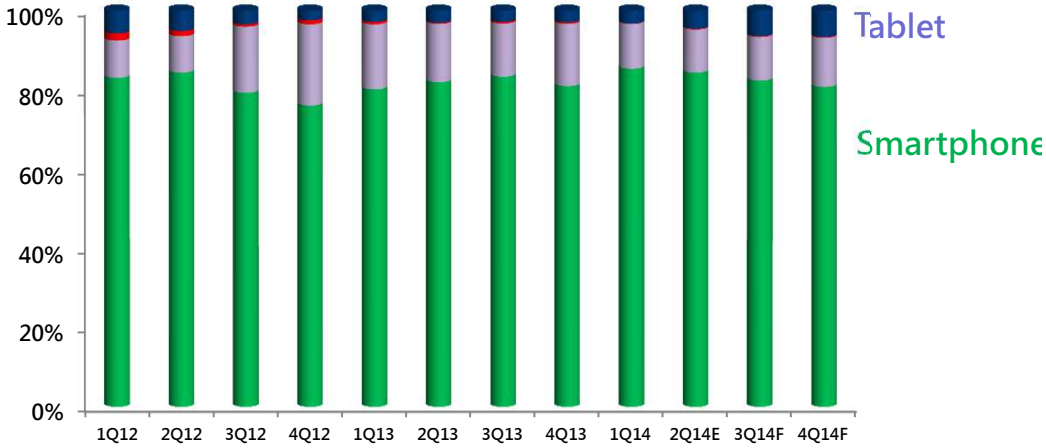
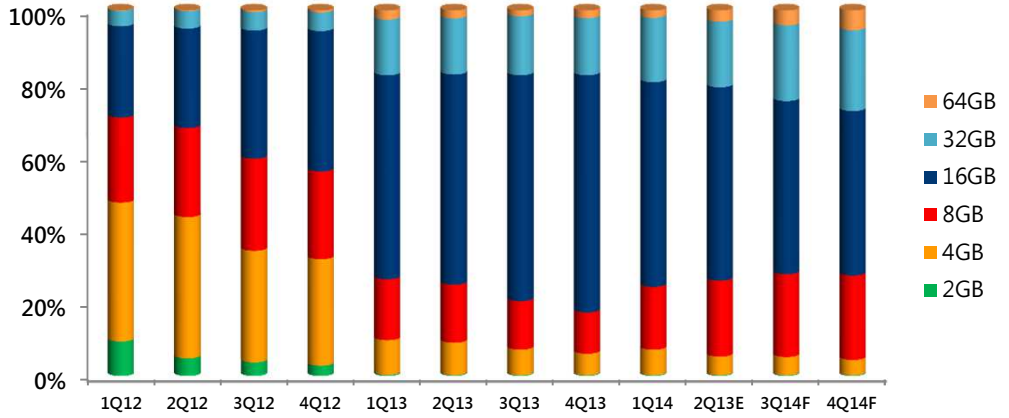
eMMC Consumption(%)



Consumption by Application



Shipment by Density



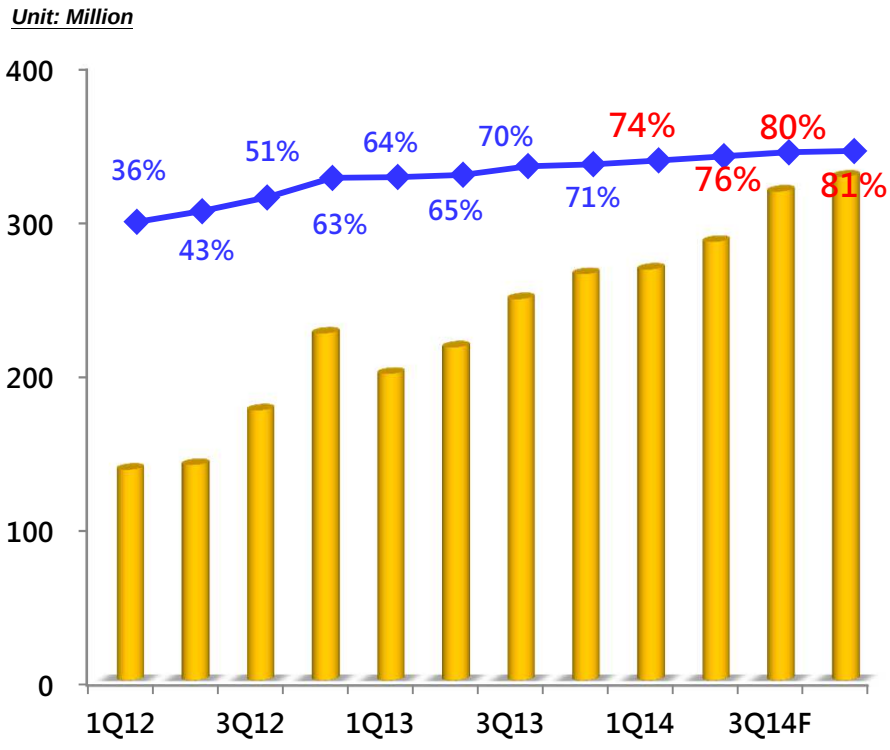
Source: DRAMeXchange,June2014

- eMMC market grows along with solid mobile devices.
- Middle/Low –end models stifles eMMC content per box.

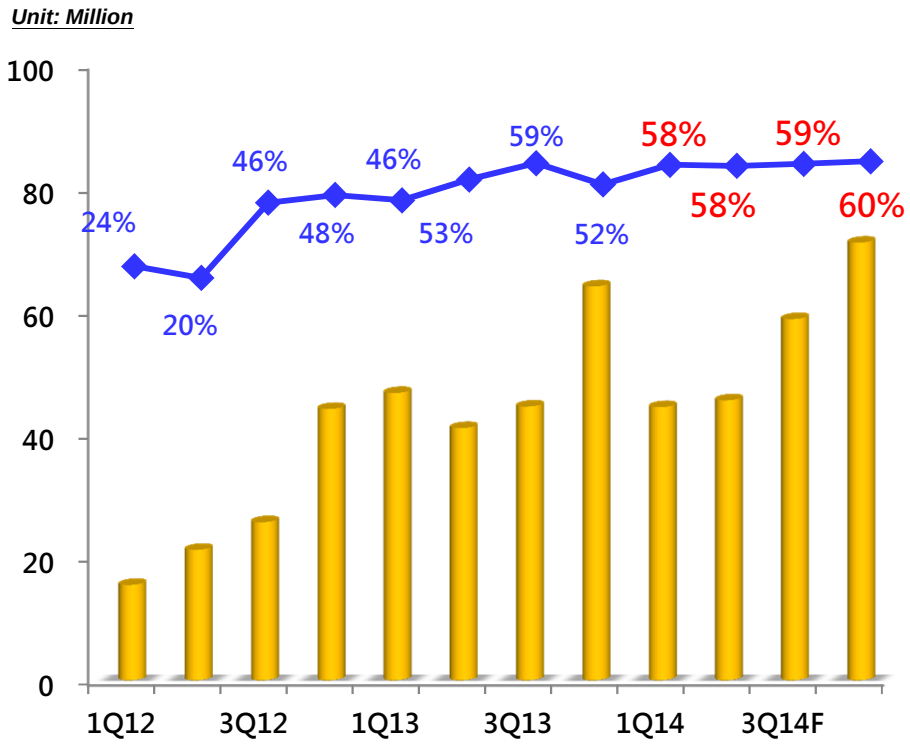
eMMC in Mobile Device: A Common Standard

- eMMC is widely adopted for better performance and advanced O.S.
- eMMC is storage standard for major AP vendors.
- Apple use pure NAND only.

eMMC % in Smartphone



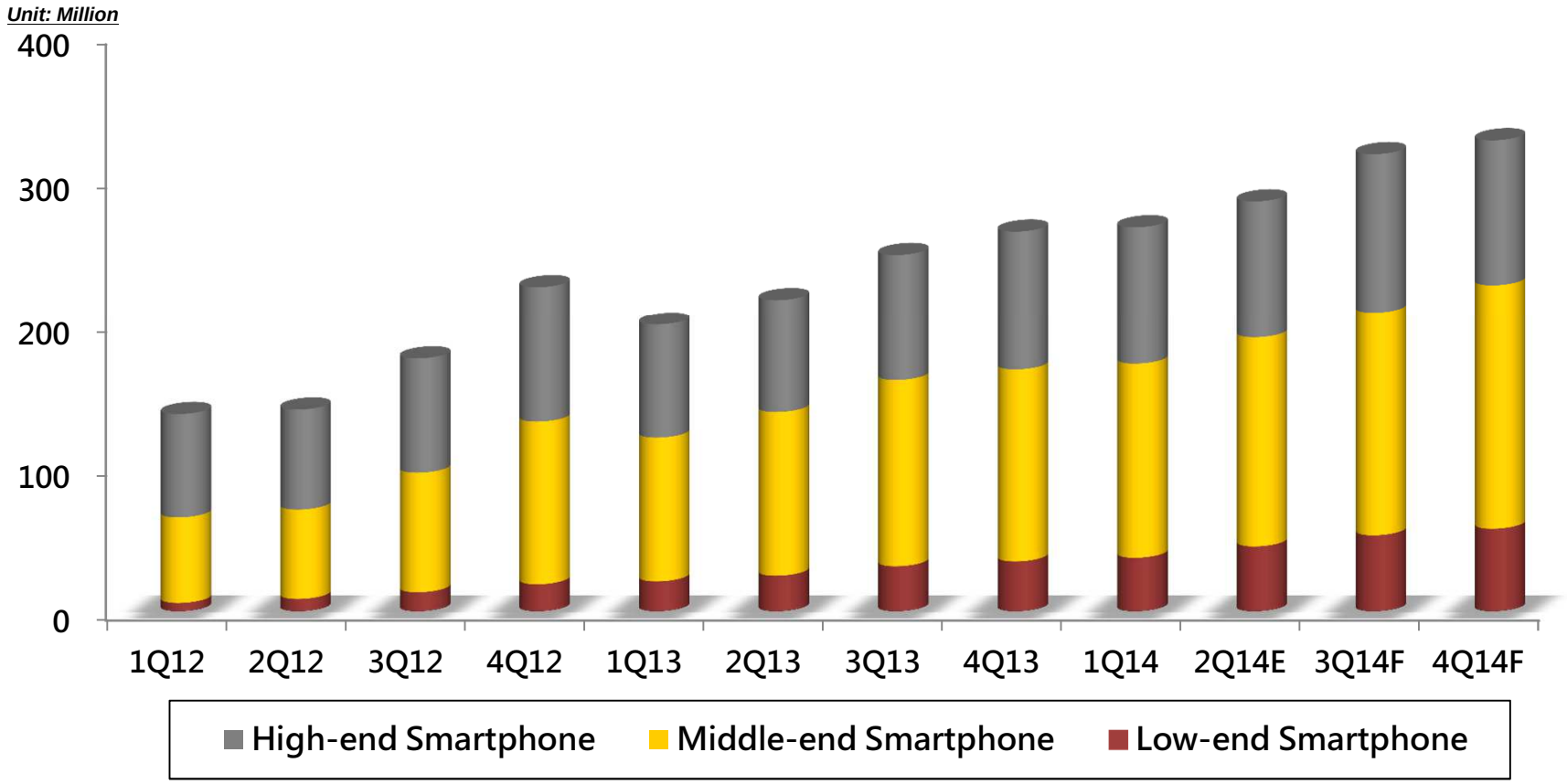
eMMC % in Tablet



Source: DRAMeXchange,June2014

Smartphone: Weak 1Q14 and Low-End Drives 2Q14

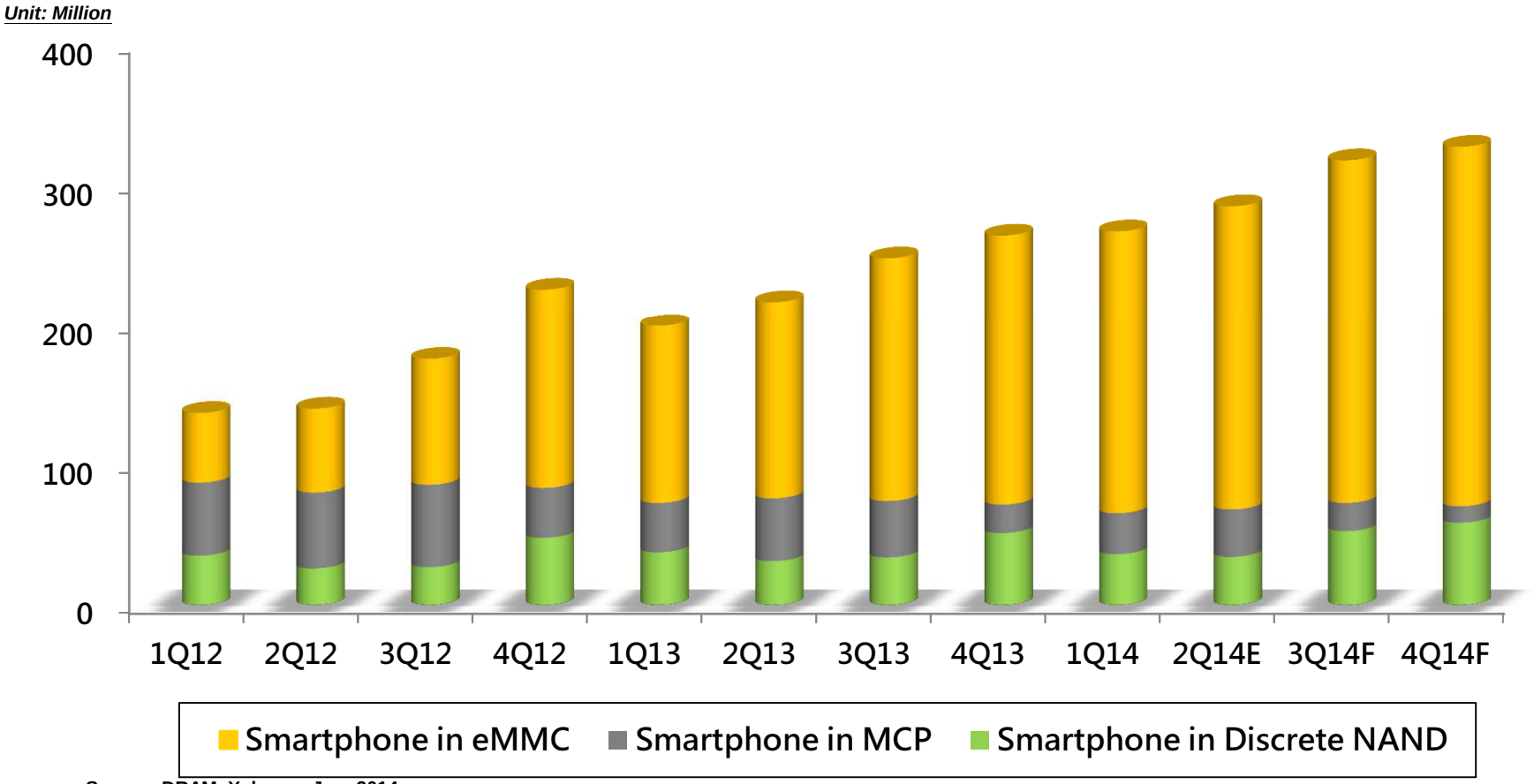
- 1Q14 smartphone drops 6%qoq for seasonality. 2Q14 pick-up from low-end models.
- Middle/Low-end models are carrying the catalyst in 2014. *(60% in 2013-80% in 2014)*



Source: DRAMeXchange,June2014

eMMC is Penetrating from Top to Bottom

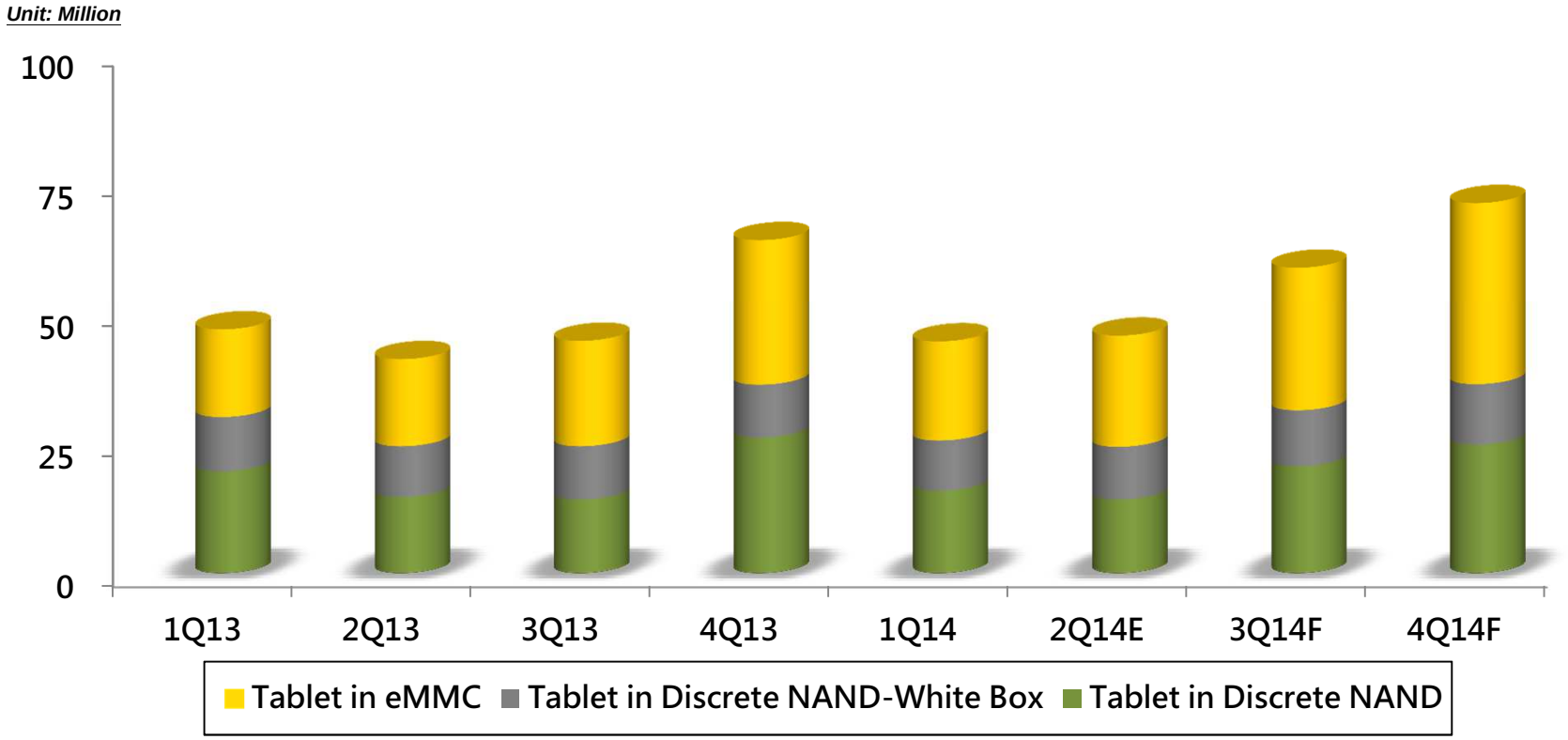
- Slowing eMMC content growth is attributed by middle-low end devices.
- Traditional MCP is replaced by eMMC or eMCP for new Android O.S and apps.



Source: DRAMeXchange,June2014

Tablet: Market Continues to Raise with Limited Content Growth.

- 1H14 tablet demand is muted, only 2%HoH compared with 1H13.
- Overall demand picks up from 3Q14 for new models unveiled.
- Tablet eMMC content declined in 2014 due to ultra-low price tablet raise.
- Raw NAND is still popular among Chinese white-box for cost concern.



Source: DRAMeXchange,June2014

WW eMMC+eMCP Market Share in 2013

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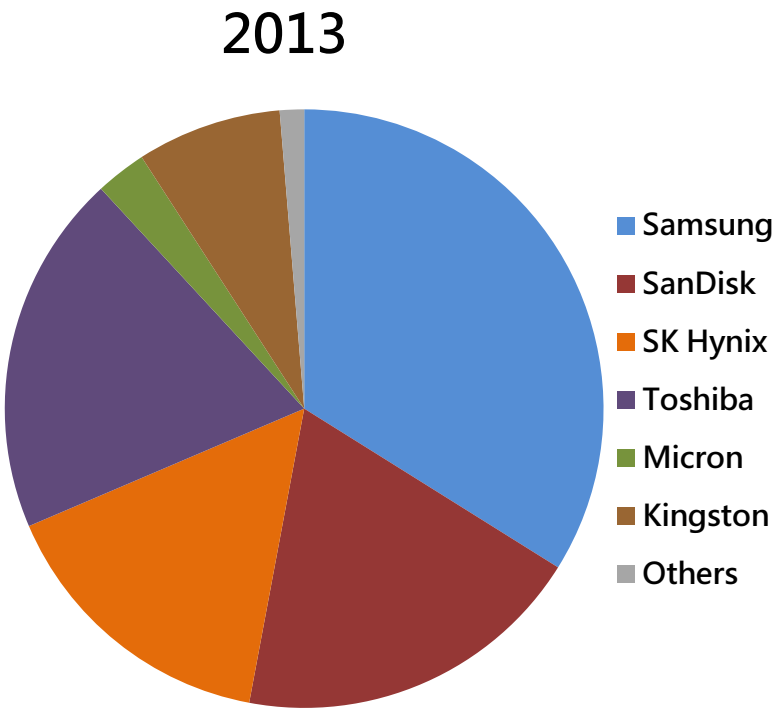

Vendor	Controller House
Samsung(19nm)	In-House
SanDisk(19nm)	In-House
SK Hynix(20nm)	SMI
Toshiba(19nm)	In-House
Micron(20nm)	Phison
Kingston(19nm)	Phison
Others	SMI, Skymedi, Phison, etc…

Source: DRAMeXchange,June2014

770mn eMMC units

- Samsung is leading with strong position in eMMC and eMCP, leveraged Samsung smartphone.
- SanDisk has most diversified customer portfolios than any other eMMC vendors.
- 3rd-party controller houses will find it difficult to compete with in-house solution.

WW eMMC+eMCP Market Share in 2014

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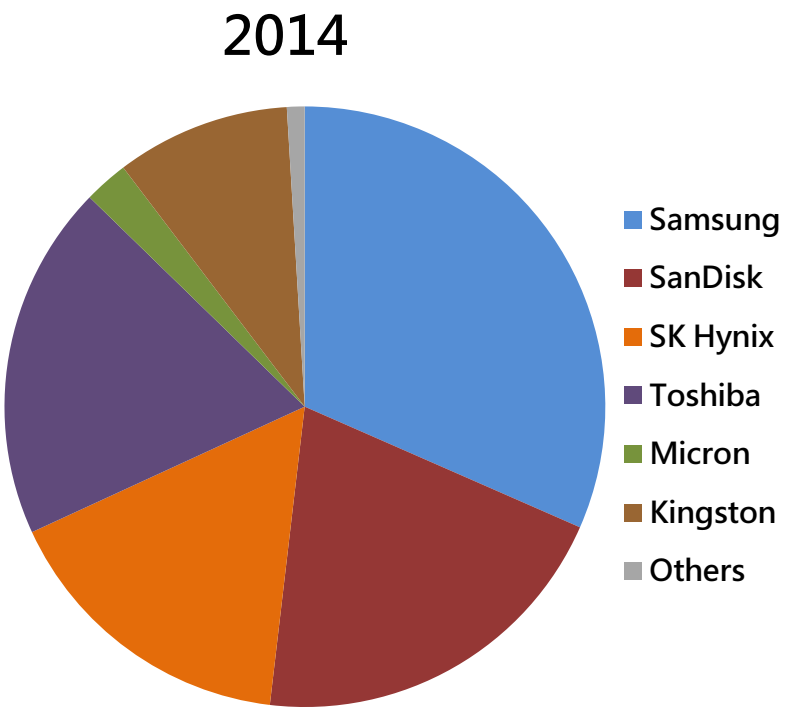


Vendor	Controller House
Samsung(19nm)	In-House
SanDisk(1ynm)	In-House
SK Hynix(16nm)	In-House, SMI
Toshiba(A19nm)	In-House
Micron(16nm)	In-House
Kingston(A19nm)	Phison
Others	SMI, Skymedi, Phison, etc…

Source: DRAMeXchange,June2014

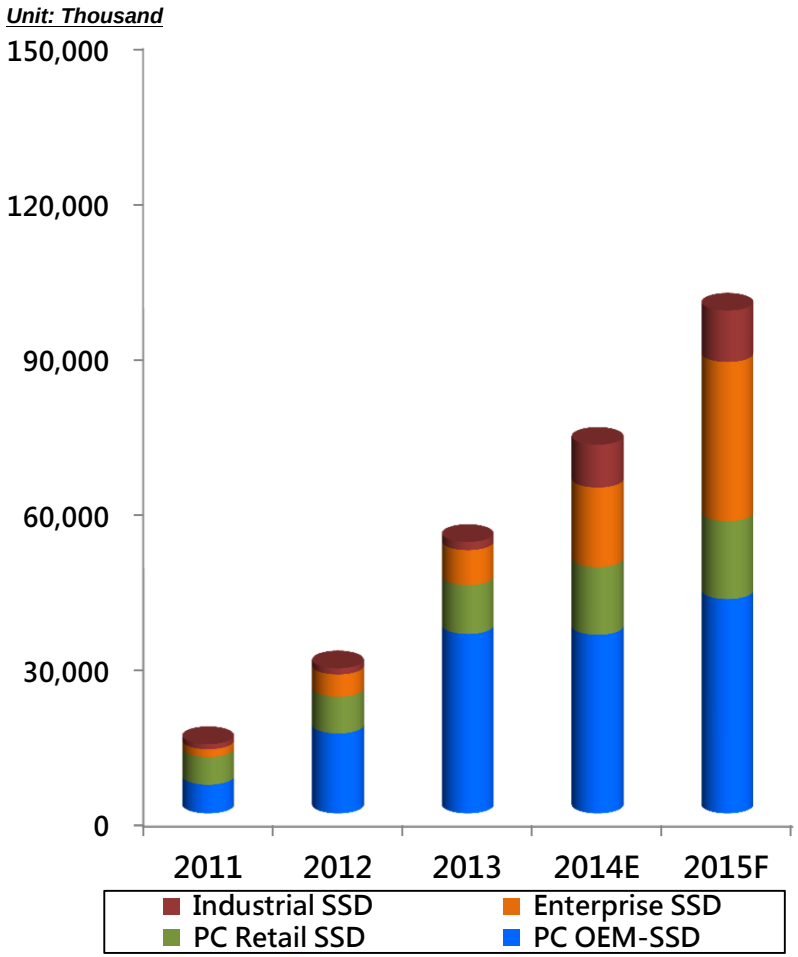
1,100mn eMMC units

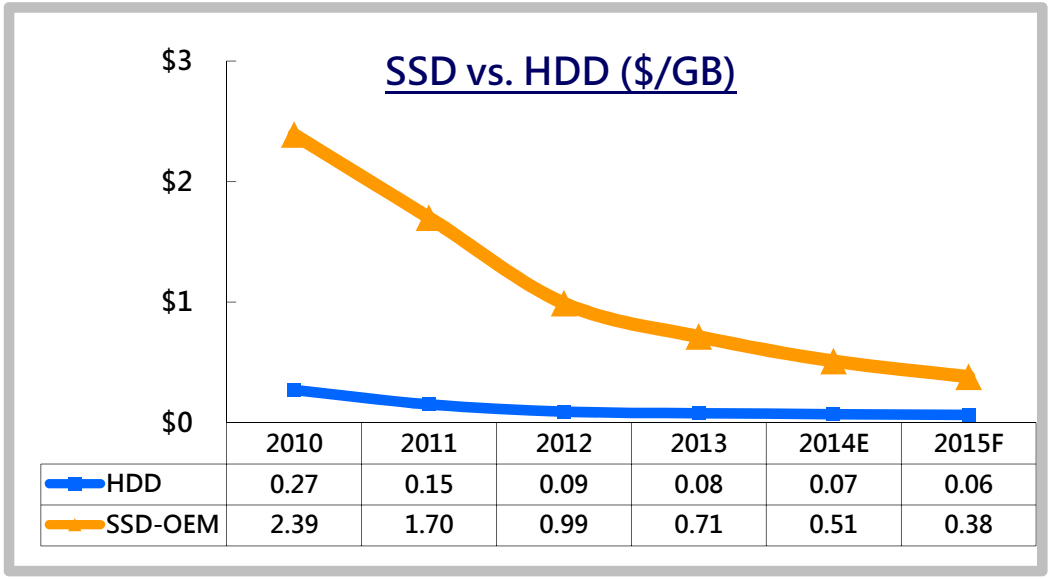
- eMMC Market share pattern remains stable.
- In-House Solutions are dominating.
- TWN vendors are narrowing to supplementary role.

SSD Market: Enterprise is the Bulls Eye

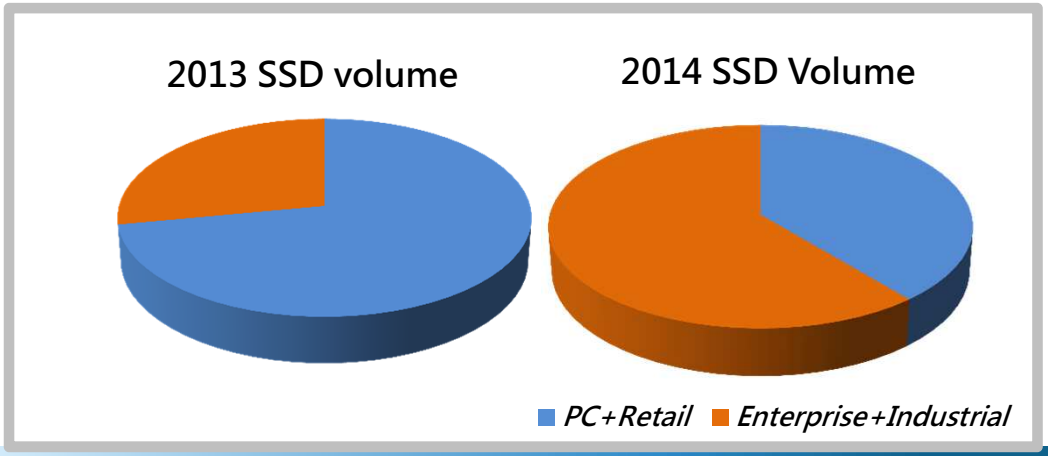
- PC-Client SSD shipment outnumbers but enterprise-SSD consumption is higher.
- Total SSD market size increases 87% /36%/37% for 2013/2014/2015

Source: DRAMeXchange,June2014





	2010	2011	2012	2013	2014E	2015F
HDD	0.27	0.15	0.09	0.08	0.07	0.06
SSD-OEM	2.39	1.70	0.99	0.71	0.51	0.38



WW PC-OEM SSD Market Share and Controller in 2013

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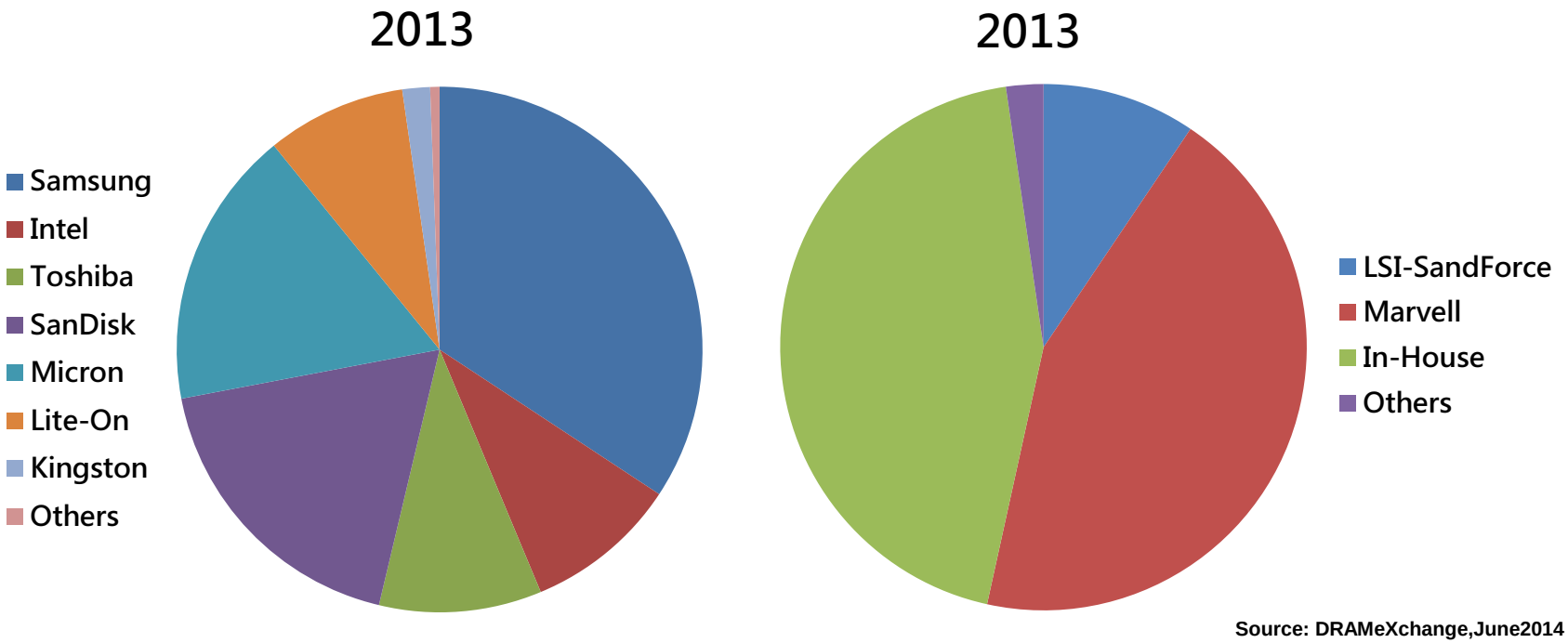

Source: DRAMeXchange,June2014

~34mn units

- Samsung is prevailing PC-OEM SSD in either MLC or TLC products.
- In-House SSD controller is facilitating to performance and time to market.
- Marvell flexible business model helps the PC-SSD makers on product differentiation.

WW PC-OEM SSD Market Share and Controller in 2014

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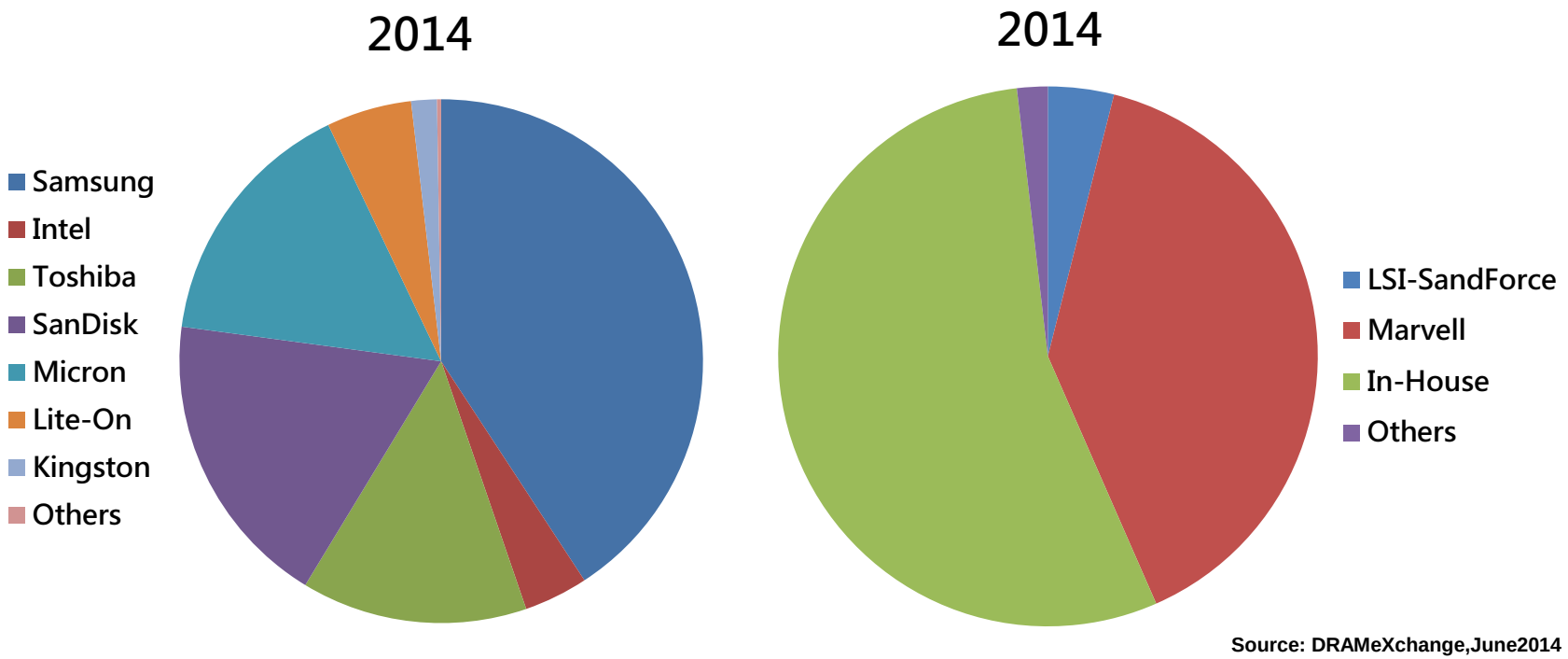


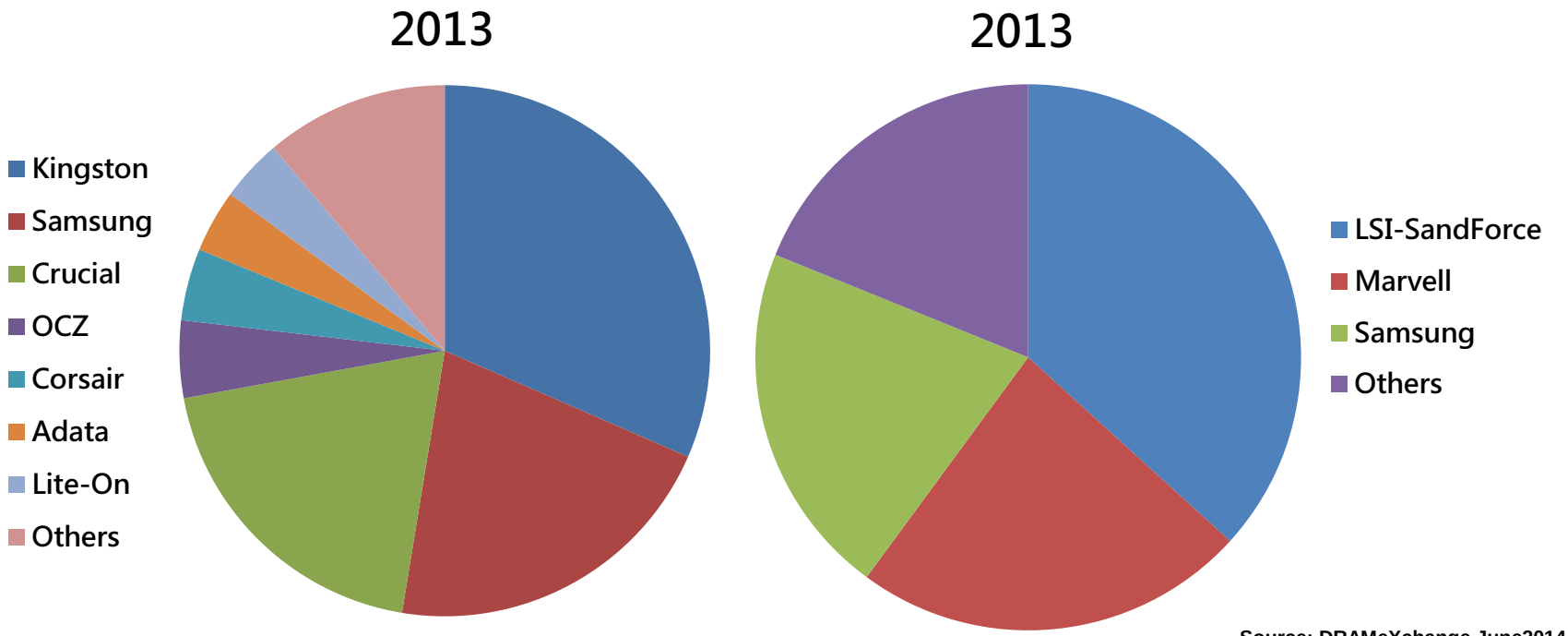
Source: DRAMeXchange,June2014

~36mn units

- 2014 NB market drops 2%YoY with limited growing SSD penetration rate.
- Expanded market share for Samsung is credit to higher TLC-SSD in 1st-tier PC makers.

WW Retail SSD Market Share and Controller in 2013

TRENDFORCE

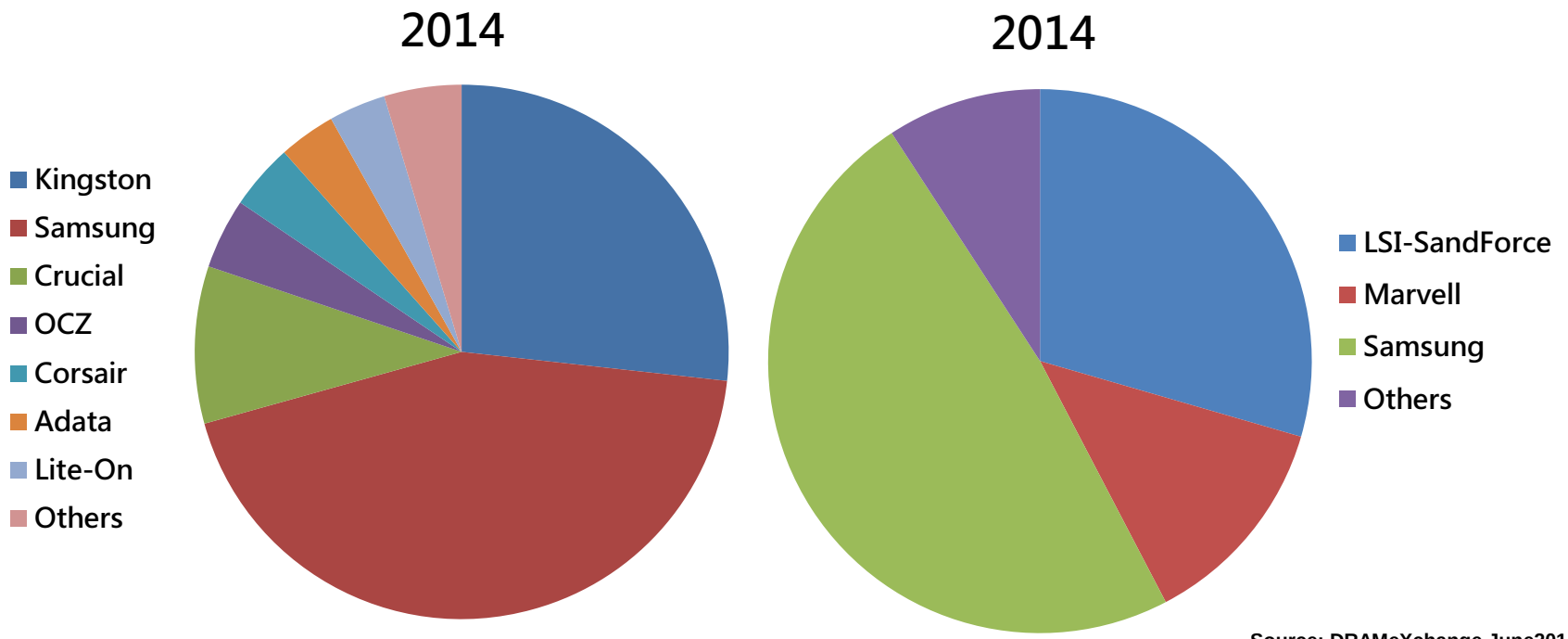


Source: DRAMeXchange,June2014

~10mn units

- LSI-SandForce remains No#1 for retail brand for comprehensive firmware support.
- Strong Samsung retail SSD sales is attributed by TLC-base SSD.

WW Retail SSD Market Share and Controller in 2014



Source: DRAMeXchange,June2014

~13mn units

- LSI-SandForce is still No#1 due to Kingston.
- Market share is consolidated to strong brand makers.
- 3rd-party SSD controller houses are moving to white-box or module houses.

Key Takeaways

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Supply

- 2014 supply bit growth is 38%, bit output is mainly derived from node migration while wafer capacity only increases by 8%.
- To cope with middle/low-end mobile devices, TLC-Basis eMMC and SSD are next battlefield. Most NAND makers will be ready from 2H14.
- 1xnm-class eMMC, eMCP and SSD will become mainstream products from 2Q14; 3D-NAND remains future story for 2015.

Demand

- 2014 demand bit growth is 39%. Smartphone, tablet and SSD continue to drive the market upward.
- Despite of strong end-device shipment pattern, content-per-box growth is limited due to cost concern and enhanced popularity of middle/low end models.
- SSD outperforms other applications in 2014, credit to solid demand from enterprise-SSD.

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Thanks

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