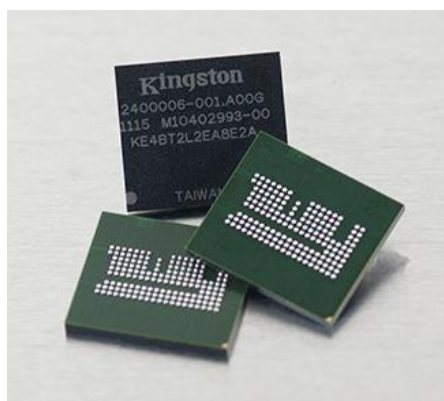# Kingston Embedded Memory Focus

eMMC

MCP
- eMCP
- SLC MCP

DDR3L

Kingston Embedded Memory Operations- eMMC/MCP
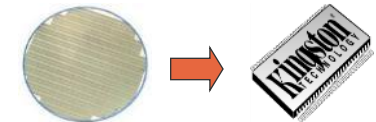
©2011 Kingston Solutions, Inc.

Established Ecosystem

Chipset Vendors
Processor Qualification

ODM Design House
Design In

Distribution Sales Rep
Sales Extension

System OEM
Design In
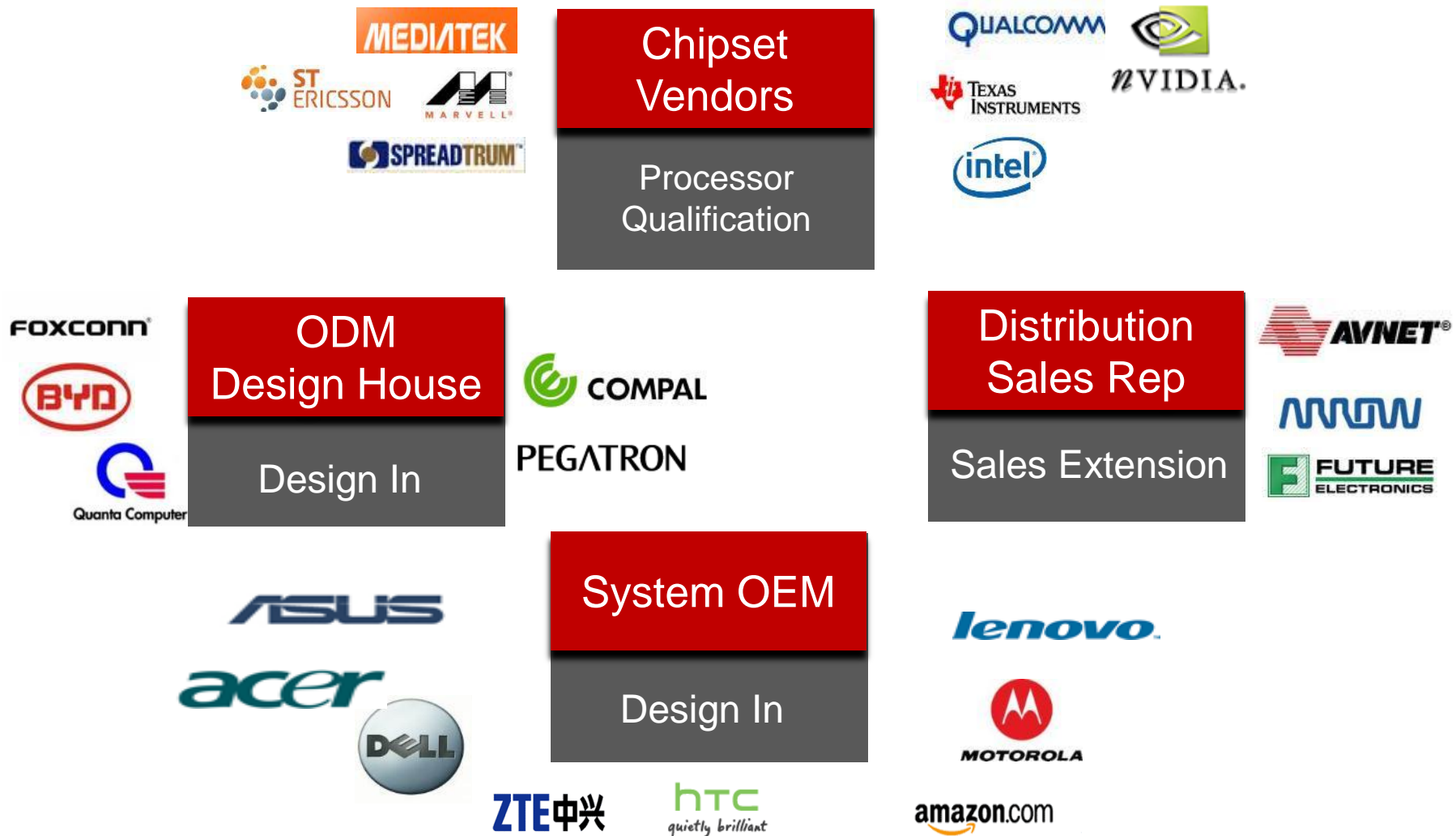
Kingston eMMC Design Wins

Google Nexus 7

ASUS Transformer

ASUS New Padfone -Infinity

ASUS Memo Pad

Sharp SH930

Fuhu pad

Acer Liquid ZX

Kingston eMMC Design Wins

MiTAC (Larch) - Thin client - E100 (Marvell 88AP510)

Marvell PXA988 Ref. Board Running HS200

OUYA - Gaming (NV T33)
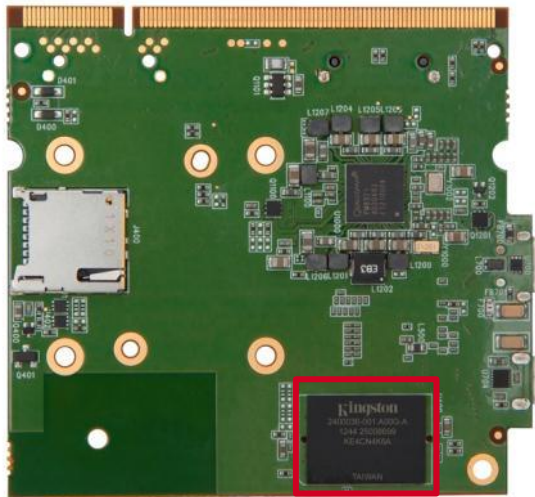
Qualcomm Dragon Board (APQ 8060A/8074)
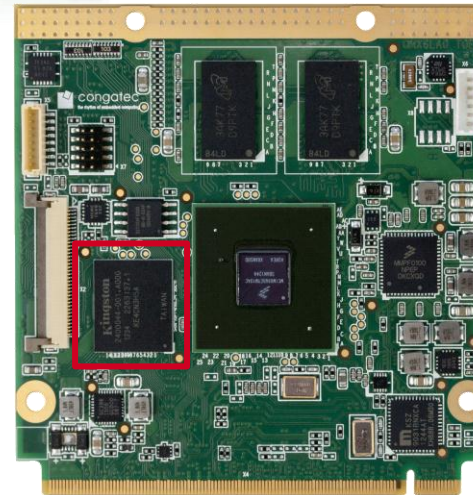
Congatec QMX6 (Freescale IMX6)

JEDEC Standard
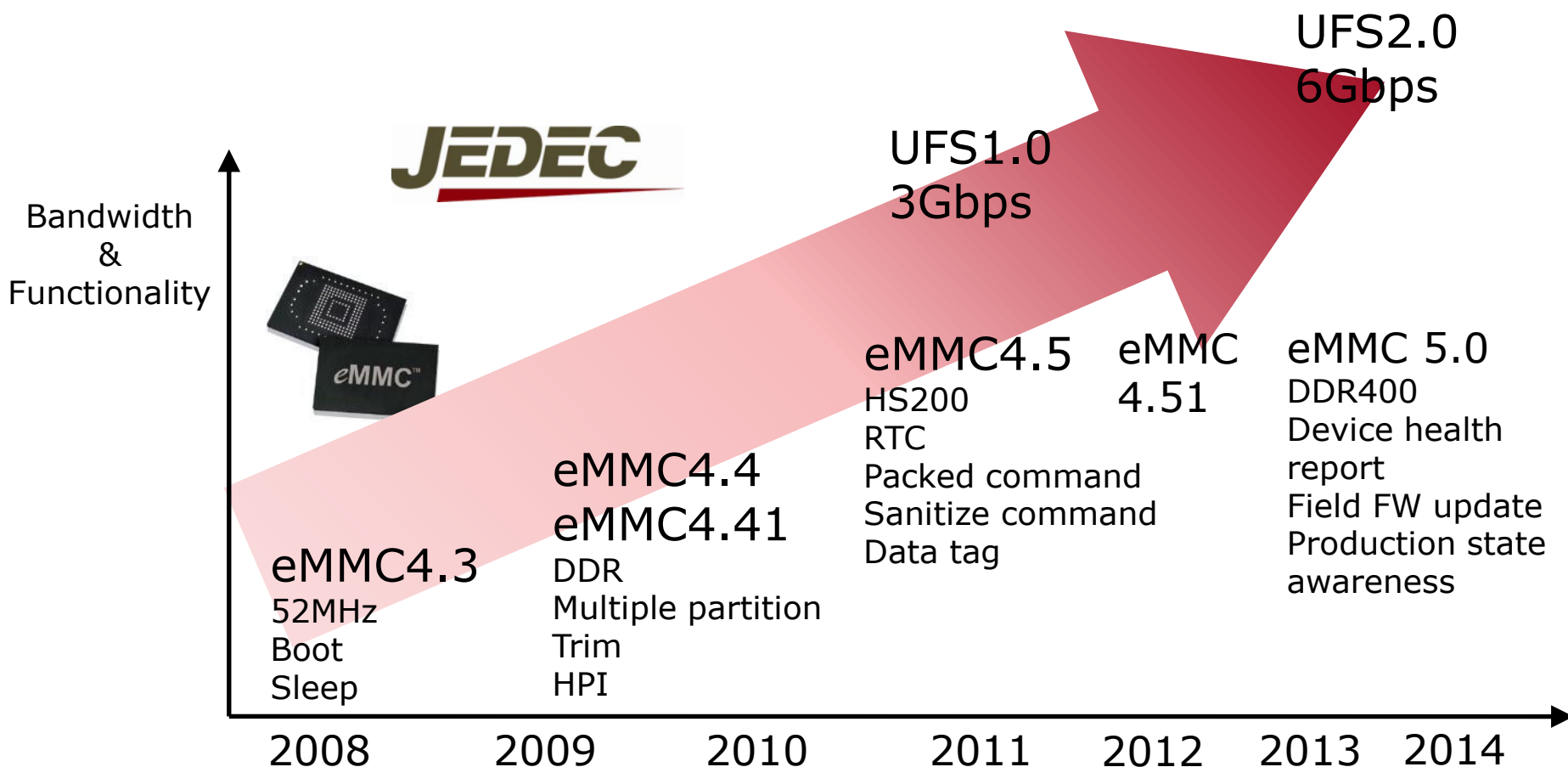
Kingston eMMC Technical Roadmap

eMMC	Speed	2012	2013	2014
eMMC4.41	DDR104	32nm MLC		
eMMC4.41+	DDR104	24nm MLC		
eMMC4.5	HS200		19nm MLC	A19nm MLC
eMMC5.0	HS400			A19 nm MLC
UFS2.0	6Gbps			A19

Different Storage Solutions

Features	eMMC 5.0	UFS 2.0	SATA III
Speed	HS 400/~400MB/s	6Gbps	6Gbps
HW reset	Y	Y	N
Boot partition	Y	Y	N
Multi-Partition	Y	Y	N
Low Power Mode	STDBY ~0.5mW	IDLE < 5mW SLEEP < 1mW	SLUMBER <15mW DEV_SLEEP ~5mW
Enhance Mode	Y	Y	N
Background operation	Y	Y	N
High Priority Interrupt	Y	Y	N
Command Queuing	Packed CMD	Y	Y
Power off notification	Y	Y	N
Reliable write	Y	Y	N
Secure Trim/ erase	Y	Y	N

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Kingston eMMC Feature Comparison

JEDEC Standard Features	eMMC 4.41	eMMC 4.51	eMMC 5.0
FLASH	**32nm MLC**	**19nm MLC**	**A19nm MLC**
SPEED CLASS	**104MB/s**	**200MB/s**	**400MB/s**
Boot Operation	√	√	√
Partitioning	√	√	√
Sleep Mode	√	√	√
Replay Protected Memory Block	√	√	√
Secure Trim/Secure Erase*	√	√	√
Hardware Reset	√	√	√
Reliable Write	√	√	√
Background Operation	√	√	√
High Priority Interrupt	√	√	√
DDR Interface	√	√	√
Discard /Sanatize CMD		√	√
Packed Commands, Context IDs		√	√
Power OFF Notification		√	√
Data Tag		√	√
Device Health Report			√
Field FW Update			√
Production State Awareness			√

Ver. 4.41 · Ver. 4.5 · Ver. 5.0

* Secure Trim/Erase*   Not required in JEDEC eMMC 4.5, but brought back to eMMC 4.51

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Downloaded from Arrow.com.

eMMC Product Line up

- **Standard Line**: Standard performance, good for most applications

- **Elite Line:** High performance

- **Value Line**: TLC based eMMC, for read intensive applications

- **I-Temp Line:** Support Industrial Operating Temperature Range (-40°C ~ 85 ^{o}C)

eMMC Internal Structure
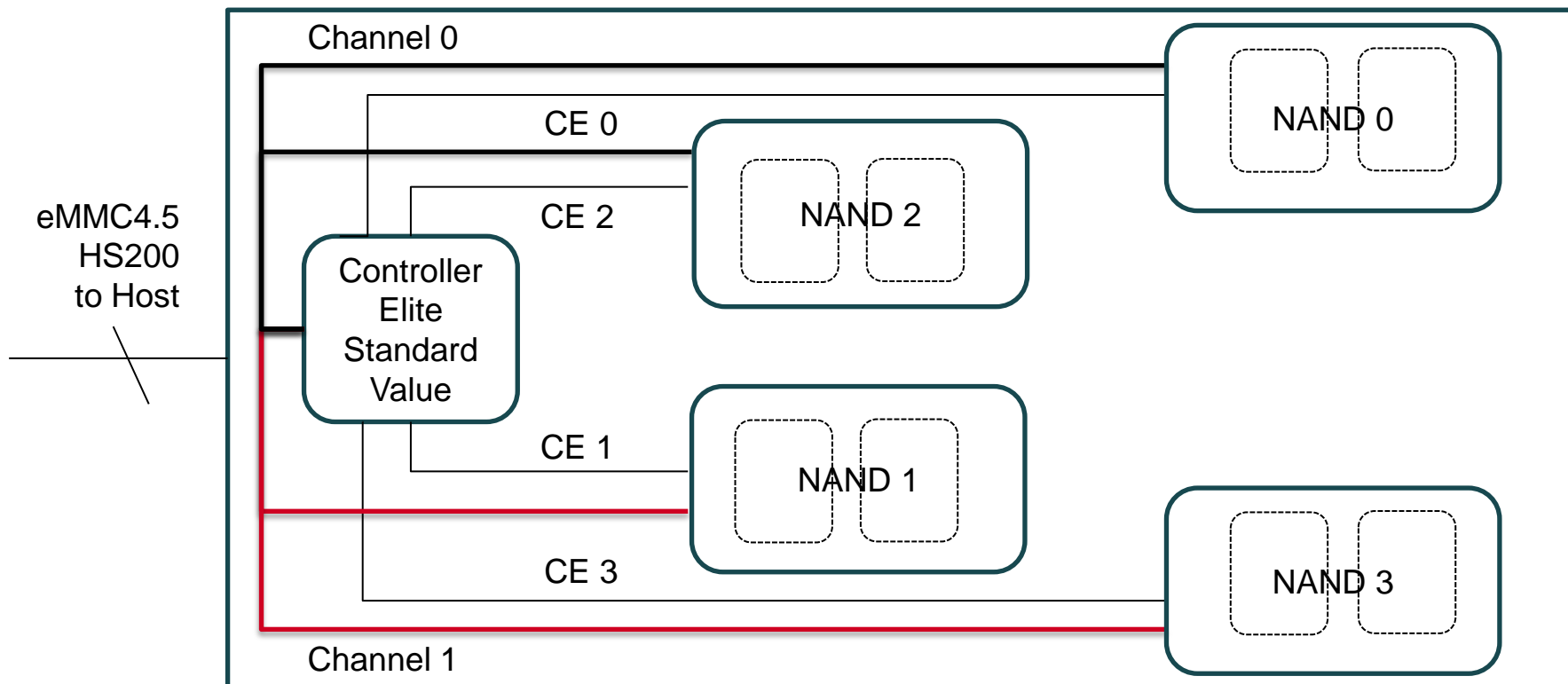
Note:
1) Elite: 2ch, up to 8 CE, support 8 die multi-way interleaving, random write performance improved by larger SRAM.
2) Standard: 2ch, up to 8 CE, support 4 die multi-way interleave.
3) Value: 1ch, up to 2 CE, support 2 die 2-way interleave.

eMMC Standard Line

	19nm MLC V4.5			A19nm MLC 5.0		
	ES	CS	MP	ES	CS	MP

Density	MP	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3	2014Q4
4GB	19nm, V4.5, 32Gb 11.5x13x1.0	19nm 11.5x13x1.0 1D					
						11.5x13x1.0 1D	
8GB	19nm, V4.5, 32Gb 11.5x13x1.0, 64Gb 12x16x1.0	19nm 12x16x1.0 1D					
		19nm 11.5x13x1.0 2D					
					11.5x13x1.0 1D		
16GB	19nm, V4.5, 32Gb 11.5x13x1.2, 64Gb 12x16x1.0	19nm 12x16x1.0 2D					
		19nm 11.5x13x1.2 4D					
					11.5x13x1.0 2D		
32GB	19nm, V4.5, 64Gb 12x16x1.2	19nm 12x16x1.2 4D					
					11.5x13x1.0 4D		
64GB	19nm, V4.5, 64Gb 12x16x1.4	19nm 12x16x1.4 8D					

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Kingston 19nm eMMC Parts List - Standard

19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
KE4CN2H5A	4GB	Embedded MMC 4.5 153B 4GB	4.5	11.5x13x1.0	Standard
KE4CN3H5A	8GB	Embedded MMC 4.5 153B 8GB	4.5	11.5x13x1.0	Standard
KE4CN3K6A	8GB	Embedded MMC 4.5 169B 8GB	4.5	12x16x1.0	Standard
KE4CN4A5A	16GB	Embedded MMC 4.5 153B 16GB	4.5	11.5x13x1.2	Standard
KE4CN4K6A	16GB	Embedded MMC 4.5 169B 16GB	4.5	12x16x1.0	Standard
KE4CN5B6A	32GB	Embedded MMC 4.5 169B 32GB	4.5	12x16x1.2	Standard
KE4CN6C6A	64GB	Embedded MMC 4.5 169B 64GB	4.5	12x16x1.4	Standard

Kingston A19nm eMMC Part List-Standard

A19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
EMMC04G-S100	4GB	eMMC 4.5 153B 4GB	5.0 (HS200)	11.5x13x1.0	Standard
EMMC08G-S100	8GB	eMMC 4.5 153B 8GB	5.0 (HS200)	11.5x13x1.0	Standard
EMMC16G-S100	16GB	eMMC 4.5 153B 16GB	5.0 (HS200)	11.5x13x1.0	Standard
EMMC32G-S100	32GB	eMMC 4.5 153B 32GB	5.0 (HS200)	11.5x13x1.0	Standard

New eMMC 5.0 Features

- Field Firmware Update

- Device Life Time Indication

- Pre EOL Information

- Production State Awareness

- Sleep Notification

- Optimal Size

- Version Control

eMMC Elite Line

A19nm MLC V5.0

ES   CS   MP

Density	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3	2014Q4
16GB				11.5x13x1.0 2D		
32GB				11.5x13x1.0 4D		
64GB				11.5x13x1.2 8D		

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Kingston A19nm eMMC Part List- Elite

A19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
EMMC16G-E100	16GB	eMMC 5.0(HS400) 153B 16GB	5.0	11.5x13x1.0	Elite
EMMC32G-E100	32GB	eMMC 5.0(HS400) 153B 32GB	5.0	11.5x13x1.0	Elite
EMMC64G-E100	64GB	eMMC 5.0(HS400) 153B 64GB	5.0	11.5x13x1.2	Elite

eMMC Value Line
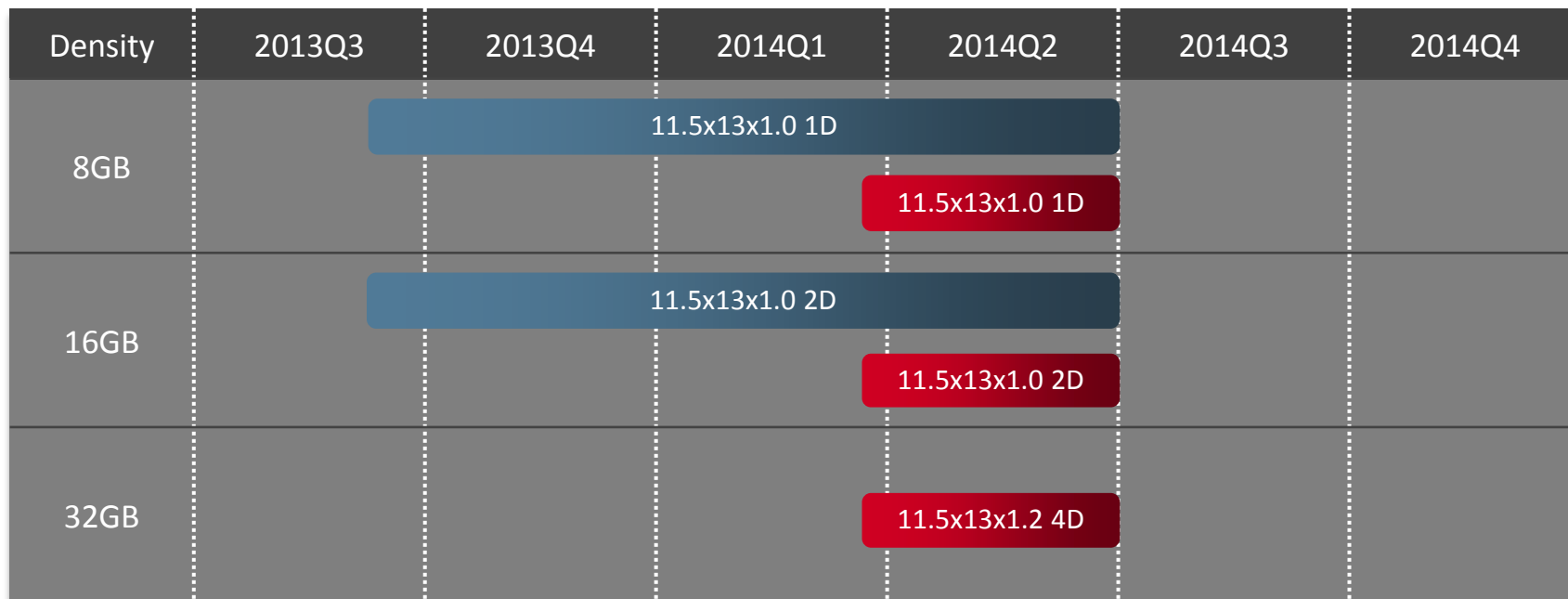
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Kingston A19nm eMMC Parts List - Value

A19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
eMMC08G-V100	8GB	Embedded MMC 4.41 153B 8GB	4.41	11.5x13x1.0	Value
eMMC16G-V100	16GB	Embedded MMC 4.41 153B 16GB	4.41	11.5x13x1.0	Value
eMMC32G-V100	32GB	Embedded MMC 4.41 153B 32GB	4.41	11.5x13x1.0	Value

eMMC I-Temp Parts

	19nmMLC V4.5			19nmMLC V5.0		
	ES	CS	MP	ES	CS	MP

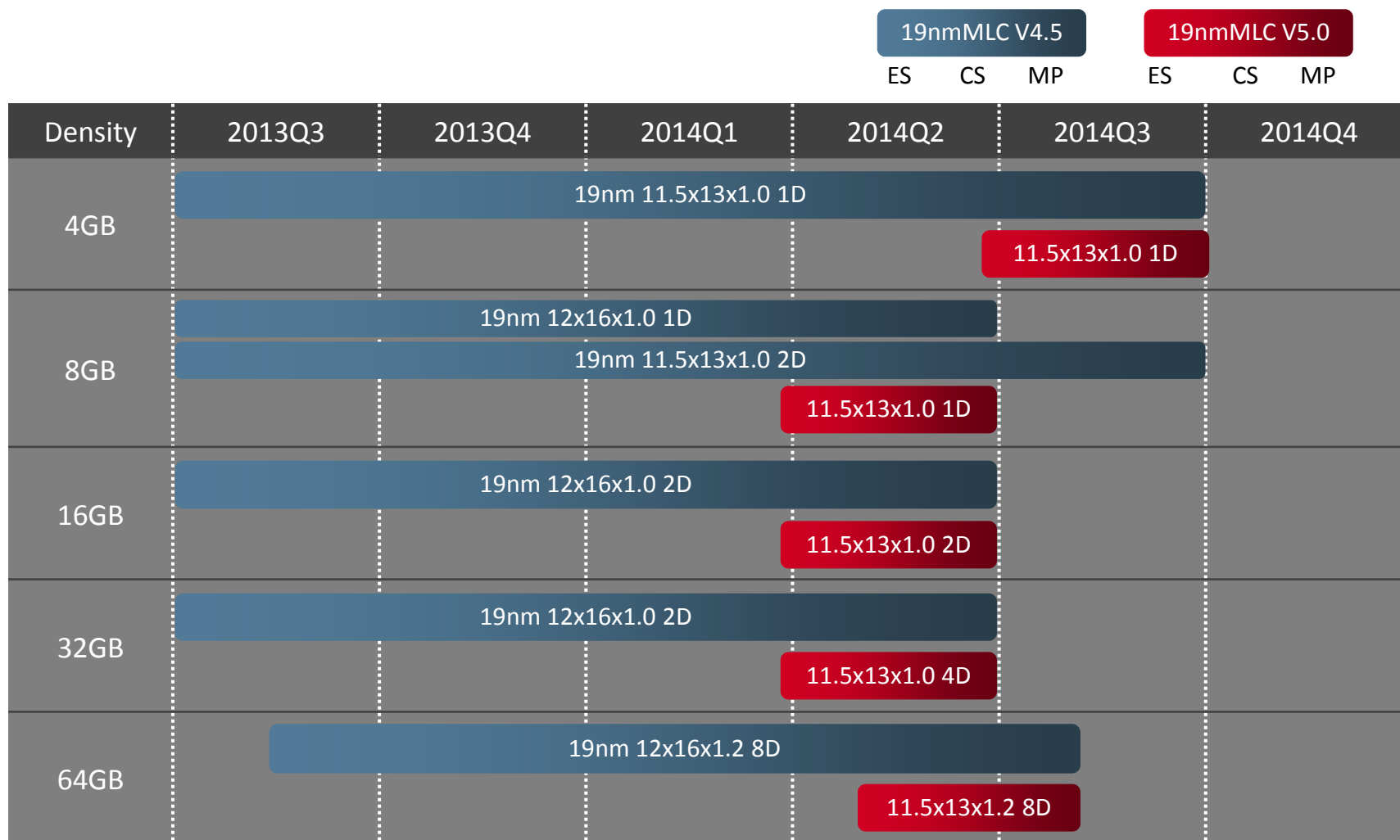| Density	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3	2014Q4
4GB	19nm 11.5x13x1.0 1D				11.5x13x1.0 1D	
8GB	19nm 12x16x1.0 1D		19nm 11.5x13x1.0 2D	11.5x13x1.0 1D		
16GB	19nm 12x16x1.0 2D			11.5x13x1.0 2D		
32GB	19nm 12x16x1.0 2D			11.5x13x1.0 4D		
64GB	19nm 12x16x1.2 8D			11.5x13x1.2 8D		

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Kingston 19nm I-Temp eMMC Parts List

19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
KE4CN2H5C	4GB	Industrial Operating Temperature Range Embedded MMC 4.5 153B 4GB	4.5	11.5x13x1.0	I-temp
KE4CN3H5C	8GB	Industial Operating Temperature Range Embedded MMC 4.5 153B 8GB	4.5	11.5x13x1.0	I-temp
KE4CN3K6C	8GB	Industial Operating Temperature Range Embedded MMC 4.5 169B 8GB	4.5	12x16x1.0	I-temp
KE4CN4K6C	16GB	Industial Operating Temperature Range Embedded MMC 4.5 169B 16GB	4.5	12x16x1.0	I-temp
KE4CN5B6C	32GB	Industial Operating Temperature Range Embedded MMC 4.5 169B 32GB	4.5	12x16x1.2	I-temp
KE4CN6C6C	64GB	Industial Operating Temperature Range Embedded MMC 4.5 169B 64GB	4.5	12x16x1.4	I-temp

Kingston A19 I-temp eMMC Parts List

A19nm Part No.	Capacity	Description	eMMC Standard	Package	Category
EMMC04G-W100	4GB	Industrial Operating Temperature Range eMMC 5.0(HS200) 153B 4GB	5.0	11.5x13x1.0	I-temp
EMMC08G-W100	8GB	Industrial Operating Temperature Range eMMC 5.0(HS200) 153B 8GB	5.0	11.5x13x1.0	I-temp
EMMC16G-W100	16GB	Industrial Operating Temperature Range eMMC 5.0(HS200) 153B 16GB	5.0	11.5x13x1.0	I-temp
EMMC32G-W100	32GB	Industrial Operating Temperature Range eMMC 5.0(HS200) 153B 32GB	5.0	11.5x13x1.0	I-temp
EMMC64G-W100	64GB	Industrial Operating Temperature Range eMMC 5.0(HS400) 153B 64GB	5.0	11.5x13x1.2	I-temp

19nm eMMC Performance - Page Mapping

Density	Standard		
	4GB (11.5x13x1.0) 8GB (12x16x1.0)	8GB (11.5x13x1.0) 16GB (12x16x1.0)	16GB (11.5x13x1.2) 32GB (12x16x1.2)
Sequential Read	85 MB/s	166 MB/s	166 MB/s
Sequential Write	12MB/s	25MB/s	45 MB/s
Random Read (4KB)	5000 IOPS	5000 IOPS	4600 IOPS
Random Write (4KB)	1050 IOPS	1350 IOPS	1450 IOPS

- Note: Sequential data from Kingston Internal tester, random data from IO Meter

A19 Standard eMMC Performance

	Standard		
Density	4GB (11.5x13x1.0) 8GB (11.5x13x1.0)	16GB (11.5x13x1.0)	32GB (11.5x13x1.2)
Sequential Read	135 MB/s	135 MB/s	145 MB/s
Sequential Write	12MB/s now, next FW 24MB/s	24MB/s	45 MB/s
Random Read (4KB)	6300 IOPS	6300 IOPS	5500 IOPS
Random Write (4KB)	1250 IOPS	1500 IOPS	1600 IOPS

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A19 Elite eMMC Performance

Density	Elite		
	16GB (11.5x13x1.0)	32GB (11.5x13x1.0)	64GB (11.5x13x1.2)
Sequential Read	185MB/s	280 MB/s	280 MB/s
Sequential Write	45MB/s	70MB/s	70 MB/s
Random Read (4KB)	7000 IOPS	7000 IOPS	7000 IOPS
Random Write (4KB)	5000 IOPS	5000 IOPS	5000 IOPS

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eMMC +LPDDR2 MCP

19nm V4.5 30nm LPD2			A19 nm V5.0 30nm LPD2		
ES	CS	MP	ES	CS	MP

eMMC	LPDDR2	Spec	2014Q1	2014Q2	2014Q3	2014Q4	2015Q1
4GB	4Gb	162-ball X8/32 IO 1066Mbps 11.5x13x1.2		19nm V4.5, 30nm LPD2	11.5x13x1.0		
4GB	8Gb	162-ball X8/32 IO 1066Mbps 11.5x13x1.2		19nm V4.5, 30nm LPD2	11.5x13x1.0		
8GB	8Gb	162-ball X8/32 IO 1066Mbps 11.5x13x1.0		11.5x13x1.0			
16GB	8Gb	162-ball X8/32 IO 1066Mbps 11.5x13x1.2		11.5x13x1.2			

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eMMC + LPDDR3 MCP

A19 nm V5.0
25nm LPD3

ES   CS   MP

eMMC	LPDDR3	Spec	2014Q1	2014Q2	2014Q3	2014Q4	2015Q1
4GB	8Gb	221-ball X8/32 IO 1600Mbps 11.5x13x1.0			11.5x13x1.0		
8GB	8Gb	221-ball X8/32 IO 1600Mbps 11.5x13x1.0			11.5x13x1.0		
16GB	8Gb	221-ball X8/32 IO 1600Mbps 11.5x13x1.2				11.5x13x1.2	

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SLC NAND +LPDDR2 MCP

	32nm SLC 30nm LPD2			24nm SLC 30nm LPD2		
	ES	CS	MP	ES	CS	MP

SLC NAND	LPDDR2	Spec	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3
2Gb	1Gb	162 ball x8/32 IO 8x10.5x0.8			8x10.5x1.0		
2Gb	2Gb	162 ball x8/32 IO 8x10.5x1.0				8x10.5x1.0	
4Gb	2Gb	162-ball X16/32 IO 11.5x13x1.0	11.5x13x1.0		11.5x13x1.0		
4Gb	4Gb	162-ball X16/32 IO 11.5x13x1.0	11.5x13x1.0			11.5x13x1.0	

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TECHNOLOGY

DDR3/3L DRAM Packages

30nm B die

ES   CS   MP

DDR3/3L	Spec	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3
4Gb	96 ball FBGA 256x16 1333/1600 9.0x13.5x1.2	9.0x13.5x1.2				
4Gb	78 ball FBGA 512x8 1333/1600 9.0x10.6x1.2	9.0x10.6x1.2				

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DDR3/3L Part List

DDR3L PN	Capacity	Description	package	Configuration
D2516EC4BXGGB	4Gb	96 ball FBGA DDR3L 1600	9.0x13.5x1.2	256MX16
D5128EETBPGGBU	4Gb	78 ball FBGA DDR3L 1600	9.0x10.6x1.2	512Mx8

Kingston Benefits

SERVICE

• Flexible, customize F/W, lock BOM as needed

• Responsive, short lead time

• World renowned for exceptional customer support

ACCESSABLE

• Supporting high and low volume customers

• Work closely with customers of any size.

COMPETITIVE

• Kingston's buying power and economies of scale allow us to price competitively

• Investment in key suppliers

QUALITY

• Widely recognized global brand

• 25 years making memory products

• Expertise in DRAM and Flash products, including SSD and eMMC

For more information, please visit:
Kingston.com &
Kingston.com/emmc

Reliability Test

- Preconditioning (TCT 5 cycles, -65 ^{o}C/150 ^{o}C ; HTS 125 ^{o} C baking 24hours ; THS(SOAK) 40hours @60°C, 60%RH ; 3xReflow $\geqq$260 ^{o}C)

- High Temperature Storage (HTS, 150°C,1000hrs)

- High Accelerated Stress Test (HAST, 110 ^{o}C, 85%RH, Vccmax, 264hours)

- Temperature Cycling Test (TCT, -65 ^{o}C ~150 ^{o}C, 500 cycles)

- ESD (HBM, CDM)

Quality Management

- ISO 9001:2008 Quality Management System

- IECQ QC 080000:2005 Hazardous Substance Process Management

- ISO/TS16949 Certified Manufacturing Facility

- RoHS/WEEE: Restriction of Hazardous Substances/Reduced Waste

- Package Reliability Test

Source: Kingston

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Thank You!