Semiconductors Keep Rolling Along, but for How Long?

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Meptec Luncheon

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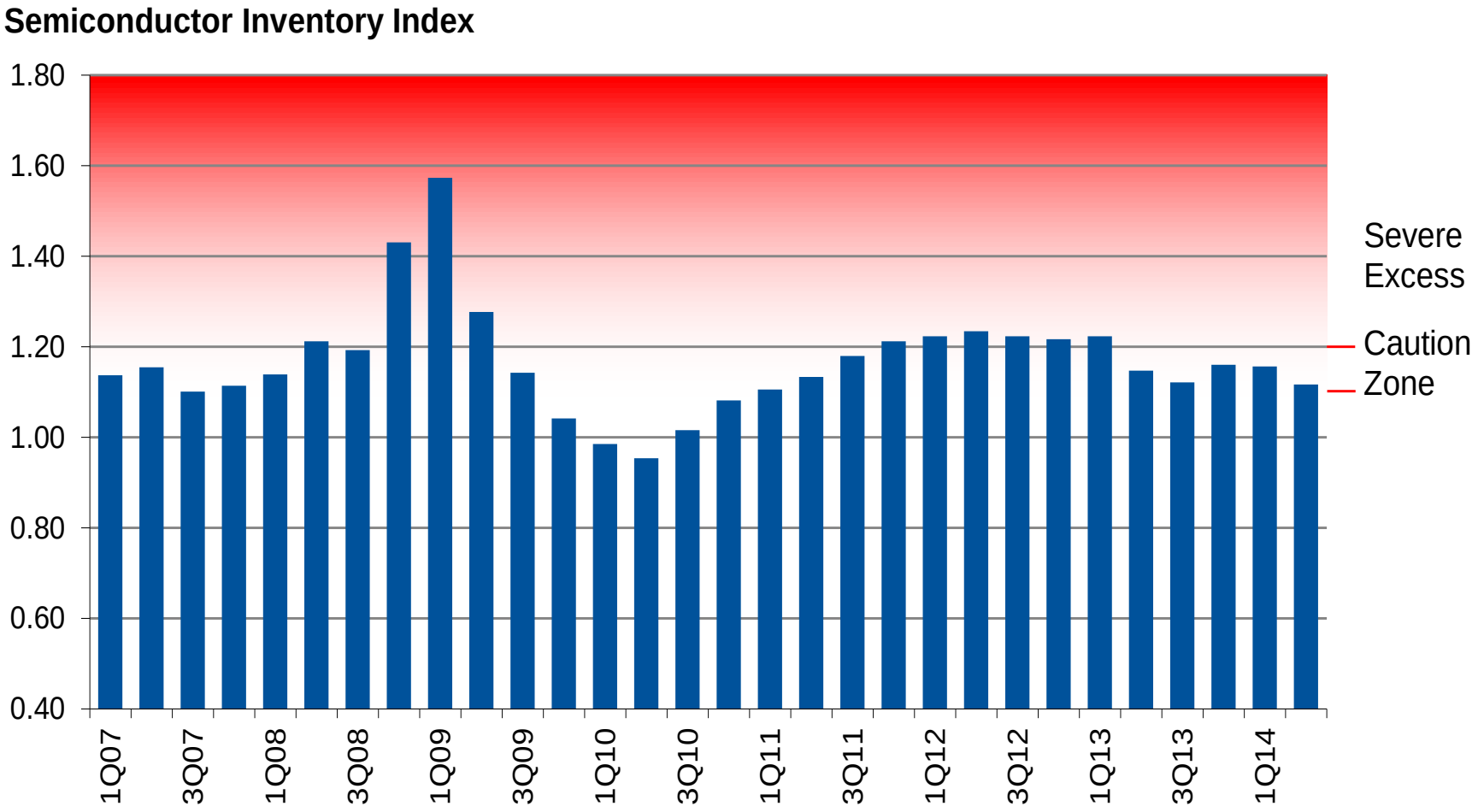
Agenda

- Forecast Outlook for the semiconductor industry
  - Devices
  - Applications
- Forecast for capital equipment and spending
- Outsourcing Services
  - Foundry
  - SATS

2014 Semiconductor Key Assumptions

- 1Q14 Assumption - excess inventory cleared from supply chain in 1H 2014. Sequential revenue growth resumed in 2Q14
- 2Q14 Assumption – foundry capacity tight, above seasonal semi growth in 2Q14 followed by seasonal 3Q14 growth
- 2014 traditional notebook and desk-based PC unit production expected to decline only 5.9%
- 2014 total ultramobile unit production growth at 39.9%
- 2014 ultramobile unit mix is 89.1% tablet, 9.3% clamshell, and 1.6% hybrid
- 2014 total mobile phone unit production at growth 2.3%, smart phone growth at 22.4%

Overall Semiconductor Days of Inventory Levels Drop in Q2



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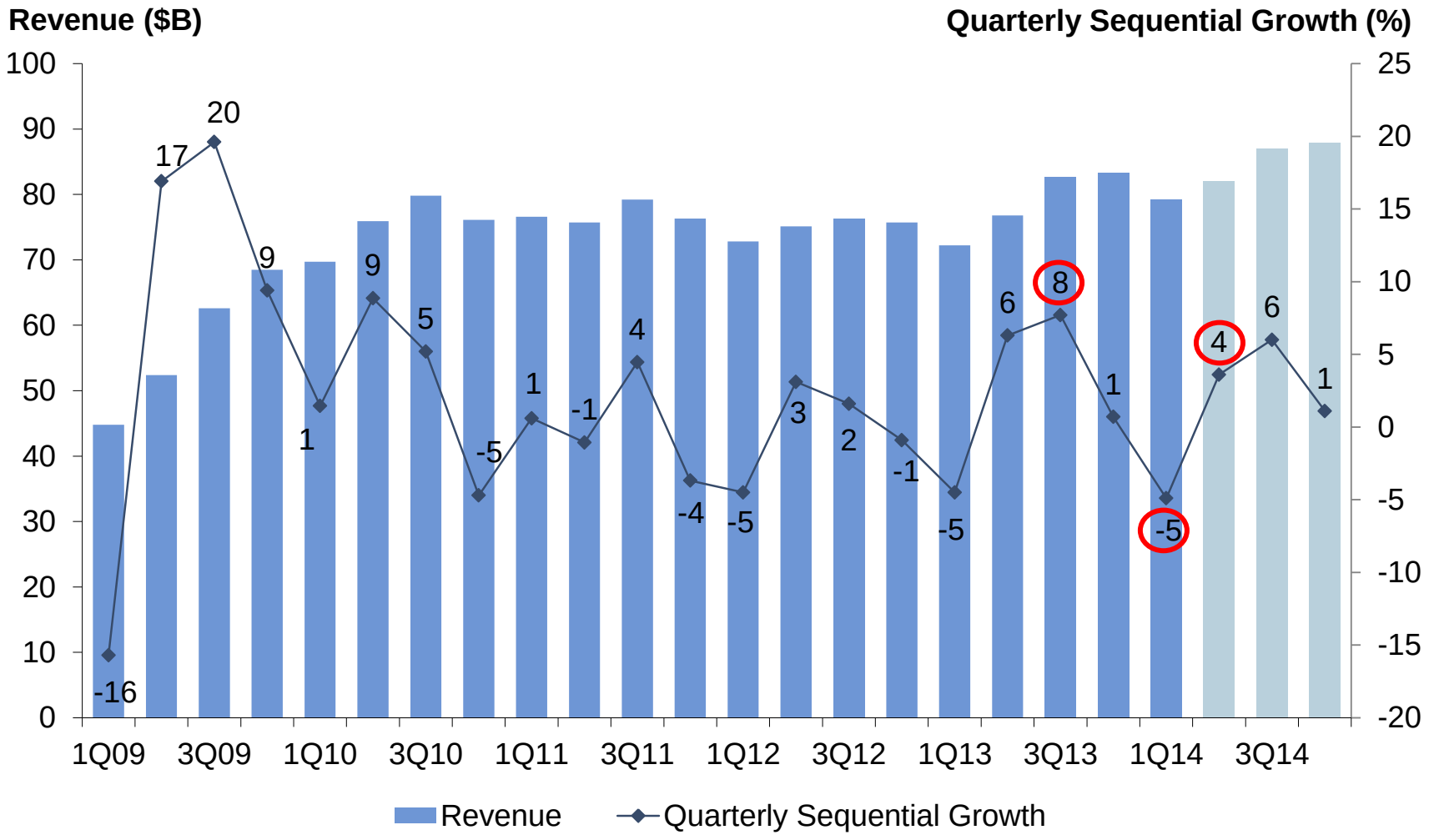
Semiconductor Quarterly Revenue Profile: Seasonal Rebound after Soft 1Q14



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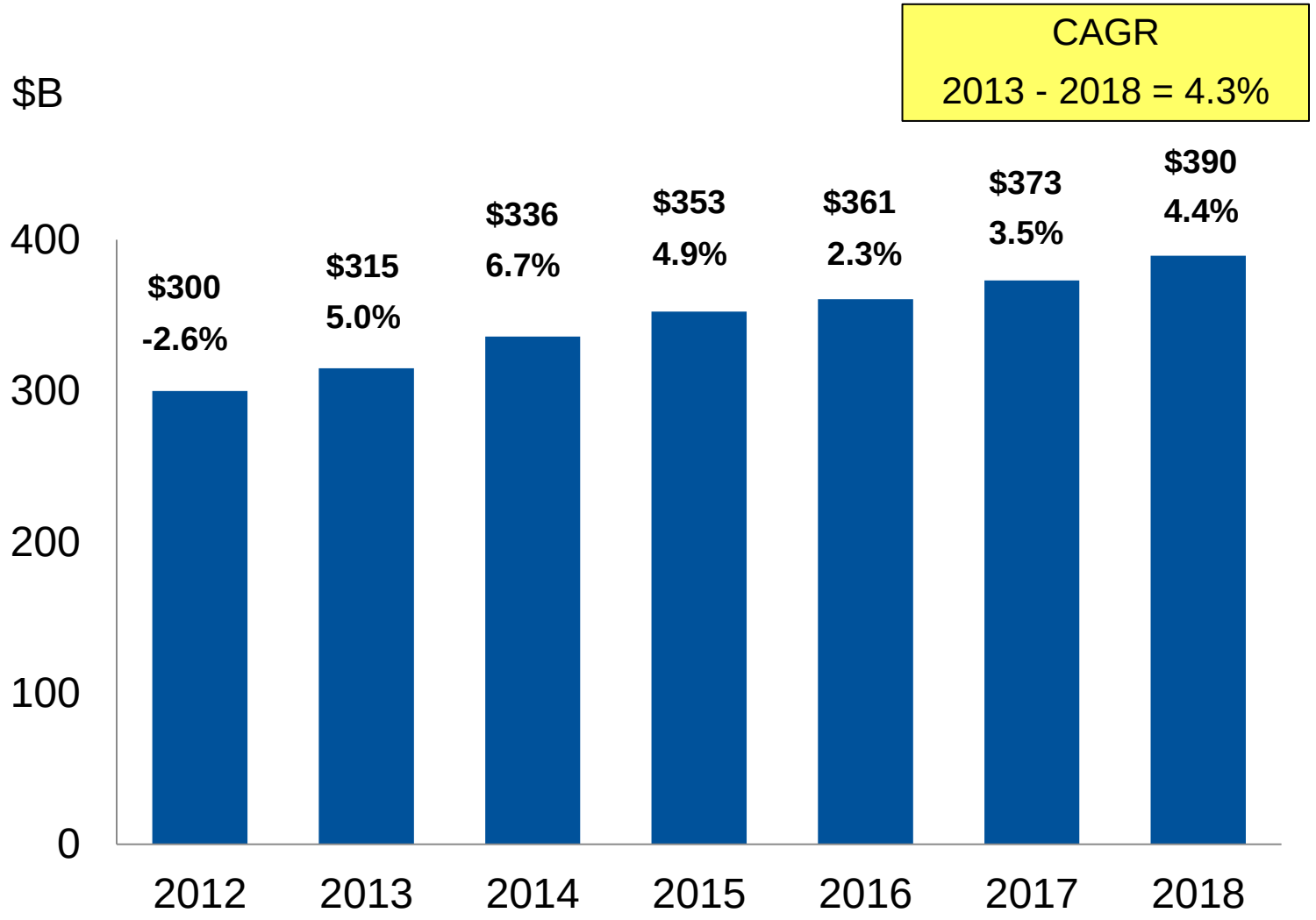
Worldwide Semiconductor 2Q14 Revenue Forecast:



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Semiconductor Revenue, 2Q14 Update: Device Revenue and Annual Growth

Revenue ($B)	2013	2014	2015	2016	2017	2018	CAGR
Memory	68.8	76.9	80.2	74.7	76.4	85.6	4.5%
Microcomponents	59.5	61.3	62.0	64.0	65.9	67.1	2.4%
Logic	12.3	13.6	14.8	16.2	17.2	18.1	8.0%
Analog	19.4	20.9	21.8	22.3	23.0	23.6	4.0%
Discrete	18.1	18.9	19.5	19.9	20.3	20.6	2.7%
Optoelectronics	25.2	26.5	28.6	31.9	35.0	36.8	7.8%
ASIC	19.6	20.7	22.1	23.2	23.9	24.8	4.8%
ASSP	86.1	90.4	96.1	100.1	102.5	103.2	3.7%
Non-Optical Sensors	6.1	6.8	7.5	8.4	9.1	9.7	9.9%
Total Semiconductor	**315.0**	**336.1**	**352.6**	**360.7**	**373.2**	**389.5**	**4.3%**
Annual Growth (%)							
Memory	23.5%	11.9%	4.3%	-6.9%	2.3%	12.1%	
Microcomponents	-0.3%	3.0%	1.1%	3.2%	3.0%	1.9%	
Logic	3.7%	10.7%	9.4%	9.0%	6.2%	5.0%	
Analog	0.2%	7.8%	4.3%	2.3%	3.1%	2.7%	
Discrete	-2.0%	4.7%	3.0%	2.3%	1.7%	1.8%	
Optoelectronics	2.7%	4.9%	7.8%	11.7%	9.6%	5.3%	
ASIC	-9.0%	5.9%	6.6%	5.0%	3.1%	3.7%	
ASSP	3.6%	5.0%	6.3%	4.2%	2.4%	0.7%	
Non-Optical Sensors	5.9%	11.6%	11.0%	12.4%	7.8%	6.7%	
Total Semiconductor	**5.0%**	**6.7%**	**4.9%**	**2.3%**	**3.5%**	**4.4%**	
Non-Memory	**0.8%**	**5.2%**	**5.1%**	**5.0%**	**3.8%**	**2.4%**	

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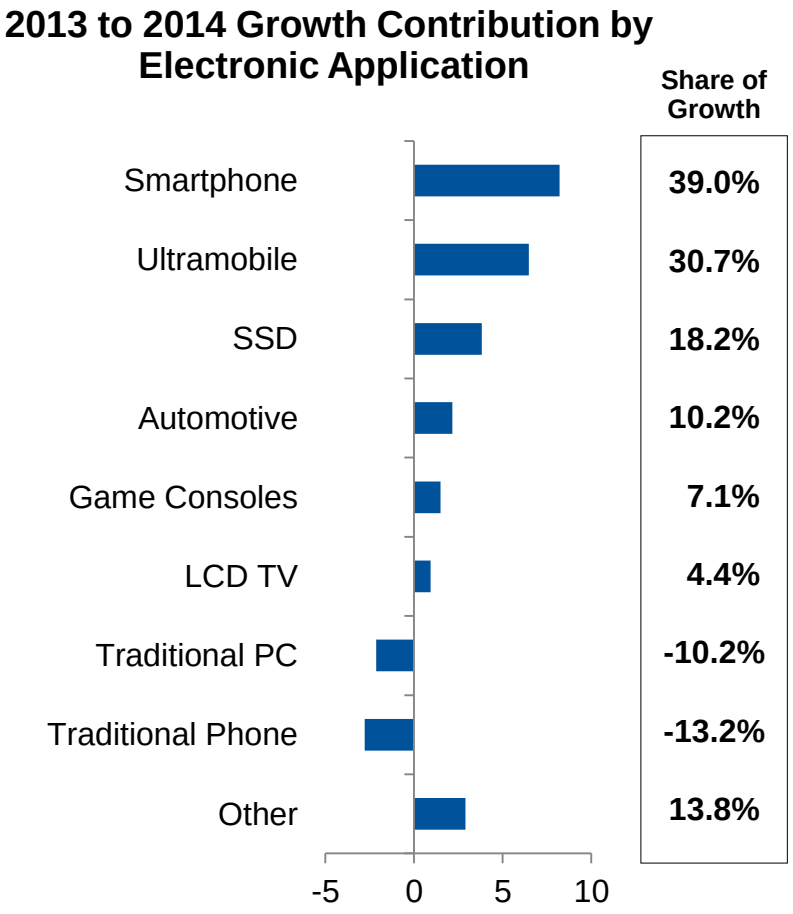
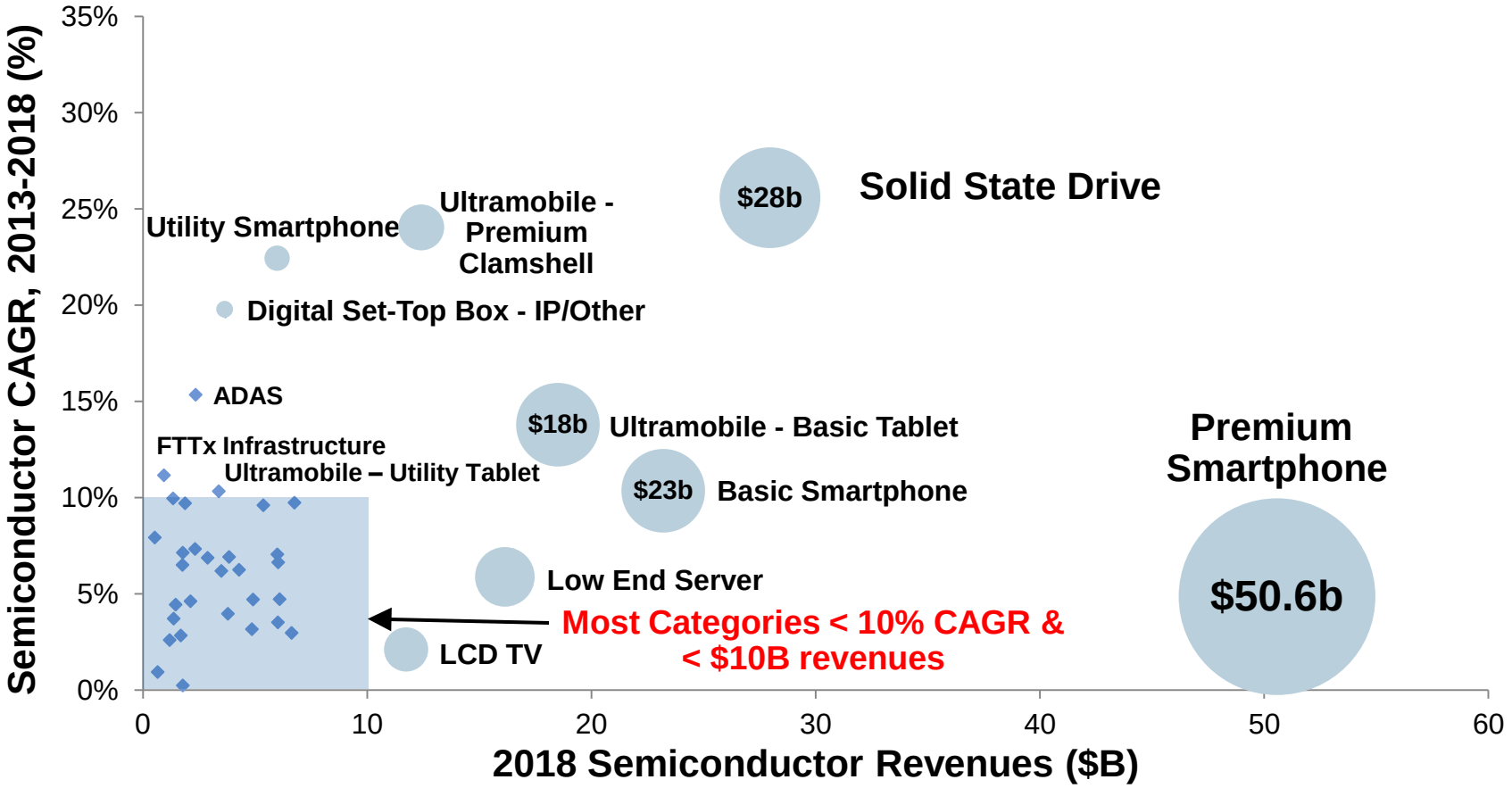
2014 Application Contribution to Semiconductor Growth



Source: Gartner, June 2014 “Semiconductor Forecast Database, Worldwide, 2Q14 Update”

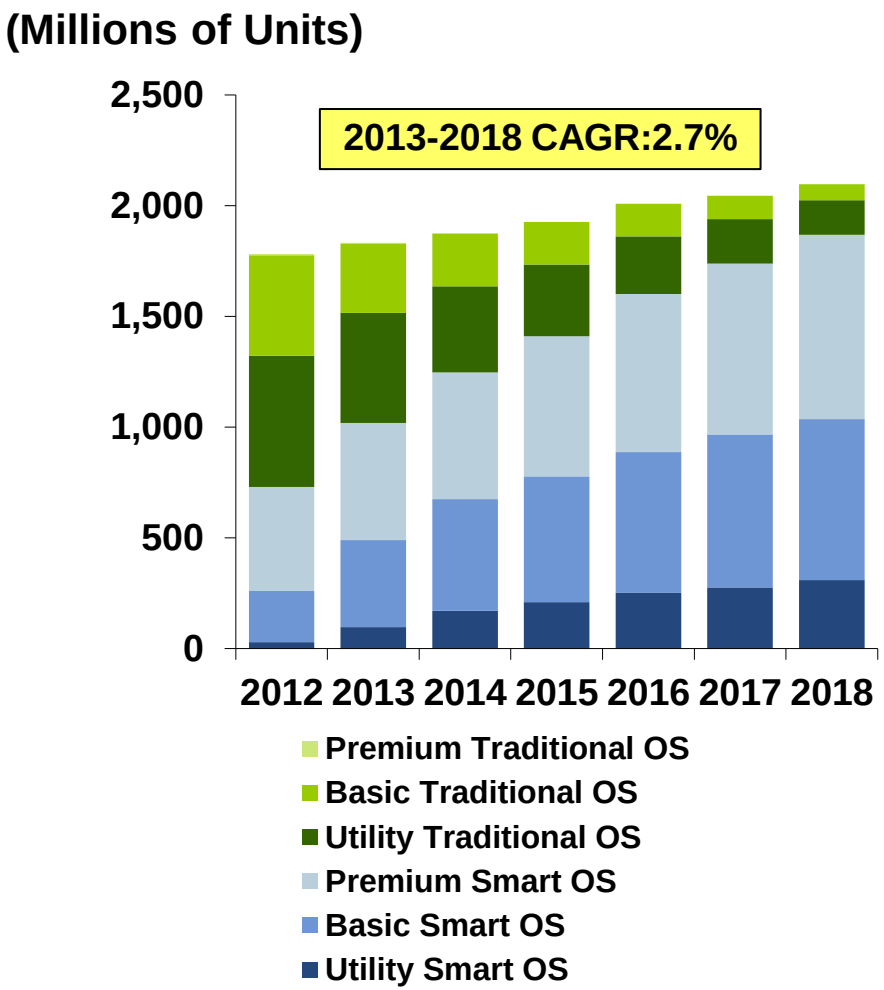
Applications Driving Growth Through 2018 Smartphone, SSD, and Ultramobile



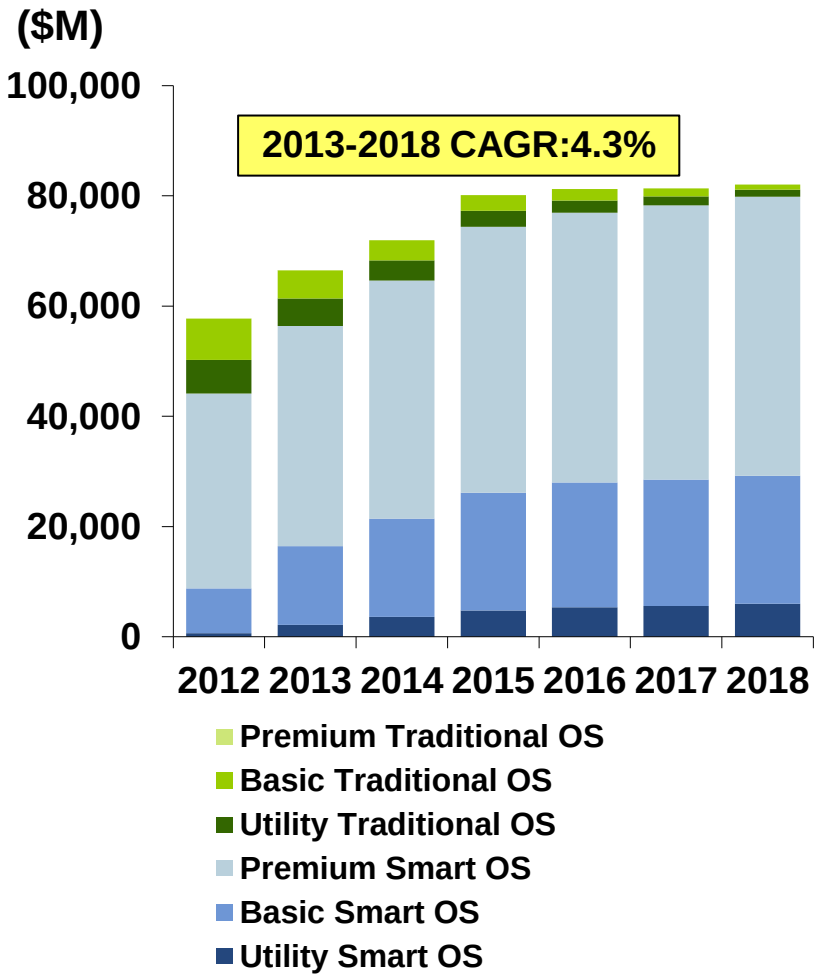
Source: Gartner, June 2014 "Semiconductor Forecast Database, Worldwide, 2Q14 Update"
Note: Y axis cut off at 0% for clarity, so some major markets like Desktop PCs do not appear in the chart as they have negative CAGR

Total Mobile Mobile Phones

Unit Production



Semiconductor Revenue



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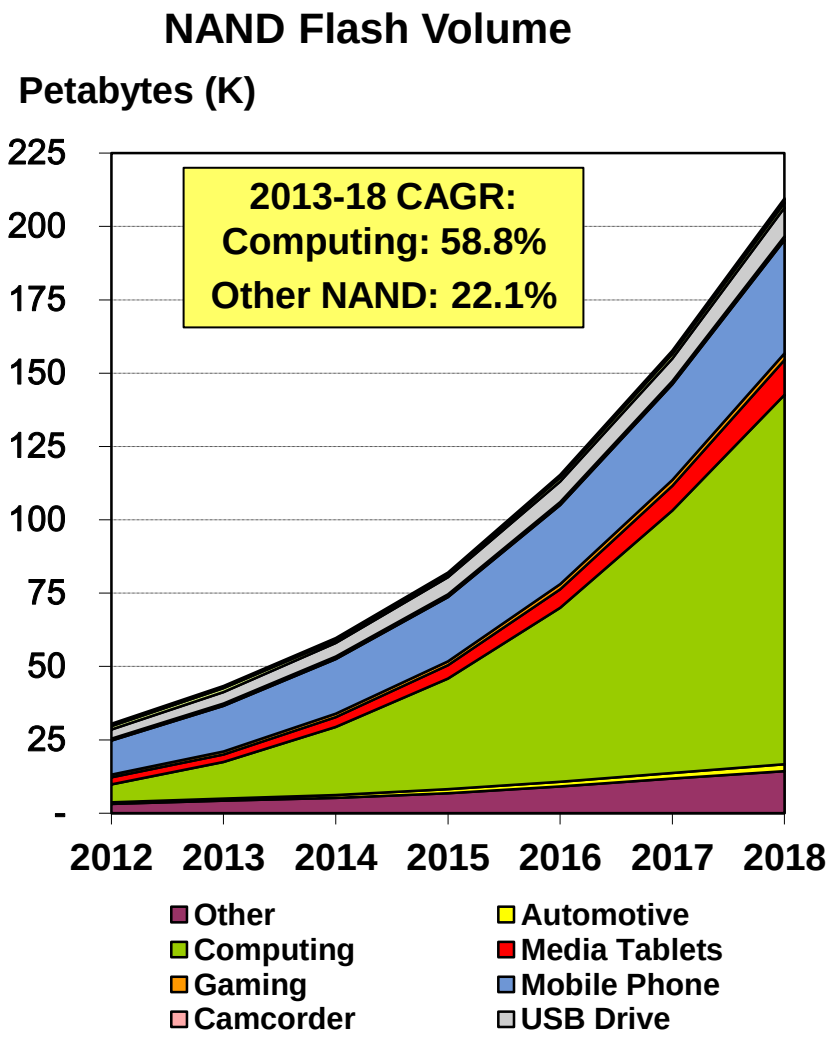
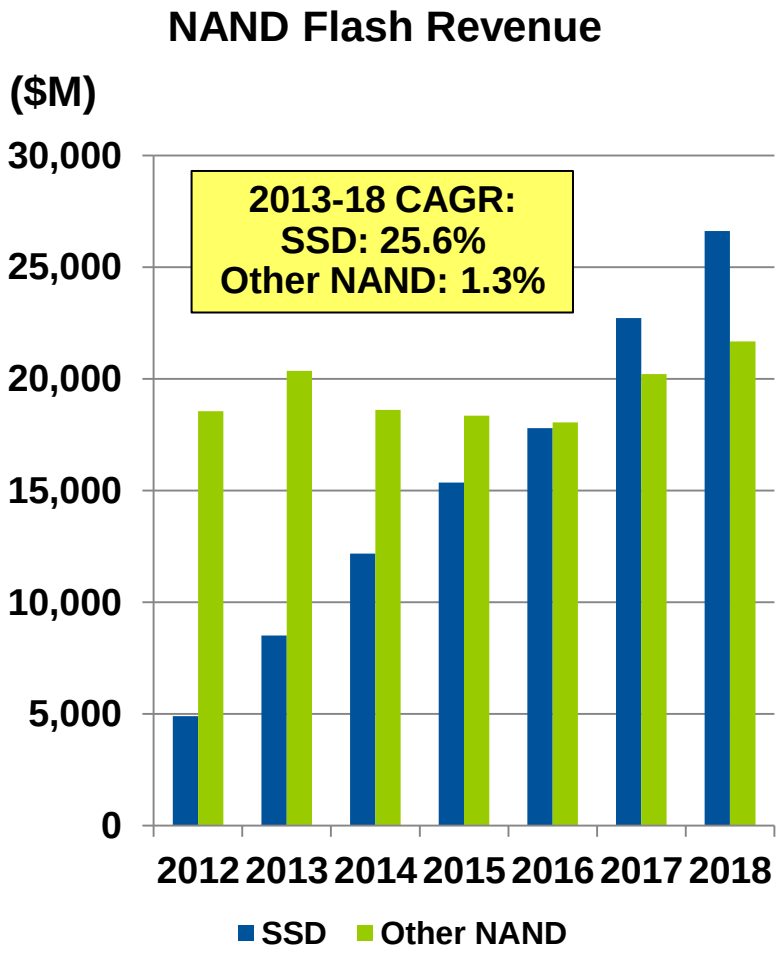
Solid State Drives Power NAND Market





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Ultramobile form factor and technology innovation in focus

Toshiba Kirabook L93

ASUS Transformer Book V

ASUS C300 Chromebook

Surface Pro 3

ASUS Transformer Book T300 Chi

Intel Core M Tablet Reference Design

Dell Inspiron 13 7000

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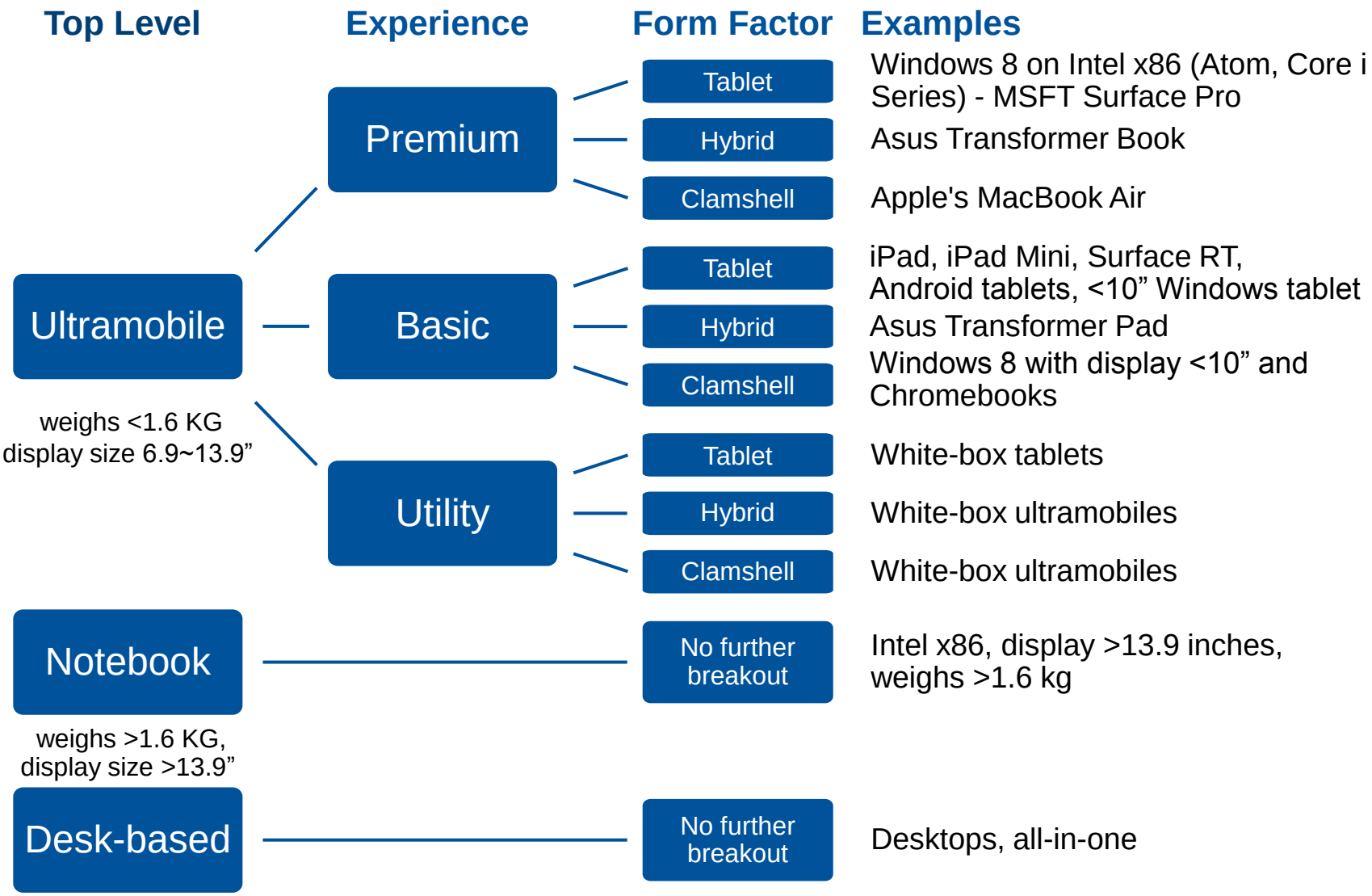
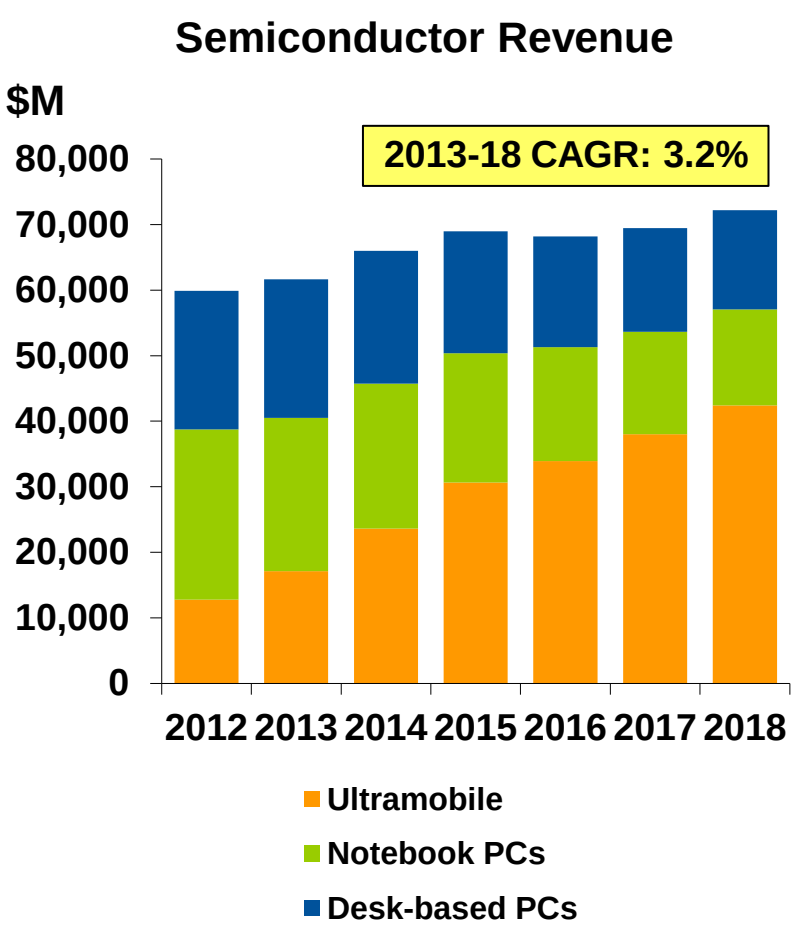
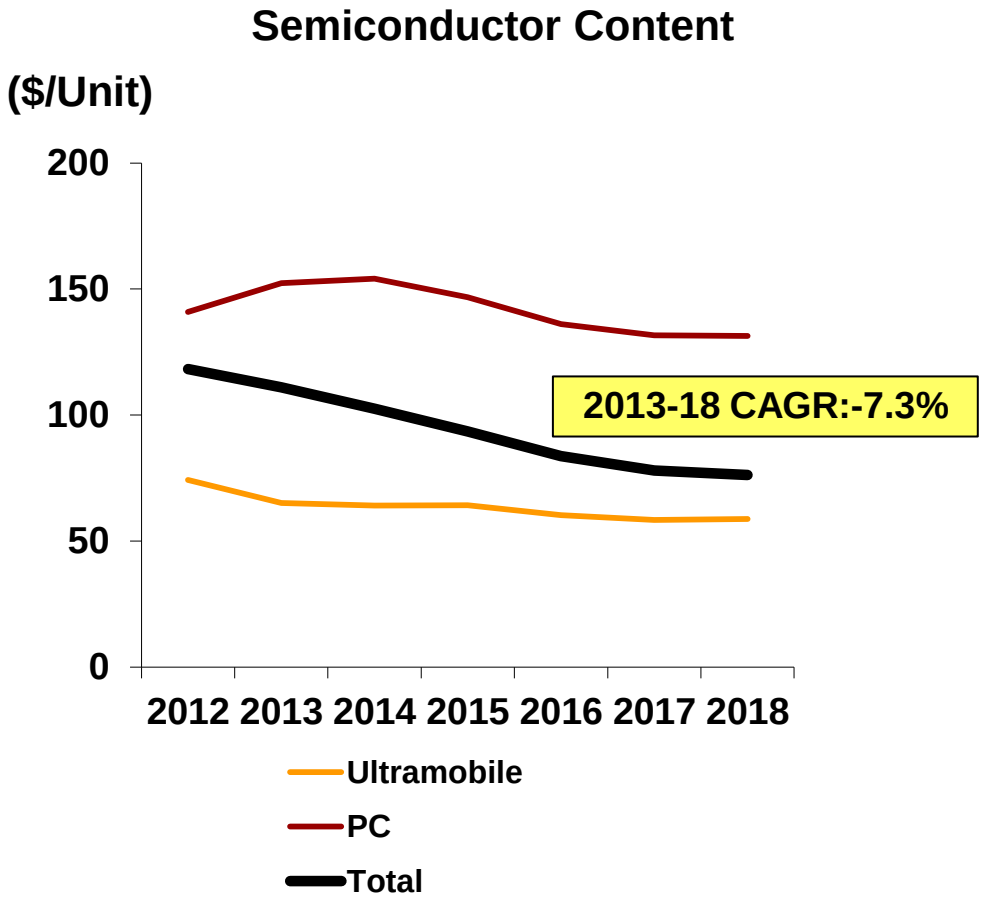
Ultramobile Forecast Segmentation - Examples



Ultramobiles Take Share from Traditional PCs





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Summary

- Economic outlook remains guardedly optimistic
- 2014 semiconductor growth at 6.7%
- Ultramobiles, SSD & Smartphones use 85% of total semiconductor device production
- Some risk of sub-seasonal 3Q14 semi growth given extra hot foundry growth and overly optimistic wearables market
- Next semiconductor slowdown in 2016 due to memory over-supply
- 2014 growth will be broad-based across all semiconductor devices but DRAM continues to lead

Capital Spending and Equipment

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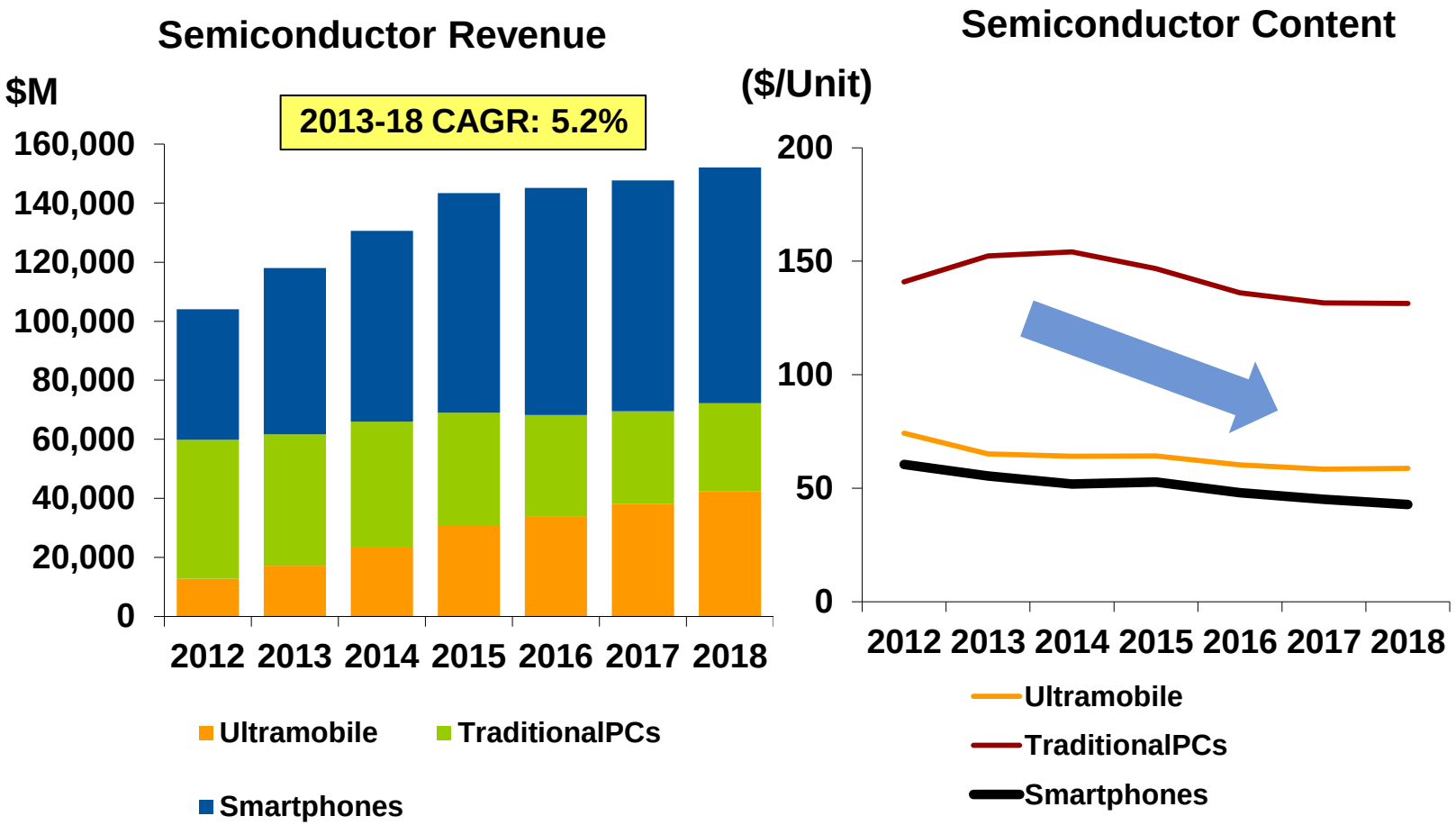
Critical Markets for Capital Investment

- Smartphones
  - Largest Growth Segment but Showing signs of Saturation
  - Revenue Growth Slows Dramatically by 2018
- Ultramobiles
  - Highest Overall CAGR, but at the Expense of PC Market
  - Tablets Drive Down Semiconductor Content
- Desktop and Notebook PCs
  - Large, but declining market.
  - Critical revenue to fund Logic capex
- SSDs
  - Driving NAND Flash Growth
  - Move to Data Centers Drives Sustainable Growth

Critical Markets for Capital Investment



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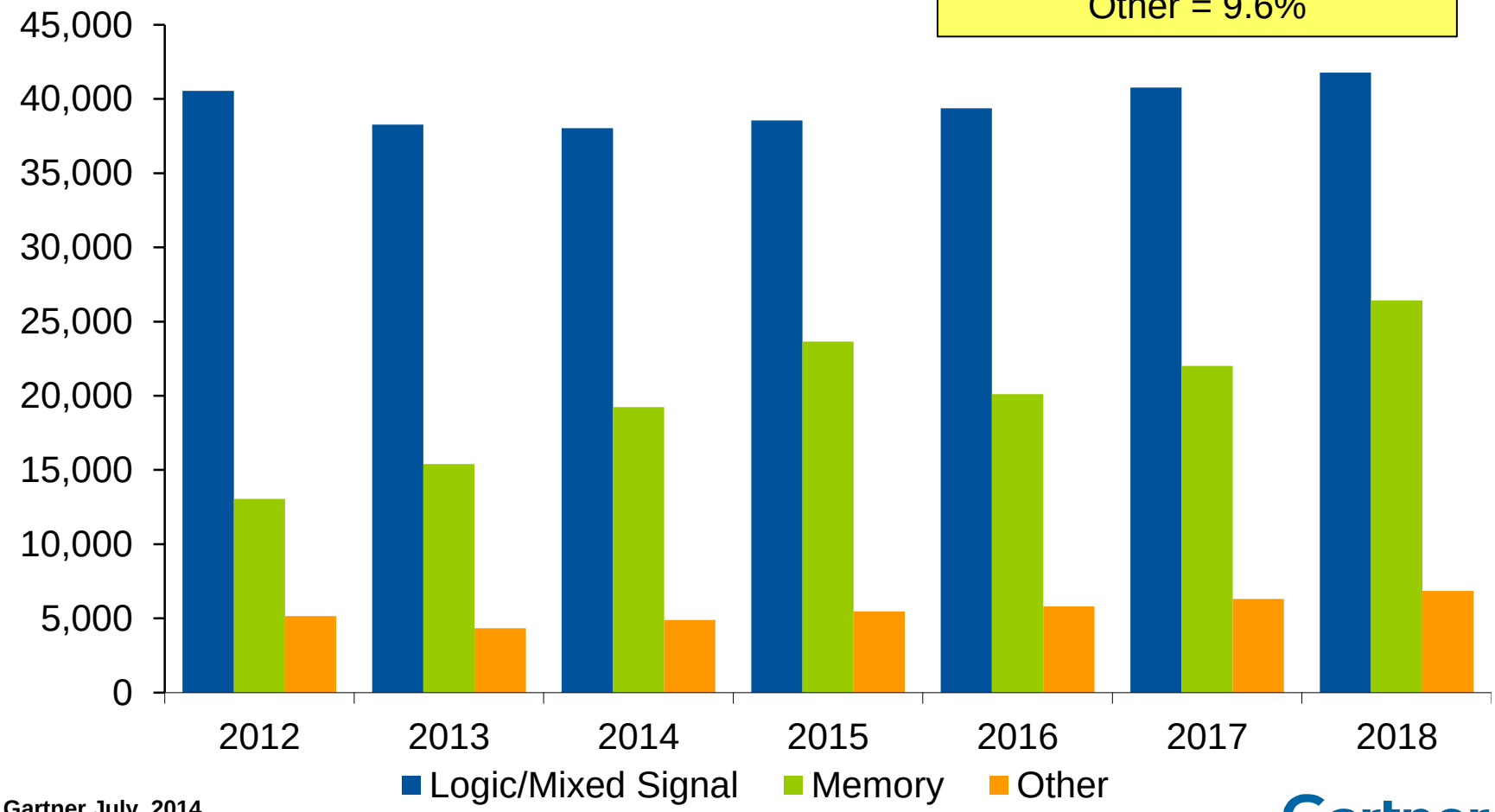
Capital Spending by Device Type

2013 - 2018 CAGRs
Logic = 1.8%
Memory = 11.4%
Other = 9.6%



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Top Semiconductor Capital Spenders, 2014

2014 Rank	2013 Rank	Company	(Millions of Dollars) 2013	2014	Change (%)	Share (%)
1	1	Samsung	11,500.0	12,000.0	4.3%	19.3%
2	2	Intel	10,711.0	10,000.0	-6.6%	16.1%
3	3	TSMC Group	9,688.0	9,750.0	0.6%	15.7%
4	5	SK Hynix	2,929.0	3,800.0	29.7%	6.1%
5	4	Globalfoundries	4,000.0	3,500.0	-12.5%	5.6%
6	6	Micron Technology	1,835.0	3,100.0	68.9%	5.0%
7	7	Toshiba	1,475.9	1,994.9	35.2%	3.2%
8	11	SanDisk	859.0	1,400.0	63.0%	2.3%
9	8	United Microelectronics Group	1,100.0	1,200.0	9.1%	1.9%
10	10	SMIC Group	880.0	1,110.0	26.1%	1.8%
11	9	Advanced Semiconductor Engineering	911.4	800.0	-12.2%	1.3%
12	13	Infineon Technologies	640.0	800.0	25.0%	1.3%
13	29	Inotera Memories	209.8	721.3	243.8%	1.2%
14	12	Sony	664.9	630.0	-5.2%	1.0%
15	16	STATS ChipPAC	507.5	613.0	20.8%	1.0%
16	14	Amkor Technology	566.3	575.0	1.5%	0.9%
17	15	STMicroelectronics	531.0	530.0	-0.2%	0.9%
18	17	Siliconware Precision Company (SPIL)	502.0	490.0	-2.4%	0.8%
19	24	Rohm	277.5	445.6	60.6%	0.7%
20	18	Texas Instruments	412.0	432.6	5.0%	0.7%
		Top 20 Companies' Total*	**50,200.3**	**53,892.4**	**7.4%**	**86.7%**
		Total Worldwide Capital Spending	**58,009.3**	**62,151.9**	**7.1%**	**100.0%**
		Top Companies (Percent)	86.5%	86.7%		

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Semiconductor Outsourcing Services – Foundry &SATS

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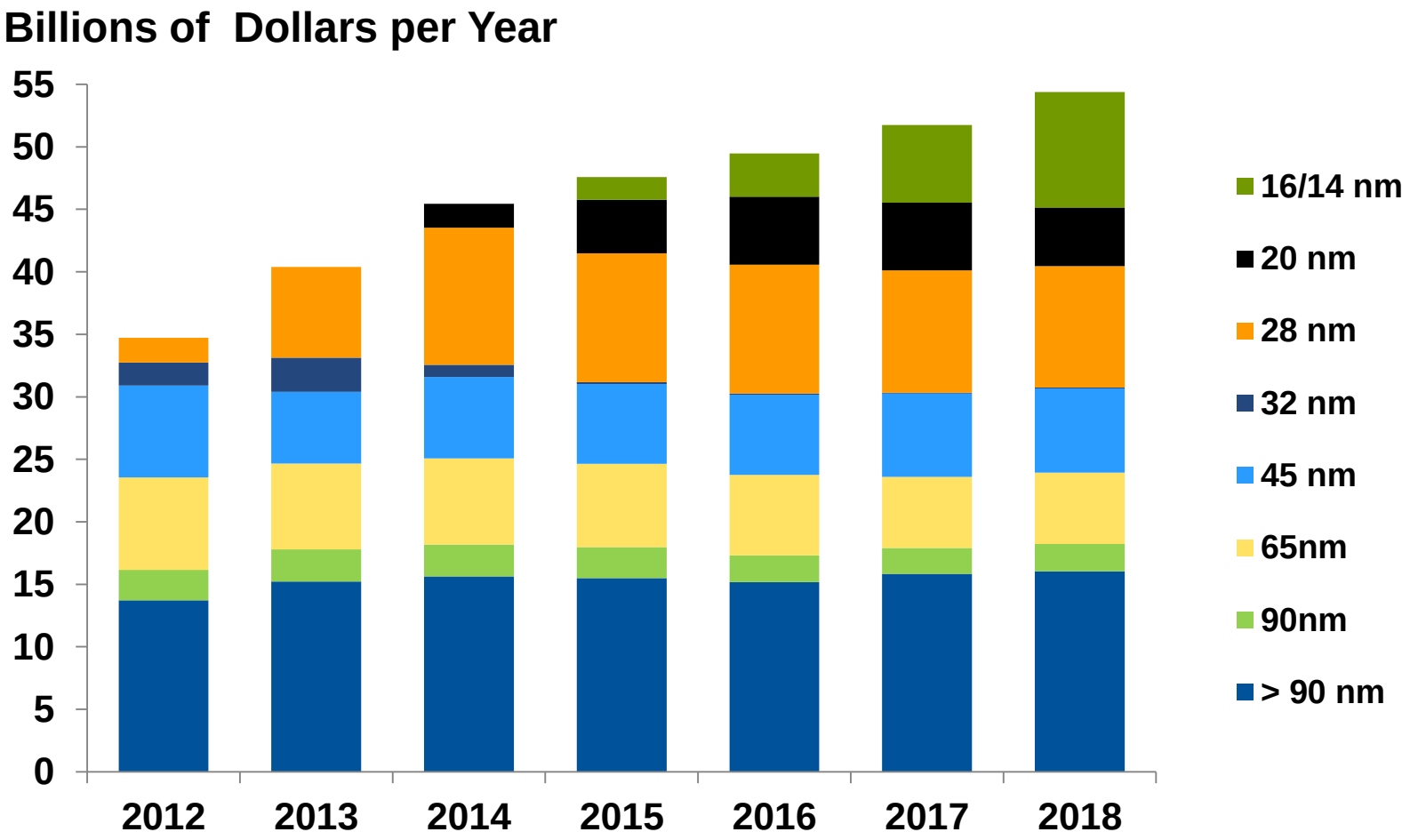
Foundry Highlights

- Foundry revenue increases by 12.5% to $45.4 billion in 2014, CAGR is 6.1% from 2013 through 2018
- Solid 16% 2Q14 sequential growth from inventory stocking and high wafer demand lead to tight capacity at most foundries
- Foundries have benefited from the chip requirement of ultramobile and wearable entries
- A seasonable business plus the absorption of former IDM business by foundries and a fast 20 nm ramp will contribute to a strong 2H14
- Competition in the race of FinFET technology has resulted in a strong EDA support of the 14 nm design infrastructure including 3D capability
- Foundry capex increases by 4.7% to $18.8 billion, overall foundry fab utilization rate of 85.5% and advanced nodes 88.1%

28 nm Is The Most Popular Foundry Node in History



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Larger Die Deteriorate Overall Yields!

Good die per 300mm wafer

	28nm	20nm	14nm	10nm	7nm
Total photo passes	**52**	**58**	**66**	**73**	**80**
Die size100mm2	**500**	**484**	**459**	**442**	**419**
Die size 200mm2	**196**	**184**	**165**	**153**	**138**
Die size 400mm2	**63**	**55**	**45**	**39**	**31**

Larger die are more likely to adopt 3DIC as technology node shrinks

1) Yield of large die suffers more with node shrinking

2) Higher yield if replaced by multiple smaller dies using 3DIC

Foundry vs. SATS - Key Stats

	Foundry	SATS
Technology	Fab	Packaging
Capital Intensity	45-50%	15-20%
R&D, percent	8 -10%	1-2%
Gross Margin	45-50%	20-25%
Market Revenue, Billions USD	45.4	26.7
Total Available Market, Billions USD	145	53
Market Penetration, percent	30%	50%

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Foundry vs. SATS – Market Share

Foundry

Company	Region	2013 Revenue	2013 Market Share (%)
TSMC	Taiwan	20,113	49.8%
Globalfoundries	U.S.	4,550	11.3%
UMC	Taiwan	4,172	10.3%
Samsung[1]	Korea	2,300	5.7%
SMIC	China	2,069	5.1%
Powerchip	Taiwan	862	2.1%
Vanguard International	Taiwan	712	1.8%
IBM Microelectronics	U.S.	570	1.4%
Shanghai Huahong Grace Semiconductor[2]	China	555	1.4%
TowerJazz	Israel	505	1.3%
Top 10 for 2013		36,408	90.1%
Others		3,991	9.9%
Total Market		**40,399**	**100.0%**

SATS

Company	Region	2013 Revenue	2013 Market Share (%)
ASE	Taiwan	4,740	18.9%
Amkor Technology	U.S.	2,956	11.8%
SPIL	Taiwan	2,335	9.3%
STATS ChipPAC	Singapore	1,599	6.4%
Powertech Technology	Taiwan	1,267	5.1%
JCET	China	850	3.4%
J-Devices	Japan	843	3.4%
UTAC	Singapore	748	3.0%
ChipMOS	Taiwan	649	2.6%
Chipbond Technology	Taiwan	530	2.1%
Top 10 for 2013		16,517	67.3%
Others		8,009	32.7%
Total Market		24,526	100.0%

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Top 20 SATS Companies' Sales, 2013
(Millions of Dollars)

2013 Rank	2012 Rank	Company	Region	2012 Revenue	2013 Revenue	2012 Market Share (%)	2013 Market Share (%)	Change 2012-2013
1	1	ASE	Taiwan	4,298	4,740	17.5%	18.9%	10.3%
2	2	Amkor Technology	U.S.	2,760	2,956	11.3%	11.8%	7.1%
3	3	SPIL	Taiwan	2,186	2,335	8.9%	9.3%	6.8%
4	4	STATS ChipPAC	Singapore	1,702	1,599	6.9%	6.4%	-6.1%
5	5	Powertech Technology	Taiwan	1,408	1,267	5.7%	5.1%	-10.0%
6	7	Jiangsu Changjiang Electronics Technology (JCET)	China	714	850	2.9%	3.4%	19.0%
7	9	J-Devices	Japan	619	843	2.5%	3.4%	36.3%
8	6	UTAC	Singapore	978	748	4.0%	3.0%	-23.5%
9	8	ChipMOS Technologies	Taiwan	662	649	2.7%	2.6%	-1.9%
10	10	Chipbond Technology	Taiwan	508	530	2.1%	2.1%	4.3%
11	11	STS Semiconductor	S. Korea	472	499	1.9%	2.0%	5.8%
12	12	King Yuan Electronics	Taiwan	422	426	1.7%	1.7%	1.0%
13	21	Tianshui Huatian Microelectronics	China	257	398	1.0%	1.6%	54.9%
14	14	Carsem Semiconductor	Malaysia	356	350	1.5%	1.4%	-1.7%
15	15	Unisem	Malaysia	354	315	1.4%	1.3%	-11.1%
16	13	Formosa Advanced Technologies	Taiwan	360	302	1.5%	1.2%	-16.2%
17	19	Walton Advanced Engineering	Taiwan	259	296	1.1%	1.2%	13.9%
18	22	Nantong Fujitsu Microelectronics	China	251	287	1.0%	1.1%	14.3%
19	18	AOI Electronics	Japan	268	282	1.1%	1.1%	5.1%
20	17	Signetics	S. Korea	281	261	1.1%	1.0%	-7.1%
		Top 20 Total		**19,116**	**19,934**	**77.9%**	**79.5%**	**3.7%**
		Other Companies		5,410	5,148	22.1%	20.5%	-3.0%
		Total Market		**24,526**	**25,082**	**100.0%**	**100.0%**	**2.3%**

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SATS Market Share History 1999-2002

Company	Region	1999	2000	2001	2002
Amkor	US	1,617	2,016	1,336	1,406
ASE Group	Taiwan	1,011	1,636	1,140	1,321
SPIL	Taiwan	340	538	472	641
ChipPac	US	376	494	329	364
STATS	Singapore	201	331	146	226
ChipMos	Taiwan	201	269	150	197
Orient Semiconductor Electronics (OSE)	Taiwan	189	262	165	188
Carsem	Malaysia	265	365	184	185
King Yuan Electronics (KYEC)	Taiwan	93	120	111	155
AIT (Swire/Astra)	US	245	284	190	150

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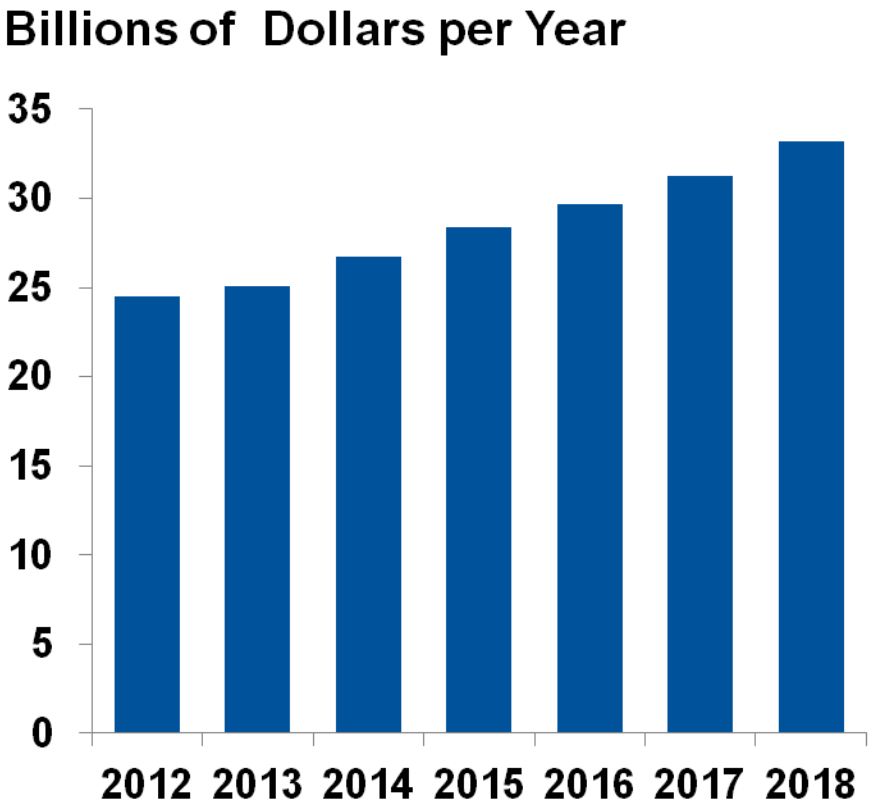
Source: Gartner (July 2014)

SATS Summary, 2Q14



- SATS Revenue CAGR is 5.8% from 2013 through 2018.
- Advanced packaging main revenue driver for top SATS companies; up to 50% of total in some cases.
- SATS capex increases announced in past month. Now 4.3 billion for 2014
- Overall SATS utilization rate of 84% and advanced pkg 87%.
- 3D Hybrid Memory Cube production starting this month.

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Key Findings for SATS Industry

- Virtual and vertical integration of outsourcing is occurring as the manufacturing processes of wafer fab, packaging, and system assembly converge. Outsourcing business models are changing.
- Wafer-based packaging processes are now mainstream. In addition to companies within the SATS market, the foundry market has also emerged as a SATS competitor.
- The SATS industry has reached above the 50% outsourcing mark. Even so, the SATS market will still exhibit a growth rate above that of the overall semiconductor device industry, with a five-year compound annual growth rate (CAGR) of 5.8% from 2013 through 2018.
- Expansion into China by the SATS companies continues, as engineering expertise and supply chain infrastructure are fully developed in the area.
- The top five companies comprise approximately 50% of the SATS market revenue for 2013. While their growth will approach 60% of the market by 2018, consolidation must occur among the more than 150 companies participating in the SATS industry.
- Many SATS companies not be able to develop the necessary capital required for the increased complexity and wafer-like equipment cost required to stay competitive.
- As competition intensifies and capital requirements increase, the market will stratify into three segments: leading edge, specialty niche and sunset/mature packaging services.

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Q2/14 Forecast Growth Scorecard

	2014			2015		
Revenue Growth (%)	**-6 Mos**	**-3 Mos**	**Now**	**-6 Mos**	**-3 Mos**	**Now**
Global Real GDP	+3.0	+3.0	+2.8	+3.4	+3.5	+3.3
U.S. Real GDP	+2.5	+2.5	+2.2	+3.1	+3.3	+3.1
Elec. Equipment[1]	+3.7	+3.9	+3.4	+4.6	+5.0	+3.5
Semiconductor[2]	+5.4	+5.4	+6.7	+2.8	+4.8	+4.9
Foundry	+7.9	+9.9	+12.5	+4.6	+4.7	+4.7
SATS	+8.6	+6.4	+6.6	+5.9	+6.1	+6.2
Capital Spending	+9.9	+5.5	+7.1	+12.2	+10.0	+8.9
Equip. Spending	+16.1	+12.2	+15.0	+16.3	+12.8	+11.0
WFE	+16.4	+13.0	+16.1	+16.7	+10.6	+8.9
PAE	+14.7	+7.4	+8.6	+12.9	+21.5	+23.6
ATE	+15.2	+11.7	+14.7	+19.2	+26.6	+14.0
Silicon (MSI)	+3.3	+4.8	+10.5	+5.3	+4.0	+3.1

[1] Production revenue

[2] Excluding solar

Source for GDP data: IHS Global Insight, June 2014

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