

Stability in an Unstable World

Jim Walker

MEPTEC Luncheon

September 11, 2013

This presentation, including any supporting materials, is owned by Gartner, Inc. and/or its affiliates and is for the sole use of the intended Gartner audience or other authorized recipients. This presentation may contain information that is confidential, proprietary or otherwise legally protected, and it may not be further copied, distributed or publicly displayed without the express written permission of Gartner, Inc. or its affiliates.
© 2012 Gartner, Inc. and/or its affiliates. All rights reserved.

Gartner[®]

Semiconductor Manufacturing Market: 2013 Key Issues

- What is the latest outlook for the economy and the semiconductor market?
- What are the current and future prospects for capital spending?
- What is the outlook for outsourced semiconductor manufacturing services (Foundry and SATS)?
- What are the latest trends for device packaging and the back-end equipment market?

Economy

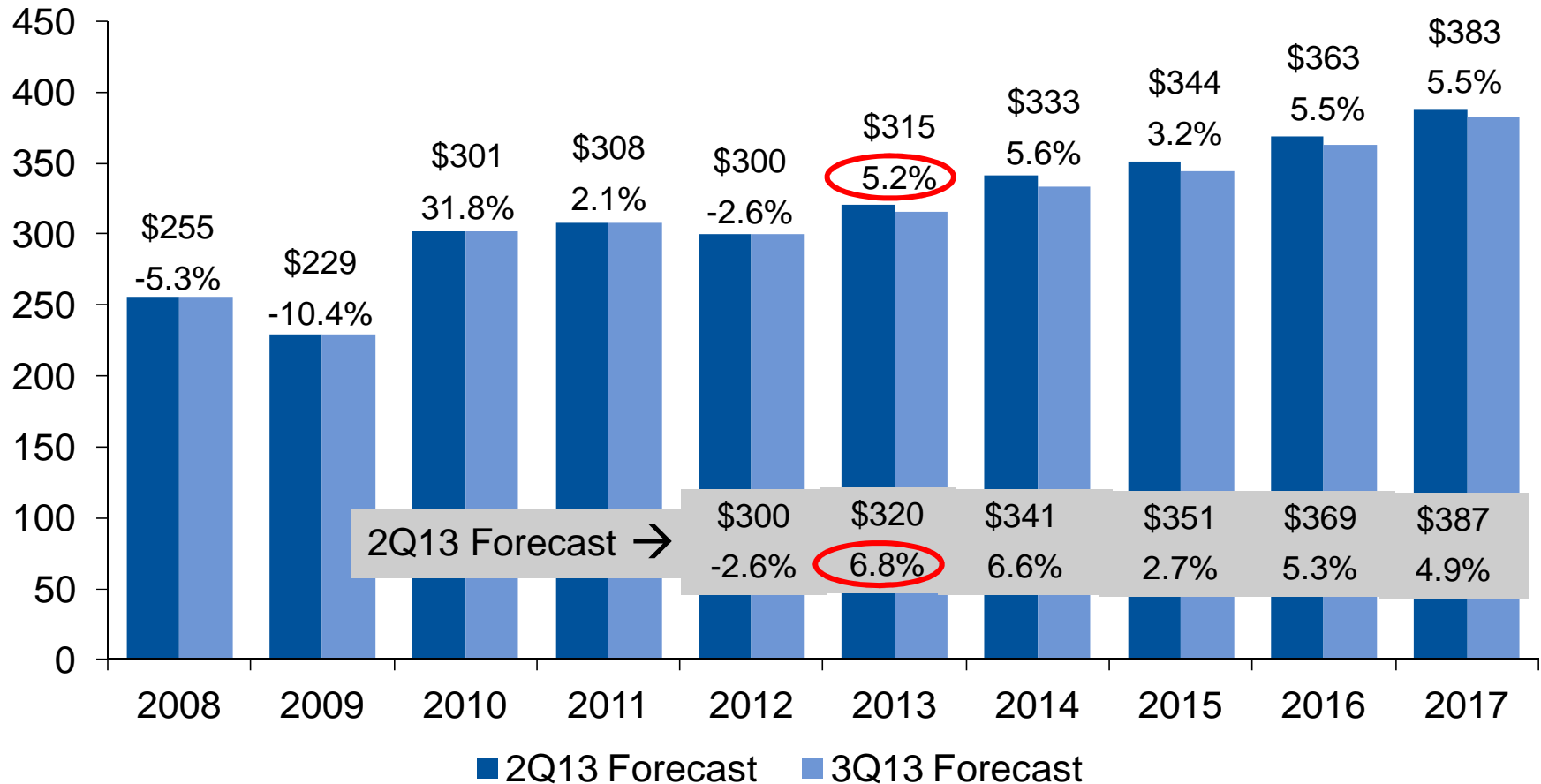
- Mixed global economy in 2013: GDP=2.5%
 - Established Economies vs. Emerging
 - Sequestration
 - Euro Zone
- Healthy economic acceleration in 2014 GDP=3.5%
- Macroeconomic risks remain the same but somewhat more worrisome, esp. for U.S. and China:
 - Eurozone Meltdown
 - Oil Price Shock
 - US Stagnation
 - China Hard Landing
 - *Middle East??*

3Q13 Semiconductor Assumptions

- 2013 PC unit production growth -7.3%, down from -4.9% in 2Q13 update
- 2013 mobile phone unit production growth is 2.1%, down from 2Q13 forecast of 3.9%, growth shifting to utility/basic smartphones as premium smart phone market saturates
- 2013 media tablet unit production forecast grows 41.8% to 211.8M units, relatively unchanged from 2Q13 forecast of 212.6 Units
- DRAM and NAND both to experience boom growth in 2013, 34% and 24%, respectively
- Near-term forecast assumes stable economy

Semiconductor 2013 Revenue Forecast: Stable Growth in an Unstable World

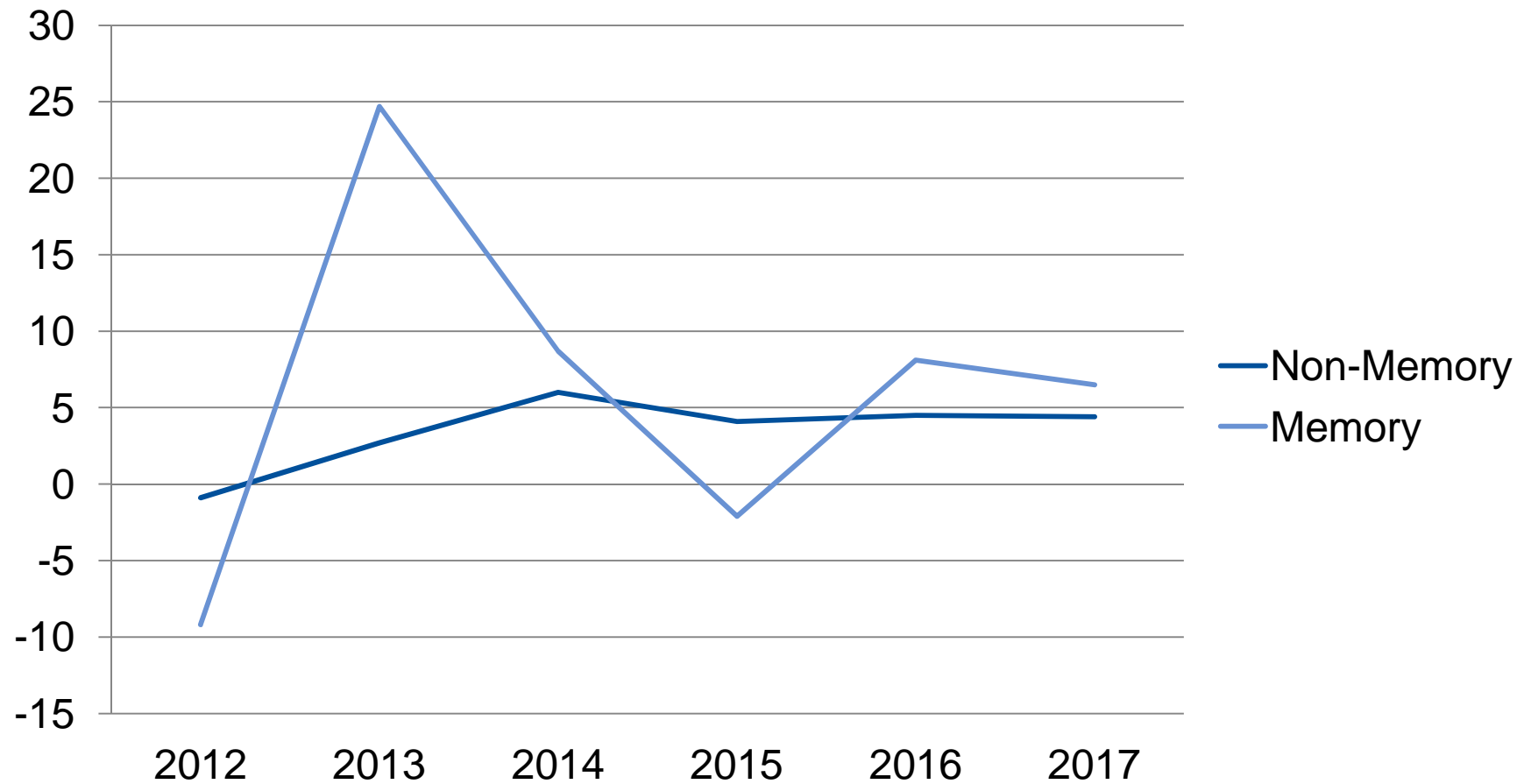
Billions of Dollars and
Revenue Growth



Semiconductor Revenue, 3Q13 Update: Device Revenue and Annual Growth

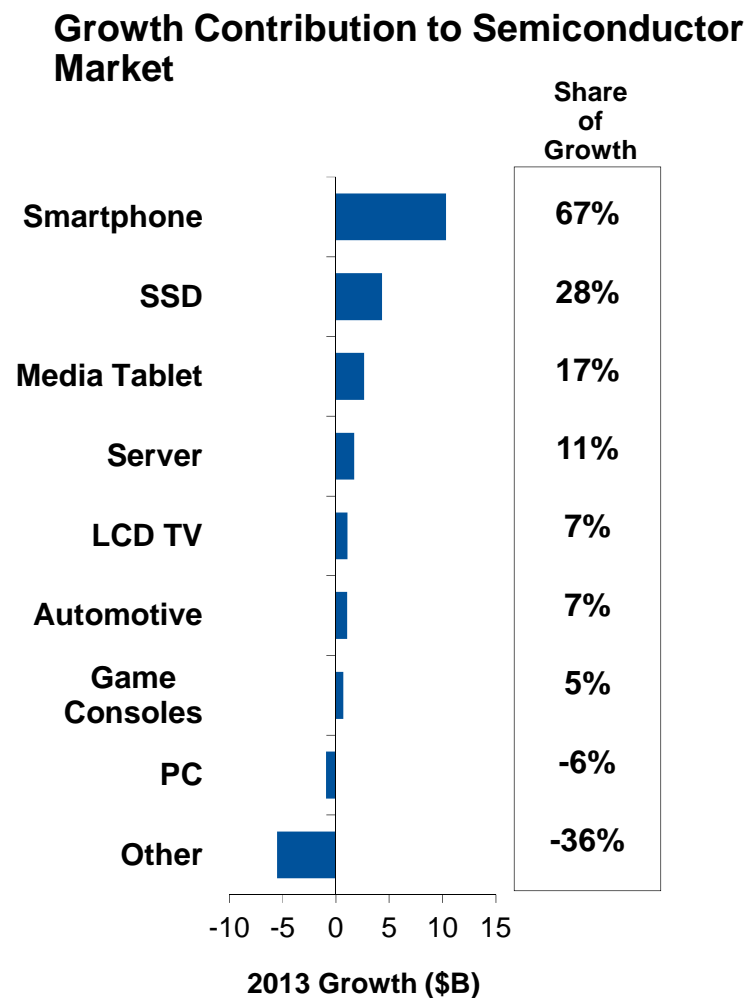
Revenue (\$B)	2012	2013	2014	2015	2016	2017	CAGR
Memory	55.7	69.4	73.9	72.0	77.3	83.2	8.4%
Microcomponents	59.3	58.1	60.2	61.1	63.8	66.1	2.2%
Logic	11.7	12.3	13.0	13.9	15.0	16.3	6.8%
Analog	19.1	19.2	20.2	20.9	21.7	22.5	3.4%
Discrete	18.5	17.6	18.5	19.1	19.7	20.5	2.0%
Optoelectronics	24.8	25.9	28.1	30.5	33.5	36.4	8.0%
ASIC	21.3	20.8	22.8	24.9	26.1	27.3	5.0%
ASSP	83.7	85.7	88.8	93.0	96.1	100.2	3.7%
Non-Optical Sensors	5.8	6.4	7.4	8.4	9.3	10.1	11.8%
Total Semiconductor	299.9	315.4	333.0	343.8	362.5	382.5	5.0%
Annual Growth (%)							
Memory	-9.2%	24.6%	6.6%	-2.6%	7.4%	7.6%	
Microcomponents	-4.4%	-2.0%	3.7%	1.5%	4.4%	3.6%	
Logic	-4.4%	4.5%	5.8%	7.1%	7.9%	8.6%	
Analog	-4.8%	0.6%	5.0%	3.4%	3.7%	4.1%	
Discrete	-9.6%	-4.9%	5.1%	3.1%	3.5%	3.8%	
Optoelectronics	5.5%	4.5%	8.6%	8.3%	9.9%	8.7%	
ASIC	-2.9%	-2.5%	9.9%	9.2%	4.7%	4.4%	
ASSP	3.2%	2.4%	3.6%	4.7%	3.4%	4.2%	
Non-Optical Sensors	13.7%	11.1%	15.9%	13.4%	10.1%	8.6%	
Total Semiconductor	-2.6%	5.2%	5.6%	3.2%	5.5%	5.5%	
Non-Memory	-0.9%	0.7%	5.3%	4.9%	4.9%	5.0%	

Tale of Two Unique Markets



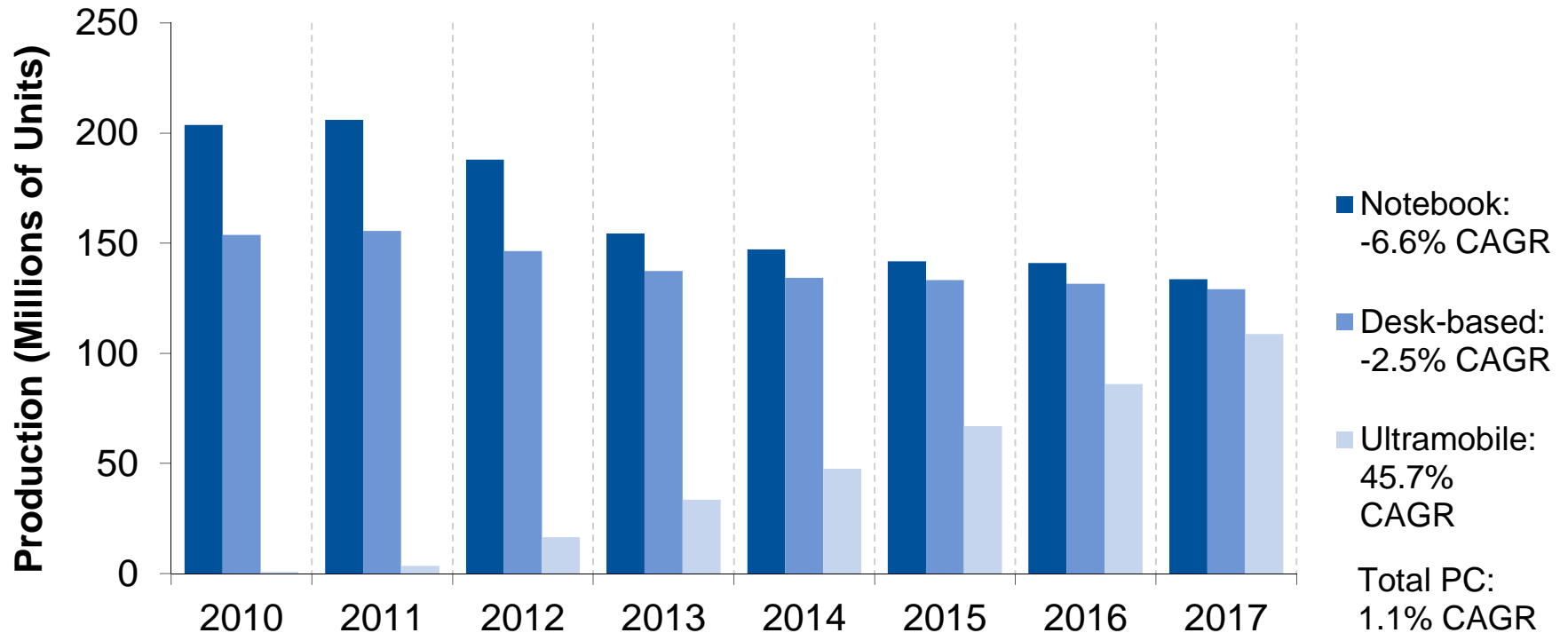
2013 Forecast Contribution Update

Application	2013 Change from Last Quarter (\$B)	% of Total Decrease
Smartphone	-2.0	41%
PC	-1.6	33%
Media Tablet	-0.4	7%
Server	-0.1	2%
Game Consoles	0.0	0%
Automotive	0.1	-2%
LCD TV	0.3	-6%
SSD	0.7	-14%
All Other Applications	-1.8	38%
Total Applications	-4.8	100%



PC Production, 3Q13 Update: Ultramobiles Bridge Between PCs and Tablets

	2010	2011	2012	2013	2014	2015	2016	2017	CAGR '12-'17
Semis(\$B)¹	62.6	57.3	51.0	50.0	49.1	46.5	48.1	49.3	-0.6%
Yr/Yr Growth	33.1%	-8.5%	-11.0%	-1.8%	-2.0%	-5.2%	3.4%	2.5%	



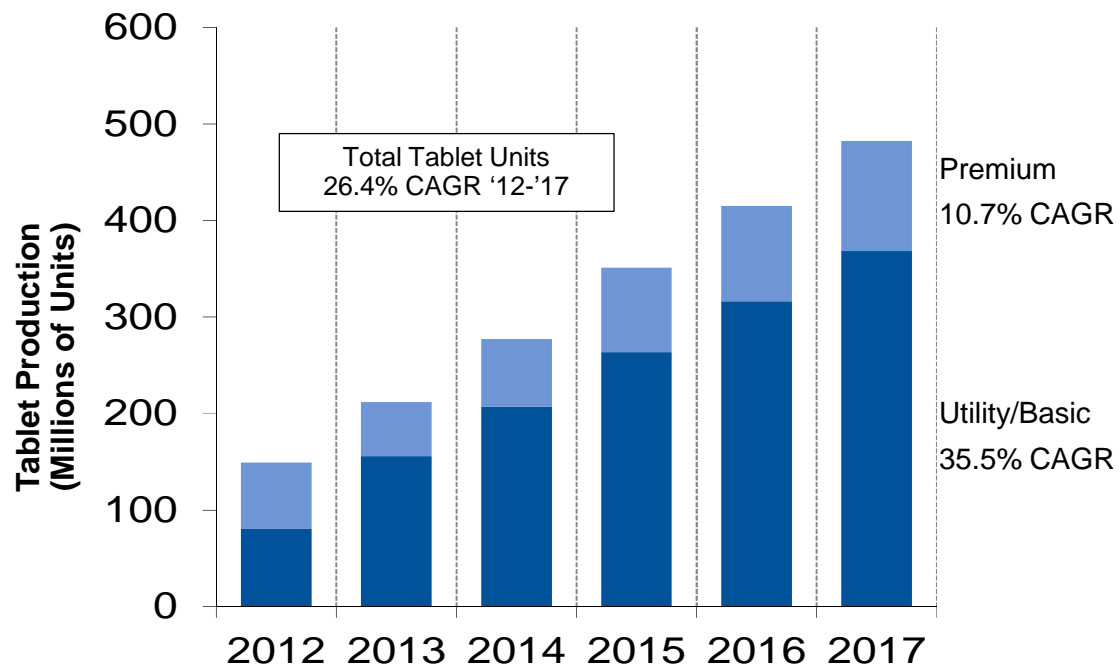
1 - excludes SSD / ODD / RDD / Ethernet
 Source: Gartner (September 2013)

PC Summary

- Emerging markets are not purchasing PCs as strongly as before and are increasingly choosing tablets as their first computing device
- 2Q13 results suggest that the decline of the U.S. consumer market is bottoming out after more than two years of steep shipment decline
- End of Support for Windows XP in April 2014 buoying business market
- Current consumer behavior supports Gartner's forecast assumption of mobile devices for each individual plus one "family" PC per household
- Market in a transition phase: 2H13 will be the testing ground for Haswell Ultrabooks, Atom-based tablets and Windows 8.1
- Haswell's power efficiency permits CPU placement behind the LCD resulting in Intel-based designs with more flexible form factors, such as hybrid and convertible Ultrabook derivatives
- X86 based ultramobiles blur the distinction between PC and tablet — for example, touchscreens, instant-on, long battery, support for legacy apps and a form factor that marries consumption and creation.

3Q13 Tablet Update: Tablet Units Exceed Mobile PC Production in 2013

	2012	2013	2014	2015	2016	2017	CAGR '12-'17
Semis ¹ (\$B)	9.4	12.1	16.1	19.7	22.1	25.4	21.9%
Yr/Yr Growth	48.1%	28.0%	33.4%	22.3%	11.8%	15.2%	

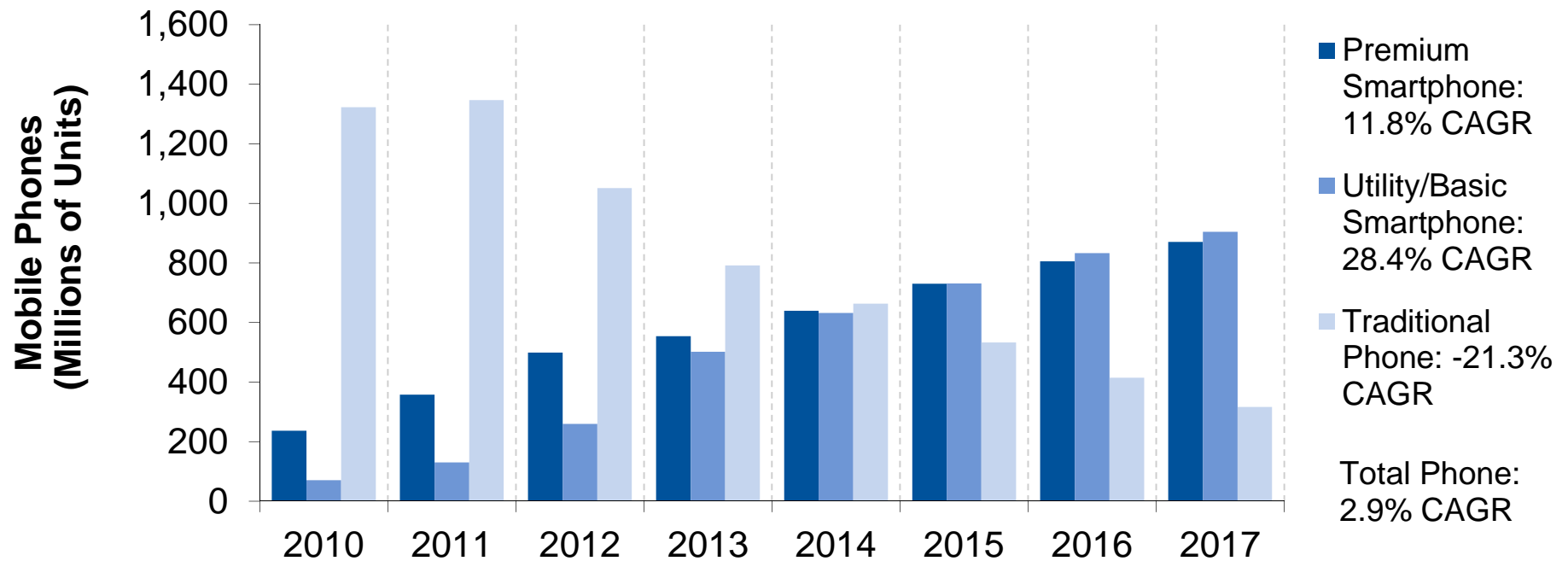


- Units increased in outer years, driven by utility/basic
- Premium tablet lifetime extended due to software upgrades, hand-me downs
- Low price, enhanced quality of basic tablets will attract new demographics of tablet adopters
- In emerging markets, utility/basic tablets primary devices for mobile consumer computing
- Phablets emerging as a converged alternative to separate smartphone and tablet
- Intel will gain in tablet form factors with Android and Windows 8.1
- Innovation in dock-able designs, multi-screen usage, new UI technology such as gesture/voice

1 - excludes SSD

3Q13 Mobile Phone Update: Smartphones Exceed Traditional Phones in 2013

	2010	2011	2012	2013	2014	2015	2016	2017	CAGR '12-'17
Semi TAM (\$B)	47.3	53.3	58.4	64.1	69.4	75.3	79.3	84.2	7.6%
Yr/Yr Growth	20.8%	12.6%	9.6%	9.8%	8.3%	8.4%	5.3%	6.2%	

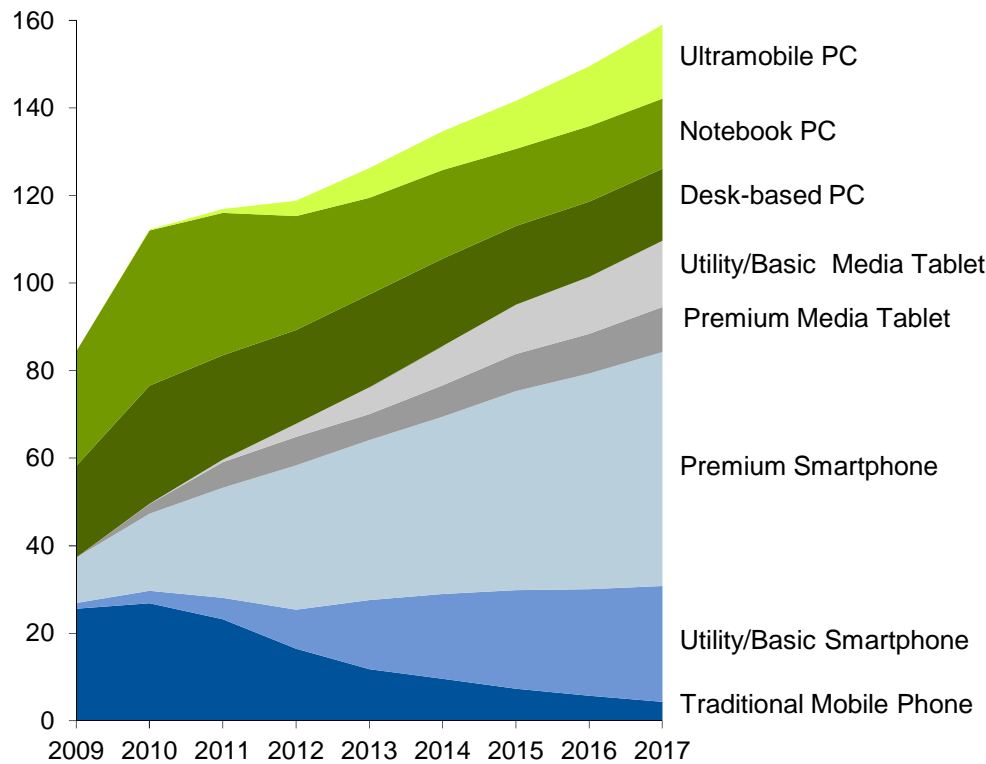


Mobile Phone Summary

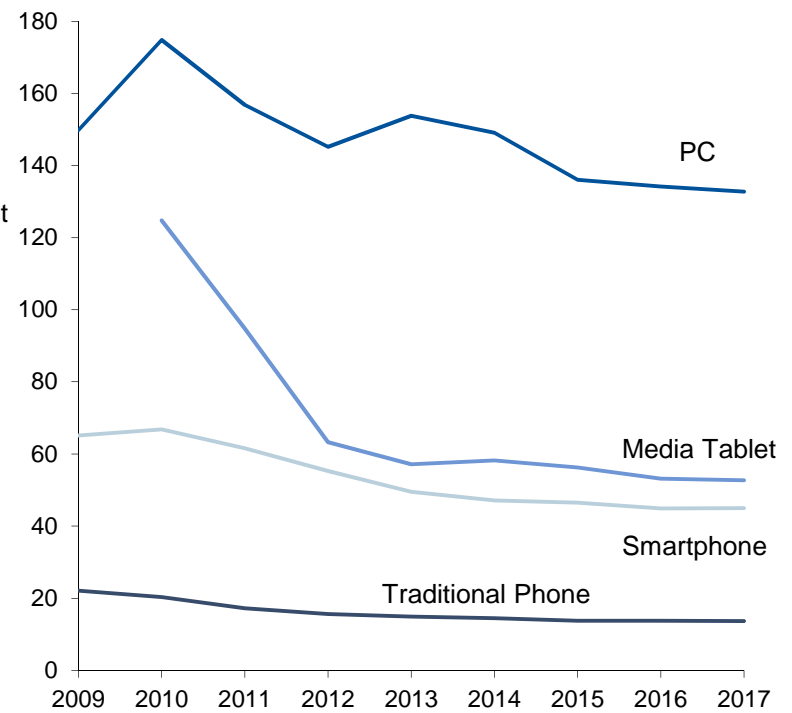
- Overall forecast through 2017 decreased:
 - Utility/basic smartphones increased in 2013, but estimates have been lowered from 2014-17
 - Premium smartphone market showing signs of saturation - designing compelling new premium features increasingly challenging
- Market for utility/basic smartphones remains robust with good unit growth driven by rapid feature/performance migration from premium models and lower ASPs
- Mix shift to smartphones driving increased semiconductor content, yielding semiconductor revenue growth above overall mobile phone unit growth
- Entry level smartphones are available for under \$50; very capable smartphones cost from \$150 to \$200 unsubsidized - quickly improving, with bigger screens, 3G capability, better cameras and more-powerful processors
- Semiconductor content in premium smartphones driven by increasing LTE penetration, support for 802.11ac, improved cameras, increased graphics and processing power, additional sensors

Growth Coming from Low Semiconductor Content Sources

Semiconductor Sales¹ (\$B)



Semiconductor Content - (Dollars Per System)

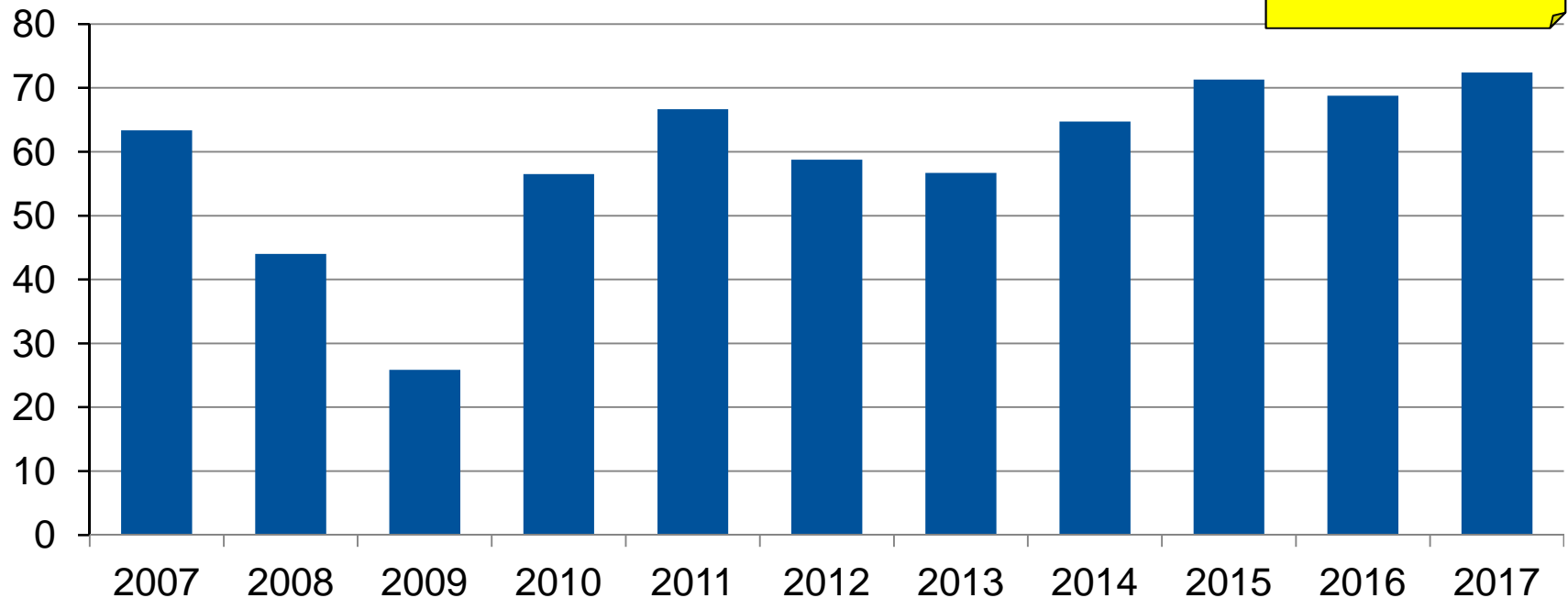


1 - excludes SSD / ODD / RDD / Ethernet

Capital Spending: Slow Growth Ahead

- 2013 spending down 3.5%, driven by slow first half
- Spending increases in second half 2013.
- 2016 softness driven by memory weakness.

Billion of Dollars



Capex CAGR
12/17 = 4.3%

Gartner®

Top Semiconductor Capital Spenders

2013 Top 3 are 54% of Total

2013 Rank	2012 Rank	Company	2012	2013	Change (%)	Share (%)
1	2	Intel	11,027.0	10,000.0	-0.2%	19.4%
2	3	TSMC Group	8,300.0	9750.00	20.5%	17.6%
3	1	Samsung	12,100.0	9,500.0	-21.5%	16.8%
4	4	Globalfoundries	3,800.0	4,500.0	18.4%	7.9%
5	5	SK Hynix*	3,420.0	2,600.0	-24.0%	4.6%
6	7	Micron Technology	1,700.0	1,800.0	5.9%	3.2%
7	6	United Microelectronics Group	1,750.0	1,500.0	-14.3%	2.6%
8	10	Toshiba	904.1	1,288.2	42.5%	2.3%
9	9	SanDisk	979.0	1,100.0	12.4%	1.9%
10	17	SMIC	499.0	675.0	35.3%	1.2%
11	8	Advanced Semiconductor Engineering	1,007.0	650.0	-35.5%	1.1%
12	11	Sony	902.1	637.3	-29.4%	1.1%
13	12	Infineon Technologies	900.0	600.0	-33.3%	1.1%
14	14	Amkor Technology	533.0	600.0	12.6%	1.1%
15	19	STMicroelectronics	476.0	550.0	15.5%	1.0%
16	13	Nichia Chemical	696.7	530.9	-23.8%	0.9%
17	15	Siliconware Precision Company (SPIL)	512.0	502.0	-2.0%	0.9%
18	18	Texas Instruments	495.0	450.0	-9.1%	0.8%
19	21	STATS ChipPAC	409.9	387.0	-5.6%	0.7%
20	22	IBM Microelectronics	405.0	380.7	-6.0%	0.7%
		Top 20 Companies' Total**	50,815.8	49,251.0	-3.1%	86.9%
		Total Worldwide Capital Spending	58,742.8	56,704.5	-3.5%	100.0%
		Top Companies (Percent)	86.5%	86.9%		

Capital Investment Conclusions

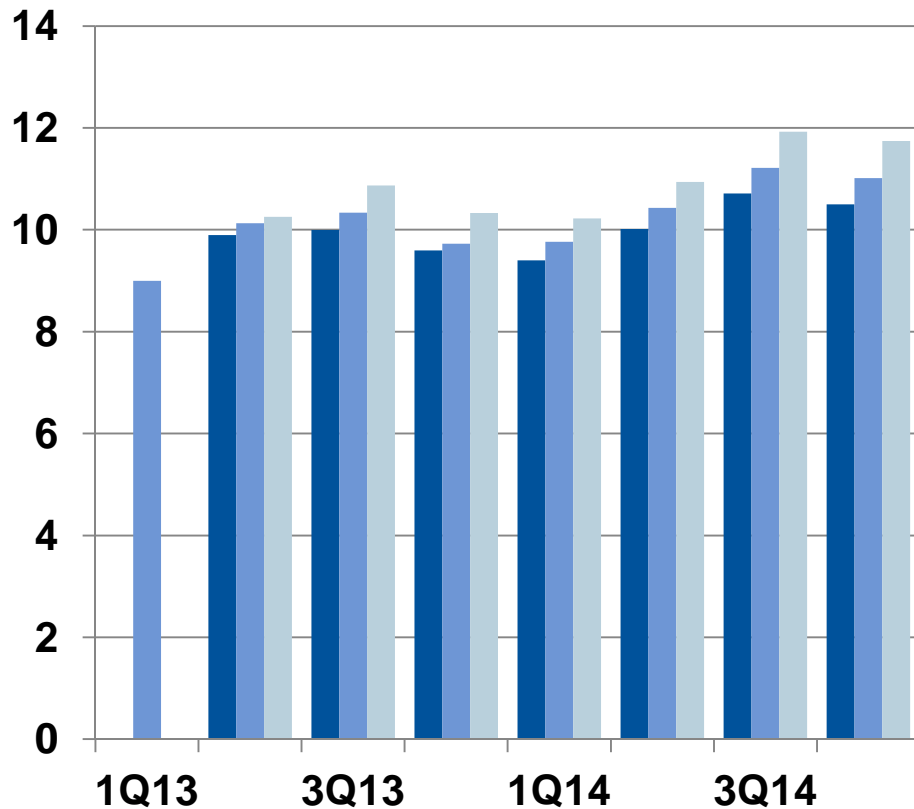
- Capital spending will increase in the 2H13
- Aggressive logic investment in leading-edge capacity for 28 nm and 20 nm advanced products throughout forecast period by foundry, Intel and Samsung
- Memory capital spending will decline 3.0% in 2013 but bounce back by 48.3% in 2014
- DRAM and NAND Flash currently in short supply, creating revenue growth as ASPs show surprising strength driving increased investment in the memory sectors through 2015
- More SATS companies among the top 20 spenders, as processes overlap and packaging becomes more wafer-like

Foundry Highlights

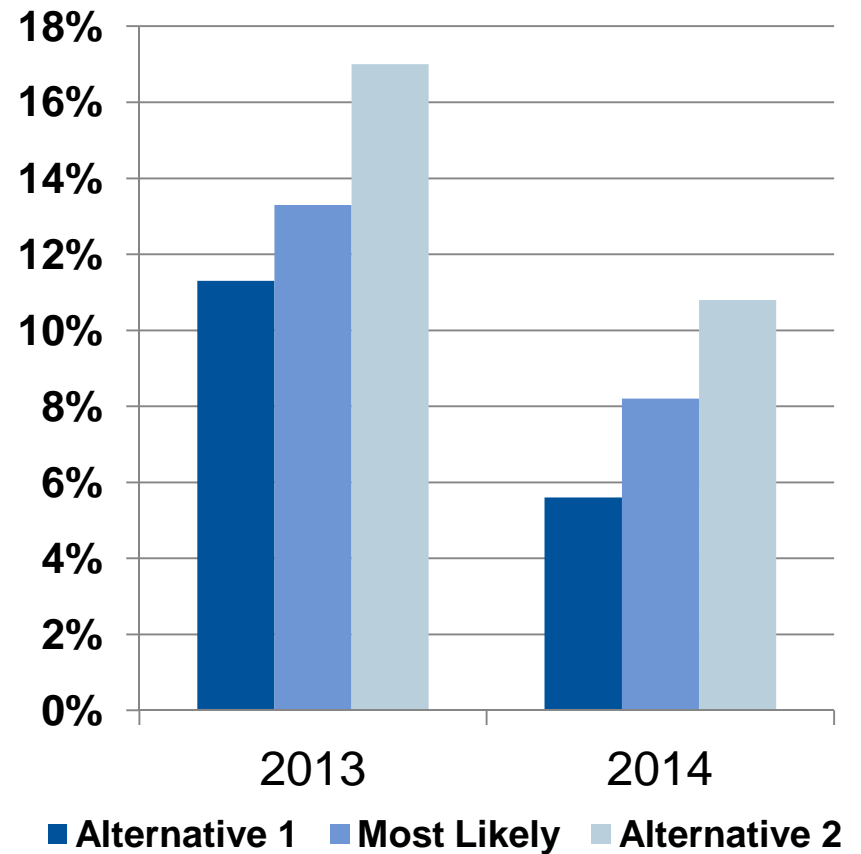
- Foundry revenue will increase by 13.3% to \$39.2 billion in 2013 and 8.2% in 2014. CAGR is 7.5% from 2012 to 2017.
- Foundry capital spending will increase 14.3% in 2013 to \$19.2 billion.
- Fab utilization overall for foundries in 2013 will be at mid 86%, with advanced nodes (<45 nm) at low 92%.
- Foundry investment for 20 nm planar technology will be sparse as many customers will skip the technology.
- An acceleration of FinFET production schedule by foundries, now targeting to be 2H14, has been triggered by the Intel/Altera news.
- FinFET nomenclature designated by nodes needs to be standardized.

Foundry Service Market: Quarterly Revenue Scenarios

Quarterly Revenue (\$Billion)

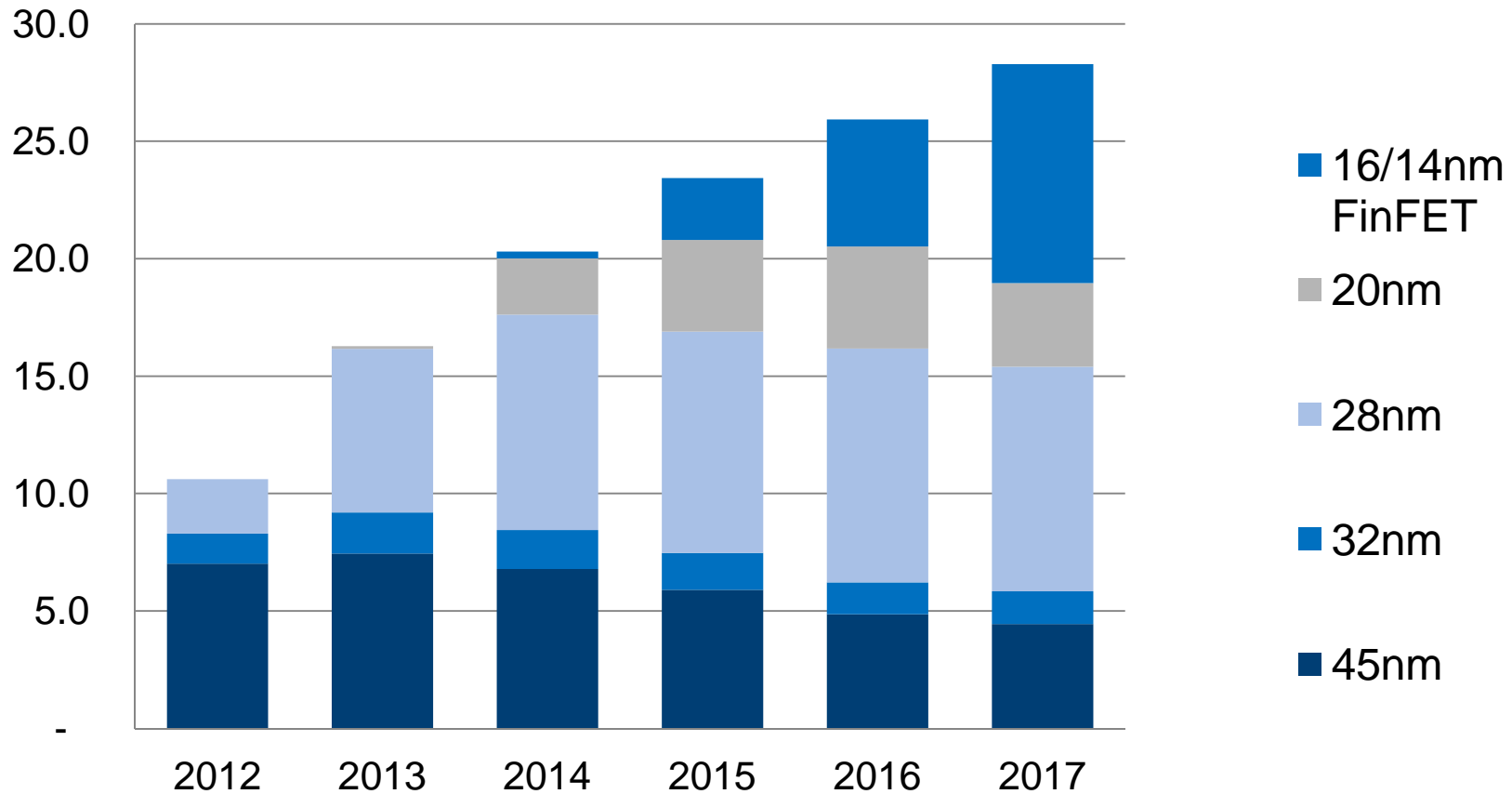


Annual Growth (%)



Foundry Revenues of Advanced Nodes

Billions of Dollars



Back-End Processing Trends

- The fastest growing packaging segments are:
 - Bare-die
 - FBGA
 - Leadless-Leadframe
- Rapid growth of WLP, Flip Chip, and Redistribution processes.
- Adoption of TSV pushed into 2014.
 - Full production ramp for memory devices expected in 2014.
 - The non-memory space will see industry-wide production levels in the 2015-16 timeframe if demand warrants the technology.
- Top SATS players seeing a majority share of the advanced packaging revenues as IDM's continue using the outsourcing model for back-end processing.

Packaging Revenue Forecast, 2010-2017

	2010	2011	2012	2013	2014	2015	2016	2017	CAGR '12-'17
Packaging and Test Market (IDM)*	24,898	24,000	23,537	24,374	25,346	26,711	27,543	29,577	4.7%
Outsourcing Market (SATS)	23,593	24,024	24,526	26,641	29,425	31,191	33,824	36,288	8.2%
Worldwide Total Packaging and Test Market	48,491	48,024	48,063	51,015	54,771	57,903	61,367	65,865	6.5%
Total Packaging and Test Market Growth	27.8%	-1.0%	0.1%	6.1%	7.4%	5.7%	6.0%	7.3%	
Ratio of Outsourced Market	48.7%	50.0%	51.0%	52.2%	53.7%	53.9%	55.1%	55.1%	
SATS Growth Rate	37.6%	1.8%	2.1%	8.6%	10.4%	6.0%	8.4%	7.3%	

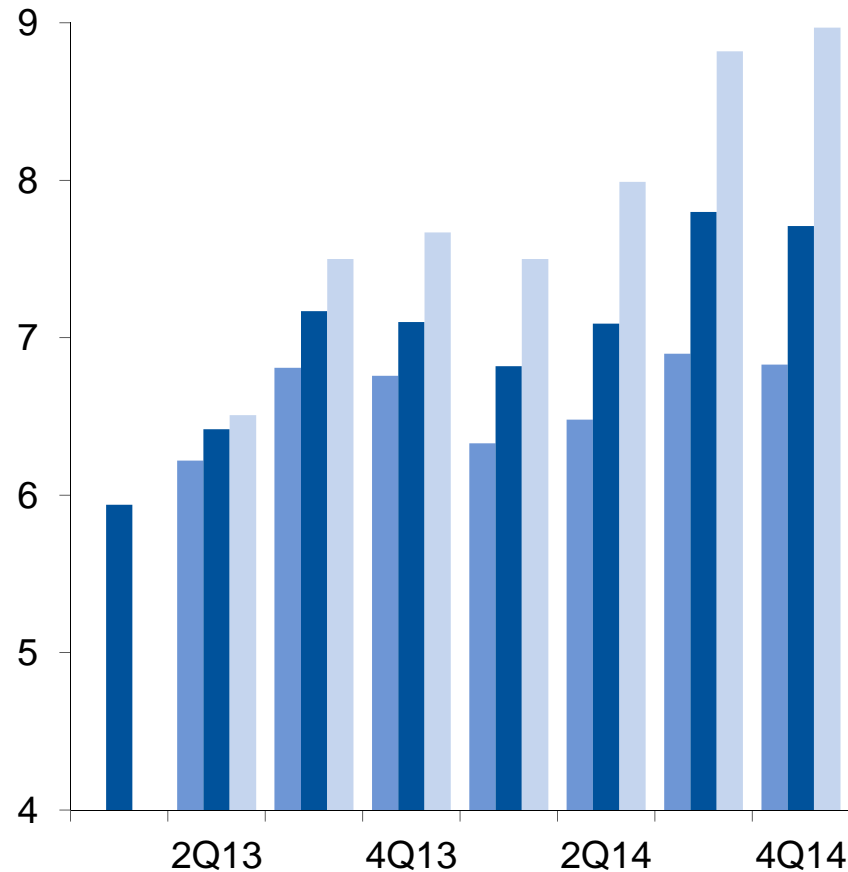
*Equivalent market value if 100% of IDM/OEM in-house packaging and test were outsourced

Note: Some columns do not add to totals shown because of rounding.

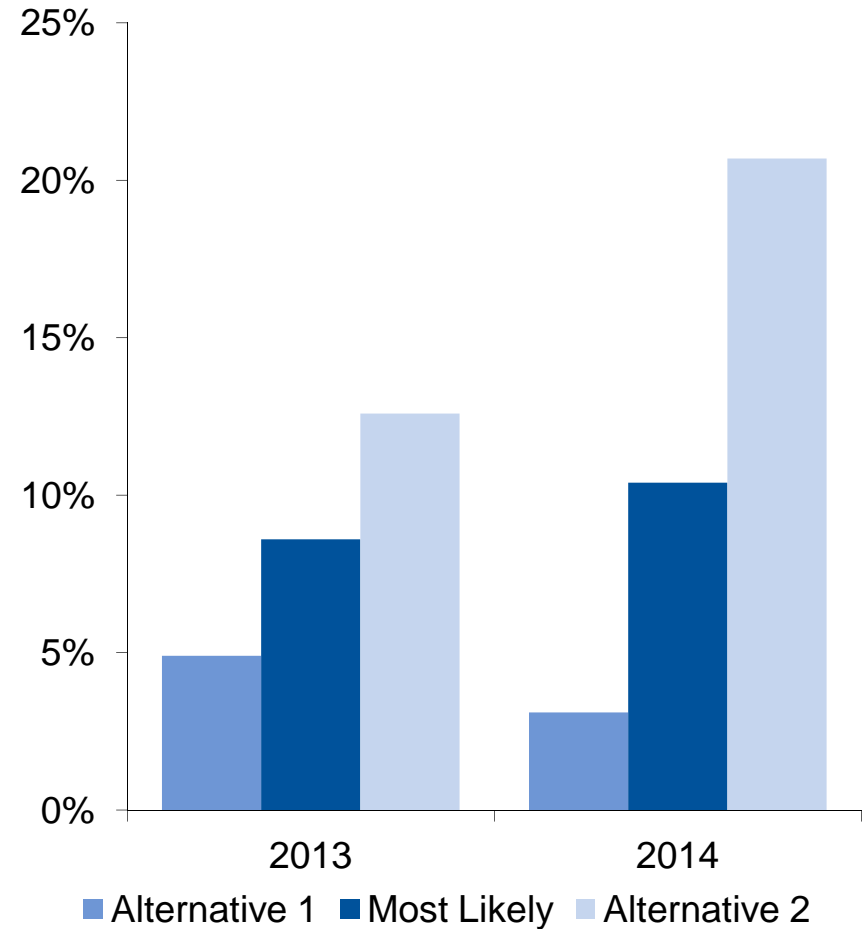
Source: Gartner (June 2013)

SATS Market: Quarterly Revenue Forecast Scenarios

Quarterly Revenue (\$Billion)



Annual Growth (%)



WW IC Package Unit Forecast

Total Package Unit Forecast (M)

	2012	2013	2014	2015	2016	2017	CAGR '12-'17
Plastic DIP	6,608	6,271	6,381	6,013	5,390	5,225	-4.6%
QFP	14,172	14,521	14,798	13,725	13,294	13,126	-1.5%
Ceramic Chip Carrier	465	498	536	481	491	484	0.8%
Total SOIC	53,550	47,797	44,337	41,800	39,022	35,900	-7.7%
Ceramic BGA	32	34	34	36	35	37	2.7%
Plastic BGA	7,885	7,839	7,929	7,712	7,450	7,672	-0.5%
Bare Chip	27,225	32,923	38,584	44,036	49,824	55,816	15.4%
Leadless-Leadframe*	38,857	46,245	53,066	57,520	63,478	68,815	12.1%
FBGA	27,801	35,667	41,807	47,389	55,334	62,188	17.5%
Others	3,464	4,176	4,528	4,822	5,222	5,607	10.1%
Total	180,059	195,971	212,001	223,534	239,539	254,870	7.2%
Year-Over-Year Growth	1.1%	8.8%	8.2%	5.4%	7.2%	6.4%	

*Includes quad flat no lead (QFN), small outline no lead (SON), dual flat no lead (DFN) and bumped chip carrier (BCC) packages

Note: IC package units include multichip packages (MCPs); totals may differ from IC die units.

Source: Gartner (June 2013)

Wafer Bumping Market

- Major growth in Fan-Out WLP as requirements will push devices to 4000+ I/O for high end applications.
- SATS vendors continue to get a greater share of revenues from advanced processes.
- Lower cost solutions drive the market. Copper pillar technology, 3D stacking, and multichip rapidly penetrating into the lower price point and commodity spaces.

TSV - Bringing Additional Wafer Fab Equipment to Packaging

- TSV processing requires equipment sets traditionally seen in the wafer fab. These include lithography, etch and clean and deposition processes.
 - Cost of these tools range from \$1.5 to more than \$8 million/system.
 - Wafer grinding tools for via exposure needed for via first and middle processes.
- Additional tools include high-cost, low throughput wafer bonders.
 - (ASP +\$6m, TP 20 wafers/hour)
 - Challenge of wafer bonding extremely thin 450mm wafers beyond the 2017 timeframe.
- **Cap-Ex requirements will segment the SATS companies and reduce competition in this market.**

3D/TSV Equipment Forecast - Largest IDM's, Foundries and SATS Firms Will Participate

<u>Equipment (Millions of USD)</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>
ECD for Through Silicon Vias	19.3	21.4	32.0	72.3	94.5	105.0	115.3
Sputtering for Through Silicon Vias	37.3	25.4	37.5	76.9	100.2	112.3	120.6
Dry Etch for Through Silicon Vias	24.2	22.0	31.6	71.0	92.7	102.6	113.3
Dry Strip for Through Silicon Vias	5.2	7.0	12.0	20.3	31.2	34.0	38.9
CMP for Through Silicon Vias	12.8	15.1	24.2	44.3	74.6	78.6	89.0
CVD for Through Silicon Vias	13.6	18.0	27.0	50.3	86.9	93.0	101.2
Wet Clean for Through Silicon Vias	12.4	13.2	18.0	34.5	52.3	57.2	65.2
Wafer Bonders for Through Silicon Vias	72.8	74.0	84.0	108.0	128.3	132.1	137.9
Wafer-Level Package Process Tools for TSV	197.6	196.1	266.3	477.6	660.7	714.8	781.4

Backend Equipment Forecast

	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>CAGR</u> <u>'12-'17</u>
Wafer-Level Packaging and Assembly Equipment (\$M) (Prober, Pkg Litho, WLP, Bump)	1,858.4	1,801.6	1,943.4	2,461.9	2,649.5	2,523.3	2,963.7	10.5%
Growth		-3.1%	7.9%	26.7%	7.6%	-4.8%	17.5%	
Die-Level Packaging and Assembly Equipment (\$M) (Saw, Bonders, Molds, Solder, Mark, Test Handlers)	4,322.4	3,867.3	3,503.7	4,258.9	3,922.5	3,232.1	3,548.2	-1.7%
Growth		-10.5%	-9.4%	21.6%	-7.9%	-17.6%	9.8%	
Automated Test Equipment (\$M)	2,511.1	2,520.0	2,357.2	3,038.7	3,166.3	2,612.2	2,853.5	2.5%
Growth		0.4%	-6.5%	28.9%	4.2%	-17.5%	9.2%	
Total Backend Equipment (\$M)	8,691.9	8,189.0	7,804.3	9,759.5	9,738.3	8,367.6	9,365.5	2.70%
		-6.1%	-4.9%	20.0%	-0.2%	-16.4%	10.7%	

Alternatives to TSV Processing: How Substantial Are the Threats?

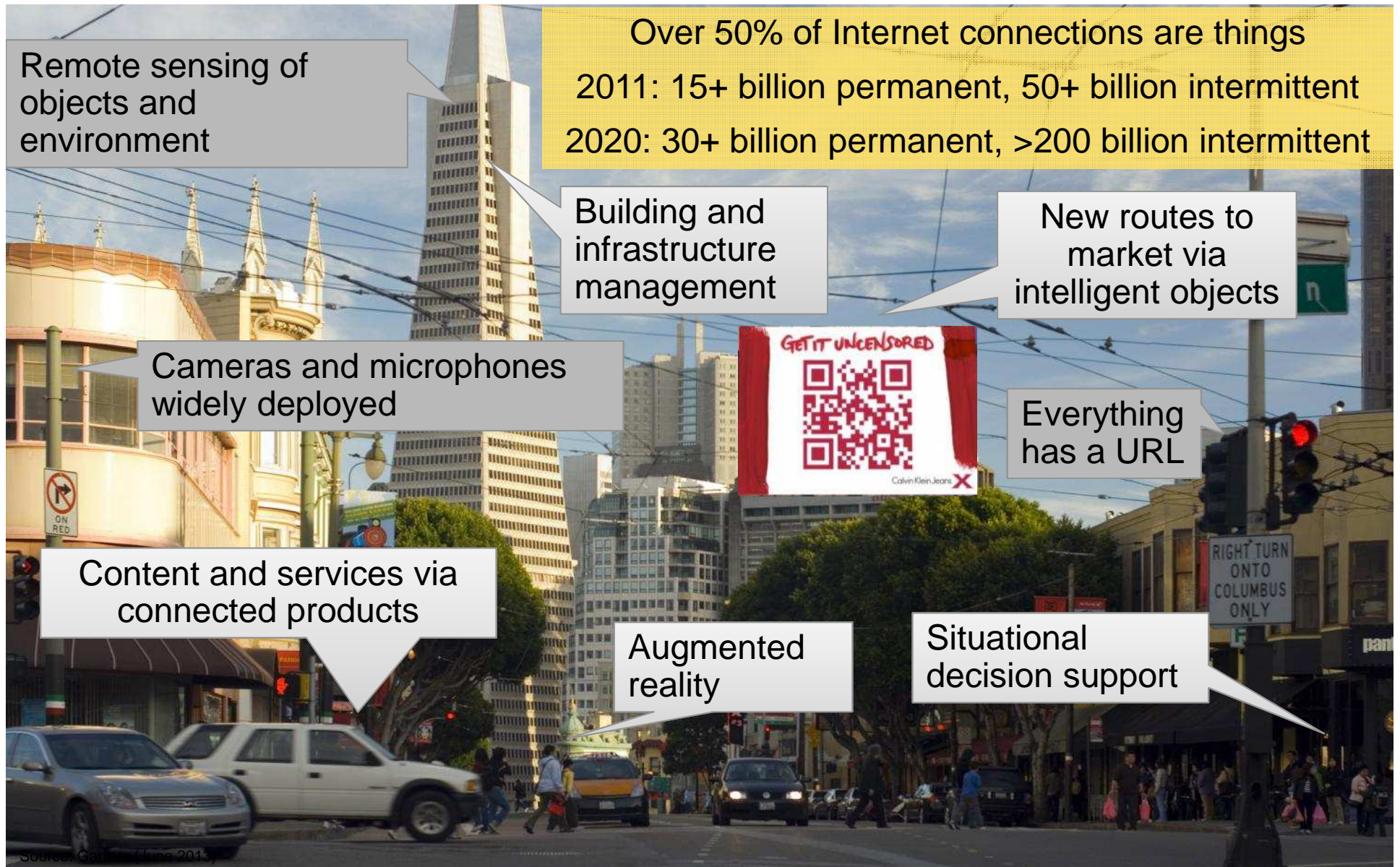
- POP devices using traditional methods of wirebonding and/or advanced/traditional mixed processes will find greater use.
- Can wirebonding packaging methods be extended below the 15nm node? Not likely.
- 2.5D processing (interposer technology) could be extended in use further than is currently expected.
 - Can non-memory effectively move to 3D format.
 - Additional capital and material costs along with process steps required

Summary

- Economic concerns continue to limit semiconductor growth.
- Longer term, the semiconductor market faces macro-based concerns and as well as capital cost issues that must be seriously addressed.
- As we move below the 2x node, major technical hurdles appear throughout the process.
- What is the next “killer application” that sends the semiconductor market to the next level? Internet of Things (IoT)?

The Internet of Things

Key Logic Driver in the Near Future





Thank You

jim.walker@gartner.com

This presentation, including any supporting materials, is owned by Gartner, Inc. and/or its affiliates and is for the sole use of the intended Gartner audience or other authorized recipients. This presentation may contain information that is confidential, proprietary or otherwise legally protected, and it may not be further copied, distributed or publicly displayed without the express written permission of Gartner, Inc. or its affiliates.
© 2013 Gartner, Inc. and/or its affiliates. All rights reserved.

Gartner[®]