2014 State of the VITA Technology Industry

November 2014

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State of the VITA Technology Industry November 2014

by: Ray Alderman, Chairman of the Board, VITA

This report provides the reader with updates on the state of the VITA Technology industry in particular and of the board and system industry in general, from the perspective of Ray Alderman, the Chairman of the Board of VITA. VITA is the trade association dedicated to fostering American National Standards Institute (ANSI) accredited, open system architectures in critical embedded system applications. The complete series of reports can be found at Market Reports. (www.VITA.com/MarketReports)

Introduction

This issue of the "State of the VITA Technology Industry" recaps our current economic conditions. A closer look is taken at the state of the U.S. defense spending as the picture has become a bit more clear on budgets for the coming year. Developments in semiconductor technology that impact the board and system market are reviewed.

Business Conditions

Q1 2014 U.S. GDP was originally announced as 0.1% growth. Thirty days later, it was downgraded to a 2.9% decline. And another thirty days later, the final DOC number was changed to a 2.1% decline. This raises an interesting question: How can the Department of Commerce be off by so much in their calculations?[1] Q2 2014 U.S. GDP was announced as 4% growth.[2] In late August, that number was revised to 4.2% growth.[3] Did the economy really grow at 4.2% in Q2 or did the DOC drop their pencil again? No matter. It's looking like 2014 total GDP will come in at 1.7% to 1.8% growth for the year if nothing extraordinary occurs. But the CBO (Congressional Budget Office) downgraded 2014 growth to 1.5% in late August.[4] That is below 2%, which is basically flat business activity

1 Samantha Sharf, "*U.S. GDP Dropped 1% In The First Quarter 2014, Down From First Estimate*", Forbes, May 29, 2014, http://www.forbes.com/sites/samanthasharf/2014/05/29/u-s-gdp-dropped-1-in-the-first-quarter-2014-down-from-first-estimate/

2 "*National Income and Product Accounts*", Bureau of Economic Analysis, September 26, 2014, http://www.bea.gov/newsreleases/national/gdp/gdpnewsrelease.htm

3 Samantha Sharf, "*U.S. GDP Grew 4.2% In The Second Quarter 2014, Up From Prior Estimate*", Forbes, August 28, 2014, http://www.forbes.com/sites/samanthasharf/2014/08/28/u-s-gdp-grew-4-2-in-the-second-quarter-2013-up-from-first-estimate/

4 Guy Benson, "*Stagnation: CBO Revises 2014 GDP Growth Projection Down to 1.5 Percent*", Townhall.com, August 28, 2014, http://townhall.com/tipsheet/guybenson/2014/08/28/stagnation-cbo-revises-2014-gdp-growth-projection-down-to-15-percent-n1884066

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for the year. On September 26th, the third and final Q2 GDP numbers were reported: 4.6% growth.[5] So, things are looking up in the U.S..

"Foreign money coming into U.S. markets is one of the reasons the U.S. stock markets are hitting new all-time highs."

Japan's report of a 6.8% decline in their Q2 GDP was attributed to a large sales tax increase.[6] The government needs the money to handle the cost of the 2011 tsunami and the nuclear reactor meltdowns at Fukushima. Japanese consumers knew about the sales tax increase, so they moved purchases ahead to avoid them, leaving a big hole in their Q2 economic activity. It doesn't look like Japan is going to exit their 20 year stretch of deflation any time soon, not with high taxes pushing consumer purchases down.

While the U.S. has adopted ZIRP (Zero Interest Rate Policies) at the Federal Reserve, the EU adopted NIRP (Negative Interest Rate Policies) in June. If a bank parks its money in the European Central Bank, they will be charged a fee on that money instead of being paid interest.[7] Low interest rates are put into place to spur lending and investment, which should lead to growing GDP. Low rates have not worked, so the ECB is penalizing any bank not lending that money out. If the EU banks are being penalized for not lending, they can surely find a place for it in the more stable U.S. markets (in stocks or bonds). Foreign money coming into U.S. markets is one of the reasons the U.S. stock markets are hitting new all-time highs.

In Europe, things changed in Q2, but not for the better. Previously, the southern countries were a drag on EU GDP. Now, it's the northern industrialized countries showing weakness.[8] Germany's GDP went negative 0.2%, along with Italy. France came in flat again, zero growth. Portugal and Spain showed 0.6% growth, but they really had no place to go but up. Due to the NATO sanctions against Russia over the Ukraine situation, and Russia's corresponding sanctions against NATO countries, you can expect even bigger GDP declines for the industrialized EU countries in Q3. For Q2, the EU saw zero GDP growth.[9]

China's GDP growth fell to 7.4% in Q1 2014, the lowest level in 18 months.[10] China's central bank lowered the reserve ratios for the regional banks to spur lending and more economic activity. It seemed to work to a degree, since their Q2 GDP showed 7.5% growth.[11] But China's economic future is based on the economic conditions in their top two export markets, the EU and the U.S. (in that order).

In July, the IMF (International Monetary Fund) lowered world GDP forecasts to 3.4% (down from 3.7%).[12] This is the latest in a string of World GDP downgrades. The sanctions on exports to Russia (over their Ukraine participation), the downing of MAL-17, the slowdown in China, and the situation with ISIS in Iraq all seem to be contributing to slower world economic growth.

The bigger news at the macro-level is in two areas: semiconductor and the military. The semiconductor industry is at a crossroads where they don't know what to do. The world's military forces know what to do, but the government is reducing their funding. We'll cover those developments in detail in other sections of this paper.

5 Jeffry Bartash, "*Business spending lifts second-quarter growth to 4.6%*", Market Watch, September 26, 2014, http://www.marketwatch.com/story/business-spending-lifts-second-quarter-growth-to-46-2014-09-26

6 Tim Worstall, "*Japan's GDP Falls By 6.8% In The Second Quarter On Sales Tax Rise*", Forbes, August 13, 2014, http://www.forbes.com/sites/timworstall/2014/08/13/japans-gdp-falls-by-6-8-in-the-second-quarter-on-sales-tax-rise/

7 Neil Irwin, "*Europe Gets Negative Interest Rates. What Does That Even Mean?*", The Upshot, June 4, 2014, http://www.nytimes.com/2014/06/05/upshot/europe-likely-to-get-negative-interest-rates-what-does-that-even-mean.html?_r=1

8 Matthew Lynn, "*When PIIGS fly, everything you know about euro crisis is wrong*", Market Watch, August 21, 2014, http://www.marketwatch.com/story/when-piigs-fly-everything-you-know-about-euro-crisis-is-wrong-2014-08-20

9 "*Quarter-on-quarter volume growth of GDP and expenditure components: 2014 Q2*", European Central Bank, https://www.ecb.europa.eu/stats/prices/accounts/html/gdp_growth_qoq_2014-04.en.html

10 Adam Rose and Xiaoyi Shao, "*China first-quarter GDP at 18-month low, to cut reserve ratio for small banks*", Reuters, April 16, 2014, http://www.reuters.com/article/2014/04/16/us-china-economy-idUSBREA3F0XR20140416

11 Mamta Badkar, "*Chinese Q2 GDP expands 7.5% as growth becomes Beijing's 'Top Priority'*", Business Insider, July 15, 2014, http://www.businessinsider.com/q2-china-gdp-2014-7

12 Greg Robb, "*IMF cuts 2014 global outlook, eyes market volatility risk*", Market Watch, July 24, 2014, http://www.marketwatch.com/story/imf-cuts-2014-global-outlook-eyes-market-volatility-risk-2014-07-24

Markets

Military and Aerospace

The big squeeze has been in place for prime contractors and board/system suppliers for more then a year now. But, we have not seen significant layoffs or facility closings. Shipments on older contracts have been rescheduled. Contracts on new programs have been delayed and quantities reduced. Enough business is flowing through the pipeline so far, to sustain the MIL board and systems suppliers.

The details of various programs and contracts have been well covered by the online and print publications. So, let's take a macro-view look at what is really happening in the military markets. What we are actually experiencing is a transition from 3GW (Third Generation Warfare) to 5GW. That statement requires some explanation.

According to Russian Generals Vladimir Slipchencko and Makmut Gareev ("Future War", 2005), Colonel Thomas Hammes, USMC ("The Sling and the Stone", 2006), and Chinese Colonels Qiao Liang and Wang Xiangsui ("Unrestricted Warfare", 2007), we have been through five generations of warfare (when you harmonize all their respective definitions):

- *1GW: massed manpower (line and column, a battle of attrition, face to face)*
- *2GW: massed firepower (where fixed fortifications and modern weapons have the advantage over 1GW techniques)*
- *3GW: maneuver warfare (Blitzkrieg, where occupied space is replaced by time and movement, neutralizing 2GW techniques)*
- *4GW: insurgency and terrorism (low-intensity protracted terrorism warfare that neutralizes 3GW techniques)*
- *5GW: non-contact warfare (precision guided weapons used to overcome 3GW and 4GW techniques)*

I have written a comprehensive series of articles that cover the details of each generation and the transitions at http://mil-embedded.com/blog/ if you care to explore them.

We now have only four major military threats today, and they are all stuck in 3GW: Russia, China, North Korea, and Iran. They all have large infantry, artillery, and tank units. Also, remember the Gulf War: U.S. forces destroyed the world's sixth largest army, 42 Iraqi Divisions. Iraq had the world's fourth largest air force, and it was destroyed in 4 hours. 60 SCUD missiles, 35 Air Defense Missile Systems, 3,847 tanks, 1,450 armored vehicles, and 2,917 artillery pieces were destroyed, all in 38 days (Pentagon simulations predicted 35 days).[13] Most of this destruction occurred without a single U.S. boot on the ground (with the possible exception of the Special Ops troops with their target-designating lasers).

Also remember that our entire military-industrial complex (the primes and the Pentagon) are all set-up for making and buying expensive 3GW weapons (tanks, artillery, planes, ships). Those weapons came into play in the later stages of the Gulf War. Non-contact weapons (cruise missiles, laser and GPS-guided smart bombs) were the primary weapons in the victory. General Schwarzkopf had over 500,000 troops with him, but they didn't have much to do except clean-out enemy stragglers and strongholds. Russian General Slipchenko, after observing the Gulf War, said that any 3GW military force would be crazy to fight the Americans (who are now using 5GW weapons). Saddam Hussein probably said the same thing about an hour after the attack began, but he was running and out of breath so it didn't get recorded.

So, here's where we are. We still have some 3GW enemies out there, but we will not fight them with traditional weapons platforms (tanks, artillery, ships, small fighter planes) or with 3GW tactics. We will not fight them with divisions of traditional 3GW tank and artillery weapons, but with a smaller number of precision highly-accurate non-contact 5GW weapons. As we move deeper into 5GW, we need fewer of the 3GW weapons that the military-industrial complex is structured to build. We can't just pull the plug on the 3GW-focused primes. We must eliminate the obsolete 3GW weapons manufacturing capability slowly, so the primes can adjust their finances and head count to building fewer, but more accurate 5GW weapons.

13 "*Unrestricted Warfare*", Col. Qiao Liang and Col. Wang Xiangsi, page 47

The Pentagon will buy a few more tanks, fighter planes, artillery pieces, and armored vehicles to replace those worn out and damaged in the Middle East wars. But, those platforms are slowly being phased-out as we focus on 5GW weapons for all types of warfare the U.S. may face in the future. THAT is why we are seeing lower military spending. THAT is why we are seeing program cancellations of older 3GW platforms. THAT is why we are seeing lower quantities on new contracts. THAT is why we are seeing reductions in the number of soldiers, sailors, airmen, and marines. The U.S. Army gave "involuntary separation" papers to 550 majors[14] and 1,100 captains[15] in 2014. In all, we're probably talking about eliminating 3,000 officers in the Army alone. The Air Force and Navy will suffer similar reductions.

This transition to 5GW (and then to 6GW) will take years to complete. But, it's all downhill from here for traditional 3GW weapons platforms. It's all uphill for 5GW and newer 6GW weapons and systems. What is 6GW?

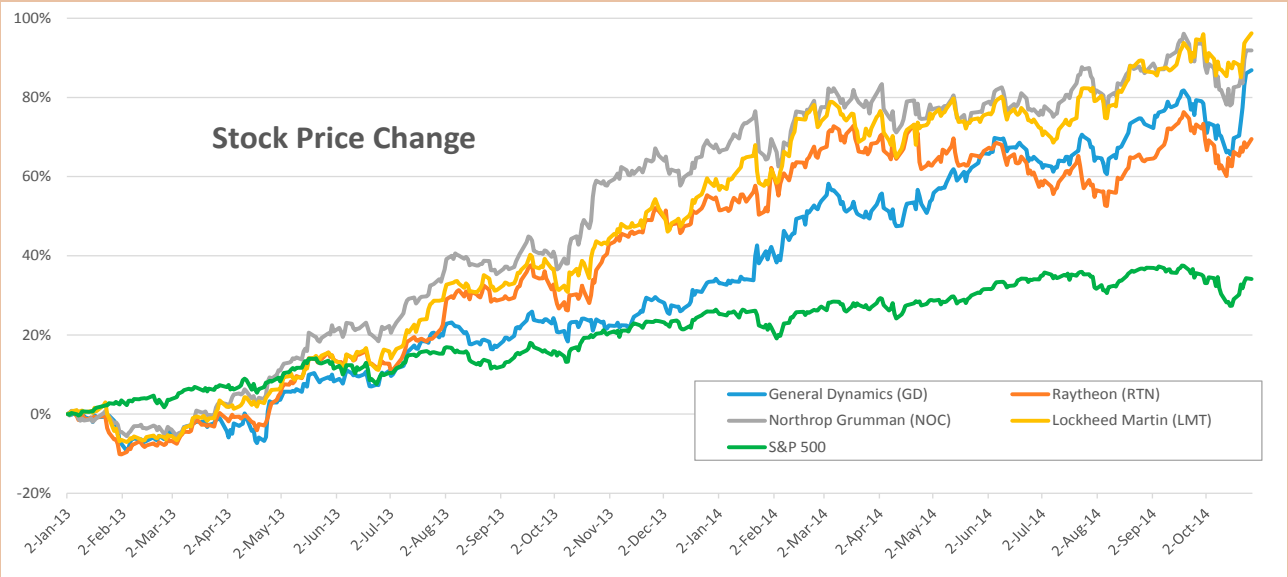
- *6GW: manipulation of space and time (weapons and systems that neutralized all previous forms of warfare tactics and their period weapons)*

We already have excellent 5GW non-contact weapons now, but our enemies are catching up in certain places. Our Middle Eastern enemies have built and are flying home-made observation drones in Iraq.[16] It won't be long before they weaponize them. So, we must integrate our intelligence systems into our present armed UAVs turning them into hunter-killer drones. They will operate autonomously, without human intervention. They will find and destroy targets on their own.

"It's all downhill from here for traditional 3GW weapons platforms. It's all uphill for 5GW and newer 6GW weapons and systems."

What happened to the Sequestor?

Last yer at this time all the talk was on what impact would sequestoring government spending have on our industry. While it has impacted jobs and company investment decisions, some stock price analysis reveals that not all has been bad the past year. The true results are still out with the results not clear for years to come. Most of the Primes are doing better than double the S&P 500 gains since the start of 2013.



14 Lolita Baldor, "*Army to force out 550 majors; some in Afghanistan*", Stars and Stripes, August 2, 2014, http://www.stripes.com/news/army/army-to-force-out-550-majors-some-in-afghanistan-1.296587

15 Chris Carroll, "*Army Drawdown Continues: 1,100 Captains to Be Cut*", Military.com, June 23, 2014, http://www.military.com/daily-news/2014/06/23/army-drawdown-continues-1100-captains-to-be-cut.html

16 Michael R. Gordon and Eric Schmitt, "*Iran Secretly Sending Drones and Supplies Into Iraq, U.S. Officials Say*", The New York Times, June 25, 2014, http://www.nytimes.com/2014/06/26/world/middleeast/iran-iraq.html?_r=0

We must get inside our enemy's OODA Loop (Observe, Orient, Decide, Act) with next-generation EW (Electronic Warfare) systems. We must manipulate the space he sees and the timeframe in which he operates. We must show him things in his space that do not exist (and hide things in his space that do exist). We must make him think he has time for analysis of his intelligence when he has no time. We must make him think he has no time when he actually does, and he commits in haste. We must give him a sense of false security in what his intelligence systems are telling him, and then take advantage of him being caught-up in the synthesized space and time we have inflicted upon him. We must eliminate our enemy's ability to communicate and coordinate his forces and weapons. In short, we must manipulate space and time. We must compress time for our enemies so they commit themselves and act on false information. We must expand time and space for our forces, so they can observe, orient, decide, and act upon our enemies with precision non-contact firepower.

However, it takes too long for actionable intelligence to filter through our massive intelligence, military, and political bureaucracy and capitalize on it. We must integrate our electronic intelligence systems into our non-contact warfare weapons systems. We must create totally autonomous weapons that will shrink the time it takes for our forces to act. We learned this lesson the hard way, when we missed the opportunity to take-out Osama Bin Laden at Tarnak Farms in the fall of 2000. We must compress the time it takes our forces and weapons to strike high value targets. The special operations people have an acronym for this process: F3 (Find, Fix, and Finish).

Sun Tsu ("The Art of War", Samuel B. Griffith, 1963, original text written in 500 BC) said: "All warfare is based on deception". He also said: "Let your plans be as dark and impenetrable as night, and when you move, fall like a thunderbolt." That is 6GW, deception and speed. However, we must slowly deconstruct the old 3GW infrastructure at the primes and modify the thinking that presently exists in the Pentagon. The problem we have right now is that the increase in purchases of 5GW systems are not happening fast enough to offset the decline in purchases of older 3GW systems. Russia (in Ukraine), China (in the islands of Japan and possibly in Taiwan), ISIS (in Iraq), and North Korea (taunting South Korea) could change the present spending patterns. And the acquisition of 6GW integrated intelligence/weapons systems has not yet started in earnest. But it will, and soon. We are now about to move from 5GW to 6GW, but we must be careful not to decimate the primes in the process. We need them, but we don't need the old 3GW systems they are structured to build.

Semiconductor

Meanwhile, back on the lone silicon prairie, the semiconductor companies are fighting-off a hoard of hostile native problems. First, Moore's Law isn't what it used to be. Shrinking geometries to 14 nm and lower are creating lots of headaches at the technical level. And making money on 22 nm and 14 nm is dicey. The cost of a new fab, tooled-out, is $6 to $10 billion depending on where you build it (here's a tax exposure hint: don't put it in California or New York). And, if you're revving that fab up to make $2 chips for commodity smart phones and consumer gadgets, you better have some seriously solid volume orders before you ever open the doors.

To the point here, IBM has been trying to sell-off their semiconductor division (IBM Microelectronics) for a year or more. They lose $130 million per year on that operation, spitting-out old gray-haired chips for old gray-haired customers used in old gray-haired applications.[17] They just closed a deal with GLOBALFOUNDRIES with an offer that includes $1.5 billion and a huge portfolio of semiconductor patents to take the Microelectronics division off their hands.[18] Both sides had to make some serious concessions to make the deal happen. Nobody wanted the old IBM fabs, and few buyers could afford to retool any of those antiquated fabs. Potential buyers don't want IBM's old product lines or their old customers. All they wanted was the intellectual property and patents that IBM Microelectronics holds. IBM was willing to give away money to get rid of the group, so they didn't have to lay-off all the people and close the fabs, leaving yet another set of empty buildings in New York (like Kodak and Xerox have already done), and possibly exposing themselves to continuing property tax and unemployment tax liabilities. Even Intel sees this

17 Dan D'Ambrosio, "*GlobalFoundries sets up shop in IBM's backyard*", Burlington Free Press, September 23, 2014, http://www.burlingtonfreepress.com/story/money/2014/09/22/globalfoundries-tiptoes-williston/16073319/

18 "GLOBALFOUNDRIES to Acquire IBM's Microelectronics Business", IBM, News Release, October 20, 2014, http://www-03.ibm.com/press/us/en/pressrelease/45110.wss

Five Misconceptions Surrounding a Wafer-size Transition

There are five major misconceptions surrounding a wafer-size transition, and the Equipment Productivity Working Group's (EPWG's) work has opened these up to examination.

1. "**A 50% wafer size changes occur every 10 years**." The length of time between equivalent 50% wafer size increases has steadily grown in time over the last four decades as the industry has slowed its growth rate, and is now much longer than 10 years. However, even if this myth were true, a cost-benefit analysis should always be performed to determine if the next change truly makes sense.
2. "**Larger die sizes drive us to 450 mm wafers**." While die size has been a driver of wafer size change in the past, industry analysis from Wright Williams and Kelly shows that current die size is stable or decreasing.
3. "**Wafer processing costs drive overall chip cost reduction**." An examination of the cost structure of current devices shows that a 450 mm wafer increase will impact less than 10% of final product cost in a positive way. Moreover, there are serious technical and economic issues for the assembly, packaging and test community that are as-yet unaddressed.
4. "**There is a significant productivity gain provided by increasing wafer size**." The EPWG found, through its cost model analysis, that previous wafer size transitions, in and of themselves, offered little gain. While for some tools there is gain to be found from increased wafer area, many tools that are constrained by how much area they can process per hour show little benefit. Gains from the 300 mm wafer size transition were, in fact, due to several factors that were independent of wafer size. Many of these improvements, such as the use of Front-Opening Unified Pods (FOUPs) and Automated Material Handling Systems (AMHS), among others, now exist and will not help to incrementally increase performance over 300 mm.
5. "**A wafer size disruption is the only way to force industry-wide change**." A realistic assessment shows that a wafer size change is the riskiest way to force change, because it will exacerbate the R&D funding gap, reduce or eliminate technology advancement on 300 mm, increase cycle time (over 50% more), and steer the industry away from the consumer-driven market trends.

A key EPWG conclusion was no surprise— technology advancements are the largest lever we have to continue along Moore's Law. The semiconductor industry's history is one of relentless innovation in many areas, but changes in product use and consumption are forcing executives to make difficult decisions about investment choices for the future.

However, the industry is now producing for a predominately consumer-driven market, which means fabs and foundries must quickly respond to rapid changes in consumer demand. This requires agile fabs running smaller lot sizes with high product mixes. In this environment, cycle time is paramount, as lengthy time to volume and time to market will significantly impact companies' profit opportunities.

Source: SEMI, http://www.semi.org/en/P044331

situation and decided to retool their Israeli fab instead of investing much money in their New York or California fabs.[19] The economics of the nanometer semiconductor node has raised the price so high that only a few companies can play that poker game today.

This is not just a problem for high-level integrated chips. International Rectifier sold-out to Infineon in early September, to get out of the rat race.[20] As chips become more integrated, the demand for discrete components (transistors, diodes) declines, except for gray-haired applications and customers.

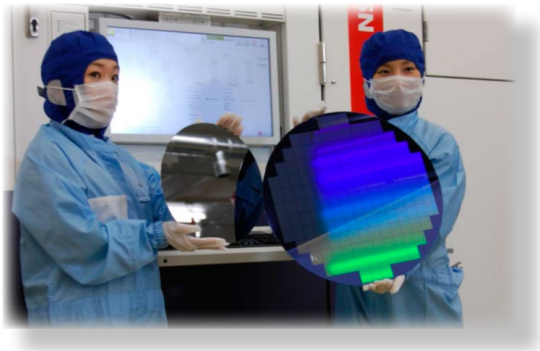


Photo courtesy of SemiEngineering.com

Aside from the economics, the technological problems of shrinking geometries to the 14 nm level and below are daunting. There's the transistor structure (FINFET), the mask complexity, double-patterning, and the variable cost issues. The EUV (extreme ultraviolet) lithography issues, the wafer size (200 mm vs. 300 mm and 450 mm), the handling equipment, and the potential die yields of the wafer are high-risk propositions. Even without going to the nanometer level, processing eight or ten 300 mm or 450 mm wafers can yield more than the total number of chips sold by smaller semiconductor companies in a entire year.

19 Pichi Chuang, "*Israel approves Intel's $6 billion investment in chip plant*", Reuters, September 22, 2014, http://www.reuters.com/article/2014/09/22/us-israel-intel-plant-idUSKCN0HH1F720140922

20 Alex Sherman, Amy Thomson and Alex Webb, "*Infineon to Buy International Rectifier for $3 Billion*", Bloomberg, August 21, 2014, http://www.bloomberg.com/news/2014-08-20/infineon-said-to-hold-talks-on-2-billion-u-s-chipmaker-deal.html

Moore's Law looks to be at its end of life, but there are other ways to continue the integration process, to get more transistors into a single IC package: 2.5D and 3D die stacking. With 2.5D, you have a number of die stacked up, one-high, on an interposer. An interposer is just a backplane, made out of silicon. And the die stacked one-deep on that interposer is just like putting mezzanine cards on daughter cards. The problem is to route all those I/O's and data paths between those die. That requires the use of TSVs (through silicon vias). They are unreliable, expensive to create, and there are too many of them on a complex 2.5D interposer. How do you mechanically attach the die to the interposer? Can the attachment survive shock and vibration? Can it survive the expansion and contraction of temperature differentials without breaking connections? Or, do you find another way to connect those die together, like induction or optical links?[21]

"Lots of small commodity chips for lots of small commodity applications is the mind-set of the semiconductor industry today."

Assuming that all the above problems have cost-effective solutions, the engineers are still pulling their hair out over architectural issues. How do you connect multiple cores? With busses? Counter-rotating rings? Switches? A Torus? Are the cores homogeneous (samo-samo) or heterogeneous (GP, GPU, and DSP)? The semiconductor industry has never shown any deep understanding about multiprocessor architectures, not like the server and embedded segments. They have been taught to use the least amount of power, the fewest transistors, and the least amount of space to connect things together on a chip. This is not a great set of skills for a multiprocessing architect, so I can't wait to see how they choose to do it. It should be both entertaining and horrifying at the same time, considering the latencies and imitations they will probably build-in to the die interconnects.

Even Intel is experiencing chaos in their future plans. A few years back, Intel announced their "True Scale" fabric architecture. It's basically a modified version of InfiniBand running on coax cables.[22] In June of 2014, they announced their "Omni Scale" fabric architecture. This is the same modified version of InfiniBand running on active optical cables (AOC's). They say that a future Xeon processor will have the Omniscale interface on-chip, similar to what Altera did when they put the optical link in the FGPA package.[23] And, Intel says they will sell the actual chips (used in their AOC) in 2015, to those who want to implement optical links between processors without using an AOC.[24]

Maybe the move to optical will clarify all the craziness about how to connect processors together in a multiprocessor architecture. Maybe we can forget about all the aberrant behaviors of busses, switches, Torus, counter-rotating rings, Fat Trees, and Stars. The best way to build a multiprocessor architecture is with point-to-point links: a Mesh. This does get messy when you have a lot of processors. You need n(n-1) links, where n is the number of processors (for three processors, you need 6 links; for four processors, you need 12 links; for five processors, you need 20 links, etc). The problem is the cost of all the link silicon, and the power consumption.

In the interim, before we get to "interconnect nirvana", whatever the semiconductor makers give us is going to have boogers all over it. Each silicon maker will try to differentiate themselves with near-total disregard for latencies and ugly protocol characteristics, not to mention nasty software requirements. That's the good news. The bad news is that most of the silicon makers are all chasing the next big market: IoT (Internet of Things, or as I like to characterize it, "Internet of Trash"). Lots of small commodity chips for lots of small commodity applications is the mind-set of the semiconductor industry today. These multiple transitions in the semiconductor industry (both in their business models and how their silicon will work) does not bode well for us in the critical embedded markets.

21 Barry Pangrle, "*Wireless 3D Stacking*", Semiconductor Engineering, August 18, 2014, http://semiengineering.com/wireless-3d-stacking/

22 "*Intel® True Scale Fabric Overview*", Intel, http://www.intel.com/content/www/us/en/infiniband/truescale-infiniband-overview.html

23 "*Optical Innovation Erases Bandwidth Limits*", Altera, http://www.altera.com/corporate/about_us/history/optical/abt-optical-interconnects.html

24 "*Intel Re-architects the Fundamental Building Block for High-Performance Computing*", Intel, June 23, 2014, http://newsroom.intel.com/community/intel_newsroom/blog/2014/06/23/intel-re-architects-the-fundamental-building-block-for-high-performance-computing

Telecom, Industrial, and Medical Markets

These markets are lumped together because they are (1) commoditized to a greater degree than other markets, (2) hopelessly fragmented across form factors and technologies, or (3) basically nonexistent for our board industry. Medical markets, due to Obamacare, moved to undeveloped countries where the medical infrastructure has not been built-out (China and India mostly). This includes both the end-user markets for medical equipment and the markets for components used to build that gear.

"The nuclear winter in the telecom market will claim more victims as their demand for systems and boards continues its downward slope."

There is nothing of substance going on in the industrial markets. The shift from PC processors and software to cellphone processors and software is ongoing, driving price points and margins down further. For most industrial applications, even the lowest-end cellphone processor is overkill. Business conditions in the U.S. and Europe are not conducive to automating factories, since consumer and business spending are down significantly. The three sentences above terribly overstate all the good things happening in the industrial markets by several magnitudes, so there's no compelling reason to continue this thought.

We did see some amazing news in the telecom market, a press release from Alcatel-Lucent in July. Their brilliant engineers got 10G Ethernet running on a cable, although they had to use 4 pairs running at 2.5G each (x4).[25] Any informed engineer reading this press release at breakfast would immediately shoot their morning coffee out of his/her nose as they collapse into a laugh-induced grand mal seizure. Announcing 10GE (2.5G x4) on a copper cable is like announcing that the earth is round. The consolidation of the telecom service providers is stifling any thoughts about upgrading networks or adding anything but incremental capacity enhancements on a sporadic basis. The nuclear winter in the telecom market will claim more victims as their demand for systems and boards continues its downward slope.

The prodigious, imaginative, and prolific fiction writer Stephen King, with all his talents and on his best day, could not possibly conceive and write a more gruesome, grizzly, hopeless, terrifying, frightening, sickening, intimidating, and horrifying tale than the present real-life situation found in these market segments. Forgive me, but I am suffering from "compassion fatigue" when it comes to these three segments.

I hope you enjoyed reading this comprehensive, in-depth, and informative analysis as much as I enjoyed researching all the new developments and announcements to recount here.

Summary

From a macro-economic standpoint, business conditions are not promising in certain areas. The western sanctions against the Russians over Ukraine, and the Russian sanctions against the West, will have negative effects on the European markets. Japan and China are not significant markets for board and systems suppliers in the embedded space. Brazil and Argentina are both tottering on recession (Brazil) or bankruptcy (Argentina). The U.S. looks more positive, even in the military segment. But the volumes will be low as the U.S. markets deal with uncertainty in world GDP growth, especially the multinational companies who sell to the countries heading into financial trouble. Of all the traditional markets, Europe looks the worst for embedded board and system sales, especially in industrial applications.

The companies that will get hurt the worst in this environment will be the ones chasing market share at the expense of margin. If you look back in history, all the companies who chased market share "blew up" before they got to $1 billion in sales. Several companies got near $800 million, but they did that by increasing sales in low-margin commodity products (motherboards, small form factor, telecom boards and systems). The embedded board and systems markets, geographically, technology, or applications-based, are all niches. Niches do not lend themselves to a market-share-based strategy: they are limited in size, the technology changes too rapidly to get to the "harvest" period for market-share leaders, and buyers of commodity boards and boxes in telecom and industrial segments show no loyalty to suppliers. They are price-driven commodity buyers. The companies who maintain a margin-driven strategy will fare better in the present business environment. Sales may lag, but good margins will keep them in the game without layoffs and management changes.

25 Desire Athow, "*Alcatel-Lucent hits 10Gbps data transfer speeds on copper cables*", TechRadar.pro, July 10, 2014, http://www.techradar.com/news/internet/broadband/alcatel-lucent-hits-10gbps-data-transfer-speeds-on-copper-cables-1256779

In the military segment, demand is shifting away from big 3GW platforms (ships, planes, tanks), to smaller more agile 5GW (non-contact warfare) weapons and intelligence systems. New UAVs like Phantom Ray and X-47 will eventually replace fighter jets on many missions. Unmanned Surface Vehicles (USV's) like the new inflatable patrol boat will replace the PBR's (Patrol Boat, River) we saw in Viet Nam.[26] Fewer soldiers, sailors, and airmen are needed when 5GW platforms take-over from the older 3GW weapons. We've already seen head count reductions in the Army and Marines. The Navy and Air Force have not yet been severely affected because we still have a lot of older 3GW platforms still in service that have had some retrofitting. But they too will see head count reductions as we make the transition. And the prime contractors will need to restructure, away from building large expansive 3GW weapons systems, to the newer smaller less expensive platforms. That will take time.

Four unmanned remotely operated high-speed maneuvering surface targets move to their blocking positions during an Office of Naval Research-sponsored demonstration of autonomous swarmboat technology on the James River in Newport News, Va. During the demonstration as many as 13 Navy boats, using an Office of Naval Research-sponsored system called CARACaS (Control Architecture for Robotic Agent Command Sensing), operated autonomously or by remote control during escort, intercept and engage scenarios. (U.S. Navy photo by Mass Communication Specialist 2nd Class John Paul Kotara/Released)

The next big step, to make this transition, will be to integrate advanced Electronic Warfare (EW) and intelligence systems into the newer 5GW weapons platforms. When that occurs, the weapons can then become autonomous, finding targets on their own and attacking them without human intervention. That technology integration will take us into 6GW. And in 6GW, we will have advanced EW systems that allow us to manipulate space and time, to our advantage. This concept was first used in the Israeli strike against the nuclear reactor in Syria (Operation Orchard), where Israeli EW systems fed the Syrian air defense radar screens from the previous week as the attack wing crossed into their airspace.[27]

Carl von Clausewitz first used the term "The Fog of War" ("On War", 1832). He generally describes the phenomenon as the confusion, uncertainty, and chaos in battle due to a lack of reliable intelligence information. In 6GW, our systems will enhance and amplify this condition for our enemies. They will make decisions and commit military resources based on the false information we feed them. Or, they will fail to commit appropriate resources when they should. We will "compress" time for our enemies while we "expand" time for our military resources. We will destroy the enemy's confidence in his intelligence systems, shrouding him in the "fog". Meanwhile, our 6GW integrated weapons-intelligence platforms will destroy his defensive and offensive capabilities without a single boot on the ground. 3GW focused on destroying the enemy's fighting forces. 6GW focuses on destroying the enemy's ability to communicate, organize, defend, and direct its forces and weapons through EW. And then their weapons and forces will be destroyed by autonomous armed UAVs, using "SWARM" tactics. To get to 6GW, we need more processing power, more bandwidth between processor and subsystems, and more efficient cooling techniques. Those needs are known and in-process now.

Even with the financial uncertainty in the world, Sequestration, and the general negative reports in the news, our industry will do well in certain segments in 2015. Prosperity will be unevenly distributed among the board vendors depending on their strategy (market-share vs. margin), the technologies they use (low-end vs. high-end), and the strength and vision of their management.

26 "*Kamikaze robot swarm: US Navy to launch AI-guided unmanned gunboats 'within a year'*", RT News, October 5, 2014, http://rt.com/usa/193328-navy-robot-patrol-boat/

27 "*Operation Orchard*", Wikipedia, http://en.wikipedia.org/wiki/Operation_Orchard

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