



## *2014 State of the VITA Technology Industry*



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# State of the VITA Technology Industry April 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 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](http://www.vita.com). ([www.vita.com](http://www.vita.com))*

## 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. A recap of recent mergers and acquisitions is presented. And we wrap up with a look at recent VPX market data.

## Business Conditions

Q3 U.S. GDP came in at 4.1% and Q4 grew at 2.6%, after being initially reported as 2.4%.<sup>1</sup> For all of 2013, the U.S. GDP grew at 2.6%. These numbers show that the U.S. is slowly emerging from the recession.

EU GDP shows some slight improvement, but nothing to get excited about. In Q3 the EU grew at 0.2%.<sup>2</sup> Q4 EU GDP grew at 0.3%.<sup>3</sup> For 2013, the EU GDP fell by 0.4% for the year. Europe seems to be recovering slowly from their financial problems, with one exception. The city of Rome may soon declare bankruptcy. Italy’s economic situation could throw the EU back into a debt crisis if Rome’s problems spill-over into the general Italian economy.

1 Paul Davidson, “U.S. GDP grew at 2.6% pace in Q4”, USA Today, March 27, 2014, <http://www.usatoday.com/story/money/business/2014/03/27/fourth-quarter-gdp-fioal-estimate/6946121/>

2 Amrutha Gayathri, “Euro Zone, European Union Q3 GDP Second Estimate Confirms Slowing Growth On The Continent”, International Business, December 4, 2013, <http://www.ibtimes.com/euro-zone-european-union-q3-gdp-second-estimate-confirms-slowing-growth-continent-1494480>

3 “Flash estimate for the fourth quarter of 2013”, Eurostat, February 14, 2014, [http://epp.eurostat.ec.europa.eu/cache/ITY\\_PUBLIC/2-14022014-AP/EN/2-14022014-AP-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/2-14022014-AP/EN/2-14022014-AP-EN.PDF)

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Forecast for EU GDP growth in 2014 is 1.4%<sup>4</sup>, but that will be hard to accomplish without help from France. The French economy is wobbling after showing a decline of 0.1% in Q3<sup>5</sup> and a decline of 0.3% in Q4.<sup>6</sup>

Japan and China are both showing declines in exports in early Q1 2014. But Japan did grow 0.3% in Q4<sup>7</sup> while China grew at 7.7%, lower than previous rates. The U.S. and most of Europe seem to be recovering slowly while Asia seems to be declining in activity. Remember that China is the #2 economy in the world now and Japan is #3.

The bigger macro-economic issues are in emerging markets: Argentina, Venezuela, India, and Turkey. All these economies are seeing high inflation and a drop in the value of their currencies. India's slower-than-anticipated growth has also devalued their currency. One primary cause is that countries that survive by exporting their natural resources (metal ores and lumber) are experiencing lower sales and shipments to China, Japan, and India. Even Canada and Australia are getting caught-up in this down cycle of lower raw material demand in the world.

There are a number of political issues that have developed in the past few months, but we will cover those in the MIL/Aero Markets section. While these situations flare-up, we are facing a much lower level of U.S. DoD spending in 2014 and 2015, as China, India, and Japan increase their military spending. EU military spending has been nonexistent since their debt crisis. With the big reductions in U.S. DoD spending for 2014 and 2015, we are about to find out how much lower military spending subtracts from the U.S. GDP.

Another area of concern is the huge increase in global debt over the past 6 years.<sup>8</sup> We now see over \$100 trillion in outstanding debt worldwide. Developed nations borrowed heavily to create liquidity and spur growth in their falling economies in the past 6 years. Default fears are present in certain regions. With all the new money sloshing around in the world, inflation could become a problem for many developed nations.

The present economic environment is better than it was a few years ago, but the primary concerns are the slow-down in Asia, India, and the emerging markets. The U.S. seems to be on much better economic footing today, but world GDP forecasts are showing only 3.7% growth for 2014.<sup>9</sup> The new normal for the U.S. is 2% GDP growth with 6% unemployment. For the EU, the forecast suggests that they may go into a period of disinflation (i.e., asset price erosion), similar to what Japan has been going through for the past 20 years. And, the EU will see less than 1% growth with 10-12% unemployment.

*“The U.S. seems to be on much better economic footing today.”*

## Markets

### MIL/Aero

We have a 2014 defense budget, smaller than anticipated (\$495.6 billion, or a decline of 0.4%), and we still don't know which specific programs are funded and to what degree. Here are the highlights:

- *The Army is the big loser in this budget with the complete dismantling of the Future Combat Systems (FCS) program. The number of active soldiers will be reduced to 440,000 by the end of 2019, the lowest level since the end of WWII.*

4 “Taking Europe's Pulse”, The Economist, March 6, 2014,

<http://www.economist.com/blogs/graphicdetail/2014/01/european-economy-guide>

5 Geraldine Amiel, “Final data confirm France's 3Q GDP contracted 0.1%”, The Wall Street Journal Market Watch, December 24, 2013, <http://www.marketwatch.com/story/final-data-confirm-frances-3q-gdp-contracted-01-2013-12-24-3485440>

6 Kiron Sarkar, “Worse than expected Japanese, German, French and Italian Q4 2013 GDP”, The Big Picture, February 14, 2014, <http://www.ritholtz.com/blog/2013/02/worse-than-expected-japanese-german-french-and-italian-q4-2013-gdp/>

7 Sam Ro, “Japan Is Sliding After An Ugly GDP Report”, Business Insider, February 16, 2014, <http://www.businessinsider.com/japan-q4-2013-gdp-2014-2>

8 John Glover, “Global Debt Exceeds \$100 Trillion as Governments Binge, BIS Says”, Bloomberg, March 9, 2014, <http://www.bloomberg.com/news/2014-03-09/global-debt-exceeds-100-trillion-as-governments-binge-bis-says.html?cmpid=yhoo>

9 “IMF raises global growth forecast, warns of low inflation and weak, uneven recovery”, EuroNews, January 21, 2014, <http://www.euronews.com/2014/01/21/imf-raises-global-growth-forecast-warns-of-low-inflation-and-weak-uneven/>

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*With a smaller Army, expect to see some base closings. To put this number in perspective, there were 543,000 U.S. military personnel (all services) in Vietnam in 1969.*

- *The Air Force will get more F-35's and some new missiles (JASSM), but they must retire the A-10 Warthog fleet and the U-2 spy plane. You can also bet the Air Force will get more UAVs of all types.*
- *The Navy will keep their 11 aircraft carrier groups and continue to test carrier-based UCAS-UAVs. The first DDGs (next-generation guided missile destroyers) will continue, with a few Littoral Combat Ships (LCSs) thrown in for evaluation. The Navy will also shrink headcount and the Marines will diminish to 182,000 active troops.*
- *The services will actually increase their Special Operations forces from 64,000 to about 67,000 troops. This would include SEALs, Special Forces, Air Force PJ's, and Delta Force. Demand for new Apache helicopters will go up as well, to haul these troops around on their special missions. Edward Snowden compromised some of the details of the Pentagon's Black Budget, so it was released to the public in 2013.<sup>10</sup>*

The new strategic plan going into place is called "The Asian Pivot". The DoD is reducing their interest in the Middle East and turning their attention toward Asia (read: China). In any Asian conflict, the U.S. will be much more dependent on ships and aircraft than soldiers on the ground.

This "Pivot" strategy is obviously a result of recent actions by the Chinese:

- *China expanded their Air Defense Identification Zone (ADIZ) in the East China Sea over a dispute concerning ownership of some islands now held by Japan.<sup>11</sup> Chinese warplanes have intercepted commercial airliners in this disputed ADIZ. Japan has sent their warplanes into that same area, in protest. The U.S. has pledged to support Japan in any armed conflict.<sup>12</sup> This dispute goes all the way back to when Japan invaded and occupied parts of China from 1937 to 1945, and the Rape of Nanjing.*
- *China is claiming ownership of vast portions of the East China Sea, and attacked Philippine fishing vessels in disputed fishing grounds with water cannons in January.<sup>13</sup> The Philippine government has filed complaints with the UN.*
- *In December, China test fired their new Dongfeng-41 multiple warhead missile, capable of carrying up to 10 nuclear warheads.<sup>14</sup> In early fall of 2013, China tested their new DF-21D "carrier-killer" missile, a land-to-sea defensive weapon. Since China doesn't have much of a navy, they must develop weapons to neutralize enemy ships off their coast.*
- *China is embarking on a program to build their own aircraft carriers.<sup>15</sup> They have one operational carrier now (the Liaoning), built from an unfinished Russian carrier hull and bought under the guise of making it a floating casino. In January, the Liaoning completed a 37 day sea trial, with J-15 fighter jets taking off and landing on its deck.<sup>16</sup>*

Meanwhile, the Russians invaded the Crimean Peninsula.<sup>17</sup> The Russian Navy has a strategic base in Sebastopol where they base their Black Sea fleet. The Russians want that back, along with some strategic airfields in Crimea.

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<sup>10</sup> "Inside the 2013 U.S. intelligence 'black budget'", The Washington Post,

<http://apps.washingtonpost.com/g/page/national/inside-the-2013-us-intelligence-black-budget/420/>

<sup>11</sup> Stephen McDonnell, "China vows to defend every inch of its territory in disputed islands row", Australia Network News,

March 9, 2014, <http://www.abc.net.au/news/2014-03-09/an-china-to-defend-every-inch-of-territory/5308332>

<sup>12</sup> "US promises to defend Japan from China as territory dispute lingers", RT, February

7, 2014, <http://rt.com/usa/kerry-kishida-china-japan-119/>

<sup>13</sup> "Philippines Protests China 'Water Cannon' Attack on Fishermen", Defense News, February 25, 2014,

<http://www.defensenews.com/article/20140225/DEFREG03/302250034/Philippines-Protests-China-Water-Cannon-Attack-Fishermen>

<sup>14</sup> "China Reportedly Test-Fires Powerful New Land-Based Missile", NTI, December 18, 2013,

<http://www.nti.org/gsn/article/china-reportedly-test-fires-powerful-new-icbm/>

<sup>15</sup> J. Michael Cole, "Why China's Carrier Program Makes (Some) Sense", The Diplomat, January 27, 2014,

<http://thediplomat.com/2014/01/why-chinas-carrier-program-makes-some-sense/>

<sup>16</sup> James Legge, "China's Liaoning aircraft carrier completes sea trials", The Independent, April 11, 2014,

<http://www.independent.co.uk/news/world/asia/chinas-liaoning-aircraft-carrier-completes-sea-trials-9034335.html>

<sup>17</sup> C.J. Chivers and Noah Sneider, "Russia's Grip Tightens With Shows of Force at Ukrainian Bases", The New York

Times, March 10, 2014, [http://www.nytimes.com/2014/03/11/world/europe/ukraine.html?\\_r=0](http://www.nytimes.com/2014/03/11/world/europe/ukraine.html?_r=0)

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Eastern Ukraine wants to be part of Russia again, while Western Ukraine wants to ally with the EU. In mid-March, the Crimeans voted to become independent of the Ukraine and be annexed by Russia. The Russians now claim that they will not invade the remainder of the Ukraine but have massed troops on the border with Crimea. This conflict goes all the way back to when Stalin annexed many parts of Eastern Europe after WWII.

During military exercises involving U.S. and South Korean troops in March, the North Koreans fired missiles that came close to a Chinese commercial airliner in that airspace.<sup>18</sup> Since then, the North Koreans have fired more missiles and artillery shells during recent South Korean and U.S. military exercises in the region. Kim Jong-un was reelected by 100% vote in March, after killing-off a few family members and high ranking officials he didn't trust. Iran threatened to invade Turkey if Israel or the U.S. attacks their nuclear facilities. Israel now claims that they cannot depend on the U.S. to neutralize the nuclear reactors in Iran, so they must take action themselves.<sup>19</sup> In February, Iran sent two of their warships off the coast of the U.S., in a show of force and reach.<sup>20</sup> Israel claims ownership of Gaza, the Golan Heights, and the West Bank as a buffer zone for security purposes. If you want to learn more about the uses and abuses of history, read historian Margaret McMillan's book, *"Dangerous Games."*

Hamas keeps lobbing short-range rockets from Gaza into Southern Israel,<sup>21</sup> but they have bigger targets in mind. The Israelis recently intercepted a Panamanian-flagged ship (the Klos-C) loaded with Syrian M-302 long-range missiles, packed in Iranian-marked containers, destined for Hamas and Gaza.<sup>22</sup> Obviously, the smaller rockets aren't doing much damage, so Hamas needed more reach to hit major Israeli cities. The evidence, on the surface, shows both Syrian and Iranian fingerprints on the shipment to Hamas. And Palestine says they will not recognize Israel as a Jewish state.<sup>23</sup> Like Japan, the U.S. has pledged to protect Israel.

So, there are some basic threats and promises that the Pentagon must consider in the future, as noted. It seems that we will be hurling stern letters at our enemies instead of advanced weaponry, based on the 2014 and 2015 DoD budgets. We are decreasing military spending overall, but you must consider that our weapons and intelligence capabilities are at least 3 to 5 times better than our closest enemies. For now and in the future, we will depend more on technology to fight conflicts than troops on the ground. The retirement of the A-10 Warthog, whose mission was air support for ground troops in battle, is a clear indicator of this trend.

If we're not going to enter conflicts with traditional combat troops in this new era, then you can be sure that we will monitor our enemies with advanced intelligence systems: RADAR, SONAR, Electronic Warfare (EW) systems, SIGINT systems, and more advanced Communications Intelligence (COMINT) systems. As the U.S. abdicates its position as the world's policeman, we will become the world's primary intelligence source. But, what about our recent commitments to defend Israel and Japan? With the reductions in force, it looks like the U.S. has made some promises that might be difficult to keep.

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There are two schools of thought on America's position as the world's only remaining superpower: (1) the U.S. will go into a period of isolationism, as it did before WWI and WWII, or (2) the U.S. will be involved in world conflicts, but now expects the other world powers to participate (with military contributions) to a greater degree than in the past. Number two doesn't seem dependable, when considering the limited support we experienced from other countries in recent Middle East conflicts. Add the paucity of military spending in the EU during and after their financial crisis and

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18 Jethro Mullen and Paula Hancocks, "Passenger jet passed through trajectory of N. Korean rocket, South Korea says", CNN, March 6, 2014, <http://edition.cnn.com/2014/03/05/world/asia/north-korea-missiles/>

19 Daniel Estrin, "Israeli minister: Israel can't rely on US on Iran", Yahoo News, March 18, 2014, <http://news.yahoo.com/israeli-minister-israel-cant-rely-us-iran-094720721.html>

20 Oren Dorell, "Iranian warships heading to USA to show reach", USA Today, February 11, 2014, <http://www.usatoday.com/story/news/world/2014/02/10/iran-warships-threat-to-usa-coast/5365335/>

21 "Gaza militants fire barrage of rockets into southern Israel", Haaretz, March 12, 2014, <http://www.haaretz.com/news/diplomacy-defense/1.579440>

22 Ilan Ben Zion, "Ship with Iran missile cargo escorted into Eilat port", The Times of Israel, March 8, 2014, <http://www.timesofisrael.com/klos-c-steams-into-eilat-with-israeli-navy-escort/>

23 "Abbas: I will not recognize Israel as Jewish state", The Jerusalem Post, March 7, 2014, <http://www.jpost.com/Diplomacy-and-Politics/Abbas-I-will-not-recognize-Israel-as-Jewish-state-344670>

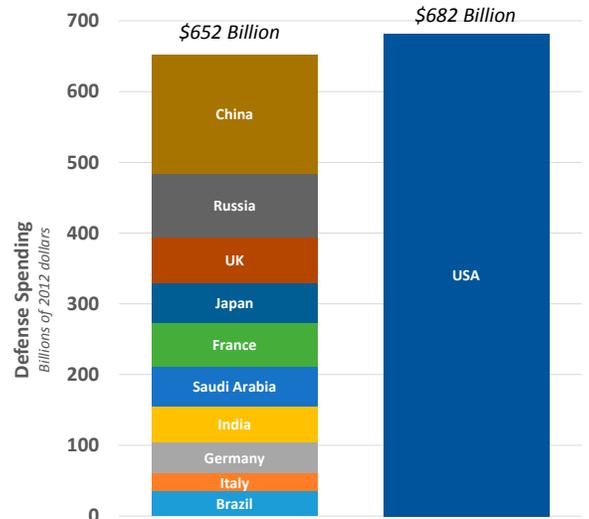
#2 seems even more remote. Additionally, look at the age demographics of developed nations.<sup>24</sup> Japan and the EU have the oldest populations (highest percentage of people over 65) which means fewer military-age men. And you can expect that countries with aging populations will spend more on social services than on their military.

So, let's pose some reasons for the reductions in U.S. military spending:

- *The U.S. spends more on its military budget than the next ten military powers combined,<sup>25</sup> or about 45% of total world military spending. That's why we have the most advanced and efficient intelligence and weapons systems on the planet. And so it goes, if our intelligence is much better, then we need fewer weapons and soldiers; we can hit any target, anywhere. Just look at the new Find, Fix, Finish, Exploit, Analyze, and Disseminate (FFFEAD) doctrine and the number of terrorists taken-out with Predator drones and Hellfire missiles in the past few years. Our military might be a victim of its own success. But hitting that target at any time is more difficult. It could take hours to move a carrier, missile destroyer, or aircraft within range of the target. That's why we need to continue development of the Falcon Hypersonic Vehicle platform that can deliver ordinance on a target anywhere in the world, in about an hour.<sup>26</sup>*
- *From a political viewpoint, some believe that we should significantly reduce U.S. military spending, since our platforms are many times better than our closest enemies, and shift spending more toward social benefits and programs for our aging and unemployed population. It would be foolish to allow our enemies to advance their capabilities while we stand still. The U.S. leads the world in UAV technology, but other countries have been developing their own UAVs with amazing speed. Consequently, we must explore counter-UAV weapon systems, like the High Energy Laser Mobile Demonstrator-Beam Control System (HEL TD BCS), to defend against them.<sup>27</sup>*
- *Paul Kennedy, in his book "The Rise and Fall of Great Powers"; gives us a good model for understanding the process of wars. For economic, religious, ethnic, or geographical reasons, certain countries seek to expand their influence. Many times, their actions create stresses that are released in armed conflict. The aggressive countries spend more on their military than their economy can support. After the conflict, each warring nation is brought back into a balance between their true economic strength and the size of their military. Considering Kennedy's model, maybe what we experiencing, through lower U.S. military spending by this administration, is the rebalancing of the size of our military to a level that our slow-growing U.S. economy can support after a decade of conflict in the Middle East.*

As we adjust to these new levels of military spending, just remember what the philosopher George Santayana said: "Only the dead have seen the end of war." Forget everything the historians have told us about the reasons for past wars. The causa prima for military conflict follows chaos theory more than historical after-the-fact reasoning. If you want to learn more about complexity theory and non-equilibrium systems, go read Mark Buchanan's book, "Ubiquity: Why Catastrophes Happen."

*"It would be foolish to allow our enemies to advance their capabilities while we stand still."*



SOURCE: Data from Stockholm International Peace Research Institute, SIPRI Military Expenditure Database, 2013, Compiled by Peter G. Peterson Foundation

24 Current Countries with the Oldest Population in the World, Charts Bin, <http://chartsbin.com/view/1239>

25 Michael Kelley, "American Military Dominance in One Staggering Chart", Business Insider, February 26, 2014, [http://www.slate.com/blogs/business\\_insider/2014/02/26/chart\\_u\\_s\\_defense\\_spending\\_vs\\_other\\_countries.html](http://www.slate.com/blogs/business_insider/2014/02/26/chart_u_s_defense_spending_vs_other_countries.html)

26 Hypersonic Technology Vehicle 2, Wikipedia, [http://en.wikipedia.org/wiki/Hypersonic\\_Technology\\_Vehicle\\_2](http://en.wikipedia.org/wiki/Hypersonic_Technology_Vehicle_2)

27 John Keller, "Army considers counter-UAV weapons; surveys industry for promising enabling technologies", Military & Aerospace Electronics, March 6, 2014, <http://www.militaryaerospace.com/articles/2014/03/army-focusing-on-counter-uav-weapons.html?cmpid=EnIMAEMarch122014>

# Semiconductor

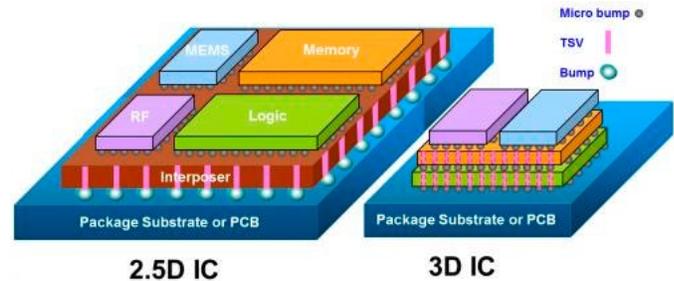
## Semiconductors Mimic Embedded Board Technologies

The semiconductor industry is now using embedded board strategies to increase their chip functionality and achieve higher levels of integration, for example 2.5D and 3D chips.<sup>28</sup> In 2.5D semiconductor structures, the die are placed side by side on an interposer, much like we put mezzanine cards on motherboards and carrier cards. In 3D semiconductor structures, the die are stacked vertically, much like the concept of stackable PC/104 small form factor cards using feed-through connectors.

What is an interposer? It is basically a silicon backplane that connects the leads of the multiple die together with traces, much like we do now with copper traces on backplanes connecting boards together. A 2.5D semiconductor, with die on top of an interposer, is almost 3D but not quite since we are only stacking one layer of die vertically. In 3D semiconductors, we have multiple vertical die stacked-up.

For 2.5D, we can see that a microcontroller die and multiple memory and I/O die can all be placed on the interposer, with traces connecting those die. This concept is much more cost effective than making hybrid chips. In the past, multiple die were mounted on a substrate in a small flat metal can (similar to a sardine can), and the leads from each die were connected with tiny wires. Then the entire module was “potted”, filled with epoxy. Some I/O and power leads protruded out the bottom and those leads were then soldered to a printed circuit board (PCB). With a 2.5D semiconductor, you have a slightly thicker IC package with surface mount balls for connection to the PCB. That eliminates the can and the expensive wire-bonding process.

3D semiconductors are similar, except they are thicker, depending on how many die are stacked vertically. The basic problem with 3D semiconductors is that you are creating high heat densities in the chip, especially if you are stacking memory die. So cooling these chips becomes a major design issue and limits the number of die that can be stacked vertically. This could be a driver in the DARPA-IBM effort to develop liquid inside the chip cooling techniques.<sup>29</sup>



In the past, we have seen large high-chip-density printed circuit boards warp under their weight and over many thermal cycles of contraction and expansion. We solved that problem by placing board stiffeners across the board to retard the warping. Semiconductor substrates and interposers are not large enough or heavy enough to demonstrate warpage. But, the silicon wafers they are made from are showing signs of “gravitational bending”.<sup>30</sup> Most fabs are running 200mm wafers, with some running 300mm sizes. The next wafer size is 450mm, and they are problematic from a warpage standpoint. All wafers must be kept perfectly flat as they enter the UV lithography phase. If the wafer is warped, the photo mask will blur the features of the transistors and traces on the warped surface, especially at the very small geometries we are working with today (sub-micron and nanometer levels). Gravitational bending reduces yield from the wafer. As the wafers increase in size, they must also increase in thickness, which raises the cost of the die from big wafers.

It looks like we will be at 200-300mm wafers for a long time. Many semiconductor companies, like the analog chip vendors, could run an entire year’s production on just a few 450mm wafers. But, the cellphone chip makers, who have large unit volumes, could benefit from the larger wafers if the gravitational bending and EUV problems could be solved.

<sup>28</sup> Ivo Bolsens, “2.5D ICs: Just a Stepping Stone or a Long Term Alternative to 3D?”, Xilinx, [http://www.xilinx.com/innovation/research-labs/keynotes/3-D\\_Architectures.pdf](http://www.xilinx.com/innovation/research-labs/keynotes/3-D_Architectures.pdf)

<sup>29</sup> John Keller, “IBM researchers to design liquid cooling directly into microchip designs and packaging”, Military & Aerospace Electronics, April 8, 2013, <http://www.militaryaerospace.com/articles/2013/04/IBM-DARPA-ICECool.html>

<sup>30</sup> “The Next-Generation Wafer”, Sumco Corporation, [http://www.sumcosi.com/english/products/next\\_generation/problem\\_bending.html](http://www.sumcosi.com/english/products/next_generation/problem_bending.html)

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## Breaking the Terahertz Barrier

Semiconductor companies are working on 300 GHz to 30 TeraHz-speed semiconductor devices. In the lab, researchers have chips running at 798 GHz (using cryogenic cooling).<sup>31</sup> That beat the previous fastest semiconductor by 200 GHz. It's pretty clear that when we start running at Terahertz speeds, we're not going to be connecting semiconductors on copper-based backplane traces. Just another reason that we must move to optical interconnects in the future. TE Connectivity, the industry's largest copper-based connector vendor, just entered the optical engine market with their new Coolbit line of products.<sup>32</sup> Molex just announced their moves into optical engines.<sup>33</sup>

And finally, we will see fewer increases in the clocks speeds of general-purpose processors in the future. Most of these processors have multiple homogeneous cores, inefficient from a power, single-thread software, and performance standpoint. Next-generation processors will start using heterogeneous cores, tuned to specific application segments (like communications protocol stack-thrashing cores, I/O control cores, application-specific state machines, etc.). We went through this same architectural cycle in the mainframe computer business in the 1970's. The main CPU was front-ended by Data Communications Processors (DCPs) and I/O Processors (IOPs) to off-load the main CPU. The industry has been building heterogeneous multiprocessor systems for decades with VME and now, with VPX. This may be one of the reasons that IBM recently announced that they will sell-off their semiconductor division.<sup>34</sup> How many instruction sets and software environments can one semiconductor maker support? Until these new semiconductor innovations come to market, we will be stuck with few improved processors to drive the new product development cycle in our embedded board industry. That might mean that many high-margin niches in our industry will become commoditized by price competition, until new chips that differentiate in performance or capabilities arrive in the market.

## Mergers and Acquisitions

Let's look at the major M&A activity in our industry:

- *September: Koch Industries bought Molex, a very large maker of connectors used in our industry.<sup>35</sup> This acquisition was a big surprise across the connector industry, considering that other connector vendors, focused on the telecom sector, have been for sale for some time with no buyers coming forward. Molex is diversified, with products spanning many industry segments, and wasn't tainted with the telecom curse.*
- *October: Curtiss-Wright bought Parvus Corp. from Eurotech for \$38 million.<sup>36</sup> Parvus was doing about \$23 million in sales, for a multiple of 1.65. This adds a significant number of small form factor (SFF) products and design-ins to the Curtiss-Wright portfolio. In the past, Eurotech was trying to buy Radstone before GE won the bidding. On the surface, it looks like Eurotech's appetite for MIL-focused board and systems companies is waning.*

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31 Mark LaPedus, "Intel joins DSA consortium; world's fastest silicon; pushing CMOS", Semiconductor Engineering, February 25, 2014, <http://semiengineering.com/manufacturing-bits-feb-25/>

32 Robert Hult, "TE's New Coolbit Leads the Optical Engine Evolution", Connector + Cable Assembly Supplier, March 18, 2014, <http://www.connectorsupplier.com/tes-new-coolbit-leads-the-optical-engine-evolution/>

33 John Wallace, "Molex activities affirm that silicon photonics is the thing for data centers", Laser Focus World, March 10, 2014, <http://www.laserfocusworld.com/articles/2014/03/molex-activities-affirm-that-silicon-photonics-is-the-thing-for-data-centers.html>

34 Ed Sperling, "Are Processors Running Out Of Steam?", Semiconductor Engineering, February 14, 2014, <http://semiengineering.com/are-processors-running-out-of-steam/>

35 John Glover, "Global Debt Exceeds \$100 Trillion as Governments Binge, BIS Says", Bloomberg, March 9, 2014, <http://www.bloomberg.com/news/2014-03-09/global-debt-exceeds-100-trillion-as-governments-binge-bis-says.html?cmpid=yhoo>

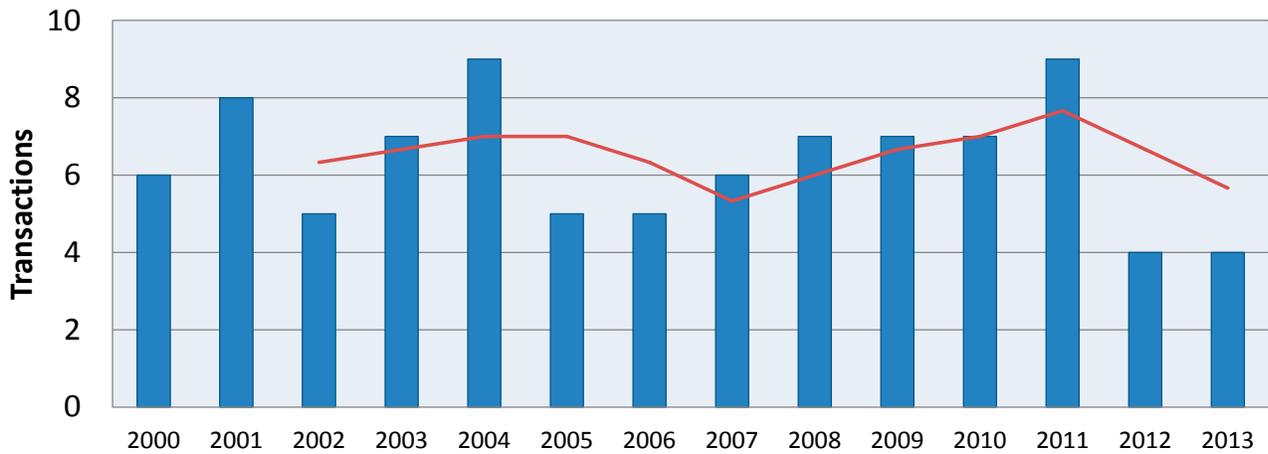
36 Press Release, "Curtiss-Wright Acquires Parvus Corporation", The Wall Street Journal, October 1, 2013, <http://online.wsj.com/article/PR-CO-20131001-900334.html>

- November: CSPI bought Myricom, a maker of high-speed interconnect solutions.<sup>37</sup> The details of the transaction were not disclosed. This acquisition will enhance CSPI's multicomputer division that designs and builds high-performance multiprocessor systems.
- December: Google bought robotics maker Boston Dynamics, bringing their total to eight robot platform companies purchased in the past year.<sup>38</sup> At this pace, Google could become one of the largest military prime contractors in the near future. What is Google going to do with all these robotic platform makers? We'll have to wait and see.
- December: Sonus Networks bought Performance Technologies, Inc (PTIX) for about \$30 million.<sup>39</sup> PTIX's sales in 2013 were about \$26 million (based on publicly announced sales of \$13.4 million for the first 6 months), for a multiple (price divided by sales) of roughly 1.15. This is astonishing, considering that previous telecom board vendors sold for 0.5 to 0.8 times sales when the bottom fell out of that market. Sonus will use PTIX's products and technologies to exploit some telecom market niches where some profitability still exists.
- As we go to press, rumors are floating that Boeing is eyeing Mercury Systems.

In recent telecom board and box history, we have seen Emerson Networking's embedded group partially sold-off to Platinum Capital. Diversified Technology, Inc. went out of business. And, PTIX has been bought by Sonus. These transactions pretty-much clean-up the mess created by the board companies who went running through the telecom equipment market with reckless abandon. Only a few board and system companies sell to the remaining telecoms these days. The available telecom equipment industry is shrinking as the Chinese take over that sector. Alcatel-Lucent announced another 10,000 layoffs in October.<sup>40</sup> Nortel is dead and gone. Ericsson Telecom is being clobbered by the Chinese, especially by Huawei. This sad part of our industry's history is finally coming to a close.

We may see more M&A activity in the MIL/Aero industry in the near future. Ongoing DoD budget cuts will inspire the larger board and box suppliers to buy-up smaller companies with solid design-ins in funded programs (as with saw in the Curtiss-Wright /Parvus acquisition). We may also see some consolidation of the primes themselves, as the budget cuts diminish the future of the weaker players. And, we may see some primes interested in buying-up some of the board companies that have solid technologies, particularly in RADAR. The plight of Malaysian Flight M370 has shown that numerous countries need to upgrade their present early-warning and ADIZ RADAR systems.

## Mergers & Acquisitions



37 Press Release, "CSP, Inc. Broadens MultiComputer Business Opportunities with Asset Purchase of Myricom, Inc.", CSPI, November 6, 2013, <http://www.cspi.com/csp--inc--broadens-multicomputer-business-opportunities--with-asset-purchase-of-myricom--inc--/>

38 Geoff Duncan, "Why is Google building a robot army?", Digital Trends, December 22, 2014, <http://www.digitaltrends.com/cool-tech/google-see-robots-anyway/#!zl6hg>

39 Press Release, "Sonus Networks Announces Definitive Agreement to Acquire Performance Technologies, Inc.", Sonus, December 12, 2013, <http://www.sonus.net/resources/press-releases/sonus-networks-announces-definitive-agreement-acquire-performance>

40 Sam Schechner, "Alcatel-Lucent Announces Deep Job-Cuts Plan", The Wall Street Journal, October 8, 2013, <http://online.wsj.com/news/articles/SB10001424052702304626104579121840306745028>

## Market Estimates

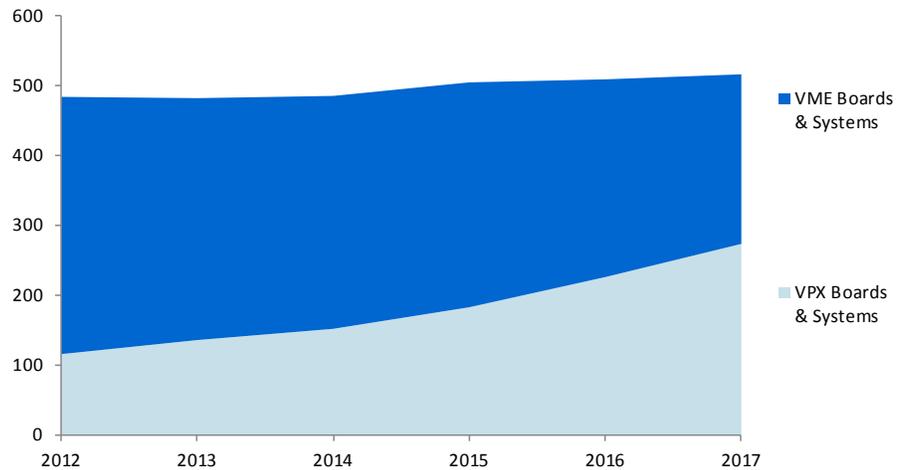
### VPX markets

VPX revenues were projected by industry analysts to match VME by 2012. This didn't quite happen, as the cuts and uncertainty on military program spending went on longer than expected and is in fact still ongoing. New data from IHS Electronics & Media shows the crossover more likely to now occur in 2016 or 2017.

VPX has established a strong foothold in many defense programs that use high performance and rugged computing platforms. The defense sector represents about 80 percent of the revenue for VME and VPX combined. This could be even higher for VPX exclusively as the defense sector is the primary market for VPX technology at this time. In the early days of VMEbus it was just the opposite – most of the focus was on industrial and defense had no interest. Over time it will be interesting to see how other market sectors pick up on the VPX technology. Members of VITA are reporting VPX design wins in some transportation and industrial applications that can take advantage of the performance and rugged packaging of VPX.

The World Market for VME and VPX Products

Revenues (\$M) - 2012 to 2017

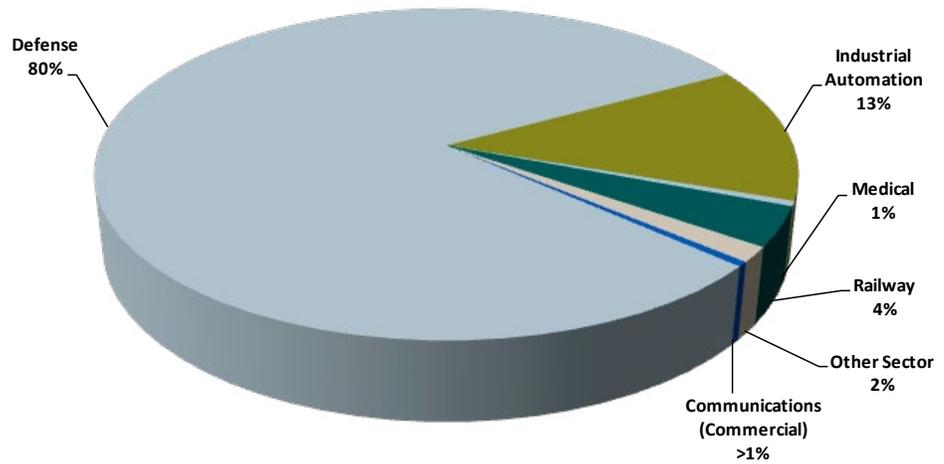


Source: IHS

Aug-13

The World Market for VME/VPX Components By Sector

Revenues (\$M) in 2012



Source: IHS

Aug-13

Charts courtesy of IHS Electronics & Media.

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## Summary

At the macro level, the U.S. is coming out of the recession slowly, but Europe is having a tougher time recovering from their financial crisis. This makes sense: it took many months for the recession in the U.S. to migrate to the EU. The U.S. economy will recover first, followed by the EU sometime later. But, the sovereign debt of the EU countries will be a drag on their economic growth. If world interest rates rise as forecasted, that could push some EU countries into a new financial crisis.

At the micro-level, our biggest concern is how the reduction in U.S. military spending will affect our GDP, the prime contractors, and the board companies who support this industry segment. The Ground Combat Vehicle (GCV) program will be limited to a few prototypes and some testing, but no large volumes. We will build another DDG class destroyer and a few shallow-water Littoral Combat Ships. We will build more F-35 fighters and the KC-46 aerial refueling tanker fleet, to replace the aging 707-based KC-135's. As you can see, we don't have significant new aviation, land-based or naval platforms in the pipeline.

*“We don't have significant new aviation, land-based or naval platforms in the pipeline.”*

That leaves mostly Intelligence, Surveillance, and Reconnaissance (ISR) platforms as the primary programs in the military. The Chinese actions over the islands off the coast of Japan, their claim of ownership of fishing grounds used by the Filipinos, and their claims that Taiwan is part of China are just the tip of the iceberg. They have ramped-up their military spending, have a new aircraft carrier in their fleet, and have developed their anti-carrier missiles and a new multi-warhead strategic missile.

The North Koreans continue to provoke the South Koreans and the U.S. They have also developed and tested new missiles, both short and long-range. Kim Jung Un continues to cleanse his cabinet of untrusted people, including family members. But, he counts Dennis Rodman as a close friend, who sings “happy birthday” and brings pro athletes to the country to play basketball for him.

The Iranians threatened to bomb Turkey and U.S. installations if the Israelis attack their nuclear reactor facilities. The Israelis have said that they must stop the Iranians from gaining nuclear weapons and destroy the reactors and nuclear production facilities, as they did in Iraq in 1981 in Operation Opera and in Syria in 2007 in Operation Orchard. And they now have to do it without the political and military support of the U.S. and the EU.

Meanwhile, the Russians, sensing a lack of interest from the U.S. and the EU, invaded and annexed Crimea. The fate of the rest of the Ukraine is unfolding. In mid-April, a Russian Su-24 fighter jet taunted a U.S. Navy destroyer in the Black Sea for 90 minutes, making low-altitude passes near the ship and ignoring queries and warnings.<sup>41</sup>

The Palestinian Hamas organization continues to lob small short-range missiles into Israel's southern region. But, they are desperately trying to acquire long-range missiles to hit major Israeli cities and do more damage. Palestine has refused to recognize Israel as a sovereign nation.

Even New Jersey is unstable. The alleged politically-motivated lane closures on the George Washington Bridge, between Fort Lee and Manhattan, irritated the folks in New York and commuters on the Jersey side. The relationship between New Jersey and New York has been strained for decades.

As of this writing, Google bought yet another UAV maker, Titan Aerospace.<sup>42</sup> That brings their total UAV-maker acquisitions to nine. Google took Titan away from Facebook, who was negotiating to buy them. Why are search engine and social media companies buying UAV makers? They claim they can use those platforms to bring the internet to starving people and impoverished areas of the world who have no internet service. That makes a lot of sense!

Then, we have the “Internet of Things” (IoT) movement. From what I can discern, the entire concept here is to enable your washing machine to talk to your refrigerator, and let you know what they discussed when you come home from work.

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<sup>41</sup> “Russia fighter jet buzzed US destroyer: Pentagon”, Yahoo News, April 14, 2014, <http://news.yahoo.com/russia-fighter-jet-buzzed-us-destroyer-pentagon-180137665.html>

<sup>42</sup> Alexei Oreskovic, “Google to buy drone-maker Titan Aerospace”, Yahoo Finance, April 14, 2014, <http://finance.yahoo.com/news/google-buy-drone-maker-titan-aerospace-183515955--sector.html>

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Just focus and concentrate on ISR systems in the military: RADAR, SONAR, SIGINT, EW, and COMINT systems. That is where the action is for now. World peace is a very precarious proposition. Somewhere, at some point in the near future, an egotistical leader of some country will become aggressive and do something stupid. The only way to eliminate armed conflict in this world is to put Prozac in the water supply of all nations, like developed nations did with fluoride to prevent tooth decay. That's not likely, unless the Bilderberg Group has that in their master plan.

*“Just focus and concentrate on ISR systems in the military.”*

Unfortunately, we will have to rebuild some of the military supply chain that is being eradicated by the DoD budget cuts when things get weird again. Our industry will be the linchpin of the rebuilding, with COTS and ruggedized electronics as the primary tools. Just remember what American editorialist and journalist Ambrose Bierce once said:

*“Peace, in international affairs, is a period of cheating between two periods of fighting.”*

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