



2013 State of the VITA Technology Industry



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P.O. Box 19658

Fountain Hills, AZ 85269

480.837.7486

info@vita.com

www.vita.com

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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 complete series of reports can be found at [Market Reports](#). (www.vita.com)

Introduction

This issue of the “State of the VITA Technology Industry” recaps our current economic conditions. We will also take a close look at unmanned vehicles of all types. Optical backplanes have been on the horizon for many years, new innovation keeps moving us so ever slowly forward, but we are quickly running out of runway. There have been a few deals made in the mergers and acquisition department, and to wrap it up, we will close with “Alderman’s Business Rules.”

Business Conditions

The final numbers for Q1 2013 **U.S. GDP growth**¹ came in at a disappointing 1.8% after two earlier estimates of 2.4%. The final Q1 GDP was revised to 1.1% by the Bureau of Economic Analysis (the Bureau of Economic Analysis issues a preliminary GDP number, and revises it three times until the next quarter GDP estimate is announced). While this is not exciting, it beats the situation we have seen in **China**² and **Europe**³ in Q1.

The preliminary number for Q2 2013 U.S. GDP came in at 1.7% after the forecast was revised down to the 1% to 1.6% range by many economists. In late August, it was **revised up to 2.5% growth**.⁴ This growth rate was welcome news, considering that Q1’s number kept being lowered.

- 1 Matthew Boesler, “US GDP, Personal Consumption Growth Slashed in Q1”, Business Insider, June 26, 2013, <http://www.businessinsider.com/q1-us-gdp-final-2013-6>
- 2 “China’s Q1 GDP growth slows to 7.7 pct”, English.news.cn, April 15, 2013, URL: http://news.xinhuanet.com/english/china/2013-04/15/c_132309224.htm
- 3 “Euro area GDP down by 0.2% and EU27 down by 0.1%”, Eurostat, May 15, 2013, http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/2-15052013-AP/EN/2-15052013-AP-EN.PDF
- 4 Rob Wile, “Q2 GDP Got Revised Way Up”, Business Insider, August 29, 2013, <http://www.businessinsider.com/q2-2013-gdp-estimate-2013-8>

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Q1 EU GDP numbers came in at -0.1% for the EU and -0.2% for the entire Euro-area. In Q2, the EU grew at 0.3%⁵, indicating that the region is coming out of recession. Conditions improved in Germany and the U.K.⁶, the bookends of the EU. Everything in the middle is being crushed, especially France.

In early July, the International Monetary Fund lowered their forecast⁷ for world GDP growth for 2013 and 2014. They reduced the world growth number for 2013 to 3.1% (down from 3.3%), and for 2014 to 3.8% (down from 4%). They based these revisions on deteriorating economic conditions in the EU and on the prospect that the Federal Reserve in the US will begin easing bond purchases, allowing interest rates to rise.

The Central Bank of Japan has been trying to inflate their currency against the U.S. dollar, moving it from 80 Y/dollar to 96 Y/dollar in the past 8 months. An inflated Yen means that Japanese products would be cheaper on the world markets, and increase their exports. Japan has limited natural resources so they must import all their raw materials, energy, and much of their food. Those imports would be more expensive, thereby inflating domestic prices inside Japan. This process is their master plan to exit their past 20 years of deflationary economic conditions where domestic prices have been falling and their exports more expensive on the world markets. Japan came in with Q2 growth of 2.6%, down from the 3.6% forecasted by economists.⁸

China's Q2 GDP growth came within expectations⁹ at 7.6%. Q1 2013 growth was 7.7%, so China has slowed slightly. New leadership in the Chinese administration wants to shift their economy from exports to domestic consumption over the next few years. The cheap money policies of the shadow banking system have increased non-performing loans (NPLs) that could cause a credit bubble for China¹⁰ in the future.

Overall, the declining world economic conditions will affect the industrial and telecom markets the worst, at the micro-economic level, reducing demand for those products further. The U.S. military market is still trapped in the initial stages of the sequester (automatic reduction of military spending) initiated by Congress. In the first weeks of July, the Pentagon started the "furloughs". 650,000 defense workers are required to take one day off per week without pay (11 furlough days from July to September). But the number of days without pay was lowered to six in early August. In March, Northrop Grumman closed some operations in Woodland Hills, Carson, and Salt Lake City. In May, Raytheon closed some operations in El Segundo and moved that division to McKinney, TX.

We have major events coming up in the U.S. that will define our future. Interest rates are rising rapidly in spite of the Fed's quantitative easing. The cost of capital for our industry is definitely going to rise for those who borrow money to operate. You can avoid this disaster by being a net-cash generator (and not a net-cash user). That means you must create GPMs of at least 40% for your products, or you will be at the mercy of the macro-conditions.

The macro-economic uncertainty we face won't be evenly spread across our industry. Those companies who ignore the macro-statistics, sub-segment the markets (based on technology, applications, and geography), raise their GPM's, and eliminate commodity products from their portfolios will do much better than those in survival-mode. If you are not a net-cash generator, you will have serious problems in 2014.

"The macro-economic uncertainty we face won't be evenly spread across our industry."

5 "Euro area and EU27 GDP both up by 0.3%", Eurostat, August 14, 2013, http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/2-14082013-AP/EN/2-14082013-AP-EN.PDF

6 Curtis Tate, "No Surprise: U.K., Germany Lead the Pack as EU Starts to Heal," Wall Street Cheat Sheet, August 5, 2013, <http://wallstcheatsheet.com/stocks/no-surprise-u-k-germany-lead-the-pack-as-eu-starts-to-heal.html?ref=YF>

7 "IMF scales back world growth forecasts for 2013-14", USA Today, July 9, 2013, <http://www.usatoday.com/story/money/business/2013/07/09/imf-world-growth-forecasts/2501711/>

8 "Disappointing Japan Data Cloud Sales-Tax Debate", The Wall Street Journal, August 12, 2013, <http://online.wsj.com/article/SB10001424127887324769704579008310496302086.html>

9 Mamta Badkar, "Chinese Q2 GDP Rises 7.5% In Line With Expectations, But Industrial Production Misses", Business Insider, July 14, 2013, <http://www.businessinsider.com/china-q2-gdp-2013-7>

10 Eve Cary, "The 'Hidden' Costs of China's Bad Loans", The Diplomat, June 6, 2013, <http://thediplomat.com/china-power/the-hidden-costs-of-chinas-bad-loans/>

Markets

MIL/Aero

Unmanned Aerial Vehicles (UAVs)

For this white paper, I was going to research and classify all known UAV platforms by payload, operating altitude, country, and then put them on a chart. My research results immediately destroyed this idea. According to recent reports from the Aerospace Industries Association (AIA),¹¹ there are approximately 556 unique UAV platforms built by 192 different companies, flying today in over 100 countries. Further research discovered a Wikipedia page listing all the UAVs¹² by country and it looks to be maintained and current.

The best classification I can do here is to categorize UAVs into groups by operating altitude. First, we have space-based UAVs like the X-37 (a mini-space shuttle)¹³ and the HSV (unmanned Hypersonic Vehicle).¹⁴ Of course, the ultimate unmanned space-based UAVs are our satellites. They are used for communications and intelligence collection activities . . . and possibly weapons platforms.

The Outer Space Treaty of 1967¹⁵ is the foundation of Space Law. Over 130 earth-based countries have signed the agreement to date. This treaty forbids the placement of offensive nuclear weapons in space or on the moon, but it does not restrict countries from placing conventional weapons in orbit around the earth or on nearby heavenly bodies. At today's rates, it costs \$10,000 per pound to put an object into stable orbit around the earth. Most of the countries that signed the treaty couldn't put a baseball in orbit if they used their entire GDP. But, there are a few countries on the list with the requisite finances and technology that could weaponize space.

Even more disconcerting than conventional weapons raining down on us from satellites is that we now seem to have lawyers specializing in Space Law. Those newly-minted attorneys will claim that Space Law is just a vacuum (pun intended), an infinite void of legal services and opinions, and they are subsequently filling that void. Only a few hundred people have ever been into space, none permanently, and we already have an army of Space Lawyers.

Disregard the horrifying threat of Space Lawyers for a moment, and factor this Outer Space Treaty into your thinking about North Korea and Iran. North Korea has nuclear weapon capabilities, but their missiles can barely lob them into nearby oceans. Iran is trying to develop nuclear warheads, but they have no capable or reliable delivery platforms (missiles). If the North Koreans and the Iranians gain both nuclear warheads and reliable launch vehicles, would they sign and abide by the Outer Space Treaty? That should keep your mind occupied for a few hours, and you will better understand the true threats from Iran and North Korea. That realization may inspire renewed justification for a "missile shield" of some type (the old SDI program proposed during the Reagan administration). Or we may need to take military action in the future against both countries before they gain space capability.

Let's get back to near-terrestrial levels here. Below the space spectrum, we have the earth's highest atmosphere where the HALE (High Altitude Long Endurance) UAVs like the Phantom Eye¹⁶, Global Observer¹⁷, and the Global

"Only a few hundred people have ever been into space, none permanently, and we already have an army of Space Lawyers."

11 "Unmanned Aircraft Systems: Perceptions & Potential", Aerospace Industries Association, May 2013, http://www.aia-aerospace.org/assets/AIA_UAS_Report_small.pdf

12 "List of unmanned aerial vehicles", Wikipedia, http://en.wikipedia.org/wiki/List_of_unmanned_aerial_vehicles

13 Chirs Gebhardt, "The X-37B: Exploring expanded capabilities for ISS missions", NASA Spaceflight.com, March 12, 2013, <http://www.nasaspaceflight.com/2013/03/x-37b-expanded-capabilities-iss-missions/>

14 John Reed, "Army Successfully Tests Hypersonic Weapon Design", Defense Tech, November 17, 2011, <http://defensetech.org/2011/11/17/army-successfully-tests-hypersonic-weapon-design/>

15 "Outer Space Treaty", Wikipedia, http://en.wikipedia.org/wiki/Outer_Space_Treaty

16 "Phantom Eye HALE Unmanned Aerial Vehicle (UAV), United States of America", Airforce-Technology.com, <http://www.airforce-technology.com/projects/phantomeyeunmannedae/>

17 "Global Observer", AeroVironment Corporate, <http://www.avinc.com/globalobserver>

Hawk¹⁸ operate. These are intelligence platforms today, with some basic atmospheric research being conducted by a few of these high-altitude vehicles.

Down at 15K-30K feet, we have a number of UAVs including the Predator, X-47b, and Phantom Ray (all basic UAV weapons platforms). This is the category that gets the most attention from the press since they are deployed operational platforms in combat zones. And these are the platforms most used by CIA and SOCOM (Special Operations Command) to find and eliminate terrorists.

At a few hundred to a few thousand feet altitude, we have all the small reconnaissance UAVs like Raven¹⁹ and Desert Hawk.²⁰ It's the low-altitude mini-UAV category that contains the most models and versions from the most countries.

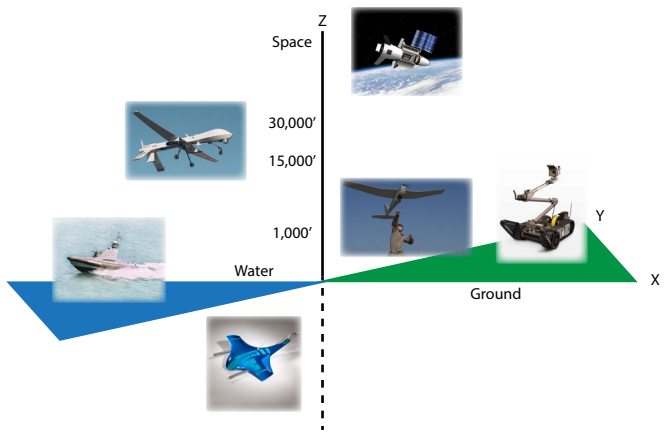
Then, there's the micro-miniature UAVs that fly a few feet above the ground. These platforms are the size of insects, and are in development stages. One example looks exactly like a mosquito²¹ while another more like a housefly.²² A recent report claims that the market for UAVs will double²³ in the next decade. This is the premier military market that will drive airborne embedded systems for the next ten years or more.

Finally, there is the unique category of unmanned helicopters. The MQ-8 Fire Scout, ShadowHawk, and Boeing Little Bird are examples. These platforms are used in applications similar to the smaller reconnaissance UAVs, but are large enough to carry munitions. Their size also allows them to deliver supplies to troops in remote areas of the battlefield. We may see unmanned helicopters used as Medical Evacuation platforms on the battlefield of the future.

According to a recent report from Frost & Sullivan, Israel is the world's largest exporter of Unmanned Aerial Vehicles (UAVs).²⁴ These are mostly the smaller reconnaissance types that operate at few hundred feet in altitude.

Unmanned Surface Vehicles (USVs)

That brings us to Unmanned Surface Vehicles²⁵, that operate on top of the water. The Piranha, Spartan Scout, and Protector are examples of these types of vehicles. These platforms accomplish river patrol, coastline monitoring, and intelligence gathering missions. Some of these platforms are just the present Zodiac rubber boats used by the SEALs, with GPS autonomous navigation and sensor packages installed onboard.



Range of Unmanned Vehicle operating dimensions

UAV Marketing Directory

Unmanned Aerial Vehicles (UAV) represents one of the largest and fastest growing military and aerospace markets. Fueled by 9-11 and the Iraq and Afghanistan wars, the military is investing heavily into UAV R&D, systems, subsystems, components, and services. Although used mainly for military applications there are potentially larger markets in civil and commercial applications.

Order the "2013 New UAV Marketing Directory" by Oct. 1, and get a copy of "DOD UAS FY 2014 Budget Analysis"!

18 "Northrop Grumman RQ-4 Global Hawk", Wikipedia, http://en.wikipedia.org/wiki/Northrop_Grumman_RQ-4_Global_Hawk

19 "AeroVironment RQ-11 Raven", Wikipedia, https://en.wikipedia.org/wiki/AeroVironment_RQ-11_Raven

20 "Lockheed Martin Desert Hawk", Wikipedia, http://en.wikipedia.org/wiki/Lockheed_Martin_Desert_Hawk

21 "US military surveillance future: Drones now come in swarms?", RT, June 20, 2012, <http://rt.com/news/us-drones-swarms-274/>

22 Jonathan Bolding, "Tiny Robotic Insect Takes Flight", The Escapist, May 2, 2013, <http://www.escapistmagazine.com/news/view/123700-Tiny-Robotic-Insect-Takes-Flight>

23 John Keller, "Teal: worldwide spending for unmanned aerial vehicles (UAVs) to double over next decade", Military & Aerospace, August 15, 2013, <http://www.militaryaerospace.com/articles/2013/08/worldwide-spending-for-unmanned-aerial-vehicles-uavs-to-double-over-next-decade-teal-says.html?cmpid=EnIMAEspecSeptember32013>

24 "Frost & Sullivan: Israel is the world's largest exporter of unmanned aircraft", IHLS, May 21, 2013, <http://i-hls.com/2013/05/frost-sullivan-israel-is-the-worlds-largest-exporter-of-unmanned-aircraft/>

25 "Unmanned surface vehicle", Wikipedia, http://en.wikipedia.org/wiki/Unmanned_surface_vehicle

Unmanned Underwater Vehicles (UUVs)

Next up are the **Unmanned Underwater Vehicles**²⁶ (UUVs). These platforms range from 2 feet long to over 30 feet in length. There are 30-40 different models developed today. Many UUVs are autonomous smart torpedoes. Others accomplish mine-clearing operations. Some are used to map coastlines and bottom features in both shallow and deep water. And some are SIGINT (Signal Intelligence) platforms, detecting and interpreting screw-sounds from passing ships. The US Navy is developing **miniature UUVs in the shape of a jellyfish**²⁷ that will serve similar mission purposes as the micro-miniature insect-like platforms planned by the Army.

There are new categories of unmanned platforms in initial development, variations and enhancements of our present UUVs. One is called **Upward Falling Payloads**²⁸ (UFP). These are weapons, sensors, communications, and electronic warfare (EW) systems that are dropped into the ocean in various places. They sink to the bottom and sit there undetected, until needed. A control signal will release them, they will rise to the surface, and attack enemy vessels and submarines on the seas. These new UUVs will probably be the first totally autonomous weapons systems deployed. The Geneva Convention tribe seems preoccupied with UAVs and might be unconscious of what can be done at sea with autonomous weapons systems.

“The Geneva Convention tribe seems preoccupied with UAVs and might be unconscious of what can be done at sea with autonomous weapons systems.”

Unmanned Ground Vehicles (UGVs)

The final category is the **unmanned ground vehicle**.²⁹ There are 19 different platforms present today, including Talon, SWORDS, MAARS, and PackBot versions. As you can see, these are mostly small weapons and reconnaissance platforms. A previous program, called the Army Mule, was basically a UGV for autonomously delivering supplies to ground troops, but that program was dropped in early 2010. Unmanned helicopters can do the logistics and supply job easier and with less vulnerability.

Telekinetic Control of UAVs

We have good electro-mechanical man-machine interfaces today, where humans control the movement and actions of our unmanned platforms on the battlefield using keyboards and joysticks. The next element in this progression toward robotic warfare is possibly to control our UAVs and other unmanned systems with the body movements of the pilot, similar to the Wii game interface. But we may just skip this step by controlling the unmanned platforms purely with the mind of the soldier, eliminating the cumbersome joysticks, “control center” hardware, and the Wii-like body movement interfaces. That’s what they are now doing at the **University of Minnesota**.³⁰ According to Geneva Convention requirements, a human must be in the loop of unmanned weapons platforms. Totally autonomous killing of enemy combatants is not yet accepted by those who make the rules of war, and the progression toward total autonomy of weapons keeps them up nights thinking about the technological possibilities. But eventually, unmanned weapons will be fully autonomous and make kill decisions based on their sensor inputs and their algorithms. We may go through the body-movement interface first and then the psychokinetic-control phases, before we can “Cry havoc, and let slip the dogs of war . . .”. Totally autonomous weapons are simply a sensor-algorithm problem.

Other equally interesting ideas and developments are ongoing, like bio-reactive chemical markers salted in the food of the terrorist supply chain, or “painted” on their bodies after capture and release, enabling our intelligence systems to track them with advanced sensors. RFID tags and chemical markers can be attached to many items in the terrorist

26 “Unmanned underwater vehicle”, Wikipedia, http://en.wikipedia.org/wiki/Category:Unmanned_underwater_vehicles

27 Dylan Stableford, “Robot jellyfish: U.S. Navy-backed researchers developing Robojelly”, Yahoo! News, March 22, 2012, <http://news.yahoo.com/blogs/sideshow/robot-jellyfish-u-navy-backed-researchers-developing-robojelly-152601359.html>

28 John Keller, “DARPA chooses Sparton to help develop hidden weapons and sensors that pop up from the ocean”, Military & Aerospace, July 24, 2013, <http://www.militaryaerospace.com/articles/2013/07/sparton-darpa-ufp.html?cmpid=EnIMAEJuly312013>

29 “Unmanned ground vehicle”, Wikipedia, http://en.wikipedia.org/wiki/Unmanned_ground_vehicle

30 “Mind over Mechanics”, University of Minnesota, <http://www.youtube.com/embed/6LWz4qa2XQA?feature>

supply chain, like food, water, ammunition, weapons, medical supplies, and newspapers. Anything they pick-up and carry with them could be marked in some way. Advanced sensor systems can then track them wherever they go.

Commercial UAV applications

Many commercial applications are obvious: terrain mapping, crop monitoring in agriculture, border patrols, law enforcement, search and rescue missions in difficult terrain, etc. Dominoes is testing the use of UAVs to **deliver pizzas in the UK**.³¹ The pizza-drone is an 8-rotor helicopter-type UAV that contains the pizza payload in a traditional insulated carrier. It flies by GPS to the delivery site and senses when the pizza is removed from the container. Then it flies back to home-base awaiting the next delivery mission.

Drone delivery of pizza could be problematic in the western states of the U.S. A small town in Colorado, Dear Trail, is considering issuing drone hunting licenses, permits to residents allowing them to **legally shoot-down small drones**³² flying around their town using traditional hunting weapons (i.e., shotguns used for bird hunting). The town will pay a bounty to any permitted hunter who brings the downed drone to the police station. The article doesn't state whether the drone-hunter gets to keep the pizza if it's a Dominoes Pizza-copter.

During the recent flooding in Boulder, CO, ABC news was using drones to get aerial footage of the flooding in inaccessible areas, one of the first news crews to do so.

4-Dimensional Unmanned Warfare

After looking at all the categories of unmanned platforms above, the best chart I can put together is to show how they are used in 3-dimensional warfare on the battlefield. We have UAVs of all sizes operating in the +Z dimension (altitude), looking down on the X and Y dimensions. The USVs (water) and UGVs (land) operate purely in the X and Y plane. The UUVs operate in the -Z dimension (depth) and across the X and Y dimensions.

There is, however, a fourth dimension on the battlefield. Let's avoid the arguments with theoretical physicists who wear stripes and plaids together, and sandals with socks, claiming that the fourth dimension must be spatial like the previous three (X, Y, and Z). Our fourth dimension in warfare is time. How do we operate in this 4th dimension? By manipulating events in time. This is the domain of EW and advanced intelligence systems. EW systems can show targets on the enemy's radar that are not really there at that point in time. Conversely, they can expand time and show no targets on their radar when our weapons platforms are physically in their airspace. Our SIGINT and RADAR systems can also close the time gap, compressing time, to respond to enemy movements and attacks. We can intercept and destroy their missiles and mortars in realtime. We know where their RADAR and communications systems are located when they come-up on the air. We can use direction finding and eradicate them very quickly. These advanced EW and intelligence systems are a "Force Multiplier" that gives our military a tremendous advantage on the battlefield. Manipulating the 4th dimension of time makes our 3-dimensional weapons systems much more efficient and accurate. Today, we have the best weapons platforms in the world compared to our enemies. What we need are more systems that operate in the 4th dimension, that can manipulate time to our advantage. That's where much of the defense budget will be spent for many years into the future. And this is where the money must be spent, until we have the sensor-algorithm technologies to make our weapons platforms totally autonomous.

“Manipulating the 4th dimension of time makes our 3-dimensional weapons systems much more efficient and accurate.”

Just to insure you don't think I advocate lethal unmanned autonomous weapons platforms as a first-option in all situations, I am very impressed with the new developments in non-lethal weapons. The Israeli chemists have been busy, developing what seems to be a marvelous option to lethal drone-based kinetic firepower: **Israeli skunk spray**.³³ Imagine air tankers or water bombers, the planes used to fight the western wildfires, loaded with 30,000 gallons of

31 Melissa Anders, "Domino's Pizza in UK uses drone to deliver pizzas (with video)", MLive, June 10, 2013, http://www.mlive.com/business/index.ssf/2013/06/dominos_pizza_in_uk_uses_drone.html

32 Walter Farah, "Hunting Licenses for Unmanned Aerial Vehicles", Blog, July 17, 2013, http://walterfarah.net/2013/07/17/hunting-licenses-for-unmanned-aerial-vehicles/?goback=.gde_941207_member_258790065

33 "Israeli Skunk Spray Weapon", Sky News, Dailymotion, http://www.dailymotion.com/video/x72yun_Israeli-skunk-spray-weapon_news%23.UVy9azckSSo%7F%7F%20%7F

skunk spray. If our intelligence systems can locate terrorist compounds and training facilities, or thousands of entrenched Taliban and al Qaeda fighters like we saw at the Battle for Tora Bora in Afghanistan, and we douse them with this solution, it could change the course of wars forever. This stuff has a very long odiferous half-life. You must burn your clothes if exposed to it. Jihadists are not known for having extensive wardrobes, so one targeted attack with this weapon would send a hoard of nude radicals running into the desert, seeking the closest bath house and clothier.

Could this new stink-bomb category be classified as a chemical weapon? Is this cruel and unusual punishment when inflicted upon combatants? That question also keeps the Geneva Convention boys up at night, just like the totally-autonomous kinetic weapon platforms we are developing for our U.S. arsenal.

Maybe, if the Geneva folks read their Bibles more often, they wouldn't be so confounded: "Blessed be the Lord my strength, which teacheth my hands to war, and my fingers to fight" (Psalms 144:1). That passage, written centuries ago, is prophetic. Today, the hand is on the joystick that guides the Predator UAV into war. And the finger is on the button, that launches the Hellfire missiles upon our enemy.

"Today, the hand is on the joystick that guides the Predator UAV into war. And the finger is on the button, that launches the Hellfire missiles upon our enemy."

Telecom

There have been some interesting developments in the telecom equipment markets lately, as that industry adjusts and adapts at the macro-level. In February, Oracle bought Acme Packet. In May, they bought **Tekelec**³⁴, a communications technology company. These acquisitions reinforce the continuing merger of IT (Information Technology) and the telecommunications markets.

According to a July report, the revenue growth for the world's telecommunications service providers (carriers) is slowing. In Europe, their **total revenues are declining**.³⁵ As the revenues decline, the expenses to expand the network bandwidth for more smartphone traffic are rising. This situation puts the carriers in a nasty financial squeeze that may be contributing to lower telecom equipment sales as they try to keep operating expenses in line with revenues. In addition, this set of financial circumstances will push the carriers to engineer a merger of IT and communications services in some way, as they enter survival-mode and seek new revenue growth opportunities.

In early July, **Nokia bought Siemens' half of their joint venture**³⁶, Nokia-Siemens Networks (NSN), for 0.20 times sales. Both companies threw their telecom equipment divisions into this Joint Venture (JV) to get them off their company books back in June of 2006. NSN then acquired three other telecom gear divisions from other companies, including Motorola's wireless equipment division. In November of 2011, NSN dumped 17,000 workers from its payroll and finally made a profit for the first time in its history in Q1 of 2013. Siemens had been trying to divest themselves of their part of the JV, but no buyers came forward. So, they were a highly motivated seller of their NSN ownership. Even struggling Contract Electronics Manufacturers (CEMs) like Solectron and SCl sold for 0.28 to 0.31 times sales in the past.

In Q1 2013, **ZTE topped Alcatel-Lucent**³⁷ and became the number two optical networking (ON) supplier in the world. The top two slots are now held by the Chinese (number one is Hua Wei). Traditional telecom equipment makers continue their financial decline and China is taking over the world telecom equipment markets, as predicted in previous white papers. Even CEMs cannot compete with the Chinese on telecom equipment prices.

34 Zack Whittaker, "Oracle buys network signaling firm Tekelec", Between the Lines, ZDNet, March 25, 2013, <http://www.zdnet.com/oracle-buys-network-signaling-firm-tekelec-7000013071/>

35 "Ovum warns telcos to make critical assessments of their assets and operations to determine future growth", Interacti Intelligence", July 24, 2013, <http://www.tmcnet.com/usubmit/2013/07/24/7298722.htm>

36 Adam Ewing, Alex Webb, and Beth Jinks, "Nokia Buys Out Siemens in Equipment Venture for \$2.2 Billion", Bloomberg Businessweek, July 1, 2013, <http://www.businessweek.com/news/2013-06-30/nokia-said-to-agree-to-buy-siemens-stake-in-nsn-networks-venture>

37 "ZTE slips by Alcatel-Lucent in global ON market", OVUM, May 28, 2013, http://ovum.com/press_releases/zte-slips-by-alcatel-lucent-in-global-on-market-top-two-slots-now-held-by-chinese-vendors-100g-passes-1bn-but-overall-market-remains-sluggish/

Cisco bought Lightwire³⁸ in 2012 to keep-up with the Chinese on optical networking equipment. Lightwire was a start-up doing optical chips in silicon (Silicon Photonics, or SiP). There is a flurry of activity in SiP and optical links lately. These developments are covered in the optical section of this paper.

The most disturbing and vexing development in communications is the recent announcement by Sky Deutschland in Germany. They have developed a Window-Cranial Data Interface (WCID). This interface **sends audio messages directly into the brains**³⁹ of passengers on trains. The passengers press their skulls (cranium) against the train windows while seated. A transmitter vibrates the glass window against their skull, and the audio is directly perceived in the passenger's minds, bypassing the ears. While this new development could reduce the need for traditional wireless telecom equipment in the future, the demand for vending machines on trains to sell glass cleaner, paper towels, and glass-sanitizing wipes looks very promising.

This leads to the topic of telepathic communications. The Pentagon has been funding experiments and programs involving **mental telepathy as a communications method**⁴⁰ for decades. Present experiments use a sensor-encrusted helmet to capture brain-wave thought patterns of one soldier and send them to others on the battlefield. The rate of correct translation of thoughts from one soldier to another is about 45% today and improving. The Pentagon's goal is to field telepathic communications capability to soldiers by 2017. If the wireless telecom carriers are still financially viable by that time, they may adopt these new technologies. But, they have no idea how to price the basic service or the number of thoughts you can send to others for free on your monthly plan, before they charge you higher thought-transmission prices.

As the Chinese overwhelm the telecom equipment markets, the Germans send communications directly into people's brains through windows, and the military moves to telepathic communications, the opportunities in traditional telecom gear looks pretty grim. The probability of being successful selling specialized boards to telecom equipment makers is only marginally better than a tornado going through a junkyard, picking up pieces of scrap metal, and perfectly assembling them into a 747 airliner in the air!

On a personal note, I have been accused of being snide, unfairly critical, and maligning of telecom in my statements, and of casting aspersions upon the telecom industry in past white papers. I have seen many good people, and some good companies, sacrificed on the alter of the telecom gods. I have seen firsthand the career-deaths and the horrible financial disfiguration inflicted upon companies in our industry by the telecom zealots who hyped the unrealistic illogical forecasts and growth estimates. I have observed acts of gross business and technical perversion in the telecom board industry, so profoundly repulsive and disgusting, that decorum, the Journalistic Creed, Judeo- Christian principles, and common decency preclude me from listing them here. Let's just say that I have been in a bad mood for the past 15 years, and I am passionately indifferent toward telecom. As for the telecom board vendors in our industry, if God did not want them financially sheared, he would not have made them low-margin commodity- thinking volume-chasing sheep.

“The probability of being successful selling specialized boards to telecom equipment makers is only marginally better than a tornado going through a junkyard, picking up pieces of scrap metal, and perfectly assembling them into a 747 airliner in the air!”

Optical Developments

In addition to the transitions in optical networking stated in the telecom section, there have been new developments in optical technology that will affect the embedded markets. In a recent article, an editor speculated that **PCIe 4.0 will be the last of the copper-based I/O interconnects**⁴¹ we will see in the computer business.

38 “Cisco Announces Intent to Acquire Lightwire”, Cisco Press Release, February 24, 2013, <http://newsroom.cisco.com/press-release-content?articleId=675179>

39 Andrew Trotman, “Sky Deutschland to broadcast adverts directly into train passengers’ heads”, The Telegraph, July 3, 2013, <http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/media/10158311/Sky-Deutschland-to-broadcast-adverts-directly-into-train-passengers-heads.html>

40 “Pentagon plan for telepathic troops who can read each others’ minds . . .”, MailOnline, April 8, 2012, <http://www.dailymail.co.uk/news/article-2127115/Pentagon-plans-telepathic-troops-read-minds--field-years.html>

41 Rick Merritt, “PCIe takes on mobile, Thunderbolt, more”, Design& Reuse, June 26, 2013, http://www.design-reuse.com/news/32348/pcie-takes-on-mobile-thunderbolt-more.html?utm_content=58915&utm_campaign=32348&utm_medium=socnewsalert&utm_source=designreuse

The PCI SIG is working on the OCuLink specification⁴², another Active Optical Cable (AOC). The connection on both ends of the cable is a copper connector that plugs into a traditional PCIe port. Inside the connector shell is an optical engine on a small PCB, that converts the electrical signals to optical beams on one end and from optical beams to electrical signals on the other. This will work for PCs and servers in climate-controlled environments, but not for embedded applications in harsh environments. There is no way to cool the electronics in the connector shell outside the computing chassis. These PCIe copper connectors are designed to be made as cheaply as possible, so you can forget about them being able to pass any significant shock and vibration testing.

In May, Mellanox, the primary InfiniBand silicon supplier, bought silicon-photonics optical engine maker Kotura.⁴³ In June, they bought IPtronics⁴⁴, another optical components company. It's not a great leap of faith to conclude that we will see optical InfiniBand in embedded applications in the near future. A quick glance at the Ethernet roadmap⁴⁵ will tell you that optical is the next technology driver for I/O in computer systems.

Back in February, IBM and Dow Corning announced a new polymer material for making optical waveguides in PCB laminate (for optical backplanes). Testing of this new polymer material is showing only about -0.030DB/cm optical signal loss on short runs and about -0.050DB/cm on longer runs. Of course, this figure is very dependent upon the irregularities, the roughness of the interior walls of the waveguide cut into the PCB laminate material.

Also in February, Laser Motive announced that they are sending 70 watts of power through optical fibers⁴⁶, onto photovoltaic cells, to power a small UAV. They are now working on a version that can send 400 watts of power over optical fiber. Just remember here what physics tells us: there is no limit to the amount of power that can be sent over an optical link, other than the size of the power supply driving the beam.

Scientists in Europe have developed "differential optical" links that were used to send recoverable data over a 12,800km distance⁴⁷ in May. This concept works basically the same way as electrical differential signal transmission. Researchers at Purdue have cloaked optical data signals over fiber in a "hole in time" with phase modulators.⁴⁸ This will add tremendous security to optical signals in the future.

If you are wondering where these new fast optical links fit into our embedded markets, just think about HPESC (High Performance Embedded Super Computing). Today, many companies are talking about their VPX products enabling HPEC (High Performance Embedded Computing). One look at NVidia's GPGPU roadmap⁴⁹ will prove that we must move to optical links, to build HPESC systems in the near future. As we see faster and better CPUs come to market, we will become critically I/O-bound. The demand for HPESC systems exists today in many military applications, primarily in RADAR, SIGINT, and EW.

And, as we move the processors closer to the sensors in intelligence gathering systems, the demand for bandwidth goes up dramatically. Just look at the latest SiN vapor sensors being developed at U.S. Navy Research Laboratories

42 Ransom Stephens, "Samtec out-geeks PCIe's OCuLink", EDN, August 15, 2012, <http://www.edn.com/electronics-blogs/eye-on-standards/4394153/Samtec-out-geeks-PCIe-s-OCuLink>

43 "Mellanox Technologies Ltd. Announces Definitive Agreement to Acquire Kotura, Inc.", Mellanox Press Release, May 15, 2013, <http://ir.mellanox.com/releasedetail.cfm?ReleaseID=765188>

44 "Mellanox deal to buy IPtronics increases focus on optical interconnects", optics.org, June 4, 2013, <http://optics.org/news/4/6/3>

45 Lisa Huff, "Ethernet Networks Progress to 400 Gb/s", Bishop & Associates, Connector Supplier, February 5, 2013, http://www.connectorsupplier.com/020513-CS-Ethernet-400-gbs-huff?utm_source=GraphicMail&utm_medium=email&utm_term=NewsletterLink&utm_campaign=%2855%29+CS+2%2D5%2D13+v2&utm_content=

46 John Wallace, "SPIE DSS 2013: Interview with Tom Nugent, president, Laser Motive", LaserFocusWorld, May 20, 2013, <http://www.laserfocusworld.com/topics/m/video/75228423/spie-dss-2013-interview-with-tom-nugent-president-laser-motive.htm?q=defense+and+security>

47 "Light-beam 'twins' take data farther", BBC News, May 27, 2013, <http://www.bbc.co.uk/news/science-environment-22656238>

48 Alex Knapp, "Take That, NSA - Scientists Hide Communications Using A Hole In Time", Forbes, June 6, 2013, <http://www.forbes.com/sites/alexknapp/2013/06/06/take-that-nsa-scientists-hide-communications-using-a-hole-in-time/>

49 Damon Poeter, "Nvidia: These Aren't Your Father's GPUs", PCmag.com, March 19, 2013, <http://www.pcmag.com/article2/0,2817,2416804,00.asp>

(NRL).⁵⁰ Imagine hundreds or thousands of these dropped in a war zone, looking for chemical, biological, or radiological enemy weapons and sending-back the results of their scans by RF.

The optical components we have today will not meet the extended operating temperature ranges and shock/vibration requirements of military systems; they were designed for climate-controlled data centers. That is true for the commodity commercial optical components like OCuLink too. But several optical engine and optical component companies are now claiming their products meet the requirements for military applications in hostile environments. The move away from hybrid optical devices (GaInPSi) to pure silicon photonics (SiP, where all optical elements made from silicon are on one die) seem to be solving the operating temperature problems. But the present commercial packaging techniques and fiber connectors leave a lot to be desired. While I am thrilled to hear about optical parts that meet military requirements, we must resort to what Ronald Reagan said many years ago: "Trust, but verify." There are marketing people working for the optical component companies, and that should cause skepticism about their claims.

Mergers and Acquisitions

After many months of rumors and speculation, it was announced in early August that **Platinum Equity bought a 51% stake in Emerson's power and embedded business.**⁵¹ If you recall, Emerson purchased Motorola back in January of 2008. This transaction is the latest in a long line of mergers and acquisitions involving Motorola, the originator of the VMEbus specification back in 1981 and driver of the VMEbus market for many years. The Motorola Computer Group (MCG) was originally spun-out of Motorola Semiconductor in 1986 and merged in with an earlier Motorola acquisition of FourPhase Computers. Computer-X was added to the mix soon after. MCG was very successful selling VME-based minicomputers to telecom equipment makers like Nortel, AT&T, Tellabs, and many others. This group bought Prolog, BlueWave (a merger of Mizar and Bluewave), Force Computers (from Solectron), and Paceline as they began to focus totally on the telecom equipment markets.

It remains unclear what the future has in store for this new combination. As an investment firm, Platinum Equity is going to want to see a fast return on their investment. The package includes several unrelated businesses that might fit nicely into other components of the Platinum Equity portfolio of companies. Some parts may survive with Platinum Equity, others will likely be spun off, and others may be closed down. How this tale spins out will make for interesting speculation in the coming months.

For another point of view, check out this story by Chris Ciuffo, "**End of an embedded era: Emerson De-"Mots" Motorola Embedded.**"

Overall, there is still plenty of merger and acquisition action going on. There are still good deals available to anyone looking for ways to buy some market share.

Changing Business Models

The Business Models section of the last white paper (March 2013) attracted a number of comments. Let's expand what that section said. There are always new markets at the top and the bottom of the market pyramid to exploit. At the top-end, it requires serious investment in technology and expertise (i.e., with intellectual value-added), like optical links for higher bandwidth and faster processors. The volumes are low, but the margins are about 70% on new products targeted at the top-end of the market.

At the bottom-end, new markets exist that may also be exploited (i.e., with manufacturing value-added). There is always a market for a lower-priced product, but the margins start approaching 8% GPM when exploiting this

⁵⁰ "SiN-Vapro Scanner Sensor", Tech Briefs, January 9, 2013, <http://video.techbriefs.com/video/SiN-VAPOR-Scanner-Sensor;Sensors>

⁵¹ "Platinum Equity spends \$300m on 51% Emerson unit stake as final fund close looms", AltAssets, August 6, 2013, <http://www.altassets.net/private-equity-news/by-news-type/deal-news/platinum-equity-spends-300m-on-49-emerson-stake-as-final-fund-close-looms.html>

segment. There are a few commodity-oriented volume-chasing low-margin/low-overhead companies attacking this segment with new boards right now, like Rasbery Pi, BeagleBone Black, Parallella, Odroid X-2, Hackberry, Udoo, APC Rock, CubieBoard, Marsboard, and A13-OlinuXeno. These boards are basically PC functionality on a small board using cellphone processors and software (ARM and Android), and these boards sell for less than \$100 each.⁵²

Our embedded markets have been undergoing some fundamental transitions for the past decade, based on the advancements in the I/O link bandwidth. Our markets are now being driven by what I term “Alderman’s Laws.”

1. **Every time the frequency of the signals on a backplane double, the distance those signals can run on copper declines by 50%.** This was particularly true when we used buses and single-ended signals. It is still true for differential serial signals, but the distance the signals can run on copper hasn’t declined by as much as 50% with the frequency increases we have experienced. As we move above 10G differential however, the distance the signals can run on copper declines by more than 50%.
2. **Every time the network link frequency doubles, the demand for backplane-based systems goes down by 50%.** Backplane-based systems offer modularity with two primary benefits: maintainability and upgradeability. A secondary benefit is that backplane-based systems can be cooled more efficiently with advanced cooling techniques. Backplane-based systems are centralized systems. As the network link bandwidth doubles, centralized systems can become distributed systems: lots of motherboard-based boxes hooked together with the faster low-latency network links. As the network link bandwidth (on a cable) increases past the link bandwidth on a backplane (i.e., on the copper traces), centralized systems will be broken apart and designed as distributed systems.
3. **To maintain the modularity benefits of backplane-based systems, each data link on the backplane, between the boards, must be equal to or greater than the bandwidth of the network link cables.** As the network connections move away from copper to optical technologies, as we have seen in the data centers, then the backplane links must also move to optical.

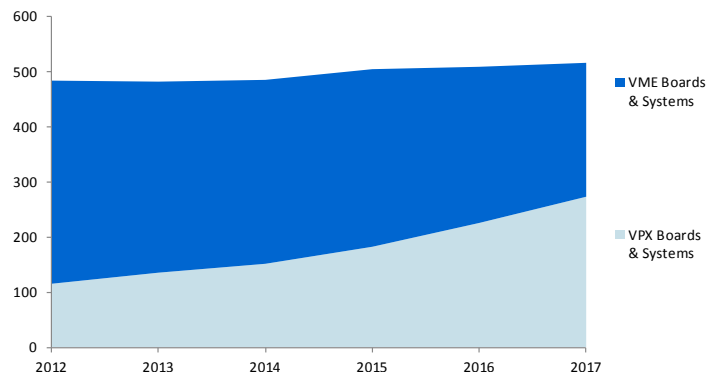
The optical section of this white paper provides a preview of the technologies coming to the embedded systems segment, that allow centralized backplane-based systems to remain advantageously beneficial compared to distributed systems. In the future, we must move to High-Performance Embedded Super Computing architectures (HPESC), with optical links on the backplane, to exploit the top of the market pyramid. If you exploit the low-end of the market, you must be focused on distributed systems, discover how to live with commodity margins, and believe with all your heart in a veiled promise of higher volumes in your future. Those are your options.

Market Estimates

VPX markets

The uncertainty continues to impact the VME to VPX transition. IMS Research has just released their “[Embedded Computer Boards, Modules and Systems - Single Board Computers and Systems - 2013 – World](#)” report. Previously they forecasted that VME will continue stronger than expected, with the inflection point moved out beyond 2016 and they reconfirmed this forecast with their newest report. VITA members are reporting strong design-in activity and the work on remaining specifications is moving forward at a rapid pace.

The World Market for VME and VPX Products
Revenues (\$M) - 2012 to 2017



Source: IHS

Aug-13

⁵² Cabe Atwell, “The Biggest-Little Revolution: 10 Single-Board Computers for Under \$100”, EE Times, August 20, 2013, http://www.eetimes.com/document.asp?doc_id=1319262&

Summary

In general terms, macro-economic conditions are improving slowly in the U.S. and Europe, according to the latest GDP reports. Other than Syria, the geopolitical situation is relatively calm. The tribes of the Middle East have been fighting each other for 5,000 years, so some level of unrest in that region is normal and expected. At this writing, it doesn't look like the world supports U.S. military intervention in Syria over their use of chemical weapons on their people. Iran and North Korea have been quiet lately, the threat level from those two powers is low.

We still don't know how badly the sequester will effect military spending in the US, but some prime contractors have been downsizing in anticipation of program cuts. Weapons platforms and big-ticket items will take the brunt of any spending reductions. But, intelligence and EW systems will probably gain more attention and funding. This is especially true for the UAV and RADAR markets in the foreseeable future. Our weapons platforms are more than 3 to 5 times better than our closest enemy, but our intelligence systems are not. We will spend more money on military systems that "manipulate time" to our advantage and operate in the 4th dimension of warfare.

The biggest unknown for players in our industry is how the rise in interest rates will affect business models. Those companies who operate on very low margins, in commodity markets like industrial and telecom, will be exposed to higher cost of capital. That, in turn, will further reduce their overall margins unless they control their operating costs by reducing headcount and other expenses.

While uncertainty is still present in our markets, the options to deal with it are becoming clear. You can either exploit the top-end of the market with products that offer faster processors and high-speed I/O links (low volume/high margin). Or, you can exploit the bottom-end of the market with cheaper ARM/Android-based boards to replace PC technologies (high-volume/low-margin). The problems associated with exploiting the top-end of the market are technical. The problems associated with exploiting the bottom-end of the market are financial.

The technologies driving the top-end of the market are coming from the data center (optical network connections). The technologies driving the bottom-end of the market are coming from the smartphone and pad computer markets (ARM and Android). If you stay in the middle, with copper-based PC technologies, you will be crushed.

There is reason for optimism in several military market subsegments, if you are an innovative engineering-driven company. And there is also reason for optimism in certain subsegments of industrial and telecom, if you think and operate like a banker. When you begin to assemble a complex jigsaw puzzle, you always start with the corners, fill-in the sides, and then work toward the middle. The goal of this white paper is to provide you with the corner pieces.

"The tribes of the Middle East have been fighting each other for 5,000 years, so some level of unrest in that region is normal and expected."

"While uncertainty is still present in our markets, the options to deal with it are becoming clear."

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