2011 State of the VITA Technology Industry

CRITICAL
EMBEDDED SYSTEMS ™

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State of the VITA Technology Industry
March 2011

by: Ray Alderman, Executive Director, VITA

This report provides the reader with updates on the state of the VME 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 www.vita.com.

Business Conditions

The world macro-economic situation improved in many ways in late 2010. The US economy stabilized with 3.2% GDP growth in the third quarter and 2.9% growth for the year.[1] The EU responded to the financial crises in Ireland and Portugal with bail-out funds, growing their GDP 0.4% in the 4th quarter.[2] China grew greater than 10% in Q-3 and even Japan was up 1.1%.

The November mid-term election results in the US brought a different attitude to the previous congressional policy of spending our way out of this recession. Gridlock in the US Congress for the next two years is the new reality and is viewed as more stable than what we have experienced in the previous two years. The looming economic concerns in the US are the severe budget deficits of many states and whether they will default on their municipal bonds.[3]

Geopolitically, conditions worsened in the past six months. Pakistan is politically unstable due to the lack of government response to massive floods, poverty, food shortages, and reductions in electricity to homes and businesses. The Tunisian people ousted their long-time president, Ben Ali. The people of neighboring Algeria took to the streets to protest high unemployment and food prices that have risen close to 25% recently, inspiring another regime change. Egypt went into revolution and regime change. That has now spilled into Libya and Morocco. These incidents have triggered concerns that other Middle Eastern countries (Syria, Saudi Arabia, Iran, and Jordan) will follow a similar path of revolt in 2011. In most of the Middle Eastern countries, over 50% of the population is under 30 years of age and desire personal freedoms. They are rebelling against the

1   Jeannine Aversa, "U.S. economy growing, but jobs still lag", Associated Press, January 29, 2011, URL: www.azcentral.com/12news/news/articles/2011/01/29/20110129us-economy-growing-jobs-need.html

2   Euro Area GDP Growth Rate, URL: www.tradingeconomics.com/Economics/GDP-Growth.aspx?Symbol=EUR

3   Elizabeth McNichol, Phil Oliff and Nicholas Johnson, "States Continue to Feel Recession's Impact", Center on Budget and Policy Priorities, Updated March 9, 2011, URL: www.cbpp.org/cms/?fa=view&id=711

Contents

older, iron-fisted rulers and parties, high food and energy prices, and government corruption. We are viewing the democratization of the Middle East as it unfolds. Middle East unrest has spiked oil prices, however, and that threatens to the derail economic recovery, especially in Europe.

Of the nine nuclear-armed nations today, two (Pakistan and North Korea) are in turmoil.[4] And Israel could soon be surrounded by hostile neighbors. Iran continues their uranium enrichment program, although their ability to create weapons-grade uranium was severely damaged by the Stuxnet virus in late 2010. The start-up of the Russian-built Iranian reactor at Bushehr has been delayed by concerns that the Stuxnet virus still exists in the control systems and could cause a Chernobyl-like nuclear meltdown.[5]

Other major events that have occurred in the past few months:

- *China leaked video of their new advanced J-20 fighter jet.*
- *China announced the deployment of their new Dong Feng 21D anti- aircraft-carrier missile.*
- *The US deployed the new Gorgan Stare ISR system in Afghanistan in December.*
- *AeroVironment flew their hydrogen-powered Global Observer UAV in January.*
- *Boeing's Phantom Ray and Northrop-Grumman's X-47B jet-powered UAVs flew test flights in the past few months.*

We did gain some clarity in the US DoD budget for the MIL/Aero industry with Secretary of Defense Gates' January budget memo.[6] The medical industry is still soft and awaits the outcome of the US healthcare bill conflict in Congress. The telecom industry remains soft. The industrial markets showed some improvement but are still depressed from previous levels. 2011 will be a year of positive improvement across all industry segments if the world economies can continue to recover, but growth will be slow. This is not a great scenario for our industry, but it surely beats what we experienced in 2010. Business conditions are getting better, but there are tremendous threats to recovery with the Middle East unrest.

In spite of the announced DoD budget reductions, the MIL/Aero markets offer the best opportunities in 2011 for board and systems suppliers. The unrest in the Middle East nations will continue for some time requiring higher levels of intelligence, reconnaissance, and surveillance information. This demand can only be satisfied by more advanced UAV platforms and systems.

The primary growth driver in 2010 seemed to come from small form factor (SFF) computers. This suggests that we have been experiencing a motherboard replacement cycle in many commodity applications and that the replacements are new SFF motherboards with add-on cards based on today's PC technology. We have also seen great interest in using SFF products in MIL/Aero applications. But, the present SFF specs and designs are incapable of handling the shock, vibration, temperature extremes, and reliability levels required by many military applications. Several VITA Standards Organization (VSO) working groups are now working on new SFF specifications defining board sizes, connector requirements, packaging techniques, and advanced cooling capabilities to eliminate the shortcomings of present SFF offerings.

2011 started out positive, with the decline in financial uncertainty around the world. But now, we have geopolitical uncertainty to deal with. And, geopolitical instability always contains a military component.

Stuxnet

Stuxnet is a Windows computer worm discovered in July 2010 that targets industrial software and equipment. While it is not the first time that hackers have targeted industrial systems, it is the first discovered malware that spies on and subverts industrial systems, and the first to include a programmable logic controller (PLC) rootkit.

The worm initially spreads indiscriminately, but includes a highly specialized malware payload that is designed to target only Siemens Supervisory Control And Data Acquisition (SCADA) systems that are configured to control and monitor specific industrial processes. Stuxnet infects PLCs by subverting the Step-7 software application that is used to reprogram these devices.

Source: Wikipedia

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4 "List of states with nuclear weapons", Wikipedia, URL: en.wikipedia.org/wiki/ List_of_states_with_nuclear_weapons

5 Joshua Keating, "Report: Stuxnet could cause Iranian 'Chernobyl' ", Foreign Policy Blog, January 31, 2011, URL: blog.foreignpolicy.com/posts/2011/01/31/report_stuxnet_could_cause_iranian_chernobyl

6 Office of the Assistant Secretary of Defense, "DOD Announces $150 Billion Reinvestment from Efficiencies Savings", U.S. Department of Defense, January 6, 2010, URL: www.defense.gov/releases/release.aspx?releaseid=14178

Markets

MIL/Aero

All the military services seem to be reading the bible these days and they must have stumbled upon this passage: ". . . for a bird of the air shall carry the voice, and that which hath wings shall tell the matter." (Ecclesiastes 10:20).

Battlefield communications between ground units, commanders, and analysts back in the states are being heavily routed through UAV platforms today. A steady stream of voice, video, infrared images, and radar images are critical to tactical planning and mission assignments on a realtime basis. The "birds" (UAVs) are carrying the "voice" and they ". . . tell the matter . . ." in many ways.

The new Gorgon Stare ISR platform[7], attached to an MQ-9 Reaper UAV in Afghanistan, flew for the first time in December, creating and transmitting so much video intelligence that it overwhelmed the analysts. This new intelligence pod dramatically increases intelligence gathering capabilities in both urban and rural areas. This system is the harbinger of many new ISR (Intelligence, Surveillance, Reconnaissance) platforms being developed for future use. The images were taken with 12 independent multi-angle sensors at 2 frames per second (instead of the normal 30 frames per second for fluid video). The data can be fed to as many as 65 information users on the ground. You can imagine the huge bandwidth requirements for fluid video on 12 x 65 channels at 30 frames per second. And, the data from the sensors is recorded too (using huge-capacity data recorders) for further comparison and analysis at a later time. While the first deployment found some problems with the system, it is evident that future ISR platforms like this will need at least 10-15 times more bandwidth and many times higher computing capability. The Reaper has the wings and ". . . shall tell the matter . . ." with enormous amounts of intelligence data captured and sent to ground units in the field.

On January 6, 2011, the AeroVironment Global Observer flew its first hydrogen-powered test flight at Edwards Air Force Base, CA. The GO-1 is the first of the HALE (high-altitude, long-endurance) ISR and communications platforms that will operate in the stratosphere (65,000 feet) for up to a week without refueling. Think of the GO-1 as a retrievable/reusable/reconfigurable satellite for many different missions.[8] The spreading unrest and regime change across the Middle East show why we need these HALE platforms; to have seamless 24/7 ISR information on each country undergoing unrest, and watch for any troop movements toward any disputed borders.

Why replace our intelligence and communications satellite missions with HALE UAV platforms? You may remember that in January of 2007, the Chinese military shot-down one of their troubled weather satellites, 500 miles up in space, with an anti-satellite ground-based missile. This Chinese action proved that our military space-based intelligence and communications resources were vulnerable and can be destroyed at any time (the satellites have repetitive orbits and time-positions available to anyone on the planet). In February of 2008, the USS Lake Erie fired an SM-3 anti-missile missile into space and destroyed one of our own errant spy satellites, proving that we could do the same to any Chinese satellite in the future. These events demonstrated that we need new network-based intelligence and communications capability beyond space satellites.

The HALE UAVs can be randomly positioned, avoiding easy destruction like the satellites and we can put many of them up in the stratosphere quickly (the SWARM concept[9]) to replace any intelligence and communications satellite destroyed by enemy forces. This concept is similar to the old SAC (Strategic Air Command) strategy of having a large number of nuclear-armed B-52 bombers flying 24/7 that could instantly respond to any nuclear attack on the US by the Soviets during the Cold War (the movies "Dr. Strangelove" and "Failsafe" detail these strategic missions).

Soaring demand

The Air Force has exponentially increased its spy plane missions over Afghanistan. The monthly number of intelligence, surveillance and reconnaissance sorties has more than quadrupled since January 2009.

Number of missions
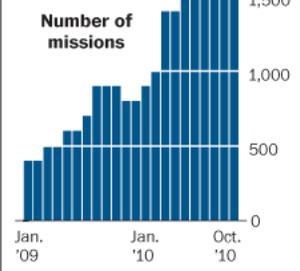
Source: U.S. Air Force | The Washington Post

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7   Ellen Nakashima and Craig Whitlock, "With Air Force's Gorgon Drone 'we can see everything' ", The Washington Post, January 2, 2011, URL: www.washingtonpost.com/wp-dyn/content/article/2011/01/01/AR2011010102690.html.

8   95th Air Base Wing Public Affairs, "Global Observer makes first hydrogen-powered flight", U.S. Air Force website, January 12, 2011, URL: www.af.mil/news/story.asp?id=123238084.

9   "UAV Swarms", NewScientist, August 29, 2007, URL: www.newscientist.com/blog/invention/2007/08/uav-swarms.html

It's also clear that the HALE UAVs can be upgraded with next-generation sensors and advanced ISR capabilities regularly. Doing upgrades and refreshes (new sensors, new electronics, more bandwidth, etc.) to satellites in orbit is challenging, especially since the Space Shuttle missions are at an end and NASA's budget has been cut to the bone. The GO-1 is just the first of many new UAV satellite-replacement communications and intelligence platforms.

From an announcement made by Secretary of Defense Robert M. Gates in January 2011, the number of large weapons-system platform purchases in the DoD budget have been reduced significantly. However, two new UAV platforms seem to be the harbingers of the future and will be funded: the Northrop-Grumman X47B and the Boeing Phantom Ray. Both are jet-powered UAV's, with the X-47B being aircraft carrier-capable for the US Navy.

On February 4, 2011, a Northrop-built X-47B flew its first test flight at Edwards AFB, CA under its own power.[10] This new jet-powered UAV has the thrust to take-off from a short aircraft carrier deck carrying up to 4,500 lbs of ordinance, much more payload than present UAV platforms like Reaper and Predator propeller-driven UAVs. It is also much faster and has longer range.

On December 14, 2010, the Boeing Phantom Ray flew from St Louis to Edwards AFB, CA on the back of the NASA Shuttle Carrier Aircraft (SCA) on its first flight.[11] Now at Edwards, it is being prepared for test flights this summer under its own jet-engine power. While it looks more like the B-2 bomber, it is being portrayed as a next-generation "spy plane" — an ISR-based UAV and not a weapons platform. We will have to wait to see what missions the Phantom Ray undertakes in the future.

Northrop-built X-47B
Photo courtesy of Northrop Grumman

In early March, the USAF and Boeing launched the X-37B Orbital Test Vehicle, a miniaturized version of the Space Shuttle.[12] This spacecraft is primarily a retrievable satellite. All the missions on this flight are classified, and more missions are planned but not announced. AFRL and NASA are participating in a post-flight analysis of the performance of the vehicle and its systems. This platform could be the basis for the new standards committees starting-up in March to design and define the interconnects and protocols for Spacecraft Networks.

From a technology standpoint, China leaked videos of their new J-20 advanced fighter jet in January that is claimed to be an equal match to the US F-22, and superior to the US F-35.[13] China further announced the development of the Dong Feng 21D, a surface-to-surface "aircraft carrier killer" missile that has a range of 1500-2000 km.[14] The planned deployment of these missiles in 2012 could give China control of a large section of the Pacific Ocean and require that US carriers remain out of range. Such a situation would diminish America's ability to protect Taiwan should China decide to take them over in the future. These announcements could speed the development of armed UAVs like the X-47B and Phantom Ray.

The US military will control the skies in any conflict we are drawn into. That is clear from the missions these new UAVs portend. On the ground, we have the robotic Talon and Swords platforms. When we reduce the number of active-duty combat soldiers, as outlined in the Gates memo, we should see more advances in ground-based robotic warriors in the future. When you delve into the details of the memo, you can see that administrative costs of our military people

10 Philip Caulfield, "Navy unveils new bat-winged stealth bomber; unmanned X-47B is military's deadliest new drone", NYDailyNews.com, February 6, 2011, URL: www.nydailynews.com/news/national/2011/02/06/2011-02-06_navy_unveils_new_batwinged_stealth_bomber_unmanned_x47b_is_militarys_deadliest_n.html

11 Chris Haddox, "Shuttle Carrier Aircraft and Phantom Ray make tandem flight", Boeing, December 15, 2010, URL: www.boeing.com/Features/2010/12/bds_phantom_ray_12_10_10.html

12 Stephen Clark, "Officials anticipate more flights of X-37 space plane", Spaceflight Now, March 7, 2011, URL: www.spaceflightnow.com/atlas/av026/110307otv3/

13 Michael Sheridan, "J-20 stealth fighter jet is for real, China tells Secretary of Defense Gates", NYDailyNews.com, January 11, 2011, URL: www.nydailynews.com/news/world/2011/01/11/2011-01-11_j20_stealth_fighter_jet_is_for_real_china_tells_secretary_of_defense_gates.html

14 Jack Phillips, "Dong Feng 21D Could Destroy US Aircraft Carriers, Says Report", The Epoch Times, August 6, 2010, URL: www.theepochtimes.com/n2/content/view/40485/

(salaries, benefits, food and shelter, medical care for veterans and their families, pensions, etc.) are a huge portion of the DoD budget and the recent target of cost-cutting to reduce federal deficits. In the US, we have automated our factories, our communications systems, and many other control systems with computing power. We are now about to embark on automating (or semi-automating) the last remaining segment of human endeavor — warfare. For these new advanced ISR and weapons systems, that means VPX and a host of SFF products, particularly in aerospace platforms.

A final point in Gates' memo declares that many existing military platforms and systems will be maintained and refreshed rather than replaced. A recent example is the awarding of a contract to BAE Systems to enhance 95 of the Bradley Fighting Vehicles.[15] That's good news for the VME vendors. If a VME card cage exists in that system, it will stay in place and be upgraded with better, faster processors and I/O devices (A/D, D/A, etc).

NASA's Shuttle Carrier Aircraft, a modified Boeing 747, carries Boeing's Phantom Ray during a test flight on Dec. 13 in St. Louis. Photo courtesy of NASA

But, our journey into these new advanced MIL systems (and VME upgrades) will not be easy. Commodity consumer ICs made in China, counterfeit chips, commodity PC software, and commodity programmed FPGAs have found their way into critical military systems over the years, as a result of inexpensive commodity hardware/software being deployed, and lax security oversight on military program components.

In December of 2010, the lame-duck Congress passed the National Defense Authorization Act requiring suppliers to the DoD to verify and continually validate that their supply chain is secure.[16] This bill was mostly inspired by the Stuxnet virus attacks on the Iranian centrifuges and the SCADA systems controlling the new Soviet-built Iranian reactor back in July of 2010.[17] The bill will require that suppliers verify and stipulate that their hardware and software contains no rogue code or "back doors" that can be used to disable or modify those system's missions. This bill will also remove any commodity industrial and telecom board vendors from the DoD supply chain, those who ran to the MIL/Aero markets with their commodity products when their traditional markets declined during the recession.

"We are now about to embark on automating (or semi-automating) the last remaining segment of human endeavor."

15 John McHale, "Bradley Fighting Vehicles to get situational awareness upgrade from BAE Systems", Military & Aerospace Electronics, February 5, 2011, URL: www.militaryaerospace.com/index/display/article-display/4201278017/ articles/military-aerospace-electronics/online-news-2/2011/2/bradley-fighting_vehicles.html

16 Tam Harbert, "New regulations reflect growing concern over supply chains for government systems", EDN, February 1, 2011, URL: www.edn.com/article/512503-New_regulations_reflect_growing_concern_over_supply_chains_for_government_systems.php

17 "Stuxnet", Wikipedia, URL: en.wikipedia.org/wiki/Stuxnet

In July, Congress passed the Dodd-Frank bill that bans mineral imports from the Congo.[18] Basically, the bill requires that you, as a supplier to the DoD, must insure and stipulate that your products do not contain components made with minerals from the Congo, since that country is now controlled by lawless elements and they are using money from exports to carry-out human rights abuses.

Another threat to the military market, as well as the electronics industry in general, emerged when China recently announced their rare-earth materials export reductions.[19] REE's (Rare Earth Elements) are used in many components critical to MIL/Aero applications as detailed in a U.S. Geological Survey report, "*Rare Earths in Selected U.S. Defense Applications.*" [20] They are used heavily in semiconductor doping processes, in magnets, in many other electronic components, and in certain metals.

China, over the years, has held their currency exchange rate low to gain price advantages in exports against other manufacturing economies. By holding labor rates low, they have become a center for low-cost manufacturing across many market segments. The benefits of these previous financial policies have reached their peak, so China is now restricting exports of these rare earth materials to force the makers of affected components to open factories in China, hire low cost labor, and continue to increase China's exports. If you make components containing REEs outside of China, you will face much higher prices and an unreliable supply of the materials. China controls about 95% of REE shipments worldwide, and it will take many years to re-open mines in other countries and bring refining and production capacity on-line to offset China's reductions in their exports of these elements.

While we continue to see incremental improvement in bandwidth over copper wires, these improvements are not keeping up with the needs of many MIL/Aero applications. A recent informal JEDEC survey showed that in 3 to 5 years, those applications will require 100 gigabits per second per channel, at a power dissipation level of 8 milliwatts per gigabit per second. It is clear that copper cannot handle those bandwidths and that using lower-frequency ganged copper pairs to achieve the collective throughput would result in much higher power dissipation than 8 mW per gigabit per second, considering all the drivers/SERDES needed for all the ganged pairs.

We saw this ganged-copper-pair concept in the recent announcements of Intel's new Thunderbolt I/O in February.[21] It uses eight 2.5 Gb/s differential copper pairs to achieve 10Gb/s duplex connections for attaching video/audio and storage devices with a daisy-chained cable to a PC. It uses DisplayPort-type connectors and an isochronous protocol. This seems to be targeted at Apple-TV or IP-TV, the new home entertainment wave using the internet as the source for streaming video and audio. This concept will be fine for commodity consumer applications, but has no place in the applications for high-bandwidth and low-power communications links for critical embedded systems.

World-wide military spending (including everything) in 2009 was about $1.5 trillion according to the Stockholm International Peace Research Institute.[22] The US spends 46.5% of this total (about $700 billion) while China is the number two spender at 6.6% (about $100 billion). US exports of military hardware in 2009 reached nearly $58 billion, mostly in sales to Middle East allies, South Korea, and Taiwan. According to the report, military spending accounts for 2.7% of worldwide Gross Domestic Product. US military spending is forecast to be flat, around $700 billion, for the next few years, while China's military spending is expected to increase.

Michael Ledeen, a well-known American foreign policy expert, once said, "Every ten years or so, the United States needs to pick-up some small crappy little country and throw it against the wall, just to show the world that we mean business." Vladimir Slipchenko, a Russian military analyst once said, " I see the main purpose of war as being the

18 Gary Nevison, "The Congo, minerals, and the electronics industry", EDN, August 10, 2010, URL: www. edn.com/blog/Critical_Links/39574-The_Congo_minerals_and_the_electronics_industry.php

19 Dustin Ensinger, "China May Restrict Exports of Rare Earth Metals", Economy In Crisis, October 20, 2010, URL: www.economyincrisis.org/content/china-may-restrict-exports-rare-earth-metals

20 James B. Hedrick, "Rare Earths in Selected U.S. Defense Applications", U.S. Geological Survey, May 2004, URL: www. molycorp.com/pdf/RARE%20EARTHS%20IN%20SELECTED%20U%20S%20%20DEFENSE%20APPLICATIONS.pdf

21 "Thunderbolt Technology, The Transformational PC I/O", Intel Technology Brief, URL: www. intel.com/technology/io/thunderbolt/325136-001US_secured.pdf

22 Sam Perlo-Freeman, Olawale Ismail, and Carina Solmirano, "Military expenditure", Stockholm International Peace Research Institute, February 5, 2011, URL: www.sipri.org/yearbook/2010/05

large-scale real-life testing by the United States of sophisticated models of precision weapons". While both statements were meant to be critical of US foreign policy and military action, the latest developments in UAV and robotic soldier platforms should give Russia (and any "small crappy little country") pause to reflect on the incredible power and capability of the US military. Arthur C. Clarke, respected English physicist and science fiction author, once said, "Any sufficiently advanced technology is indistinguishable from magic." There is no dishonor in our military strength or the sophistication ("magic") of our weapons. 9-11 taught us that there are people striving to destroy our economy and our way of life. The only true deterrent (and response) that works against those foes are ultra-sophisticated, highly-capable, stealthy autonomous "magical" intelligence and weapon-system platforms. We are now on the cusp of automated warfare, and our industry segment (along with VME, VPX, and SFF technologies) will play a significant role in the transition.

Telecom

Telecom will probably suffer in Europe as each EU country imposes austerity plans. Telecom promises to be the most negatively affected by reduced spending in Europe. Asian board vendors are gaining strength in Europe and will drive margins down further as they seek new customers.

Some volume for large telecom boxes has been inspired by Verizon's sales of the Apple iPhone. As they take customers from ATT, they will need to add bandwidth. ATT may see idle bandwidth develop depending on how many iPhone customers migrate to Verizon in the coming months.

The rollout of LTE continues with new systems coming online each month. We still have a long way to go to get respectable coverage, but at long last, systems are being deployed. Smartphone and tablet growth is exploding, driving the demand for even more bandwidth. Ultimately, how fast LTE grows may depend on consumers' willingness to pay even more for the greater bandwidth.[23]

Industrial

The industrial and telecom board segments share several common characteristics. They are both commoditized markets, especially at the processor board

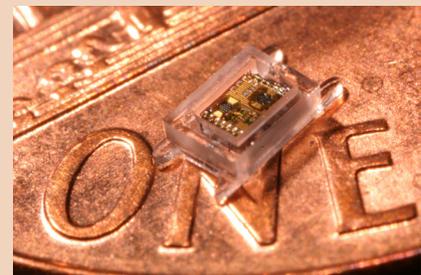*"The industrial segment was the fertile ground where small form factor computers took root and prospered."*

level, since they are both based on PC board technology. Both segments show low margins for hardware, with the exception that the industrial markets require many different I/O interface types (motor controllers, optically-isolated I/O lines, servo controllers, etc). The telecom segment shows no significant I/O diversity or niches for innovative companies to prosper when compared to the industrial segment.

The industrial segment was the fertile ground where small form factor computers took root and prospered. That is now spreading to the telecom segment as micro/pico/femtocells are being installed for cellular

23 Richard Quinnell, "Cost Can Constrain LTE Rollout", Test & Measurement World, blog, March 4, 2011, URL: www.lte.tmworld.com/blog/cost-can-constrain-lte-rollout

communications. Stalwart form factors like PC/104 are now giving way to newer, faster, more powerful SFF form factors such as COM Express.

Competitively speaking, Asian board vendors are challenging US and European industrial board makers, creating margin pressures. The fragmented industrial I/O segment offers the best defense against total commoditization, particularly with mezzanine cards and SFF cards using FPGAs.

Industrial sales may also suffer in Europe as each EU country imposes austerity plans affecting government spending and subsidization of certain industries. Low demand for factory automation equipment, due to low demand for manufactured goods, will affect sales. This difficult situation is amplified by the Asian board vendors coming into this geography and driving margins down further as they seek new customers.

Semiconductors

Recent reports state that spending on fab equipment in 2011 will rise by 28%.[24] That's good news for commodity board makers. Companies like Applied Materials use a number of board-level products to control their gear and processes. We should see nice orders coming for those board-level products. The equipment makers ran down their inventories over the last few years, due to very slow demand for equipment and the recession. Now, conditions seem to be getting better in that segment.

In the last few years, semiconductor geometries have shrunk from microns to nanometers. We have chips made at 65nm, 45nm, and 22nm in our products today. IBM and ARM have announced their new 14nm process, and Intel recently announced their new 14nm fab in Arizona.[25] The work being done on the VITA 51 Reliability Prediction standards is revealing drastically shorter operating life cycles for semiconductors in the smaller nanometer range, some as short as three years. And, the operating life cycles of nm semiconductors decrease even faster during high operating temperatures. Semiconductor experts claim that the lower limit to the size of a transistor is 5nm using silicon (about 50 silicon atoms in width). To resolve the failure mechanisms of silicon (Si) at small geometries, and to increase operating life cycles, semiconductor makers are exploring and using new materials, like Hafnium (Hf), Zirconium (Zr), and Molybdenum Disulfide (MoS2).

In the future, we will need to pay special attention to the operating life cycles of small-geometry semiconductors. Three-year operating life cycles are fine for consumer gadgets and telecom gear, but not for critical embedded systems. Studying the VITA 51 standards will give you an education about the failure mechanisms (Physics of Failure, or PoF) associated with small-geometry semiconductors.

Healthcare/Medical

Many imaging devices (ultrasound, MRI, CAT, CT) have experienced high levels of integration, and semiconductor makers, as well as board vendors, are now offering parts of the systems and subsystems to the OEM medical device makers.[26] Samplify Systems, a new model semiconductor company offering semiconductors and systems, announced a complete electronics solution for ultrasound machines in a commercially-available, board-level package with the software.[27] The lines between semiconductors, boards and systems continues to blur as integration continues to scale into the semiconductors. Board and systems suppliers will continue to loose opportunities to the new generation, highly integrated semiconductors.

We can expect to see more commoditization in the medical equipment markets in the future and more defensive reactions from the medical equipment makers to maintain their high margins. But, there is a lesson to be learned here

24 Suzanne Deffree, "2011 fab spending expected to break record, SEMI says", EDN, March 3, 2011, URL: www.edn.com/article/517215-2011_fab_spending_expected_to_break_record_SEMI_says.php

25 Suzanne Deffree, "Intel targets 14 nm with new fab", EDN, February 18, 2011, URL: www.edn.com/article/512821-Intel_targets_14_nm_with_new_fab.php

26 Allan Evans, Samplify Systems Inc, "Lowering the cost of medical-imaging R&D", EDN, February 3, 2011, URL: www.edn.com/article/512531-Lowering_the_cost_of_medical_imaging_R_D.php

27 Allan Evans, Samplify Systems Inc, "Samplify Debuts Ultrasound Development Kit", EDN, February 3, 2011, URL: www.medicexchange.com/Ultrasound/samplify-debuts-ultrasound-development-kit.html

for our industry. As computing hardware continues its commodity-oriented decline in price (and margin), software becomes the value-added differentiation that stabilizes or raises margins and profits.

The medical equipment makers are reacting to increasing use of lower cost PC technology in this segment by fragmenting the equipment specialties. Devices like ultrasound systems are becoming more specialized (cardio, mammograms, lung, kidney, etc) to maintain margins and customer control. The specialization allows more value add to be included in the electronics helping to shore up the margins in this competitive environment.

Market growth for medical applications using embedded computing devices is very bright but it is being driven hard by the demand for smaller, more mobile devices for "HoMedics," or home-based consumer medical equipment, fitness equipment, disease management, life monitoring, and other wellness applications. In the future, hospitals will not be able to keep up the demand for healthcare forcing even more innovation in HoMedics. Highly integrated semiconductors and small form factor boards and systems will benefit the most from the growing demand in wellness devices.

Frost & Sullivan estimates that $127.9 billion (8.0% CAGR) was spent on devices in the very fragmented U.S. medical device market in 2010. Device manufacturers are under a lot of stress as they are pressed to quickly get products to market under the massive regulations of the Food and Drug Administration (FDA). Regulatory agencies are not willing to skip steps to speed up the process of approval. Long life cycle products are still going to be popular with designers because of the time lost to regulatory approval cycles. Manufacturers are seeking out European and Asian markets to target with their first product releases, avoiding some the regulatory bureaucracy of the FDA and generating revenue in those markets while waiting for approval by the FDA.

Ex Ante Update

The European Commission adopted new guidelines and processes for all EU-based standards developers.[28] On page 81, paragraph 299, in the Horizontal Guidelines, you will see that the EU has adopted VITA's ex ante mandatory patent disclosure requirements. At the November VSO meeting in Scottsdale, an attorney working for NIST (National Institute of Standards and Technology in the US) came to the meeting to observe and document VITA's implementation of ex ante as part of an in-depth legal study, to be presented to NIST early next year, for their consideration. VITA was the first accredited standards development organization (SDO) in the world to adopt ex ante patent disclosure policies in January of 2007, after a testy legal fight at the USDOJ and at ANSI. I predict that a variant of these new EU policies will be adopted in the US standards community in the coming years.

The new EU Horizontal Guidelines and Regulations can be found at: ec.europa.eu/competition/antitrust/legislation/horizontal.html

Mergers & Acquisitions

We did see some activity in mergers and acquisitions in the past six months.

- *In mid January, Mercury Computer Systems bought LNX Corp, a maker of SigInt and RF components for Electronic Warfare.[29]*

- *Esterline bought Eclipse, a maker of SigInt and ComInt (Signal Intelligence, Communications Intelligence) products, also in early January.[30]*

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28 Europa Press Room, "Competition: Commission adopts revised competition rules on horizontal co-operation agreements", European Commission, December 14, 2010, URL: europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1702

29 Mercury Computer Systems Press Release, "Mercury Computer Announces Acquisition of LNX Corporation", January 12, 2011, URL: www.mc.com/mediacenter/pressrelease.aspx?id=13624

30 Esterline Technologies Press Release, "Esterline Acquires Eclipse Electronic Systems", January 3, 2011, URL: www. esterline.com/NewsnbspPressCenter/tabid/208/EntryId/4798/Esterline-Acquires-Eclipse-Electronic-Systems.aspx

- *Molex purchased the active optical cable (AOC) operations of Luxtera In January.[31] This acquisition is further indication that many critical computing applications are moving away from slow and troublesome copper-based connections to optical interconnects.*

- *Curtiss-Wright Controls bought Predator Systems Incorporated in January, continuing to solidify their position in MIL/Aero markets. "PSI's proprietary electro-hydraulic technologies broaden Curtiss-Wright's motion control portfolio, further entrenching our position as a premier supplier for the aerospace and defense markets," said Martin R. Benante, Chairman and CEO of Curtiss-Wright Corporation.*

The Mercury Computer Systems and Esterline acquisitions show the transition from weapons systems and platforms to signal intelligence and communications systems in the new DoD budgets and initiatives mentioned in previous industry reports. We can expect to see more M&A interest and activity involving smaller companies with expertise in the SigInt/ComInt arena in 2011.

Spinouts

Is a new trend emerging? In January, Pigeon Point Systems re-established their independence, spinning out of Microsemi Corporation.[32] You may recall that Pigeon Point was purchased by Actel Corporation a few years back. Can more be expected as larger corporations seek to optimize their operations?

Parent	Target	Market Focus	Date
Kontron	Thales Computer	MIL/Aero	January 2008
Curtiss-Wright Controls	Pentland Systems	MIL/Aero	February 2008
Adlink Technology	Ampro Computer	Industrial control	March 2008
Interconnect Systems Inc.	Nallatech	MIL/Aero	May 2008
Finmechanica	DRS	MIL/Aero	May 2008
Curtiss-Wright Controls	VMETRO	MIL/Aero	August 2008
Kontron	Intel rack mount server group	Telecom	October 2008
Elma Electronic	ACT/Technico	System integration	January 2009
SIE	Carlo Gavazzi-Mupac	Packaging	April 2009
IDT	Tundra Semiconductor	RapidIO chipsets	April 2009
Intel	Wind River Systems	Embedded	July 2009
Mentor Graphics	Embedded Alley	Linux	July 2009
Kontron	Digital-Logic AG	Rugged computers	September 2009
Cavium Networks	MontaVista Software	Linux	November 2009
Curtiss-Wright Controls	Skyquest Systems	MIL/Areo	December 2009
Curtiss-Wright Controls	Specialist Electronics Services	MIL/Aero	June 2010
Parker Hannifin (Aerospace)	SprayCool	Technology	March 2010
Kontron	AP Labs	System integration	May 2010
Curtiss-Wright Controls	Hybricon	Packaging	June 2010
Mercury Computer Systems	LNX Corporation	MIL/Aero	January 2011
Esterline	Eclipse Electronic Systems	MIL/Aero	January 2011
Molex	Luxtera's active cable operations	Technology	January 2011
Curtiss-Wright Controls	Predator Systems Incorporated	MIL/Aero	January 2011

Market Estimates

New Industry Benchmark

Kontron and Advantek appear to be tied for first place in our industry. Preliminary financial reports suggest that they are both near the $695 million (USD) level for 2010 sales. Any slight differences could be the result of currency exchange rates (NTD for Advantek, Euro for Kontron). Advantek financials consolidate the revenue from several of their Chinese subsidiaries, and it's not clear that those products are relevant to our industry. Any acquisitions by Advantek are obscured by their complex and foreign financial statements. Those obscurities do not exist on the Kontron financial statements. The highest sales level in our industry was achieved by Motorola Computer Group (now owned by Emerson) in 2001. They reached about $750 million in sales that year, bolstered by the massive

31 Luxtera Press Release, "Molex Purchases Luxtera's Silicon Photonics-based Active Optical Cable (AOC) Business", January 11, 2011, URL: www.luxtera.com/20110111226/molex-purchases-luxtera's-silicon-photonics-based-active-optical-cable-aoc-business-partners-on-future-aoc-development.html

32 Pigeon Point Systems Press Release, "Pigeon Point Systems Re-establishes Independence", January 10, 2011, URL: www.pigeonpoint.com/pdf/PPS_News_2011-1_PPS_Independence.pdf

increase in telecom board and system sales. A short time later, telecom equipment markets collapsed worldwide, followed by the rapid decline of board and system sales to those equipment makers. Both Kontron and Advantek will be within striking distance of the industry sales record in 2011. They only need to grow at a 10% rate in 2011 to eclipse the old record.

Market Research Reports

In the past few months, I have been allowed to read several new market research reports relevant to our industry:

- *In January, Bishop & Associates released their new study on the market for optical cables and connectors.[33] This report is an extensive overview of the rapidly-developing market for optical connections across all application segments.*

- *A new report on the embedded board market, "The Merchant Embedded Computing Market, 2011 Edition" was released by New Ventures Research.[34] I have not read this report, so I cannot comment on it.*

- *In early March, Information Gatekeepers released their report and analysis of Intel's Thunderbolt I/O concept.[35] This report has consolidated most everything known about Thunderbolt (since Intel has not released many details). And, this report is also a good overview of the developing AOC (Active Optical Cable) market, with special emphasis on Intel's LightPeak technology.*

VITA Architectures for Optical

From the 1950's and the era of the mainframe, to about 1993, all computers were processor-bound: the interconnects could feed more data than the CPU could process. This is evident by all the buffering and the asynchronous protocols used in those days, including VMEbus (designed in the 1980's). But, semiconductor geometries shrunk rapidly in the '90s, enabling CPU's to run in the GHz range. Since about 1993, we have been I/O-bound: the CPU can process more data than the interconnects can deliver. The advances in multi-computing and multi-core processors have just exacerbated this problem. We have seen incremental improvement in bus speeds and interconnect performance over the years, even with multi-gigabit serial links.

But, we are still grossly I/O bound compared to the amount of processing cycles we can muster on a single board or in a single chassis. Copper has frequency limitations, as we have seen with 10G Ethernet. The only substantial solution is to move to optical connections and much higher data rates, up to 100Gb/s.

In my February 2010 industry report, I mentioned the new effort for a plug-and-play satellite bus. Technical committees under the USAF and NASA will form in March to start defining the needed optical interfaces and protocols for the Spacecraft Network data and control buses. Some of this work will surely spill-over into the numerous plug-and-play avionics buses being developed, also mentioned in previous reports.

The semiconductor industry is taking up the challenge, and we are seeing many new optical components coming to market. The data centers are moving to 40G optical NICs (Network Interface Cards) and telecom needs to move to 40G for their backhaul operations. It's clear that we need 10-15 times more bandwidth in certain types of systems to break our I/O-bound bonds. In many ways, military applications are driving the move to optical interconnects and revolutionary higher bandwidths.

"Optical technology will be critical to overcoming the physical limitations of copper-based interconnect technology that is hindering performance of future embedded computing systems."

33 Bishop & Associates, Inc., "Fiber Optic Connectors in Military and Commercial Applications", January, 2011, URL: www.bishopinc.com/new_reports.htm#new_reports

34 New Venture Research Corp., "The Merchant Embedded Computing Market, 2011 Edition", February, 2011, URL: www.newventureresearch.com/wp-content/uploads/2011/02/mec11bro1.pdf

35 Information Gatekeepers, Inc., "Active Optical Cables Market Report 2011", January, 2011, URL: www.igigroup.com/st/pages/aoc.html

Now a new forum, OpComp, dedicated to optical computing technologies is being launched in September 2011. It is intended to bring together academia, research and development, and application developers in one place to discuss optical computing technologies for critical embedded computing systems. Technology to be covered at OpComp includes connectors, waveguides, backplanes, chipsets, and other key technologies. A conference advisory panel is currently defining the program details. (www. op-comp.com)

VITA has collected numerous papers and articles on the state of optical interconnects at www.vita.com/vao. This collection provides an orientation of the developments, the problems, and the opportunities in optical interconnects and backplanes as we go forward. We have already seen 4-5 new system designs using the VITA 66 optical interface standard in MIL applications. And, as many designers strive to break the I/O bound limitations, we will see many more programs using optics in the near future.

Summary

Business conditions have improved in our industry over the past few months, especially in the US. From a macro-economic standpoint, US growth could be negatively influenced by the looming state budget deficits and potential defaults on municipal bonds. Europe's growth could suffer because of the austerity plans being implemented and their continuing sovereign debt problems. Restructuring and reduction of government debt seem to be the only solutions to these financial problems. It is unknown what effect the Japanese earthquake and tsunami will have on worldwide GDP, but it's clear that Japan's GDP will decline.

The recent US DoD budget reductions are primarily aimed at large multi-billion dollar programs, and that will hurt the prime contractors most. A smaller number of new advanced platforms and an increase in upgrades to existing platforms will be beneficial to our industry overall. In Europe, military spending will decline as a function of reduced government spending, and the savings will be used to continue their social benefits. Also, declining subsidies for telecom, factory automation, and public works projects will affect those equipment market segments negatively in Europe.

The recent award of the KC-X tanker replacement aircraft to Boeing, the new X-47B and Phantom Ray UAV platforms, and the positive results of the GO-1 UAV flights show that DoD spending has shifted from the Army and it's ground platforms, to the Air Force and Navy. The delays, cancellations, and unfunding of ground combat vehicle programs show the shift to new UAV platforms that will accomplish both ISR and armed combat missions. Additionally, recent acquisitions of board/systems companies in SIGINT and ISR areas further verify this transition. While we will see a large number of upgrades and refreshes to legacy systems in the coming months, the majority of the new opportunities will be for flight-qualified boards and systems in new and existing UAV platforms.

Finally, the Dodd-Frank bill, the National Defense Authorization Act, the Congo Minerals Ban, and the restrictions on rare-earth element exports from China will make it increasingly difficult for telecom and industrial suppliers to enter the DoD supply chain. Reliable, proven, and tested suppliers will have the advantage in the coming years.

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