2016 State of the VITA Technology Industry

October 2016

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by: Ray Alderman, Chairman of the Board, VITA

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

Introduction

A lot has happened in the past six months. It's election season in the U.S., and that means reality has taken a holiday. Worldwide economic conditions continued to deteriorate, especially in Europe and South America. The United Kingdom slipped the surly bonds of the EU with Brexit, but the jack-booted dictators in Brussels are plotting to severely damage the British economy as the UK departs. ISIS is being driven out of the caliphate, so they are lashing out with attacks in Europe and the U.S. as they move their primary operations into other failed North African nations. An attempted military coup in Turkey has NATO in a twist.

A massive chasm is developing in computer architectures on the technology front, as the data centers go one way and the CPU vendors go another. Cloud computing is breaking into fog, mist, and fluid computing.

Actor and comedian Steve Martin once said, "Chaos in the midst of chaos isn't funny, but chaos in the midst of order is." The recent events and developments recounted and interpreted in this report will propose the only plausible scientific explanation for our present political, economic, and technological turmoil: we are all living in a Monty Python movie.

Contents

Business Conditions

At the macro level, there are a number of topics to cover here. You will have to do some web searches to explore specific topics in more detail. So, put your hand on your laptop computer power supply and feel the warmth of my honesty and sincerity as you read this paper.

The U.S. GDP came in at a lackluster 1.1% growth for Q2 2016, after showing incredibly anemic growth of 0.8% in Q1. But both numbers beat the pants off conditions in the Europe and Japan. World GDP growth is about 3.1%, mostly driven by mature economies shifting industrial production to third world (low labor cost) countries. More disconcerting is that global trade growth has recently been downgraded to 1.7% .[1]

The EU-28 showed GDP growth of 0.4% in Q2, compared to 0.3% in Q1 of 2016, not much to get excited about there.[2] The only thing you can really say about these numbers is that they are positive. The ECB (European Central Bank) has run-out of sovereign bonds to buy to keep interest rates negative. Now, they are buying-up corporate bonds.[3]

However, Ireland grew at 26% in 2015 and is doing well this year too.[4] In fact, Ireland is doing so well, compared to the rest of socialist Europe, that the EU has fined Apple $14 billion in back taxes, saying their tax deal with the Irish government is illegal. Not to be left out, France says part of that $14 billion is theirs.[5] Assessing Apple $14 billion in back taxes inspired the U.S. DOJ to fine Deutsche Bank (Germany) $14 billion for selling fraudulent mortgage backed securities in 2008, so it's a wash from a cash standpoint.[6]

Japan, during a 20-year recession, showed 0.2% growth, after the Bank of Japan bought-up most of the country's sovereign bonds and has now begun to buy-up ETF stocks. The Bank of Japan is the equivalent of the U.S. Federal Reserve, and now owns 60% of the country's ETF's (Exchange Traded Funds) holding stocks in Japanese public companies.[7] The Bank of Japan is the largest stockholder in Japanese companies today, but they did it with ETFs. Otherwise, their ownership level would be considered nationalization of their public companies.

Russia's GDP declined 0.6% in Q2, continuing their downward spiral.[8] "Russia is a gas station masquerading as a country", as John McCain once said. The price of oil is killing them. But they still have enough money to create military problems in Syria and Ukraine.

China grew at 6.7% in Q2, driven primarily by government stimulus and creative accounting techniques.[9] Both imports and exports have been down for several quarters now, so internal economic activity would have to be a

1   Tom Miles, Business News, "*WTO cuts 2016 world trade growth forecast to 1.7 percent, cites wake-up call*", September 7, 2016, http://www.reuters.com/article/us-trade-wto-idUSKCN11X0HB

2   Eurostat, Press Release, "*Flash estimate for the second quarter of 2016*", August 12, 2016, http://ec.europa.eu/eurostat/documents/2995521/7590656/2-12082016-BP-EN.pdf/5f4b863e-e886-46fa-894c-351fb274c276

3   Jim Rogers, The Daily Reckoning, Business Insider, "*Brexit was nothing compared to what's coming*", August 7, 2016, http://www.businessinsider.com/brexit-was-nothing-compared-to-whats-coming-2016-8

4   Eric Chemi and Nicholas Wells, CNBC, "*Ireland's 26 percent GDP growth just doesn't add up*", July 14, 2016, http://www.cnbc.com/2016/07/14/when-26-percent-is-100-percent-bogus.html?__source=yahoo%7Cfinance%7Cheadline%7Cheadline%7Cstory&par=yahoo&doc=103786316&yptr=yahoo

5   Mark Deen, Bloomberg Technology, "*Sapin Says France Isn't Trying to Get Share of Apple Tax Fine*", September 9, 2016, http://www.bloomberg.com/news/articles/2016-09-09/sapin-says-france-isn-t-trying-to-get-share-of-apple-tax-fine

6   Ely Razin, Forbes, "*Deutsche Bank Was Fined $14 Billion. What Does That Mean For U.S. Commercial Real Estate?*", September 19, 2016, http://www.forbes.com/sites/elyrazin/2016/09/19/deutsche-bank-was-fined-14-billion-what-does-that-mean-for-u-s-commercial-real-estate/#687aa46c1522

7   David Floyd, Investopedia, "*Bank of Japan Owns 60% of ETF Market: What Next?*", August 15, 2016, http://www.investopedia.com/news/bank-japan-owns-60-etf-market-what-next/?partner=YahooSA&yptr=yahoo
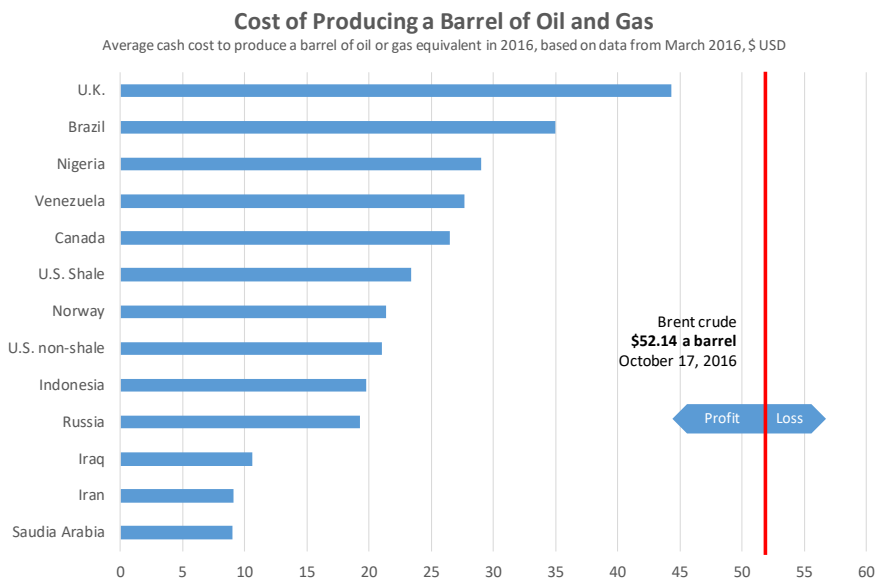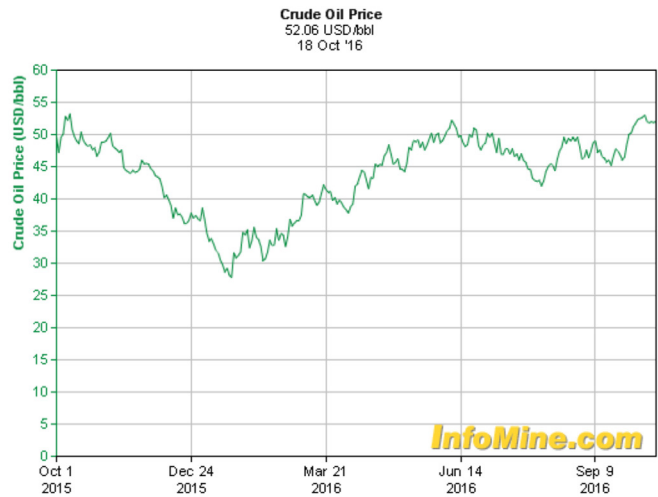
8   Elena Holodny, Business Insider, "*Russia just saw its smallest economic contraction since 2014*", August 11, 2016, https://amp.businessinsider.com/russia-q2-gdp-2016-2016-8

9   CNBC, "*China Q2 economic growth beats estimates as stimulus shores up demand*", July 15, 2016, http://www.cnbc.com/2016/07/14/china-q2-gdp-growth-slightly-beats-expectations-reuters.html

big percentage of the 6.7% number. And authorities have cracked-down on money leaving China for safer havens, even for legitimate business deals.[10]

The Olympics in Brazil were a bust, and now they have impeached their president. Venezuelans are starving as their economy collapses and oil stays below $50 per barrel.[11] Argentina is following Brazil and Venezuela into recession with an inflation rate of 40% and slowing GDP growth. Just look at the one-year crude oil price chart to explain the problems in Russia, South America, and the Middle East.[12] Oil is stuck between $40 and $50 per barrel. The latest talks between Russia and Saudi Arabia about a production freeze (to raise prices) will not likely go anywhere.[13] So, take a look at this chart of the break-even price on oil by country, and guess which countries will go broke first.[14] Things are so tough in Saudi Arabia that they just reduced the salaries of their top bureaucrats by 20%, and reduced their housing and car allowances.[15] Even Canada's GDP went negative by 1.6% in Q2, and the Loony dropped down to 75 cents U.S.[16]

I'll forgo another paragraph and footnotes about the poor financial condition of the banks in Europe, Japan, China, South Korea, and South America. What does all this information tell us? Economic conditions worldwide are not conducive to growth and stability anywhere. The only reason any of the numbers mentioned above are positive is due to financial engineering and deceptive manipulation by the central banks and large corporations. This is the opening scene of the Monty Python movie we are living in.

Crude Oil Price
52.06 USD/bbl
18 Oct '16

InfoMine.com

Cost of Producing a Barrel of Oil and Gas
Average cash cost to produce a barrel of oil or gas equivalent in 2016, based on data from March 2016, $ USD

Brent crude
$52.14 a barrel
October 17, 2016

Profit | Loss

10 Dan Harris, Harris Moure, "*Getting Money Out of China: The Reality Has Changed*", March 10, 2016, http://www.chinalawblog.com/2016/03/getting-money-out-of-china-the-reality-has-changed.html

11 Federico N. Fernández, Austrian Economics, "*Why is Venezuela starving?*", July 9, 2016, http://www.austriancenter.com/2016/07/25/why-is-venezuela-starving/

12 InvestmentMine, http://www.infomine.com/investment/metal-prices/crude-oil/1-year/

13 Myra P. Saefong, Market Watch, "*Russia, Saudi Arabia are all talk, no action when it comes to oil-output freeze*", September 7, 2016, http://www.marketwatch.com/story/russia-saudi-arabia-are-all-talk-no-action-when-it-comes-to-oil-output-freeze-2016-09-06

14 Wall Street Journal, "*Barrel Breakdown*", April 15, 2016, http://graphics.wsj.com/oil-barrel-breakdown/

15 Fox News World, "*Saudi king reduces salaries, perks for senior officials*", September 26, 2016, http://www.foxnews.com/world/2016/09/26/saudi-king-reduces-salaries-perks-for-senior-officials.html

16 RBC Economics Research, "*Canadian Q2/16 GDP drops an annualized 1.6%*", August 31, 2016, http://www.rbc.com/economics/economic-reports/pdf/other-reports/cdn-national-gdp-accounts.pdf

Military and Aerospace

Things have been basically normal on the geo-political-military threat scene lately:

- *North Korea tested nuclear weapons again in January and September. And, they said they will explode a hydrogen bomb (which they don't have) on Seoul, South Korea.[17] Analysis of previous nuclear test seismic waves said that their bombs had a yield of 7 kilotons. The September test registered about 10 kilotons, so they are making progress. And they have been test-launching some new missiles too. So, the U.S. is deploying THAAD (Terminal High Altitude Area Defense) intercept missiles in South Korea, upsetting Russia and China.*

- *Iranian patrol boats have been harassing U.S. Navy warships in the Straits of Hormuz again. Their military commanders continue their threats to turn Israel into dust.[18] SIPRI (Stockholm International Peace Research Institute) claims that Israel has about 80 nuclear weapons, but Colin Powell says they have about 200.[19]*

- *Chinese fighter jet encounters with U.S. aircraft are getting more frequent as they continue to militarize disputed islands.[20]*

- *Not to be outdone, Russian aircraft are also harassing U.S. aircraft regularly.[21]*

- *After a coup attempt, Turkey purged many of their military commanders, priests, school teachers, and government officials. Then they invaded parts of Syria, to rid the border areas of ISIS troops.[22]*

- *India moved 100 tanks and troops to their border with China in a dispute over Nepal.[23]   Meanwhile, Indian and Pakistani troops have clashed on their border over who controls Kashmir again.[24]*

- *Viet Nam has moved rocket launchers onto islands to defend against Chinese aggression.[25] Obama lifted the arms sale embargo against Viet Nam earlier this year, so they are getting their shopping list ready.[26]*

Looking at our defense industry, all the DoD contracts for new military aircraft have been issued (B-21, F-22, F-35, KC-46, C-130J). But, our allies are buying new planes like crazy. Japan is buying KC-46 tankers.[27] Japan, Canada, UK,

17 Elizabeth Shim, UPI, "*North Korea threatens hydrogen bomb retaliation after Seoul confirms military plan*", September 22, 2016, http://www.upi.com/Top_News/World-News/2016/09/22/North-Korea-threatens-hydrogen-bomb-retaliation-after-Seoul-confirms-military-plan/2971474556845/

18 Patrick Goodenough, CNSNews.com, "*As Rouhani Prepares to Address UN, Iran's Military Threatens to Turn Israeli Cities to 'Dust'*", September 22, 2016, http://www.cnsnews.com/news/article/patrick-goodenough/rouhani-prepares-address-un-irans-military-threatens-turn-israeli

19 Judah Ari Gross, The Times of Israel, "*In leaked emails, Colin Powell says Israel has 200 nukes*", September 15, 2016, http://www.timesofisrael.com/in-leaked-emails-colin-powell-says-israel-has-200-nukes/

20 Idrees Ali and Ben Blanchard, Reuters, "*U.S. says China fighter made 'unsafe' intercept of spy plane*", June 8, 2016, http://www.reuters.com/article/us-usa-security-china-intercept-idUSKCN0YT2P6

21 Fox News, "*Russian jet flies within 10 feet of US Navy spy plane, defense official says*", September 7, 2016, http://www.foxnews.com/world/2016/09/07/russian-jet-flies-dangerously-close-to-us-navy-spy-plane-over-black-sea.html

22 Brandon Turbeville, Global Research, "*Turkey Invades Syria, Backed By U.S.*", August 26, 2016, http://www.globalresearch.ca/turkey-invades-syria-backed-by-u-s/5542443

23 Sputnik, "*India Moves Nearly One Hundred Tanks, Troops to Chinese Border*", July 7, 2016, https://sputniknews.com/asia/20160721/1043371135/india-china-ladakh-tanks.html

24 Fayaz Bukhari, Reuters, "*Indian soldiers kill suspected militants in clashes at Kashmir frontier*", September 21, 2016, http://in.reuters.com/article/india-kashmir-uri-idINKCN11Q1HD

25 Greg Torode, Reuters, "*Exclusive: Vietnam moves new rocket launchers into disputed South China Sea*", August 10, 2016, http://www.reuters.com/article/us-southchinasea-vietnam-idUSKCN10K2NE?il=0

26 BBC News, "*Obama lifts US embargo on lethal arms sales to Vietnam*", May 23, 2016, http://www.bbc.com/news/world-asia-36356695

27 Richard Tompkins, UPI, "*Japan wins State Dept. approval for KC-46A acquistition*", September 22, 2016, http://www.upi.com/Business_News/Security-Industry/2016/09/22/Japan-wins-State-Dept-approval-for-KC-46A-acquisition/6451474560435/

Netherlands, Italy, and Israel are all onboard with F-35 purchases issued or forthcoming.[28] But, India decided to buy French Rafale fighters.[29]

Congress just approved the purchase of 130 Abrams tanks by Saudi Arabia.[30] And the Saudis are buying 600 Patriot missiles.[31] Taiwan, Japan, and most of our Middle East allies are buying Patriot systems. Taiwan wants to buy F-35 fighters, maritime patrol planes, and diesel submarines to defend themselves against China, but those are hung-up in politics. They have ordered 24 Black Hawk helicopters though.[32] Even Denmark is buying F-35's.[33]

It is hard to track all the weapon sales to our allies in the Pacific, Europe, and the Middle East these days. These lists are just snippets of what is being bought. The U.S. is the world's largest weapons supplier, with 45% of the $176 billion market, and that is irritating other major industrial countries like China, Russia, South Korea, Brazil, and Israel (France and the UK are already big players in weapons). These countries want a piece of the market that has been supporting our primer contractors during sequestration.[34] There's more to this trend than pure economics. American weapons may be more sophisticated and reliable than those coming from the other suppliers. But they are expensive. Many countries want something that is "good enough" at a lower cost. And, some countries don't trust U.S.-made weapons. They believe that U.S. makers put back doors in our systems, so they can be shut down if the buying country gets into a conflict that goes against U.S. foreign policy. Maybe that's why India bought the 36 Rafale fighters from the French instead of F-35's.

The KC-46 tanker has finally gone to production.[35] The first JLTV's (Joint Light Tactical Vehicles) are scheduled to roll off the Oskosh production line in September and be delivered to the Army.[36] So, orders from our allies should follow soon.

The U.S. Navy issued stand-down orders for the four new LCS boats after one of the ships sustained major engine damage from a seal malfunction.[37] Crews will go through remedial training classes while engineering teams inspect every nut, bolt, and screw on the those troubled ships.

The Chinese launched a satellite with a quantum communications link in August. It uses quantum entanglement to keep the U.S. intelligence from intercepting their communications.[38] In September, they claim to have perfected

28 Robert Johnson, Business Insider, "*Here's Why The F-35 Is Going To Be The Allied Fighter Of The 21st Century*", November 11, 2011, http://www.businessinsider.com/lockheed-martin-f35-pictures-japan-south-korea-canada-2011-12

29 Ian Marlow, Bloomberg, "*India Buys 36 Rafale Jets to Bolster Aging Air Force Fleet*", September 23, 2016, http://www.bloomberg.com/news/articles/2016-09-23/india-to-acquire-36-rafale-warplanes-to-bolster-aging-air-force

30 Jeremy Herb and Seung Min Kim, Politico, "*Senate backs tank sales to Saudi Arabia*", September 21, 2016, http://www.politico.com/story/2016/09/senate-saudi-arabia-tank-sales-228479

31 Clay Dillow, Fortume, "*U.S. greenlights sale of 600 Patriot missiles to Saudi Arabia*", August 1, 2015, http://fortune.com/2015/08/01/u-s-patriot-missiles-saudi-arabia/

32 Defense Industry Daily, "*Taiwan's Force Modernization: The American Side*", September 6, 2016, http://www.defenseindustrydaily.com/taiwans-unstalled-force-modernization-04250/

33 Robert Wall, Market Watch, "*Boeing challenges loss in Danish combat jet deal*", September 15, 2016, http://www.marketwatch.com/story/boeing-challenges-loss-in-danish-combat-jet-deal-2016-09-15

34 August Cole, The National Interest, "*Think the U.S. and Europe Have a Lock on the 21st-Century Defense Market? Think Again.*", September 18, 2016, http://nationalinterest.org/feature/think-the-us-europe-have-lock-the-21st-century-defense-17743

35 Aaron Mehta, Defense News, "*KC-46 Tanker Cleared for Production*", August 12, 2016, http://www.defensenews.com/story/defense/air-space/support/2016/08/12/kc46-tanker-cleared-production-milestone-c/88642282/

36 Jen Judson, Defense News, "*Oshkosh To Roll First JLTVs Off The Line This Month*", September 18, 2016, http://www.defensenews.com/articles/oshkosh-to-roll-first-jltvs-off-the-line-this-month

37 Hope Hodge Seck, Military.com, "*Navy Orders Stand-Down of Littoral Combat Ships After Breakdowns*", September 6, 2016, http://www.military.com/daily-news/2016/09/06/navy-orders-stand-down-of-littoral-combat-ships-after-breakdowns.html

38 Josh Chin, The Wall Street Journal, "*China's Latest Leap Forward Isn't Just Great—It's Quantum*", August 20, 2016, http://www.wsj.com/articles/chinas-latest-leap-forward-isnt-just-greatits-quantum-1471269555

quantum RADAR, that can readily detect stealth aircraft.[39] DARPA and the prime contractors have supposedly been working on quantum RADAR for years, but no announcements on their progress.

Lockheed just got a contract to build a Hypersonic Weapon that can travel at Mach 20 (13,000 miles per hour).[40] It will be capable of delivering a warhead precisely on a target anywhere in the world in less than an hour. The Russians and Chinese have both been testing their versions of hypersonic weapons platforms. These things are hard to hit with missiles, so a lot of effort is going into building high-powered laser weapons to take them down.[41] Other options are to enhance our present CHAMP (Counter-electronics High-powered Advanced Missile Project) systems directed EMP weapon[42] and expanding our electronic warfare capabilities.

Artist's conception of the laser-armed U.S. Navy Self Defense Test Ship, nee USS Paul F. Foster (DD 964). Image source: **Northrop Grumman**.

European leaders are starting to discuss the formation of an EU Army, under a centralized command.[43] EU militaries already use 19 different kinds of combat vehicles and different weapons. If they were to standardize on platforms and weapons for a common army, the internal fight over which EU country builds them, and gets the jobs, will be a bigger fight than an all-out war with the Russians.

There's also a clash in Washington going on, about breaking-off the U.S. Cyber Command from the National Security Agency (NSA) and making it independent.[44] We already have sixteen intelligence agencies, and they don't work together very well. Each of these agencies already have their own internal cyber teams. Adding yet another intelligence agency to the mix couldn't possibly make things any worse. But in early September the White House appointed retired Brigadier General Gregory Touhill as the first federal cyber security chief. That should make things much better – right?

There's a lot more going on in the military arena, but not enough space here to cover it all. It looks like the military board and system business will do well in the coming months and years, as countries in the Middle East, Europe, and the Pacific gear-up against treats from Russia, China, North Korea, and Iran.

Technology

Conditions in the technology segment are almost as bizarre as the financial sector. PC sales fell 9.6% in Q1 and another 5.2% in Q2, bringing the total decline to almost 30% since 2011.[45] Many segments of our board industry are losing their silicon driver for new products, so they have to start following the cellphone CPU market to survive. We are already seeing a number of Small Form Factor (SFF) products based on ARM processors. That means margins will fall and the financial fortunes for those suppliers could decline.

39 Stephen Chen, South China Morning Post, "*The end of stealth? New Chinese radar capable of detecting 'invisible' targets 100km away*", September 21, 2016,
http://www.scmp.com/news/china/article/2021235/end-stealth-new-chinese-radar-capable-detecting-invisible-targets-100km

40 Kyle Mizokami, Popular Mechanics, "*Lockheed to Build a Mach 20 Hypersonic Weapon System*", September 21, 2016,
http://www.popularmechanics.com/military/research/a22970/lockheed-hypersonic-weapon/

41 Rick Smith, The Motley Fool, "*Northrop Grumman Builds the Biggest Laser Gun Ever*", January 2, 2016,
http://www.fool.com/investing/general/2016/01/02/northrop-grumman-builds-the-biggest-laser-gun-ever.aspx

42 Brandon Lewis, Military Embedded Systems, "*Raytheon EMP weapon tested by Boeing, USAF Research Lab*",
http://mil-embedded.com/news/raytheon-emp-missile-tested-by-boeing-usaf-research-lab/

43 Alastair Macdonald, Reuters, "*Post-Brexit EU needs joint military HQ, Juncker say*s", September 16, 2016,
http://www.reuters.com/article/us-eu-juncker-defence-idUSKCN11K143

44 Jason Devaney, NewsMax, "*US Cyber Command Could See New Leadership in Obama's Final Months*", September 13, 2016,
http://www.newsmax.com/Newsfront/us-cyber-command-new-leadership-obama/2016/09/13/id/748021/

45 Douglas A. McIntyre, 24/7 Wall St., "*PC Sales Fall, as Apple Crumbles*", July 11, 2016,
http://247wallst.com/apps-software/2016/07/11/pc-sales-fall-as-apple-crumbles/?yptr=yahoo

Additionally, the industrial segments are about to be overwhelmed with what I call "Frankenboards": Frankenstein board products that will kill their inventors. These are coming from the IIoT (Industrial Internet of Things) movement. They are $20 boards populated with 50-cent chips, that have the capabilities to do most anything needed in factory automation and machine control. As a result, the board companies in the industrial markets are getting hit from both sides (the decline of a PC silicon driver, and the rise of IIoT Frankenboards). This transition will definitely be ugly.

The telecom board segment looks like an Arkansas trailer park after a tornado. Cisco dumped 5,500 people recently (the original estimate was 14,000).[46] Ericsson laid off 3,000 in early October.[47] Nokia is dumping 10,000 to 15,000 after buying Alcatel-Lucent.[48] The business premise for the Nokia/Alcatel-Lucent merger is that if you tie two rocks together and throw them in the ocean, they will float. Telecom is starting to make the industrial Frankenboard market look attractive by comparison.

"The telecom board segment looks like an Arkansas trailer park after a tornado"

But, enough about the crumbling segments of the board industry. Let's explore the massive architectural bifurcation in the data center and cellphone architecture markets . . .

Data Centers

We have four basic architectures now for data centers:

- *Cloud Computing is a centralized computing model where all the data goes from the user at the edge, up through the cloud, to the data center. It then gets processed and reports are sent back down to the edge. If you look at it closely, this is the old GEISCO (General Electric Information Services Company) RJE-to-mainframe (Remote Job Entry) services model from the 1970's using HASP (Houston Automatic Spooling Priority) software and punched cards. Today's cloud architecture assumes that (1) we have the bandwidth on the internet to handle billions of transactions per second and (2) the users don't mind the massive latencies. CPU utilization in data center servers is running about 10%. It was 6-7% just a couple of years back. All the servers in a data center are waiting for I/O: they are I/O-bound (the CPU can process more data that the communication channels can deliver) while sucking-up lots of power and dissipating lots of heat.[49]*

- *Fog Computing is a distributed computing model where a new tier of smaller data centers, regional for example, are placed between the cloud severs and the user at the edge. User data only needs to travel to these intermediate data centers to be processed, reducing the network latency and increasing CPU utilization in the fog servers. Then, these fog servers send some consolidated data or reports up to the cloud servers.[50]*

- *Mist Computing is a mixture of both centralized and distributed computing models. It moves another set of servers, in yet a smaller data center (like in a city) closer to the edge, closer to the user. Mist servers communicate with the fog servers, and they communicate with the cloud servers.[51]*

- *Fluid Computing is a distributed computing model, where the embedded computers controlling machines or processes share their individual resources among themselves (i.e., storage, computing power, etc.). Somewhere in*

46 Reuters, Fortune, "*Cisco's Layoffs Are Just the Tip of the Spear for Tech*", August 18, 2016, http://fortune.com/2016/08/18/expect-more-tech-layoffs/

47 Matthias Verbergt, The Wall Street Journal, "*Ericsson Slashes 3,000 Jobs in Sweden*", October 4, 2016, http://www.wsj.com/articles/ericsson-slashes-3-000-jobs-in-sweden-1475569376

48 William White, Investor Place, "*Nokia Corp (ADR) (NOK) Layoffs Likely to Hit 10,000-15,000 Employees*", May 24, 2016 http://investorplace.com/2016/05/nokia-layoffs-nok/#.V9d7YDuapE4

49 Angelo Corsaro, Prismtech, Embedded Computing Design, "*The IoT needs fog computing*", http://embedded-computing.com/guest-blogs/the-iot-needs-fog-computing/

50 Angelo Corsaro, Prismtech, Embedded Computing Design, "*Defining Fog Computing: For those who thought it was just deploying some logic on an edge gateway*", http://embedded-computing.com/guest-blogs/defining-fog-computing-for-those-who-thought-it-was-just-deploying-some-logic-on-an-edge-gateway/

51 Thinnect, "*Evolving Computing Architectures*", http://www.thinnect.com/mist-computing/

that local network, one of the machines sends data up to the Mist servers, or maybe to the fog servers, or maybe the cloud servers.[52] It is hard to tell in this model which level of data center servers are needed.

There is a fifth computing model, Blockchain, used primarily in the financial industry and for Bitcoins. It operates like a broadcast-based cache coherent network, not relevant to most cloud/fog/mist/fluid computing applications.[53] There are no centralized data centers in a Blockchain network. Any message from one computer is sent to all the computers in the network (i.e., broadcast). It's pretty interesting how it works and I encourage you seek out more on this subject.

If you read the papers written about these new computing architectures, the justification for them involves cost (to operate a data center), CPU utilization, bandwidth bottlenecks on the network, "softwarization", unpredictable paths with very high latencies, and a host of other ridiculous explanations. All of these reasons are self-serving rationalizations by uninformed people, most of whom are selling hardware. These architectures have nothing to do with efficient networking or computing theory.

There are basically two ways to make networks and data centers operate more efficiently: (1) prioritize the traffic into critical, prompt, and routine transactions or (2) move the servers closer and closer to the user. Why do cloud/fog/mist/fluid computing architectures each move the servers closer to the user, and not use prioritization?

The singular reason is FCC order 15-24 dated February 2015, Section II, Subsection A, paragraph 18.[54] That paragraph states that no specific traffic on the internet may be given a higher priority over any other traffic. If this order did not exist, I think the present internet could handle at least twice as much traffic, and CPU utilization in data centers would jump up to 50% or more. Whether the ultimate architectural structure looks like a set of nested concentric circles (like Russian Matryoshka Dolls), a bewildering set of overlapping Venn diagrams, or a horribly complex and grotesque Fat-tree is yet to be seen, thanks to the FCC's order and the perverse and depraved minds at the telecom companies. Remember the deep-packet inspection idea, that would allow the telcos to charge by the byte? Roaming charges? Remember collect, station-to-station and person-to-person long distance telephone calls?

If the internet allowed prioritization of traffic, the internet service providers and telecoms would certainly come up with a new pricing model, charging the sender and receiver more for the faster traffic than the slower messages. Telecom people will sell their children's organs to make another penny or two, and cannot be trusted in a prioritized traffic environment. The Stanford University folks have come up with a method that would allow the end-users to establish the priorities of the data they receive, making the internet more efficient.[55] But that idea will just open the can of pricing worms, inspire more egregious behavior, and introduce malfeasance by telecom companies, as well as flood the streets of America with rabid telecom zombies again.

> *"But that idea will just open the can of pricing worms, inspire more egregious behavior, and introduce malfeasance by telecom companies, as well as flood the streets of America with rabid telecom zombies again."*

Cellphone CPU architectures

The cellphone CPU makers are showing much higher levels of engineering intelligence than the data center engineers. But those CPU companies don't have to tolerate the FCC (except for their RF chips). They have the exact same problem as the data center guys: the CPU is always waiting on I/O (cellphone CPUs are also I/O-bound, due to all the internal data transfers between cores). With the distances involved in the data center, they are required to move the data through routers, across internal networks, into server main memory, and then into the CPU cache. They must move the data at least 5 times before it gets processed. The cellphone guys don't have to move the data

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53 Steven Norton, The Wall Street Journal, "*CIO Explainer: What Is Blockchain?*", February 2, 2016, http://blogs.wsj.com/cio/2016/02/02/cio-explainer-what-is-blockchain/

54 Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-24A1_Rcd.pdf

55 Tom Abate and Glen Martin, Stanford News Service, "*Stanford engineers propose a technology to break the net neutrality deadlock*", September 13, 2016, http://news.stanford.edu/press/view/9895

once it's inside the device. They can use cache coherent memory architectures. These CPU makers are moving the data from the I/O, straight into shared virtual cache memory, using AXI Coherency Extensions (ACE) on top of the popular Advanced eXtensible Interface (AXI) protocol introduced by ARM.[56] Any processor (CPU, core, or GPU) that needs the data simply reads the shared cache. With the new ARM Bifrost processor architecture, the CPU and GPU share a fast cache coherent memory, independent of the shared virtual memory cache used by the other cores.[57] These CPU makers know that every time they move the data, they induce latencies and consume lots of power, so they don't move the data. The data center guys, however, don't have that option. At least not yet. I/O to cache (instead of I/O to main memory) in a server could be beneficial to CPU utilization and eliminate at least one data movement operation.

There are number of new concepts concerning memory and data sharing schemes in cellphone processors. More recently, the people at North Carolina State University have developed a core-to-core communications acceleration framework (CAF) using a new queue management device (QMD) in silicon.[58]

There is another potential future solution to the I/O-bound and CPU utilization problems in the data center: quantum-entangled cache coherent I/O. This goes back to a paper written by Einstein and others in 1935. When certain particles are created together (entangled), each of the particles will maintain the same state, no matter how far apart they are. If an entangled particle on one side of the universe changes spin direction, the other entangled particles will change their spin instantly, on the other side of the universe. This, however, occurs faster than the speed of light, a characteristic that bothered Einstein.[59] Scientists at NIST successfully accomplished quantum teleportation/communication over a distance of 100km in late 2015, breaking the old record of 25km, proving the concept works.[60] If you are still skeptical, the Chinese have just launched their first satellite that uses a quantum entangled communications link to earth.[61] And, this one is accomplishing quantum communication over a distance of 1200 km (746 miles). In a few decades, data centers and the internet will no longer need connectors, wires, or optical fibers. The I/O-bound and CPU utilization problems will go away. And we will become CPU-bound again (i.e., the quantum communications channel can deliver more data than the CPU can process), just like we were back in the 1970's with mainframes.

A lot of work is also being done on Organic Computing (using DNA and bacteria), Neuromorphic Computing (implementing the synapses of the brain, in silicon) and Quantum Computing (quantum and optical computing are merging). Aside from the computing spectrum, we are also manipulating human DNA in ways never previously imagined. What we are really doing today is reading the mind of God and that has both beneficial and catastrophic consequences. But even the catastrophic effects on the planet and humanity, if they occur, are probably much better than what will happen to the telecom and industrial board segments over the next few years.

Denis Diderot (1713-1784), a French philosopher, once said about the nefarious association of church and state in France: "Men will never be free until the last king is strangled with the entrails of the last priest." It is my solemn duty, imposed upon me by my rigorous Southern education, to properly adapt and apply what he said to today's technology situation: Computing and networking will never be efficient until the last FCC commissioner is strangled to death with the innards of the last telecom engineer.

"Computing and networking will never be efficient until the last FCC commissioner is strangled to death with the innards of the last telecom engineer."

56 Neil Parris, ARM Connected Community, "*Exploring How Cache Coherency Accelerates Heterogeneous Compute*", May 29, 2016,
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57 Freddi Jeffries, ARM Connected Community, "*Bitesize Bifrost 2: System coherency*", August 31, 2016,
   https://community.arm.com/groups/arm-mali-graphics/blog/2016/08/31/bitesize-bifrost-2-system-coherency

58 Yan Solihin and Matt Shipman, NC State University, "*Researchers Use Hardware to Accelerate Core-to-Core On-Chip Communication*", September 6, 2016 https://news.ncsu.edu/2016/09/hardware-boosts-core-to-core-communication/

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61 Tim Fernholz, Defense One, "*China's New Satellite Puts Quantum Encryption Into Orbit*", August 22, 2016,
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Mergers and Acquisitions

Still a lot of acquisitions happening upstream from our industry, especially in semiconductors. In June, Cavium bought Qlogic.[62] In July, SoftBank (Japan) bought ARM.[63] Also in July, Analog Devices bought Linear Technologies.[64] Renesas bought Intersil in September.[65] We can expect to see more of our supplier base being bought up as the PC market steadily declines and the cellphone/tablet market goes into saturation. Both Moore's Law and Dennard's Law[66] are reaching the end of their life.

Qualcomm announced that they had signed an agreement on October 28 to purchase NXP (who bought Freescale) for $37 billion, creating a semiconductor company on the scale of Intel or Samsung.[67] If this deal goes through, it will put the PowerPC architecture three levels down in Qualcomm's mind. Their commitment to ARM cores doesn't bode well for continuing the PowerPC architecture, and that could create some problems for the many MIL customers who use it.

Moving to Intel architecture is not a panacea either. Not only would it cost a billion dollars to recode all the DO-178 PowerPC code, but it looks like Apple may be preparing to drop Intel processors in their computers. Pieces of new code in MAC OS Sierra show hooks to ARM processors.[68] This move would make sense. Apple is maintaining operating systems for their desktop and laptop computers, their pad computers, and the cellphones. Creating a new ARM-based OS for their computers, and using subsets of it for their pad computers and cellphones, would certainly cut their maintenance costs.

In our industry, VadaTech acquired RFSS in May, One Stop Systems merged with Mission Technology Group, Inc (AKA, Magma) back in July.[69] Emerson sold another chunk of their Network Power division (including the old Motorola Computer Group, now known as Artesyn Embedded Technologies) to Platinum Capital in August.[70] Otherwise, things have been calm in our corner of the universe.

> *"Both Moore's Law and Dennard's Law are reaching the end of their life."*

Summary

Let me start this summary by saying that we have lost a great industry leader recently: Joe Pavlat, PICMG president, passed away in late August. I knew Joe through his Prolog, Motorola, and then PICMG days. He was a strong leader, and a great thinker about what the future could be for our industry. God speed, Joe.

In looking at all the data presented here, it is clear that we are in a period of turmoil and transition, on both the financial and technology fronts. Some market segments, like industrial and telecom, will be more unstable than others as we progress. The military segment will be the most stable, considering that technology transitions happen

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67 Anton Shilov, AnandTech, "Qualcomm to Acquire NXP, Creates A Massive Semiconductor Company", Octoeber 28, 2016,
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69 One Stop Systems press release, "*One Stop Systems Announces Merger with Magma*", July 18, 2016,
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70 Thomas Black, Bloomberg Technology, "*Emerson's $5.2 Billion in Asset Sales Allow Focus on M&A*", August 2, 2016,
http://www.bloomberg.com/news/articles/2016-08-02/emerson-to-sell-network-power-for-4-billion-to-platinum-equity

more slowly there, but will still be affected to some degree. As far as our industry is concerned, I have written one paper, "RAW - How This Embedded Board and Systems Business Works", using Boston Consulting Group, the New Lanchester Strategy, and "Margin Call" (the movie) models. I am working on another version, using the Harvard Business School book, "The Keystone Advantage" model. There are some common patterns and rules this industry uses to grow and succeed and these articles seek to identify them.

The world is getting more dangerous as Russia, China, North Korea, and Iran challenge the world's only superpower. Whether their reasons are purely internally motivated, or they sense weakness from America's leadership and recent decisions is certainly debatable. A better explanation is that the world is in transition from nation-states to market-states. Each time we made such transitions in the past (from princely states to kingly states 1494-1648; from kingly states to territorial states and then state-nations 1648-1776; from state-nations to nation-states 1776-1914), these changes spawned wars. For a better understanding of this history, read Phillip Bobbitt's informative but tedious book, "The Shield of Achilles".

Whether we are in such an epochal state transition again or not, the probability of military conflict is rising. Peaceful countries are arming themselves, from Asia to Europe, as never before. Japan, Vietnam, Lithuania, Poland, Denmark, Sweden, India, Saudi Arabia—to name a few— are buying weapons and moving troops to their borders. Military business is good, and will probably get better as this new world scenario plays out.

The technology world is also getting more dangerous as the market moves away from traditional PC processors, to smaller mobile heterogeneous multicore devices. The longevity of the PowerPC architecture, used in many critical military applications, is coming into question again. Intel is being replaced as the top CPU maker by ARM, by volume. Apple may soon transition away from Intel CPUs, as will some server makers. Cloud computing is breaking into three or four subsets. We have several new memory technologies coming to market.[71] Great strides are being made with Quantum Computing and Neuromorphic Computing, at the expense of traditional von Neumann architectures.

So, let's end this paper with a quote, by the prophet reading from the Book of Cyril, in Monty Python's "The Life of Brian": "There shall, in that time, be rumors of things going astray, and there shall be great confusion as to where things really are, and nobody will really know where lieth those little things . . ."

71 Mark Lapedus, Semiconductor Engineering, "*Sorting Out Next-Gen Memory*", September 22, 2016, http://semiengineering.com/sorting-out-next-gen-memory/

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