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Interconnecting the Mobile Revolution Means Big Profits

By Ray Blanco

Inside This Issue

Right now, we are in the early stages of an epic transformation in how we use computers. The first three decades of growth in personal computing were concentrated on the desktop or its more mobile variant, the notebook. Those that invested in the Intels and Dells during the early phases of the PC boom made fortunes.

The personal computing boom, however, isn't over. Piggybacking on the exponential improvements in semiconductor technology, first foretold by Intel co-founder Gordon Moore, computing is transitioning to a different platform— a more portable one.

The power of the Internet is moving out of the home and office and into our pockets and purses. Speedy yet energy-efficient processors and circuits are placing the equivalent of a PC in our hands.

I think the most notable recent example of this PC-in-your-pocket phenomenon is the Atrix, Motorola Mobility's new Android phone. I'll try not to get into too much jargon here, but in a package weighing a mere 135 grams, it sports dual one-gigahertz ARM-based processors and a full gigabyte of fast DDR2 memory.

These specifications were enviable in a desktop computer setup weighing more than 50 pounds only a few years ago. Now it fits in your pocket. The Atrix is so powerful, in fact, that it can even replace a traditional computer. It is available with a screen and keyboard docking accessory that turns it into a small notebook.

As impressive as these specifications are, the Atrix wouldn't be of much use if it could not communicate wirelessly. The real computer is the Internet. Without radio frequency circuits (RF), your mobile device would be little more than an expensive lump of plastic and silicon in your pocket.

In order to do its job and connect to wireless networks, advanced smartphones like the Atrix need several RF circuits. These are the glue that attaches your phone to the outside world, and are what makes all the other technology in the phone worth anything. The shift in how we compute represents an explosive growth investment opportunity for leaders in the RF space.

In this issue, I'd like to tell you about a company that makes RF circuits for the world's most powerful smartphone. You probably carry its product around every day and don't know it. Not only that, its technology finds its way into the most advanced aviation and defense applications, and is even on the surface of Mars.

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I've been following this company for some time, but a mention in a conversation I had with Peter Charles, a mobile computing guru, raised its profile in my mind.

Peter Charles is the chief operating officer for **Protext Mobility (OTCBB: TXTM)**, a revolutionary company that is bringing Google-like intelligence to SMS texting. When Peter mentions a company operating in the mobile space in a positive way, it gets my attention. Those of you attending this year's Agora Financial Investment Symposium may get a chance to meet him. Patrick Cox is trying to get him on board to talk to you about investing in mobile technology.

RF Innovator Surfs Mobile Wave

The name of the RF innovator I am alluding to is **TriQuint Semiconductor (NASDAQ: TQNT)**. While researching TriQuint, Patrick and I had the pleasure of interviewing Brandi Frye, director of corporate marketing and communications, as well as Roger Rowe, director of financial planning and analysis.

"TriQuint operates its own state-of-the-art-compound semiconductor facilities, and has been sharply increasing its capacity to deal with long-term market growth."

TriQuint was founded in 1985 by a group of engineers wanting to research and develop the use of next-generation semiconductors using gallium arsenide (GaAs). Gallium arsenide semiconductors have electronic properties that make them a superior choice for high-performance RF applications.

TriQuint differentiates itself from the competition by being the only major player in the space that addresses both the power amplification and the filtering components of an RF circuit in an integrated solution. TriQuint sells the total RF circuit, and is a solution provider, rather than merely a discrete components supplier.

This gives TriQuint a competitive advantage, because it makes it easier for TriQuint's customers to procure a total RF solution for their products. They don't have to design one from scratch. Additionally, integrating both amplification and filtering offers greater electrical efficiency, superior miniaturization and lower costs.

TriQuint operates its own state-of-the-art-compound semiconductor facilities, and has been sharply increasing its capacity to deal with long-term market growth. Among the world's largest commercial gallium arsenide foundries, these are located at its Hillsboro, Ore., headquarters. TriQuint also has a chip fab in the Dallas, Texas, area, where it manufactures product lines for use in the aerospace and defense sector, as well as mobile device and network infrastructure applications. Lastly, it has a foundry in Orlando, Fla., that concentrates on RF filter technology.

TriQuint's strongest growth over the last few years has largely come from its volume mobile business, which represents 70% of its revenues. Overall, 1.4 billion mobile phones were shipped worldwide last year, and growth will continue to be strong in the years ahead. Certain segments in the mobile device market, however, are growing more strongly than others.

At a projected 41% for 2011, smartphones will grow at a far higher rate than the overall mobile phone market, which is projected to grow at 13%. The real profit

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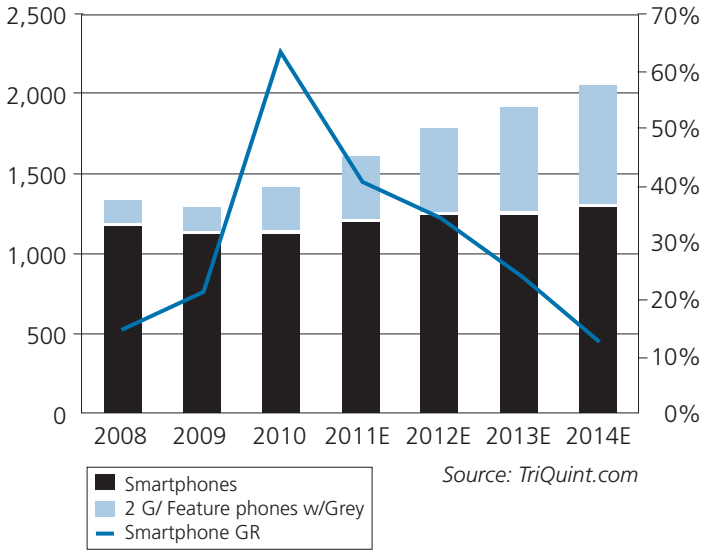
transformation is taking place in smartphones. Since smartphones have to handle more wireless data bands, the RF content is five–six times what is needed in ordinary feature phones. This multiplier presents huge growth opportunities for RF suppliers like TriQuint.

Smartphone Market Volume



Source: TriQuint.com

We also cannot forget the big story in a brand-new product class: tablet computers. 2010 sales of iPads and other tablets totaled 17 million units. However, sales of 50 million are expected this year, and the total market size is forecast to approach 200 million units in 2014. Roughly half of those tablets will feature 3G/4G wireless connectivity in addition to WiFi. While the RF content is several times higher in 3G/4G enabled tablets, all tablets need RF components.

Beyond smartphones and tablets, there will also be explosive growth in what is called machine-to-machine communications (M2M). It is also called the "Internet of Things," although I like to shorten the term to "thingternet." We are going to see more and more wirelessly connected machines, ranging from security cameras to electrical meters to things we can't even imagine yet.

For example, wirelessly connected smart refrigerators will be able to automatically reorder your favorite food items from an online grocer. Medical monitoring devices, such as continuous glucose meters developed by companies like Echo Therapeutics, will be able to wirelessly interface with your smartphone and alert medical personnel if you are in trouble.

These products aren't yet commonplace, but they will become so in a few years, just as the smartphone and tablet boom starts to taper off. Some M2M products, of course, will be hitting the market sooner than others. Eventually, there will be tens of billions of wirelessly connected machines, and all of them will need advanced RF circuits.

About 20% of TriQuint's business comes from a collection of markets that it categorizes as "network." This market segment deals largely with data transport and base stations. Transport includes optical and cable networks, as well as point-to-point radio systems — basically anything that moves data through the network.

Base stations are the hubs of wireless networks and are where your mobile device gets its signal. TriQuint's power amplifiers provide the boost for the wireless signal to reach out from a base station on a phone tower and communicate with your hand-set.

The growth in tablets and smartphones is creating huge growth in data traffic,

"We are going to see more and more wirelessly connected machines, ranging from security cameras to electrical meters to things we can't even imagine yet."

and wireless carriers have to expand their network capacity to accommodate it. In metropolitan areas, wireless carriers are upgrading the capacity of their fiber optic links. In more rural areas, they are putting in point-to-point microwave and radio links. On towers, 3G base stations are being upgraded to 4G.

In all of these cases, since new network devices have to contain many RF components, expansion creates demand for TriQuint's RF solutions.

To Infinity, and Beyond!

The final 10% of TriQuint's business is in defense and aerospace, which has a cutting-edge technology focus. Many of TriQuint's contracts involve advanced research in conjunction with defense contractors. For example, TriQuint has received a $20 million contract for funded gallium nitride (GaN) semiconductor research for the next three years.

"Recommendation: Buy TriQuint Semiconductor (NASDAQ: TQNT) up to $13.30."

What I really like about this is that the federal government, through DARPA, the Office of Naval Research and the U.S. Air Force, is basically funding next-generation RF technology for TriQuint. Over time, I expect the R&D from this line of business to become available commercially. All of today's devices were once futuristic ideas on a white board. That TriQuint can focus on advanced technologies will give it a technological edge over the competition for years to come.

TriQuint's RF technology, by the way, is found in the most advanced aerospace applications. The phased array radar systems in the F-18 and F-22 fighters have TriQuint technology. The new Joint Strike Fighter will have advanced TriQuint GaAs components and bulk acoustic wave filters. Next-generation unmanned aerial vehicles will contain TriQuint GaN components.

In describing this technology company, I also won't fail to highlight the "space" part of aerospace. TriQuint technology finds its way into satellites, and even NASA's Mars rovers Spirit and Opportunity have TriQuint content in order to communicate with Earth.

TriQuint has a strong balance sheet with no debt and $225 million in cash. This gives it tremendous flexibility in pursuing future growth. TriQuint is actively looking for attractive acquisitions and has acquired several companies over the last four years.

However, even in the absence of acquisitions, its organic growth is strong, especially in the mobile space. Last year, it was able to increase its gross margins by 8%. Its stated goal is to achieve 20% operating margins. The current expansion of TriQuint's GaAs foundries also gives it the benefit of increasing economies of scale. With years of strong growth ahead in wireless communications and as a leading, diversified RF technology company with a broad technology portfolio, TriQuint Semiconductor represents an excellent long-term investment.

Recommendation: Buy TriQuint Semiconductor (NASDAQ: TQNT) up to $13.30.

The Cardiac Stem Cell Beat

Once stem cell-based organ replacement becomes a reality, it is going to make an enormous dent in some of our largest health care problems. It will mint numerous new millionaires in the process.

The top cause of death in the United States is heart disease. More than 600,000 people die of heart disease each year in the U.S. alone. More than 1 million people suffer a heart attack. Worldwide, the number swells to 22 million. For the survivors, living with a damaged heart becomes their day-to-day reality. For those needing heart

transplants, the waiting lists are long. Even when a recipient does receive a transplant, it is from a foreign donor, and a lifelong course of immunosuppressant therapy is needed so that they do not reject the organ. The health care costs associated with heart disease are vast.

Although heart cells are grown in culture and can even be made to beat, the heart is much more than a mere collection of cells. It has a complex structure that needs to be recreated in order for a whole transplantable organ to be possible. Within the heart itself, there are different types of cells. Any kind of attempt at regrowing a heart will need to place the right kinds of cells in their correct locations within the organ.

This seems like an insurmountable problem, but a breakthrough based on research carried out by Doris Taylor and Harald Ott while working at the University of Minnesota is making it possible. They have found a way to create a complete structure to which stem cells can attach and grow into a working heart. When it comes to science and the human heart, there are no limits.

Plumbing for a Solution

"They have found a way to create a complete structure to which stem cells can attach and grow into a working heart."

The Minnesota researchers theorized that if a heart could somehow be reduced to its basic skeleton, it could then be used to create the framework for growing a new one. In order to do this, all the old cells would have to be removed while leaving behind the extracellular matrix (ECM). This matrix consists of the protein fibers that form the scaffolding that gives the body's organs their shape and structure.

Of course, decellularization techniques have been around for a long time. Existing methods immerse the organ in a solution containing a detergent. The detergent, in turn, reacts with the cells, in effect "scrubbing" the protein skeleton clean of cells from the outside in.

The problem with existing decellularization methods is that the protein scaffolding also takes some damage. The protein matrix not only provides the structure for the tissue, it also contains important biochemical markers that tell growing cells where they are in the organ and what they are supposed to be doing. Without the signals provided by these markers, called cytokines, stem cells do not reliably differentiate into the right kind of tissue in an extracellular matrix. In addition, stem cells seeded into the matrix to regrow the organ do not always end up close enough to food and oxygen to survive and multiply into new tissue.

In order to address this problem, Drs. Taylor and Ott invented a completely new method of stripping cells away from the protein skeleton called profusion decellularization. Instead of merely immersing an organ in a solution, they connected the blood vessels to pumps that circulate detergent solution throughout the entire organ's vasculature. This keystone technology allows the vascular plumbing of the organ to act as a conduit to clean out the organ from the inside. It provides a far superior environment for stem cell seeding in which the new cells are able to receive the nutrients and oxygen they need to proliferate and differentiate.

Lather, Rinse, Repeat

Even after inventing this breakthrough new technique, however, it was an open question whether the biochemical markers on the physical structure could be conserved. Detergents used for the task still removed molecules that are important if a skeletonized "ghost heart" is going to be useful as a framework to grow a new one.

In order to address this problem, Drs. Taylor and Ott withheld no effort and went the Thomas Edison route. Thomas Edison once famously said: "Genius is 1% inspiration and 99% perspiration." In his attempt to make the light bulb a practical commercial

reality, Edison used every conceivable material for the filament — until he finally hit on a common material. Specifically, he noticed bamboo threads on a fishing pole while fishing. When he carbonized these, they proved to be the light bulb filaments he was looking for.

In a similar fashion, while trying to find the right detergent to decellularize a whole heart, the researchers tried every conceivable detergent. Scientists ran these through rat hearts one at a time. The interesting thing is that — as with Edison's bamboo strands — what worked best was not some rare compound, but a very common one called SDS, or sodium dodecyl sulfate. Otherwise known as sodium lauryl sulfate, you would be hard-pressed to find a shampoo at the grocery store that does not contain it as a primary ingredient.

Another important breakthrough came from the new decellularization technique. Other scientists had tried immersing organs in detergent to remove cells. This, however, removed the "ZIP code" information that stem cells need if they are to develop exactly as they are supposed to in their respective locations. At one point in the experimentation, however, the SDA detergent was pumped through the organs' own vascular system, instead of being used as a bath.

"The discovery won **Popular Science's** *award for best health innovation of 2008."*

When the test hearts were decellularized with SDS by the new profusion method, the difference was stunning. There was a now pristine protein framework on which to attempt to regrow a new heart, complete with the blood vessel structures needed to feed the seed stem cells.

The scientists decided to push their experiment further and see if they could return the decellularized organ to function after seeding it with stem cells. Late one night, Dr. Harald Ott sat in the lab looking at the bioreactor. Amazingly, the heart was beating. He jumped on the phone and called his collaborators, and a new era in stem cell therapeutics was off and running.

Following the Heart

These findings were published in the prestigious peer-reviewed scientific journal *Nature Medicine*. The discovery won *Popular Science's* award for best health innovation of 2008. Additionally, after acquiring full licensing for the technology from the University of Minnesota, the discovery provided the key technology for a new startup: Miromatrix Medical Inc. Patrick Cox and I interviewed its management team in order to bring you information regarding this breakthrough technology.

Currently, Miromatrix is a very-early-stage company seeking additional private funding to continue developing the technology to realize its ultimate goal of whole organ regeneration. However, Miromatrix has a stepwise business plan for bringing new heart products onto the market in the next few years.

The first iteration of the technology will consist of a cardiac patch derived from decellularized pig hearts. Porcine ECMs are similar enough to those in humans to be useful in therapies. In order to simplify the FDA approval process for the first version, the patch itself will not be recellularized, but will be the protein matrix alone. When grafted into tissue damaged by a heart attack, it will provide the framework for the patient's own stem cells to migrate, attach and regrow.

The second-stage product will be partially recellularized. In this version, the blood vessels in the patch will be regrown with endothelial stem cells.

The final version of the patch will be fully populated with new heart cells for transplant. Miromatrix expects the first product to be available in three years.

In parallel with these steps, Miromatrix plans to develop the ability to regrow entire hearts, with commercialization of the technology in mind. They expect this to be a commercial reality in 10 years. The technology, however, has applications that go far beyond hearts alone. The basic profusion recellularization technology can be used on other organs, such as lungs, kidneys and livers. While focusing on cardiac applications, Miromatrix intends to license its technology to firms wanting to work on these other applications. This should, of course, represent a considerable revenue potential.

I would like to mention that these other applications have already received important proof-of-concept third-party validation. Last year, scientists at the Department of Biomedical Engineering at Yale University published research in which they grew a rat lung using Miromatrix's technique. Upon transplantation, they found that a rat could breathe through the lung and exchange gases to and from the bloodstream. Also published last year, researchers at Massachusetts General Hospital were able to demonstrate the use of a liver-specific refinement of Miromatrix's method to regrow a rat liver. The new organ showed normal liver function.

Part of the elegance of Miromatrix's technology is its flexibility. The platform can use different kinds of stem cells. For example, induced pluripotent stem cells created from adult cells harvested from the patient could be used to grow new organs. The beauty of such an arrangement is that the risk of rejection of the new organ is reduced or eliminated, because the cells come from the recipient.

"Part of the elegance of Miromatrix's technology is its flexibility. The platform can use different kinds of stem cells."

On the other hand, parthenogenic stem cell lines can be matched ahead of time to the great majority of human beings. In theory, this would allow the creation of a large organ bank, much like how blood transfusions are banked and sorted by types. This scenario would allow transplant organs to be immediately available in case of a catastrophic event, such as an automobile accident or a massive heart attack.

Miromatrix has exclusive license to this technology, along with the U.S. patents. It is pursuing further protection of its intellectual property around the world. Miromatrix has introduced a foundational technology with a vast commercial potential worth billions of dollars. Current organ replacement therapies such as kidney dialysis, pacemakers and cardiac stents affect more than 20 million Americans and incur $140 billion in expenses yearly.

Since Miromatrix is still a private company, we cannot add it to our portfolio, but we are watching it very closely and hope to add it in the future. Miromatrix, meanwhile, is seeking private funding. If you have venture funds you would like to consider investing in this breakthrough technology company, I would be more than happy to introduce you to Miromatrix's management team.

Ad lucrum per scientia (toward wealth through science),

Ray Blanco