G00263846

Market Trends: Commercial Drones — New Market for Semiconductors

Published: 4 August 2014

Analyst(s): Gerald Van Hoy

With the U.S. and EU about to lift restrictions on commercial drones, a growth market for semiconductor vendors looms. Aeroflex, Xilinx, STMicroelectronics and Freescale are already in the drone market and should benefit from expanding commercial drone markets, such as agriculture.

Key Findings

- The U.S. Congress has ordered the Federal Aviation Administration (FAA) to put into effect a plan to allow commercial drones (also referred to as unmanned aerial vehicles [UAVs]) in the U.S. airspace in 2015. The EU has a similar deadline set for 2018.
- As the restrictions on commercial drones lift, agricultural drones — given that they will be a large percentage of the commercial market — will be of interest to semiconductor vendors.
- Current drone manufacturers in the military sector have plans to expand into the commercial drone sectors, such as agriculture, when current restrictions lift.
- The semiconductor industry should benefit from the uptake in the commercial drone market, particularly those vendors that currently have a stake in the global military commercial drone markets, such as Aeroflex, Xilinx, STMicroelectronics and Freescale.

Recommendations

Product development managers should do the following:

- Leverage existing application processor and microcontroller unit (MCU) designs and competitive pricing by marketing/refocusing current products and reference designs as much as possible toward drone manufacturers.
- Restrain from developing dedicated medium- to low-cost drone-specific designs until the commercial drone market proves its robustness (there should be actionable market evidence in three to five years).

- Develop general solutions with a portfolio of vertical-industry (for example, agriculture or real estate) modifications after the market demonstrates drone acceptance, and anticipate larger robotic market trends.
- Encourage students to generate more drone designs and applications by offering "teaching kits" to universities, colleges and high schools.

Table of Contents

List of Tables

List of Figures

Introduction

The U.S. Congress mandated that the FAA devise a plan for "safe integration" of UAVs by 30 September 2015. Similarly, the EU mandated the lifting of restrictions for commercial drones by 2018 (according to the European Commission). The Association for Unmanned Vehicle Systems International (AUVSI) estimates that the commercial drone market will grow to an $89 billion market by 2025. The next five years will see the commercial market exploring the use of drones. Agriculture will be the first large wave within the commercial drone market because it already has an established base of manufacturers.

Agriculture is a key segment for the worldwide drone market, and as such, it represents the opportunities that exist in the niche drone market. AUVSI estimates that agriculture will account for 80% of the commercial drone market initially. Given the amount of agriculture and the demand for it, agriculture should remain a large and growing segment of the commercial drone market for the foreseeable future. Worldwide, drones (both aerial and ground) are used in agricultural applications, such as aerial application (crop dusting), inspection, surveying, plowing and cultivation. On most commercial farms, these machines will be found favorable because they can work longer hours, be programmable and require little maintenance. Because of their versatility, UAVs could be put to work on a farm to do any number of jobs in a given day, from warding off birds, pollinating crops, surveying for erosion or infestation, and irrigating or chemical spraying in the evenings. The UAV can collect a large amount of data on crops that cannot be gleaned as easily or efficiently by humans on the ground. This collection means higher yields and faster diagnoses, as well as better decisions when problems occur.

Market Trend

Key Drivers and Inhibitors for the Commercial UAV Market

The commercial UAV market is emergent. There have been some uses in markets, including agriculture, filmmaking, land surveying and parcel delivery. However, key items, such as cost structures, legal frameworks, standards and product types, are still in development. Table 1 lists the core drivers and inhibitors for the commercial drone market.

Table 1. Drivers and Inhibitors for the Commercial Drone Market

Drivers and Enablers	Inhibitors
Local and state legislation	Social fear
Agriculture, aerospace, film, real estate and delivery service industries	Need for insurance and appropriate regulations
Falling costs of semiconductors	Slow lifting of inhibiting regulations
M2M communications services	Pilot and labor lobbies
Business need for higher yields	Security concerns
Business need for cost reduction	No common command system
New business models	No standardization of hardware, thus keeping costs up
New applications of drones	Lack of standards for software, security and connectivity
Enthusiasts/hobbyists	Use of crowded communications frequencies
M2M = machine to machine	

Source: Gartner (August 2014)

With the lifting of commercial drone restrictions, the agricultural industry will be a major driver/enabler of commercial drones during the next three to five years. The use of drones in the agricultural industry has the potential to increase yields and reduce costs. Because of the drones' versatility and diversity, these benefits (increased yields and reduced costs) can be envisioned at all sizes and levels of commercial agriculture. The aerospace industry will also see an opportunity to expand beyond the budgetary and economic constraints of the traditional military and aerospace markets to a much larger commercial base. The falling costs of semiconductor technologies, along with the rise of a new generation of reference designs that is driven by the rapid evolution of both the smartphone and the development board markets, mean the semiconductor industry would welcome the expansion into the drone market (that is, it is easier for semiconductor vendors to adopt the existing products and designs in commercial drones from existing smartphones and board development markets than to have to design everything from scratch).

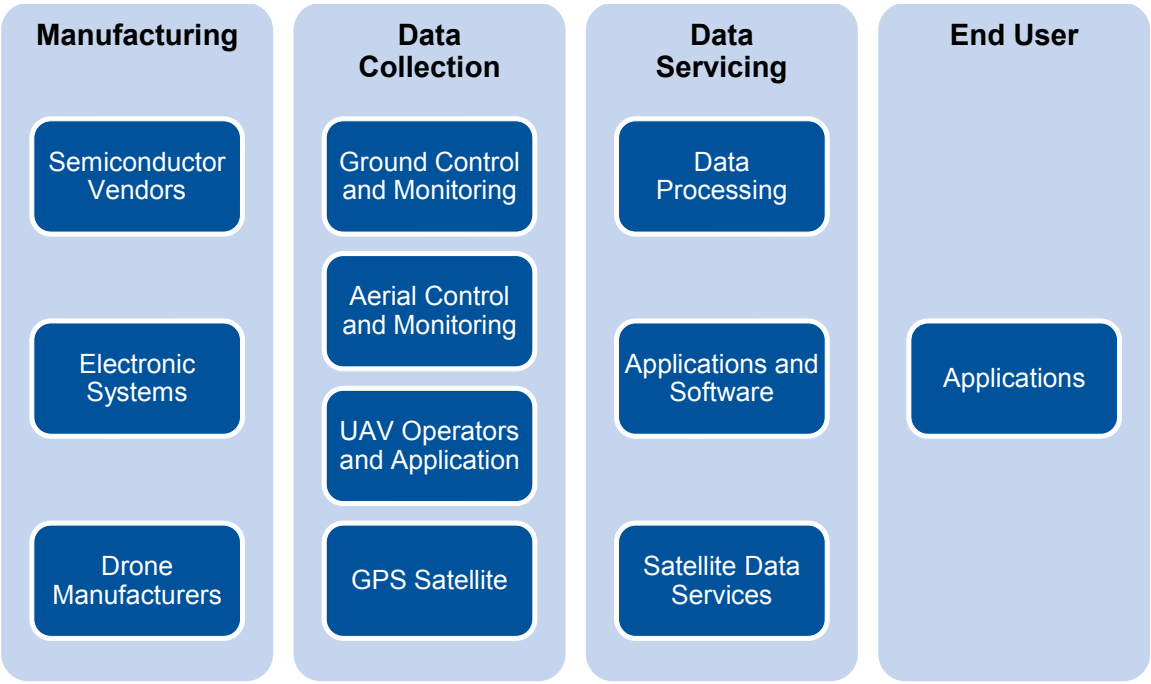
The U.S.'s and EU's airspace restrictions on UAVs will be the major inhibitor of the commercial drone industry. Any slowing or delay in lifting of the restrictions sets back the timetable for adoption of commercial drones and advancements in their application. Furthermore, security issues are another inhibitor to early adoption. For example, some businesses fear that if the drones were hijacked, they would lose their assets, which could adversely affect the businesses' processes.

These businesses also fear they could be held liable for subsequent damages incurred by the drone's hijacking.

Market Structure Evolution Will Challenge Product Managers

Currently, the UAV market is dominated by military applications. But semiconductor product development managers should be aware of the overall UAV market structure (see Figure 1) and any changes as opportunities begin to emerge in the commercial drone market and as the UAV market begins to focus on more standardized, lower-cost solutions.

Figure 1. UAV Market Structure



Source: Gartner (August 2014)

Major differences exist between the specialized military market and the commercial drone market, and therefore, the commercial drone market will require a "mind shift" toward general-purpose manufacturing. In particular, these major differences require a mindset focused on cost reduction while at the same time focused on adding new features and functions. The UAV market structure has four main areas for product development:

- Manufacturing — Industry participants can leverage the electronics industry's history of leading reference designs to reduce costs and improve yields as well as to enable adjacent markets to evolve. We expect there will be some attempts at standardization with regard to communications, operating systems and other functions. We also expect startup companies to enter this market, while other companies will be acquired. Furthermore, military drone manufacturers will likely move into the commercial drone market.

- Data collection — Leveraging a variety of assets on the ground and in the sky will enable owners of commercial drones to either build a view of historical patterns or comprise a set of reference data that they can start to plumb to become more efficient in current processes or to drive new models. But this data collection will also raise the following questions that must be addressed:
  - What data is considered private?
  - What types of data can be owned?
  - Who owns the data?
  - How will the different data streams in the different drone vertical markets be sold or monetized?
- Data servicing — There will be a need for the following:
  - Data storage both locally and in the cloud
  - The ability to mix data from other M2M sources, such as weather data
  - Analytical software to crunch data and store results
- End user — In this area, there is the possibility for software applications and hardware add-ons. Product development managers should expect commercial drones to have adjustable, mountable or clip-on cameras, microphones and sensors; specialized software controls; possible preprogrammed flight patterns; additional encryption; and decision-making software.

The Agricultural Market Will Be a Major Part of the First Wave

According to the most recent United States Department of Agriculture (USDA) report, crops are planted on 426 million acres in the U.S. Of that, 71 million acres are "treated" by aerial application (crop dusting). The number of acres being treated by aerial applications has the potential to grow: Recent studies have shown that aerial application is a more effective, and less expensive, method for chemical spraying and/or irrigation than that of tractors. The potential for UAVs to take over in aerial applications is increased because UAVs are not limited to just this one function.

UAVs Appear to Be More Cost-Effective Than Manned Crop Dusters

According to the National Agricultural Aviation Association (NAAA), more than 1,300 third-party contractors performed the traditional dusting flights for multiple farms in 2012. The cost of manned crop dusters range from $140,000 to $1 million; furthermore, the manned crop duster is limited in scope by staff hours and functions and usually sprays only at night.

The base unit cost for an agricultural UAV is lower than that for a crop duster and ranges between $75,000 and $100,000. However, with add-ons and upgrades (these include computational processors, sensors, cameras, ground control units, image processing software and analysis software), a UAV can run as high as $1 million. While the UAV's cost is comparable to that of a conventional manned crop duster, the true value in the UAV is in its potential to perform additional functions that would:

- Save farmers extra money in wages
- Save farmers extra money for additional equipment
- Provide the ability to perform multiple functions in a single flight

In some of the specifications for the helicopter UAV, Gartner found that it can fly 60 to 90 minutes per mission and cover five to seven acres per flight, spraying up to 28 liters of liquid. Moreover, these UAVs can handle irrigation applications as well as standard crop dusting with pesticides, herbicides and fungicides. Studies at UC Davis show that these applications by UAVs are not only more efficient but also more cost-effective than the traditionally used tractors. Furthermore, most aerial applications are performed at night.

In addition to crop dusting, UAVs could perform crop surveys — via thermal imaging, infrared, ultraviolet and multispectral sensors — to detect potential infestation and irrigation problems sooner in the field than what is currently possible with conventional methods. The benefit would be a minimization of conditions that decrease yields.

Additionally, with fitted GPSs, image sensors and other sensors, UAVs could be used to survey the fields for erosion, predation and other environmental situations. Thus, the UAV, capable of numerous functions, may take on the caretaker role in the farming system, decreasing the need for multiple employees working on one specific task.

UAVs May Hold Great Potential for Crop Surveillance

The surveillance drone is another UAV used in the agricultural industry. While the crop-spraying drones can do surveillance work when upgraded with surveillance equipment, surveillance drones can do the troubleshooting aspects of the aerial surveillance less expensively. Most drones run on batteries, with flight times (depending on which model) varying between 20 and 60 minutes. Some use video cameras, while others use high-resolution still image cameras, and other drones are outfitted with a number of sensors. Some drones (currently not deployed in the U.S.) can fly several hundred feet in the air. The market potential for these nonspraying UAVs is greater because they could benefit any commercial farm by flying different kinds of missions (for example, surveying for infestation, flooding, drought or predation, as well as warding away birds, herding cattle or monitoring erosion). The price range is more affordable — between $2,000 and $25,000 — versus the cost of a conventional plane. Because of the variance in cost and equipment for these UAVs, it is difficult to estimate the market size of these units, but these UAVs should be seen as a market opportunity.

Add-Ons for Agricultural UAVs

Agricultural UAVs are designed to "add on" further features. The base unit may come with a standard set of sensors and cameras, but additional hardware units can be added to each UAV, for data collection or other surveillance functions, making the UAV versatile in a number of situational conditions. The UAV industry, as a whole, focuses on consolidating functions into a single chip wherever possible to save on power consumption, space and weight in the hopes of more data

collection capacity, more flight time and/or less fuel consumption. More and more accuracy in UAV positioning, through either GPS, lidar or radar, is also important for spray efficiency.

UAVs can also augment their onboard power consumption with solar energy as more advances are made in thin-film solar, which means they can be operated during both the day and night, expanding their functionality. Most aerial application (spraying) is performed at night to avoid evaporation.

We suspect that, with UAVs, the third-party business model for agricultural applications not only will continue but will also thrive and expand into potential peripheral markets, such as real estate, independent filmmaking and land surveying/mapping.

The Semiconductor Market Opportunity in Agricultural UAVs

In much of the world, an unmanned helicopter is the most commonly deployed UAV for agricultural applications. The unit consists of onboard electronics and a ground control system. The key electronic systems or modules on an agricultural UAV are navigation, GPS, flight control, sprayer controls, safety measures built into the power engine, and data processing chips. The onboard electronics include semiconductors such as (but are not limited to): high-end MCUs up to 10 CPUs that monitor operations — these range from Intel Core Duo processors at the upper end of costs to ARM-based microcontrollers at the lower end of costs; GPS receiver; two GPS sensors (redundancy built in for safety); altitude sensor; wireless Ethernet bridge; Global System for Mobile Communications (GSM) modem; charge-coupled device (CCD) image sensor; infrared sensor; laser rangefinder; power management; proximity sensors; liquid tank sensors; cameras; microphones; sensor arrays; multifunctional sensors; and combination sensors. All of these must be drip-proof in case of spray blowback. We estimate that a midrange commercial agricultural drone would have a semiconductor value between $500 and $2,000.

Potential Semiconductor Market in Agricultural UAV Add-Ons

Because the base UAV unit is designed for add-ons, there is a potential secondary market for semiconductors, such as multifunctional sensor arrays, specialized cameras and GPS units. As the UAV systems become lighter, it's possible we will see more onboard data processing that is designed to determine situational conditions, potential actions and execution of those actions in a single mission. The UAV may have the capacity to carry multiple specialized payloads, allowing instantaneous responses to unexpected problems. It is hard to say how big this market may actually be; for example, larger agribusiness farms may be inclined to use the add-ons for their UAVs, whereas smaller farmers might use a separate surveillance UAV to collect additional information because it might be less expensive.

Security Issue Presents a Semiconductor and Software Opportunity

The potential for hijacking a drone has already been realized among hobbyists and enthusiasts, and as drones become commercially accepted, there will be a need for secure communications between the UAV and ground control. This security issue may require either, or both, a semiconductor and software solution. The issue should be addressed before the commercial market expands and the potential dangers arise.

The other issue that must be addressed in earnest before commercial drones can really take off is bandwidth. Currently, there are no dedicated frequencies for robots. All drones are operating on frequencies dedicated to other devices. Drones have been hacked in the past because the wireless signal is "spoofed" by another device.

The U.S. Department of Homeland Security identifies agricultural application as one of the areas it watches because of the potential to modify the aircraft either for biochemical dispersal or to poison crops. Hijacking an agricultural application UAV should be preventable with regard to secure communication and control (both hardware and software), and by having legislation in place.

Contrarian View

Factors That Could Slow Commercial UAV Adoption

Current agricultural applications are performed usually by a third party who charges a fixed rate and moves from farm to farm, so there isn't much need for a farmer to purchase a unit when the farm owner could have the function performed by a third party. The average third-party agricultural application operator owns 2.1 aerial vehicles, according to the National Agricultural Aviation Association — the potential UAV market is therefore much lower.

There's too much controversy around drones, and their acceptance into the U.S. and EU airspace is tentative. It's possible that commercial drone acceptance will be slow due to public fear of drones and privacy issues. In addition, commercial drones may require too many operational changes, and thus, smaller businesses may believe they may not be worth the trouble. Larger corporations and agribusinesses may adopt drones sooner because they can afford the initial costs.

Security and privacy issues are concerns. There must be some additional laws and/or licensing in place not only to prevent hijacking drones, but also to prevent a drone equipped with high-resolution cameras and sensors from flying over and through residential spaces.

There also is the risk that the FAA may overregulate commercial UAV flight, which potentially would kill or cripple the market before it could take hold.

And finally, consumers who distrust and dislike larger corporations might begin to see drones as a symptom of corporate largeness and seek out companies that operate without drones.

Vendors to Watch

Table 1 lists drone vendors that currently have or plan to have products in the agricultural market. There also are several military drone manufacturers that could enter other commercial drone markets, and these include Boeing, General Atomics, Lockheed Martin, Prox Dynamics, Denel Dynamics, Aviation Industry Corp. of China (AVIC), DJI, Israel Aerospace Industries, Northrop Grumman and General Dynamics.

Table 2. Drone Vendors to Watch

Company	Products	Notes
AeroVironment	Surveillance drones	FAA approved BP to fly AeroVironment drone over Alaska
AgEagle	Crop scouts/surveillance drones	Offers both helicopter and "flying wing" designs
AgAiRobot	Agricultural spraying drone	Provides two different designs; both with combustion engines
Guided Systems Technologies	Crop scouts/surveillance drones	Provides helicopter designs for the agricultural industry, first responders and military
Lehmann Aviation	Crop scouts/surveillance drones	Offers flying wing designs
Parrot	Crop scouts/surveillance drones	Offers designs for hobbyists/enthusiasts; also owns senseFly, which offers scout/surveillance drones
PrecisionHawk	Crop scouts/surveillance drones	Offers training, data processing software and services, and storage
RoboFlight	Crop scouts/surveillance drones	Acquired Aerial Precision Ag
Scion UAS	Military drones	Announced its intention to enter the agricultural drone market
Volt Aerial Robotics	Crop scouts/surveillance drones	Offers both helicopter and flying wing designs
Yamaha	Agricultural spraying drone	Contracted with the U.S. Navy for military UAV that is based on agricultural RMAX design

Source: Gartner (August 2014)

Table 2 lists some semiconductor vendors that are supplying components to the drone market. We know a number of components, such as transistors and power management chips, are used in drones, but we could not find them attributed to vendors yet.

Table 3. Semiconductor Vendors to Watch

Company	Notes
Aeroflex	Wireless chips
Altera	FPGAs for military use
Analog Devices	Gimbal control, imaging, radar, avionics, data link communications and MEMS
Atmel	Arduino development board in drone hobbyist/enthusiast kits; MCUs in UAVs such as those from Parrot
Broadcom	Raspberry Pi developmental board for the drone hobbyist market
Cypress	Radio SoC in UAVs such as those from Parrot
Freescale	DSPs in military drones; MCUs and sensors, including multisensor chips
Infineon Technologies	Collaborates with UAVs vendors, such as those from Parrot
Intel	CPUs in UAVs such as Yamaha RMAX
InvenSense	Gyroscope in UAVs such as those from Parrot
Microchip Technology	PIC MCUs in UAVs such as those from Parrot and in development boards in drone hobbyist/enthusiast kits
Micron	Flash and RAM in UAVs such as those from Parrot
Microsemi	FPGAs for military use
Nvidia	Embedded processors for DARPA-funded experimental drones
Parrot	Internal use ASICs
Qualcomm	Communication chips in UAVs such as those from Parrot
Sony	Image sensors and cameras
STMicroelectronics	MEMS in UAVs such as those from Parrot; processors and sensors in UAVs such as those from 3D Robotics
Texas Instruments	Radio chip in UAVs such as those from Parrot; BeagleBone for drone hobbyist market
Vicor	Power management chips for military drones

Xilinx	FPGAs for military use

ASIC = application-specific integrated circuit
DARPA = Defense Advanced Research Projects Agency
DSP = digital signal processor
FPGA = field-programmable gate array
MEMS = micro-electromechanical systems
SoC = system-on-chip

Source: Gartner (August 2014)

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Advanced Imagery Offers Utility CIOs New Benefits"

"Predicts 2014: Global Logistics Differentiating for the Future"

"Hype Cycle for Operational Technology, 2014"

"Hype Cycle for the Internet of Things, 2014"

"Hype Cycle for Emerging Technologies, 2014"

"Hype Cycle for Digital Government, 2014"

"As UAVs Proliferate, CIOs Must Monitor Standards, Policies and Regulations to Integrate Them Into Commercial Airspace"

Evidence

The analysis and advice provided in this document are built from constant scanning of the market, as well as from the aggregation of analyst experience and ongoing interactions with end users, financial organizations, technology providers and policymakers. We have used a range of sources to feed our perspective on the topics discussed in this document, including:

- Gartner customer inquiries and conversations with enterprise and government end users, and technology and service providers
- Discussions among Gartner analysts with expertise in semiconductors for drones, such as sensors, industrial applications and power management

Gartner analysts also leverage secondary sources of information, including government and media reports on agriculture, drones and related developments. Specifically, we cite the following sources:

- FAA.
- P. Westcott and R. Trostle, "USDA Agricultural Projections to 2023," USDA Economic Research Service, USDA Agricultural Projections No. (OCE-141), February 2014.

- The National Agricultural Aviation Association's Industry Facts.
- "Remote-Controlled Helicopter Tested for Use in Vineyard Applications," UC Davis, 5 June 2013.
- Transportation Security Administration.
- Association for Unmanned Vehicle Systems International.

This document is published in the following Market Insights:

Semiconductor Applications Worldwide
Semiconductor Industry Asia/Pacific
Semiconductor Industry Worldwide

GARTNER HEADQUARTERS

Corporate Headquarters
56 Top Gallant Road
Stamford, CT 06902-7700
USA
+1 203 964 0096

Regional Headquarters
AUSTRALIA
BRAZIL
JAPAN
UNITED KINGDOM

For a complete list of worldwide locations,
visit http://www.gartner.com/technology/about.jsp