Drones Revolution

By
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This eBook is a compilation of articles written by Mike Tully, President & CEO of Aerial Services, Inc., over the last two years. Each article addresses in some capacity the rising use of a phenomenal new, transformational drone technology aka Unmanned Aerial Systems (UAS), Unmanned Aerial Vehicles (UAV), and small UAS (sUAS).

Our desire is that you find this information engaging and instructive. Drones are powerful, new "enabling" technology, a remote-sensing and mapping game-changer. Many new business opportunities will be discovered and emboldened by their widespread adoption and exploitation. It is our desire this material accelerates your success with these technologies.

Each chapter contains a single article written in the past and includes a graphic indicating when in time the article was published relative to other defining UAS events during this period. The articles are compiled in descending chronological order.

The defining regulatory events of the period from which these articles were written are described below to help the reader appreciate the historical context of each article.

FAA Modernization & Reform Act (FMRA) - February 2012
The Federal Aviation Administration reauthorization legislation (P.L. 112-095) enacted on February 14, 2012 authorized appropriations to the FAA from Fiscal Year 2012 through Fiscal Year 2015. The legislation included the comprehensive plan for the full integration of UAS into the national airspace. Read more here.

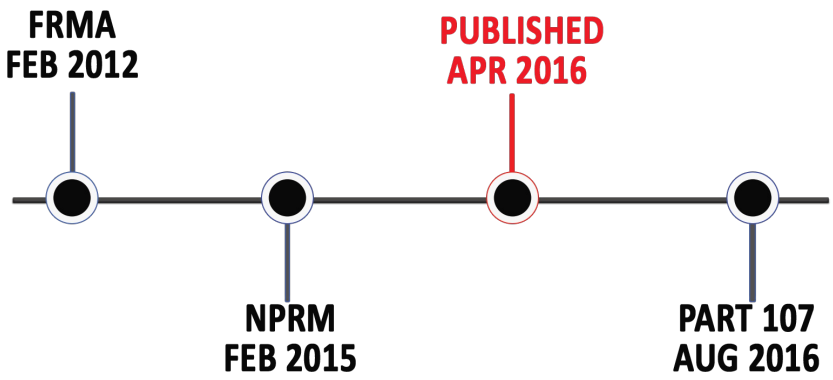
Operation and Certification of Small Unmanned Aircraft Systems (NPRM: FAA-2015-0150-00017) - February 2015
This NPRM included the proposed rules to allow the operation of small UAS in the national airspace. It required the public and other stakeholders to comment on these proposed rules before 24 April 2015. Read more here.

FAA Part 107 - August 2016
The new rules for non-hobbyist small unmanned aircraft (UAS) operations – Part 107 of the Federal Aviation Regulations (PDF) – cover a broad spectrum of commercial uses for drones weighing less than 55 pounds. Read more here.

Aerial Services, Inc. *is a veteran-owned small business located in Iowa. We have been providing professional geospatial services throughout North America since 1967. We specialize in delivering quality remote sensing, mapping and GIS solutions with speed, accuracy, innovation to the public and private sectors. Our main tools are manned, now unmanned aircraft, LiDAR (Light Detection and Ranging) sensors, digital aerial cameras, and other specialized aerial sensors and all manner of sophisticated geospatial software. All phases of a project are produced in-house from the acquisition of aerial and survey data, to the delivery of the digital 3D mapping data, orthophotography, and/or GIS solutions.*

Table of Contents

Chapter 1: "Commercial" Drones, Just Barely



Published at [Aerial Services Inc](#) and [Lidar News](#)

FAA Section 333 exemptions allow operators to fly drones in the national airspace for commercial purposes. We were excited in May 2015 after receiving ours. At last we could use this new technology to expand our remote sensing and mapping operations. We were primed for starting a new profitable business doing amazing things flying drones. On the surface the approval to fly "commercially" sounded great. But after a look under the hood we are no longer encomiasts and our ebullience quickly faded as we uncovered the true nature of the bullyrag regulations. It turns out the Section 333 exemption allows commercial operations but "just barely".

"Our ebullience quickly faded as we learned how restrictive the regulations are."

Like other remote sensing and mapping firms we provide professional services to government and civil entities throughout North America in markets like transportation, oil/gas pipeline, forestry, mining, and power distribution. Typically, the remote sensing is accomplished using manned aircraft and sophisticated sensors like lidar, digital cameras, radar, and gravimeters. Our manned aircraft systems have great "reach". They fly fast. They have large fuel tanks. We can land at any airport, refuel, and keep flying. We can fly virtually anywhere at any time with few restrictions. Therefore, the number and types of applications for which they can be used profitably are numerous and our utilization rate remains high. This is important to realize profitability.

As tremendous as these aircraft systems might be, they are big and very expensive. This makes them ill-fitted for many remote sensing applications. Flying under 1,200 feet, or flying small areas of high or immediate importance, or flying oil/gas pipelines once a month, or performing detailed infrastructure mapping are all either impossible, unsafe, or too expensive to do with

manned systems.

Enter Drones.

Drones are technologically sophisticated remote sensing platforms capable of autonomous flight. Today for the first time in history anyone can fly drones in the national airspace. We have entered a new age of "personal remote sensing". Drones are small, inexpensive, and technological marvels. Drones (almost unbelievably) "fly themselves". The remote sensing and mapping technology bundled with them enable non-mappers to produce sophisticated mapping products. The barriers to entry into flight and remote sensing and mapping are nearly gone thanks to drones.

Using drones we can now fly very low. Mapping small areas is affordable. Mapping infrastructure from the air is now possible and puts no lives at risk. The number and types of remote sensing and mapping applications have multiplied thanks to unmanned aerial systems. Hurray!

But.

The regulatory cords tying drones to a perpetual state of "grounded" are effectively neutering their chief societal benefits and preventing most profitable remote sensing and mapping applications.

Visual Line of Sight

The most limiting operative regulation is that drones must be operated only within visual line of sight (VLOS). That is, the operator must fly the drone only to the limit of his own unaided sight. This means that on a clear day, the drone cannot fly more than one-half to one mile away. For all practical purposes, because sUAS are so small, they can't be observed if much over one half mile away and certainly not if they go around a curve a few yards away. VLOS flight restrictions are the most distressing impediments to profitable remote sensing and mapping applications.

> *"Visual line of sight flight restrictions are the most prohibitive impediments to profitable remote sensing and mapping applications."*

"Corridor mapping" is needed for gas & oil pipelines, highways, rails, and transmission lines. Long corridors that stretch for dozens and hundreds of miles need mapping and monitoring. Although today's small drone systems are technically capable of producing quality, accurate information for these markets, they cannot do so profitably because of the VLOS flight restrictions.

VLOS regulations are so restrictive they have even impacted how drones are manufactured. The majority of the "first generation" drones are fueled by batteries. They have a reach of 15 – 60 minutes of flight time on a single charge. To "refuel" they must be flown back to their take-off location to swap out their batteries. This renders their effective geographic reach to

“miniscule” (a maximum of a one square mile). This, in turn, severely limits the number and type of profitable applications. Sure, some profitable remote sensing and mapping applications exist but they are a small blip of the opportunities afforded manned systems, and less than that compared to the potential that exists for sUAS. Manufacturers have responded with battery systems because no one needs a drone with a 6-hour flight time if all it can do is buzz around like a gamboling sweat bee at a picnic and never venture far away.

> *“No one needs a drone with a 6-hour flight time if all it can do is buzz around like a gamboling sweat bee at a picnic and never venture far away*.”

But it’s worse than that.
If flying a corridor containing trees or hills, the drone can’t be flown “around the corner” behind a grove of trees or around a bend in the road or rails. This effectively renders drones impractical for virtually any type of corridor remote sensing and mapping with the exception of “special case” scenarios where cost is not an obstacle.

Flying Height
A second major regulatory restraint is that flights above 200 feet are not allowed without special permission and only after filing for a “certificate of approval”. This process can take 30-90 days. The request is typically limited to the specific geographic area of the project. In addition, for most remote sensing and mapping applications, flights at 200 feet AGL are simply too close to features on the ground to be practical.

Distance to People & Structures
Another importunate regulation is that “all flight operations must be conducted at least 500 feet from all non-participating persons, vessels, vehicles, and structures”. While flying at 200 – 400 feet AGL, the operator cannot fly over a highway, or people, or houses without passing within 500 feet of these features. The most conservative rendering of this regulation forces the interpretation that if even one person or car might pass under the drone the flight should not be conducted.

Populated Areas
Exasperating the drone operator even more, the Section 333 exemption includes the stipulation that the drone “may not be operated over congested or densely populated areas”. However, there is no definition given for “populated”. Everyone has their idea of what “populated” means. But again, the most conservative interpretation means “no people”, “no cars” should be in the operational area of the drone.

Many drone operators are less than trepidant about these regulations and fly wherever they choose. Others intent to abide by the regulations as they understand them fly over people, over highways, and over urban areas hoping there will be no problems and that no one is the wiser.

Insurance & Liability
But there are legitimate professional concerns operating drones in this manner even if the local

FAA authorities have given a nod to such operations. A firm's professional liability insurance may not cover an "incident" if the drone operations do not comply with the regulations. Because these regulations have not been legally tested and because of the considerable ambiguity with terms like "congested", "populated", "persons", an insurance company may have the standing to deny claims because the operator is in violation of the FAA regulations as written. The wise professional will operate drones using the most conservative interpretation of the regulations so as to avoid liability for personal or property damage.

> *"Regulatory ambiguity forces the wise professional to operate drones using the most conservative interpretation and avoid liability for personal or property damage."*

The Future?

Our future will be one of flying drones. Over one million were sold in the U.S. last Christmas. After the obdurate regulatory burden is lifted (that's optimism!) the landscape will be vastly different from today. Drones will pullulate across the land and sky. Beyond visual line of sight and "softer" regulatory language are being studied now. No one, even the FAA, can say when drones can be routinely sent off "over the horizon" to perform remote sensing. 3-5 years? It's anyone's guess.

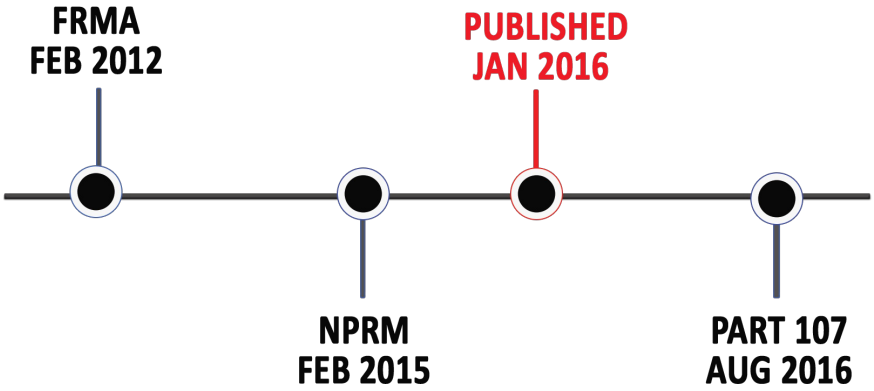
In the near future, we will probably not own any battery-powered aircraft. Their geographic reach and sensor payload capacity is simply too limiting. The next gen remote sensing drones will be designed with gasoline- or fuel cell-powered engines. They will fly for 4 hours to days on end. They will not be landed and refueled at airports but at other waystations located everywhere and specially designed for autonomous drones.

The good news is that just as this article was being published the FAA announced that all Section 333 exemptions (that allowed drones to fly up to 200') were now authorized to fly at 400'. This will make a considerable difference in the number and types of commercial applications in which drones can be profitably used. But even 400' is too low for many, if not most, applications.

> *"Next Gen drones will not be landed and refueled at airports but at other way stations located everywhere and specially designed for autonomous drones*."

When the "final sUAS rule" is released (FAA anticipates June 2016), it may clarify or ease the restrictions that prohibit flying within 500 feet from persons, vehicles, and structures and may allow flights over "populated" areas. Although this is the hope of remote sensing and mapping professionals everywhere, it is by no means assured. In all likelihood, the FAA final rule will still be overly restrictive. It may still feel like swimming in a coffee cup at the beach. If so, the tremendous potential of drones for good will remain confined to this one small speck on the beach of limitless opportunities.

Chapter 2: Just How Accurate is Your Drone?



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Unmanned Aircraft Systems (UAS) continue to influence the profession of remote sensing and mapping like few things ever have. Advances in computer technology, global positioning, and miniaturization have conspired to remove considerable barriers to entry. Many new practitioners are buying drones and providing these services and data for the first time. Much (not all) of the science and art of photogrammetry is now coded on a chip. These advancements enable new practitioners to provide a greater array of services to new and existing markets than ever before and fosters the misperception that "anyone can do it".

New practitioners of drone-based remote sensing and mapping need to understand the fundamentals of remote sensing, mapping, photogrammetry. Typical deliverables like orthophotography, digital elevation models (DEM), contours, cross-sections, and 3D models depend on this understanding. Nescience of these fundamentals is certain to cause considerable pain, financial loss and compromises to public safety. This article introduces the fundamentals of positional accuracy to help new practitioners provide these services consistent with professional accuracy standards.

I have talked with several practitioners that did not know what "ground control" was or how to use it to establish positional accuracy. This lack of familiarity is not uncommon among novices. They may not know that positional accuracy requirements are needed, or that they are often assumed by the client. They may not know how to discuss positional accuracy with their clients, nor how to measure the positional accuracy of their deliverables.

Truth 1: Positional accuracy doesn't just happen.
Professionals know that an accurate ortho (or DEM or 3D model) can look identical to an inaccurate one. Both are "pretty" pictures with lots of great detail, but one has more intrinsic

value for a greater number of uses than the other because it is more accurate.

Truth 2: Positional accuracy is a product of the entire drone "system" (aircraft, sensors, operation, and processing software) not any single component.
It matters very little what the drone vendor says about the positional accuracy of its products. A combination of factors (and seldom a single factor) affects the positional accuracy of an orthophoto, DEM, or other derivative of remotely sensed data. Poor operation of the best drone can vitiate the positional accuracy of a deliverable. If a drone manufacturer claims their camera is accurate to two pixels for any given ground sample distance (GSD), the resultant positional accuracy for the orthophoto is dependent on each of the following factors. [The list below is not a comprehensive list of error sources but includes the major contributors of error.]

A. the cameras inherent potential accuracy
B. the stability of the flight
C. the quality of the GPS data
D. the quality of the inertial system (if the drone even uses one),
E. the quality of the DEM used to make the orthophoto, and
F. the type and quality of processing of the raw imagery into an orthophoto (this factor alone has several important sources of error from a "raw" to "finished" product)
G. the number and quality of ground control points

Each factor contributes some error to the ultimate positional accuracy of the final product. The sum of all errors determines the measurable positional accuracy.

Truth #3: Positional accuracy standards exist and are important.
Understanding accuracy and accuracy standards sets your operations apart from others'. The American Society of Photogrammetry and Remote Sensing (ASPRS) is the major "standards body" for this profession. Their Standards for Geospatial Data reflect the realities of new sensors and digital data. They are "scale- and technology-agnostic". That is, the standards apply to data produced at any scale using any kind of sensor today or tomorrow. They can be used to measure and report the positional accuracy of geospatial deliverables like orthophotography, DEMs, digital surface models, 3D models, contours, topographic mapping, etc.

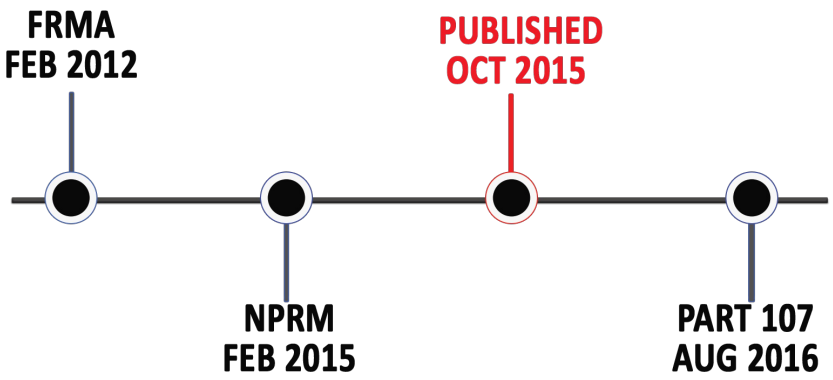
Deliverables with good, consistent positional accuracy can be an important differentiator for your drone-based remote sensing business. Unfortunately, a main cost driver of geospatial deliverables is positional accuracy. More accurate data will generally be more expensive than less accurate data. Profitability is highest when the required accuracy is not "over-engineered" and drives up costs.

Truth #4: Best possible positional accuracy today has error of 1 to 1.5 pixels (RMSE).
What level of positional accuracy is achievable using today's drone systems? Assuming "best practices" with a drone using a metric camera (most drones do NOT have a metric camera), high quality ground control, and solid production procedures (all difficult to achieve consistently) the best possible accuracy for orthos would have a root mean square error (RMSE)

= 1 to 1.5 Pixels (GSD). Are these levels of accuracy achievable flying a drone with a non-metric camera and without any ground control? Not a chance ... not today!

Because increasing accuracy comes at a premium it is imperative that the practitioner understand what accuracy is achievable from their drone “system”, what the client expects, and what is needed (this is often at odds with client expectations) to meet the deliverable's intended use. Because quality remote sensing products and services are difficult to deliver and need considerable expertise that is not yet programmed into the “easy button”, many drone fliers are choosing to collect data and have established firms like Aerial Services produce positionally accurate, irrefragable, geospatial deliverables.

Chapter 3: Is Your Drone Near-sighted?



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Aerial photography is awesome. A near-sighted drone that is unable to clearly see distant objects is a bummer.

The utility of drone photography is directly related to whether important details are discernible in the imagery. The “resolving power” of your drone (a “flying camera system”) is a key consideration. It is imperative to understand resolving power’s impact on your drone deliverables.

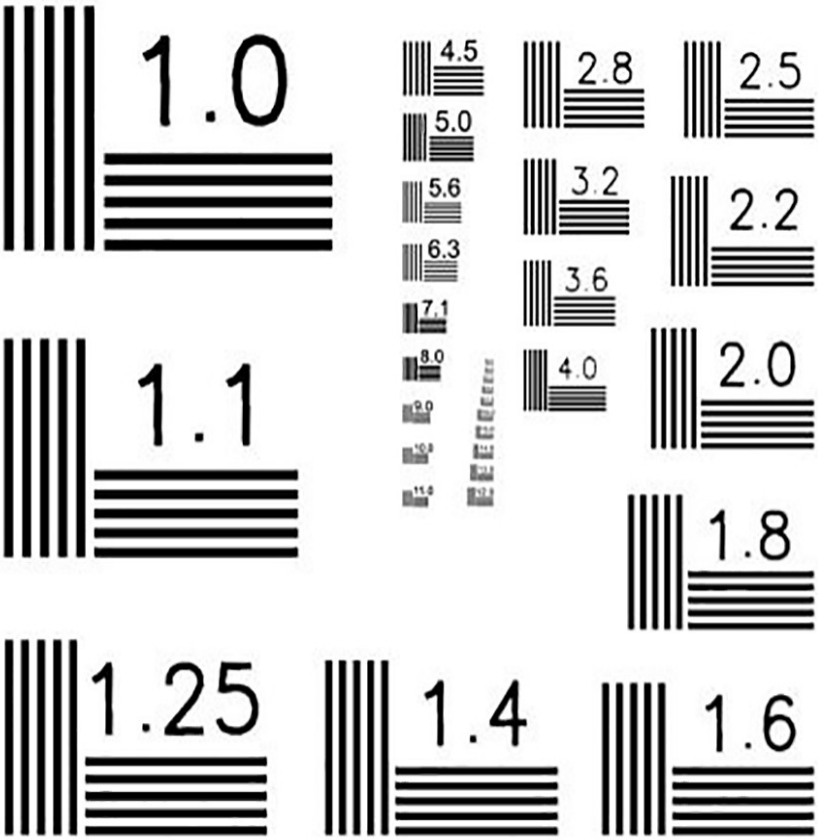


Figure 1. Typical target used to measure resolving power of a camera system. The more lines that can be distinguished from one another as they get smaller and closer together gives an objective measurement of resolving power.

Drones (aka "flying cameras") operate in an inherently unstable atmosphere under constant, random motion where lighting conditions can vary continuously and dramatically. Resolving power is a measure of how much detail is discernable in photography (Figure 1). The ultimate resolving power is a product of not only the quality of the camera and lens but also the performance of the entire "camera system". These and other factors affect the ultimate detail visible in drone photography. Clarity of detail is often needed to accurately measure or map visible features. Clarity (high resolving power) also has a direct impact on the ultimate positional accuracy of the orthophotography generated from the aerial photography. As budding new drone operators or consumers of these professional services we need to understand these fundamentals of remote sensing and mapping.

Camera Motion. Perhaps the most significant factor that can destroy the resolving power of the "camera system" is motion. If a camera is moving at the moment of exposure, the photo is blurred. Resolving power is lost. The more rapid the camera motion, the more blur and the less resolving power. Less and less detail is visible as resolving power is lost.

In our traditional aerial camera systems made for manned aircraft we often incorporate special

features called forward motion compensators. These effectively “push” the camera backward (opposite the direction of travel) at the instant of exposure. This greatly reduces forward motion of the camera and subsequent blurring of the image. Today’s drones do not have these capabilities. To make matters worse, as the camera flies closer to the ground the blurring effect becomes even more pronounced at a given speed. We typically are flying drones at below 400’ AGL where blurring is a real problem compared to our manned aircraft that rarely fly below 1500’ AGL. Without forward motion compensators, there is little that can be done to minimize this loss of resolving power caused by the forward motion of the flying camera.

Figure 2. 3D Robotics IRIS uses a stabilized mount to minimize camera motion during flight.

Wind and Vibration. Not only is the drone travelling at a certain speed but it is flying in this constantly moving, turbulent sea of air. It is lurching up and down. Right and left. Tipping side to side. All at the same time. This motion kills resolving power. Detail that is needed to interpret features in the imagery and contribute to accuracy is increasingly lost. Some drones have stabilized mounts for their camera systems. Many drones do not. Stabilized mounts can provide stabilization in 2 directions or in 3. The best systems will provide 3-axis stabilization. Which of these stabilizing systems are needed for your application?

Vibration is a different source of motion that can have very detrimental effects on image quality and resolving power. The drone engines are the primary source of vibration. Depending on the drone model in use, vibration can be a major source of image degradation. For example, the Sensefly Ebee engines actually shut off just before image capture to eliminate vibration. Other drones have cameras mounted to the airframe on rubber bushings to isolate their sensors from sources of vibration. Ensure your drone has some effective camera mount that limits vibration. Any camera directly attached to the airframe could suffer important losses of resolving power.

Metric Camera. A metric camera is one whose glass or plastic lens has been precisely measured to identify all distortions. These distortions bend incoming light and cause inaccuracies in the resultant picture. Camera lenses cannot be made distortion-free. Not only are there flaws in the manufacturing process but most lenses are intentionally designed to artificially bend light

(Figure 3). The best and most expensive lenses have fewer distortions.

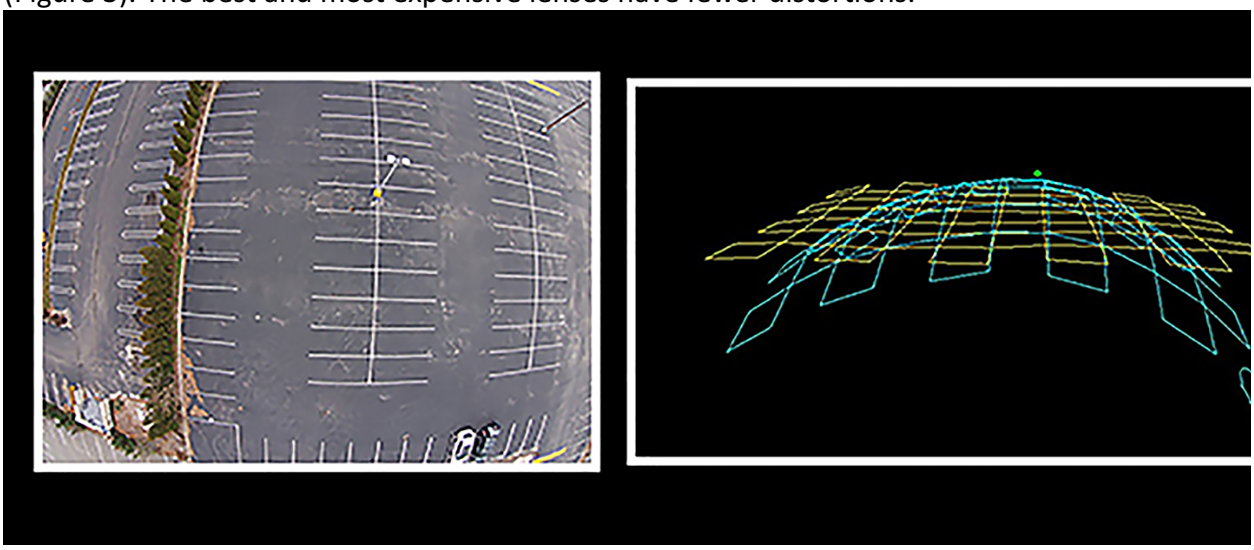


Figure 3. The GoPro "fish-eye" camera introduces considerable distortion into photography (left). Accurately measuring features from this imagery is not possible unless this distortion is modeled out (right) by the image processing software. The amount of distortion in XY and Z is depicted in the center picture. [Credits: M. Kitaif, Cardinal Systems]

Most cameras on drones are not metric cameras. The problem with non-metric cameras is that features in the image are not positioned correctly due to this arbitrary bending of light as it passes through the flawed lens and strikes the CCD. These distortions are very difficult to see with the untrained eye. But they are not trivial and can have a big impact on positional accuracy if uncorrected.

Specialized image processing software is designed to take lens distortion information about a metric lens and "fix" the imagery. It will move pixels back into their "true" position as the image is created as if there was a "perfect" lens. Some drone systems use cameras with non-metric cameras and use sophisticated algorithms in their bundled image processing packages to model out much of this distortion. This is accomplished by precisely comparing where each feature is located in multiple overlapping images and removing the errors in these positions. Although this method may not be as effective as physically measuring distortion values in the camera lens, much of the image distortion introduced by non-metric cameras is reduced using software methods. As a drone operator or are buying drone deliverables it is imperative you determine if the image processing software bundled with your drone has these lens distortion-correcting capabilities.

Figure 4. Dynamic range of the camera is a measure of sensitivity to light. This affects how much detail can be seen in light or dark areas as seen under the canopy in this picture. The picture on the right has much better dynamic range than the one on the left.

Dynamic Range. Dynamic range is another important aspect of a camera system that can have a profound impact on the ability to interpret features in the imagery. Dynamic range is a measure of the camera's sensitivity to light (higher is better). The ability to discern subtle tonal differences in dark (like canopy shadows) or bright areas (like reflective rooftops) is directly affected by dynamic range. Exposure settings of the camera can certainly effect the dynamic range of a photo, but the sensor itself has a hard-coded dynamic range that effectively constrains just how much detail can be seen by adjusting exposure settings alone (Figure 4).

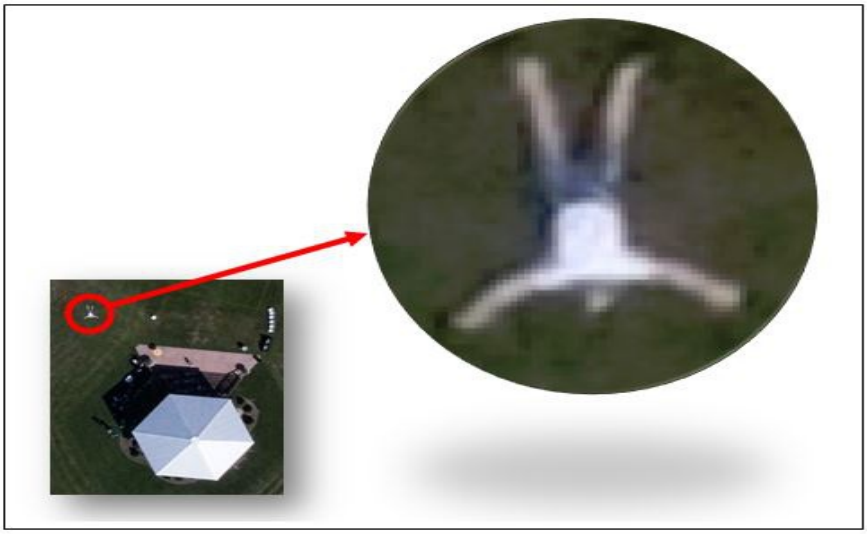
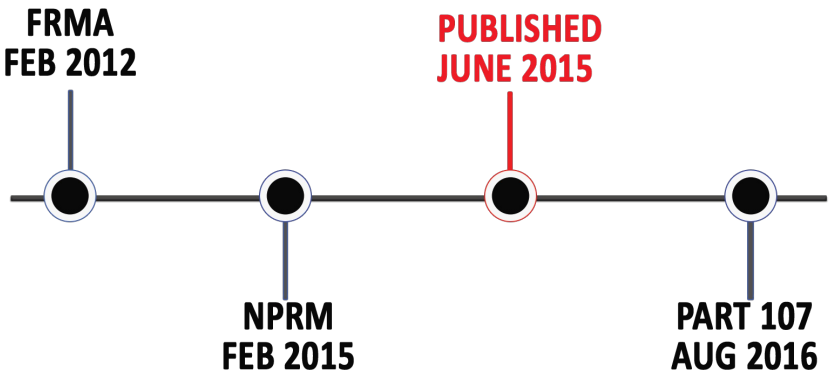


Figure 5. The image (left) is a 4 cm GSD photograph taken by a quality drone camera at 400' AGL. However, even though this is a very high resolution photo, the resolving power (right) has been impacted so severely that very little detail is discernable in the man's features. High resolution does not automatically equate to high resolving power!

Finally, it is prudent to mention a very common misunderstanding about image resolution (pixel size or ground sample distance GSD). Many people wrongly believe that high resolution imagery will have high resolving power (the ability to see tiny details). Although increasing resolution may generally be related to increasing resolving power there is no direct relationship (Figure 5). A high resolution blurry photo (due to excessive motion) with poor dynamic range will ultimately be a high resolution blurry photo with little discernable detail. It will have very poor resolving power. Do not make the false assumption the two always come together. The quality of the camera system and the crews operating skills while conducting the flight and while processing the imagery all have profound effects on the achievable resolving power of the imagery … even if it is super high resolution.

Drone operators or firms procuring remote sensing and mapping services from professional drone operators should understand the importance of resolving power to their applications for the aerial photography. When procuring a camera system (drone + camera + software) it is important to ask the right questions to ensure the camera system's performance will meet the intended use. Likewise, the professional procuring drone services should know what to ask the provider to ensure the deliverables are more likely to meet desired quality specifications.

Chapter 4: Implications of Drones on American Privacy and Freedom



Published at [Aerial Services Inc]

Unmanned aerial systems (UAS), aka "drones", are an amazing and capable new technology. We are witnesses to the beginning of a revolution and the introduction of disruptive technology that will fundamentally change access and use of the national airspace and create tremendous new economic and humanitarian opportunities. But like any disruptive technology in days gone by, it comes with warts. It can be applied to "good" and "evil" ends. The technology itself is neither. But its application can cause great "harm" or great "good".

Drones have grown up in the theater of war over the last 20 years being used primarily to "kill" and "spy". As this technology is unleased in our neighborhoods and businesses for "work" and "play", citizens will have to sort out which applications are threatening and which are not. Wise public policy will be needed to encourage the technology and the tremendous good it promises, but curb the harmful applications of that technology.

Imagine a person peering across your yard into your home with a camera through open curtains and at the partygoers on your deck all afternoon from a public spot. Although you may find this creepy, that person is not violating your privacy. He's not trespassing, and you have no "reasonable expectation of privacy" outside on your home in plain view of anyone who looks that direction. Most of us understand this and accept it. Likewise, in many cities we are photographed continually as we walk down the street by surveillance cameras inside stores owned by shop keepers and on poles operated by the government. Knowing this we continue to frequent these areas because we are mostly comfortable with this concept of "no reasonable expectation of privacy" when in public places.

"The liberties of our country, the freedom of our civil constitution, are worth defending

against all hazards: And it is our duty to defend them against all attacks."
– Samuel Adams

But move that camera into the sky out of view on a drone operated by the government. This is called "persistent surveillance".

It is still only photographing people in public places. There is still no "reasonable expectation of privacy". But we start feeling creepy. There are a number of reasons:

The government is surveilling us.

One cannot sense they are being surveilled. The camera is secret. It can't be seen or heard.

The camera is no longer recording your movements while on or near that single property, but across the entire city.

Everyone's actions are being recorded continuously for long periods of time.

This single recording are in the possession of a single government actor.

We don't know who is using the information or how it is being used.

Technological advancements often enflame legal and cultural sensibilities because they often "enable" new activities that have not been practical or possible. Current law and practice never imagined these situations. Examples abound: the moldboard plow, gunpowder, nuclear fission, the assembly line, anesthesia, the internet, the personal computer, photography, vaccination, and the pill. All of these technologies promised (& delivered) great good, but enflamed legal and cultural norms. Public debate ensued and new understandings evolved. Legislation was changed to allow and control the technology to balance their "good" and "evil" application in society.

Drones are no different.

Persistent surveillance could do great good. It was used in war zones to detect bombing of American troops then track back in time and observe who set the bomb. Then the same recording was used to track the perpetrators current location and arrest or kill them. With persistent surveillance over our cities, most traffic accidents would be recorded so "fault" could often be discerned. Many crimes, even murders and kidnappings, could be solved by witnessing them occur then following the perpetrators to their present location for arrest. Child abductions could be solved rapidly. Real lives will be saved.

However, this good cannot be considered separate from the real evil applications that would threaten our liberty and property. Not only are the 1% criminals among us being surveilled, but also the 99% law abiding citizens. The government now has detailed information on all of us.

Who did you visit? With what groups do you associate? With which merchants do you do business? How do we know how the data will be used by the government? How will my activities be interpreted by a bureaucrat? How long will the data be archived? How do I know?

If one political party (especially the one you disagree with) controls most of the government, what pressures will there be to illegally and secretly use this goldmine of information against their enemies? This is not a fictional scenario. We are seeing it played out before our eyes more and more commonly:

A. The 2013 IRS scandal where selected conservative political groups applying for tax-exempt status were targeted and harassed.
B. The NSA violating the law and collecting unknown masses of information about all US citizens using PRISM;
C. The FISA Court, established to oversee the NSA and ensure its secret operations remained legal, making "secret" rulings and interpretations that were not shared with congressional oversight committees.
D. Big government is acting more frequently with less effective congressional oversight and accountability. Can we trust the government with a far greater volume and breadth of information about its citizens?

One could respond: "Sure! I have nothing to hide. Only if you're doing something wrong should you worry, and then you don't deserve to keep it private. If you've got nothing to hide, you have nothing to fear." But even Supreme Court Justice Breyer said "The complexity of modern federal criminal law, codified in several thousand sections of the United States Code and the virtually infinite variety of factual circumstances that might trigger an investigation into a possible violation of the law, make it difficult for anyone to know, in advance, just when a particular set of statements might later appear (to a prosecutor) to be relevant to some such investigation." If the federal government had access to every person or group you visited and every email and phone call I've ever made, it's almost certain that they could find something you've done which violates a provision in the 27,000 pages of federal statues or 10,000 administrative regulations. [By the way: that was the size of federal statutes and regulations in the 1980's. In 2013, the Congressional Research Service reported that they lacked the manpower and resources to accomplish the task.] You probably do have something to hide, you just don't know it yet.

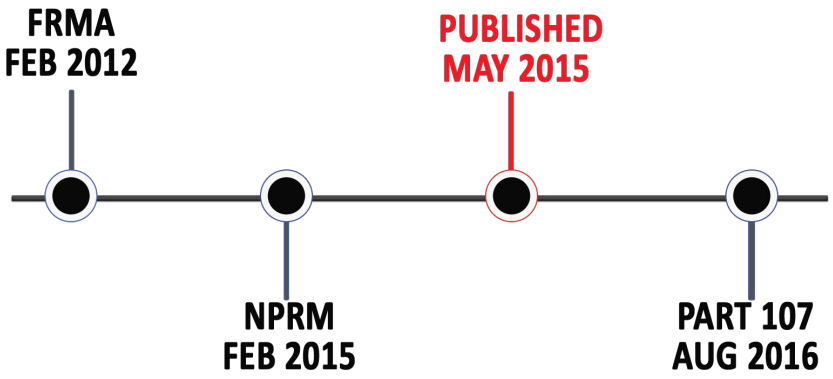
We all have something to hide. But this does not imply as the above quote presumes that we want to hide "bad" or "wrong" things. We all have curtains in our home. We don't make public our credit card bills. We don't tell our coworkers how much we are paid. We insist on warrants before our privacy and property is violated by government. Not because we are "wrong" but because "it's none of your darn business".

Privacy takes many forms: disclosure of my secrets, revealing information about me, blackmail, improper use of my personal data, and the simple compilation of an extensive dossier about me.

Surveillance can inhibit lawful activities like free speech, free association, and other First amendment rights essential for democracy. It can impart a real sense of powerlessness and vulnerability to the individual through indifference, error (think government leaks or the theft of government databases), abuse, distortion, frustration, or lack of transparency and accountability. Privacy is slowly eroded through a series of relatively minor acts or regulations. "Privacy is rarely lost in one fell swoop." Privacy and Liberty are joined at the hip. You can't have one without the other. As Privacy is lost Liberty dies. The annual Index of Economic Freedom shows the USA slipping ever faster (especially since 2008) to #12 in the world. By any measure our liberty is slipping away.

Liberty and security are not mutually exclusive. Though difficult, we can reconcile the requirements of security with the demands of liberty in a manner consistent with our Constitution. We need to consider legislation calmly and deliberately with a determination not to erode the liberties and freedoms that are at the core of the American way of life and our economic vitality. To be truly free means accepting some measure of insecurity knowing that not all bad guys or ill will can be stopped, ever. Sacrificing too much liberty for utopian security will ensure the loss of both by a government bent on tyranny … "to keep us safe" in our golden, trans fat-free cage.

Chapter 5: Comments on the FAA Proposed Rules for Drones



Published at [Aerial Services Inc]

The Federal Aviation Administration (FAA) released in February the long-awaited draft rules on small UAS. Aerial Services submitted comments on these rules before the first public comment period ended on April 24th. These draft rules are part of the 2012 congressional FAA Reauthorization Act that mandated the establishment of rules and standards for the full integration of sUAS into the national airspace by September 2015. The rules represent a "proposal" only and do not change the extant ban on commercial applications. Unless an operator receives an exemption from the ban that prohibits commercial operations. It may take another 18-24 months of review before the FAA is able to establish the "final" rules.

The rule making process allows for the public and stakeholders of the national airspace to critique and comment on the proposed rules. The hope is that a fair and wise government "of the people" will use those comments to craft rules that balance the legitimate, and often, conflicting concerns of competing stakeholders.

Aerial Services' comments on the proposed rules focused on several main ideas. The rules allow for operation of drones in visual line of sight only. Further, a visual observer must assist the drone operator and nighttime flight is not allowed. These restrictions we feel are unwarranted given current technology. Operation of drones beyond the visual line of sight is not only possible using current technology, but will foster a much safer application of this technology. We described in an earlier article how existing technology coupled with drone manufacturing standards could enable the safe operation of drones beyond visual line of sight. This plan consists of three fundamental components.

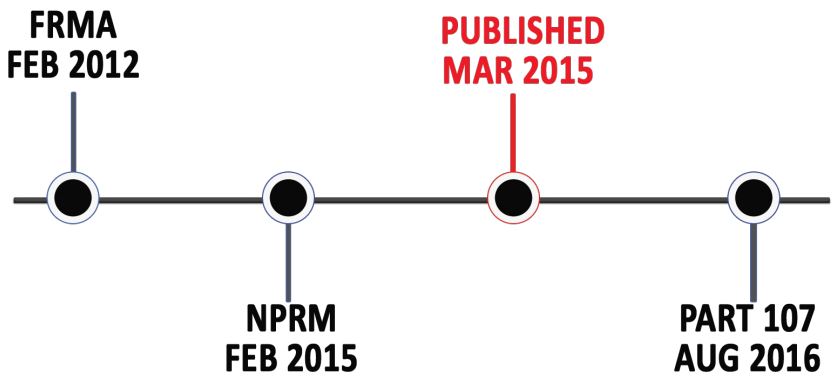
First, all drones sold in the U.S. should meet minimal manufacturing specifications. These guidelines would mandate safe materials and design that foster safe operation. Without certification to these standards, a manufacturer could not sell the drone. Second, an operator must upload to a national database the drone's flight area of operations. This national, constantly updating database then designates each area as a "no fly zone" for other manned and unmanned vehicles. The drone's on-board computer prohibits flight until after it has made contact with the database and downloads nearby restricted areas. Third, the flight management system (FMS) in all drones would check for the constantly updated list of restricted areas. "Restricted" areas would include all areas occupied by other drone operations. For example, drones could not fly within three miles of airports, over 500' AGL, near sporting events or parades. In fact, the drone's FMS would prevent an operator from flying the drone into any other restricted area. The operator could not override these instructions. It follows that if the operator is confident that other drones and manned aircraft would not be in the operational area a second visual observer is not needed. This frees the operator to observe the drone with visual aids while the drone flies on a preprogrammed mission. The FAA already has data that indicates it is extremely difficult for general aviation pilots to see and avoid each other. When flying these tiny drones the probability of detection using the human eye becomes even smaller. Defining operational areas for each drone and preventing manned and unmanned flights from entering those areas would eliminate the majority of collisions. Operations at night should not prohibited. With additional lighting on the aircraft there is little justification for

restricting night flights, especially within visual line of sight. If small drones can fly during the day, then there is little increased risk if flown at night with proper lighting. The proposed rules also restrict flying over “populated areas” and that a drone cannot be flown if “any single person within the area of operation is not inside a structure”. This definition of “populated area” is overly restrictive. Drone operations should be allowed over populated areas unless an area has been designated “restricted” (like a stadium, parade, white house, etc.).

Micro drones are so small they can fit in your hand.

Aerial Services also recommends that a new category for “micro drones” (<5 pounds) is needed and should be regulated apart from small UAS. These aircraft are the size of sparrows and represent a tiny risk to people and property. If micro drones are manufactured to standards, operators should be allowed to fly them under 500’ AGL. In fact, the draft rules even forbid flying these tiny drones using pre-programmed flights. This is overly restrictive. The micro drone category of unmanned vehicles has tremendous economic and social potential. Restrictions as proposed will undercut this potential. This sector of the drone market will grow to be extremely important if the FAA loosens the restrictions. Market analysts estimate that commercial UAS will create $13.6 billion in from economic value. Upwards of 70,000 new jobs are possible in the first three years after full integration. UAS are already selling within the United States at levels far greater than anyone anticipated just a couple years ago. This has occurred within a regulatory environment that forbids commercial application! These amazing tools will become immensely popular and prove to be indispensable to many segments of our society. This is an observable fact in other countries in which drones fly for commercial purposes. The FAA has the ability to usher in a new wave of safety and innovation with its rule-making for small UAS. Therefore, it is important that the FAA listen to stakeholders. The FAA needs to establish risk-based rules that promote safety, create new economic opportunities, and help spur innovation.

Chapter 6: Why we love drones (and you should too)!



Published at [Aerial Services Inc](#) and [Cedar Valley Business Monthly](#)

"Drones." We've all heard of these flying machines by now. Maybe you bought one for Christmas and fly it with your iPhone. The Parrot Bebop costs about the same as an iPhone and is flown using it. A six year old can fly it and see what it sees using its hi-def camera. Approximately 150,000 Drones were sold in the U.S. last Christmas. Drones will eventually come in all shapes and sizes and will be designed for a myriad of uses … most we have not yet even imagined.

Drones are here to stay!

Aerial Services, Inc., located in the Cedar Falls Industrial Park, is a remote sensing and mapping company that has been flying manned aircraft. We're interested in drones too (aka Unmanned

Aircraft Systems - UAS). They represent to the geospatial and remote sensing professions the most significant onslaught of enabling technology since the first camera took flight 150 years ago. No previous technology will have a bigger impact! Today, folks are not allowed to fly Drones for commercial or business purposes, but anyone can fly them recreationally. Once this technology is combined with virtually unrestricted access to the national airspace for anyone and for any business, the repercussions to our professions, our culture, and economy will be tremendous. This will happen within the next two years, and when it does personal & commercial interests could take to the skies like a nest of disturbed hornets. The eventual application of Drones will not be restricted only to Aerial Services' pursuits of geospatial and remote sensing. They will influence many other major areas of commerce such as transportation, shipping, surveillance, recreation, wildlife management, and many more.

The Parrot BeBop Drone (really just a "flying camera") costs about $500 and is operated using on a smart phone.

Miniaturization, location, and wireless communication technologies have conspired to enable free-flying (pilotless and remotely piloted) aircraft to safely crisscross our skies unlike never before. Today, except for the 0.6% of the pilots among us, few American have access to "up there". Now the common person and ordinary business with a few bucks is able to fly. "Personal remote sensing" is possible. Drones are a "great enabler" for the masses to perform remote sensing and recreate. This is the really "revolutionary" aspect of Drones and why they will impact our society and culture so notably. Assuming government over-regulation does not throttle the application of Drones, it's difficult to not envision a reality where anyone, around the clock, everywhere on earth is performing remote sensing.

Drones will be doing an unprecedented amount of remote sensing and much of their work will have never been done before simply because it's been unaffordable, impractical. Drones are radically changing the soup of possibilities.

"Flying sensors" that make no sound will enable us to learn and witness amazing secrets of wildlife. We will learn about climate, hurricanes, and tornadoes … things unimagined as hordes

of inexpensive seeing, smelling, X-ray-vision robots are sent into their violent, thrashing hearts. We will learn about air, pollution, migrations, and human activity using vast networks of tiny, flying, sensing, communicating robots tethered invisibly to the sky all over the globe.

Consider that after the automobile became affordable, and roads and fuel were available wherever we wished to drive they enabled for the common person the uninterrupted travel across vast distances. No longer would most of us die within 30 miles of where we were born. Whole new industries like gas stations, motels, amusement parks, travel/leisure were borne. Similarly, as we all fly affordable Drones into the 3D fabric of sky suspended over our 2D terrestrial existence, we will see amazing innovation, exploration and a comprehension of "big things" that are unfashionable or impossible today.

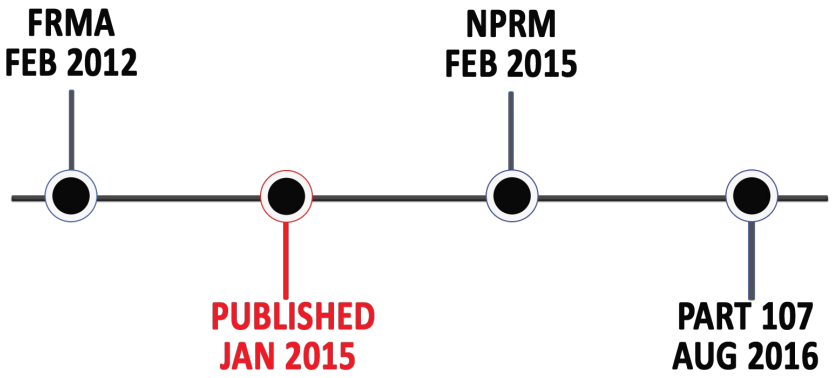
Virtual reality technology, like Occulus Rift, will certainly be further enabled by UAS in many compelling business and recreational activities.

Another related and important new technology is aligning well with the Drones and open skies: virtual reality. Occulus Rift headsets are set to make a big impact in our lives and work. The combination of Drones and inexpensive, realistic virtual reality will further open up for the common person the 3D blue marble on which we live. Anyone can "climb aboard" a small Drone and tour the Grand Canyon, even remotely pilot the vehicle, and fly wherever they want within a geo-fence imposed by the provider. This newest virtual reality technology has the potential to redefine human experience and will most certainly be integrated to Drones and provide the masses with views from above that have been impossible (or at least uncommon) to date.

Access to the skies is about to explode. Drones will become a platform supporting tremendous business, scientific and recreational activities. Personal remote sensing by individuals and businesses will become routine and common. The boon for business, culture, science and recreation is hard to overstate. It promises to be exciting to participate in this transformation.

Tomorrow, we will scarcely imagine how we lived without Drones.

Chapter 7: Important UAV Tech for Mapping



Published at [Aerial Services Inc]

Someone once said: "Better to be approximately relevant rather than precisely irrelevant." As we see commercial UAS exemptions dripping out of our Federal leviathan bureaucracy, actual remote sensing and mapping applications in the U.S. may become more common. If true, then practitioners (experienced and not) using these new technologies need reminding of some basic truths. Small UAVs are an entirely new platform for remote sensing and mapping. The aircraft, sensors, and software differ substantially from the manned systems used for decades. The techniques used to provide information from remotely sensed data are changing too. The practitioners who hope to apply these tools to this art and science, the foundational principles of remote sensing and mapping remain unchanged and must be understood to fully exploit these tools and create meaningful deliverables.

That said, this author is a remote sensing "professional" and I am describing the application of a transformative technology by innovators. "Professionals" engaged with the "old order" of doing things are often blinded to seeing "the new way". Therefore, myself and the reader are cautioned to take heart the old proverb:

The ark was built by amateurs, but professionals built the Titanic.

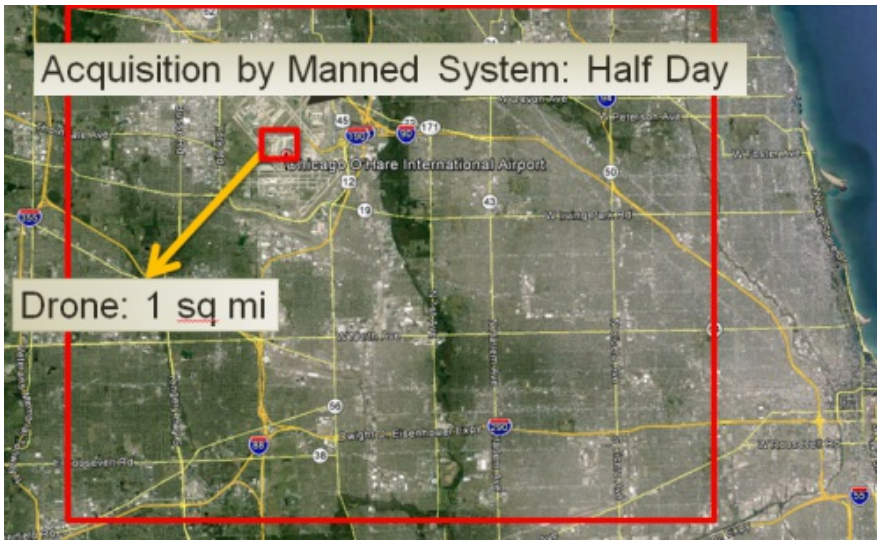
Acquisition

Wind

Many of the sUAS weigh under 10 pounds. Excessive movement of the sensor causes blur in the imagery and maybe holes in the coverage of an area. 15-20 mph winds are a lot. How stable is the aircraft in winds? Are the sensors “stabilized” so atmospheric forces are minimized? There are many applications that will require stabilization in both two and three dimensions. Stabilization can be active and passive. Know what you are getting.

Time & Space

It takes time to remotely sense a piece of the planet. Most of the time the project area is distant from our office and travel to the site is required. We call these “small UAS” for a reason. They are tiny and slow. Their sensor footprints from 400’ above ground are quite small. It will take considerable time to capture the entire area. How much area can I cover per hour? How long will it take? What are my contingencies if I can’t capture the area once I get there because of wind or weather or malfunction?



For perspective consider that using manned aircraft today, we can easily photograph 250 square miles in half a day at 6” GSD. Using a small UAS like the SenseFly Ebee we might be able to acquire 1 square mile in the same time. There are economies of scale here that practitioners need to carefully consider. That said, drones have their advantages here. Manned systems can’t typically get 1” resolution from the air. Manned systems require licensed pilots with specialized skills, expensive aircraft and camera systems to fly. Matching this new tool to the right application is key.Drones are Cool Image

Training

Without sufficient preparation and training crews will struggle to be effective. Are your pilots and observers trained? Are you carrying all the needed components (drones, computers, batteries, cables) and spares (drones, computers, batteries, cables)? What are the criteria for deciding whether to deploy a crew given certain weather expectations?

Power

Manned systems can run for 6 hours or so. Today’s sUAS typically run on battery for 30 minutes or so (less on a windy day). Many sUAS can remotely sense 100 acres per battery. Recharging batteries in the field is slow. Do you have 3-4 fully charged batteries in the field? Do you need a gas-engine drone?

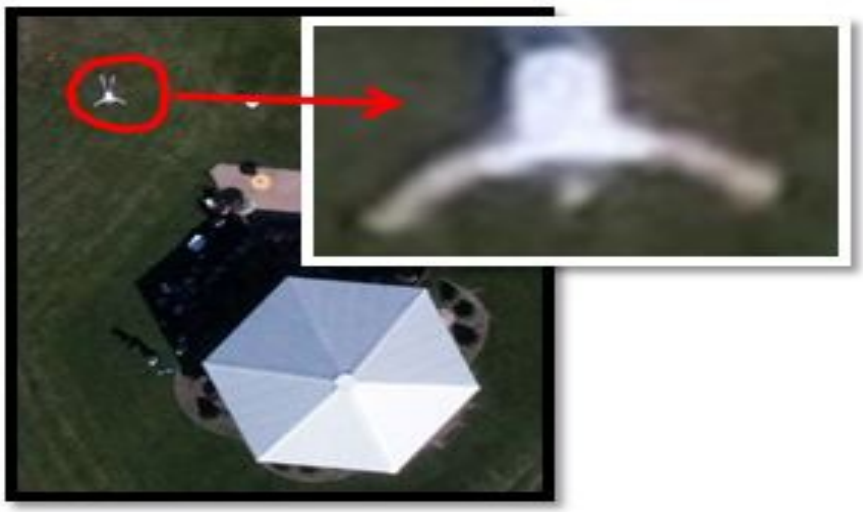
Ground Control

There are requirements for “good enough” and then there are requirements that need a prescribed level of positional accuracy. What is needed? How many ground control points are required to achieve the specified accuracy? Why does this matter? What is the intended use of the deliverables? Many new drone users know nothing about “ground control”. This [and positional accuracy] are a couple concepts that can be ignored only at your own peril.

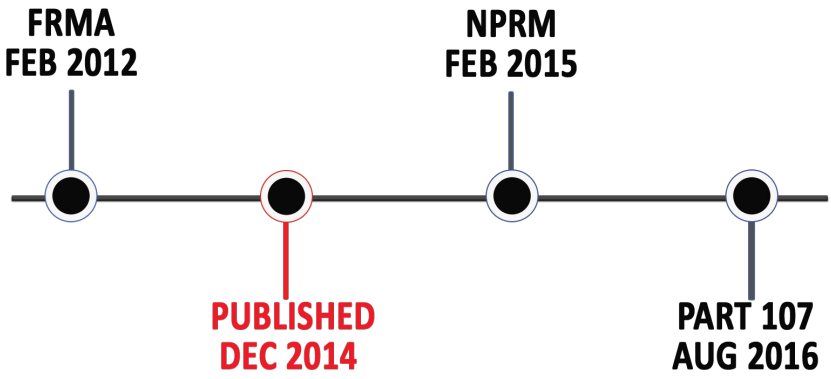
Cameras & Imagery

There are a number of important considerations when it comes to cameras and the resultant imagery derived from them. For example:

A. Metric: What is a “metric” camera? Are these important for my application? What are the “costs” associated with using a non-metric camera? What effects will this have on the quality and accuracy of the resulting imagery?
B. Resolution: How big are the pixels from a given altitude (ground sample distance – GSD)?
C. Dynamic Range: Good resolution is often negated by poor dynamic range. Dynamic range is a measure of the camera’s sensitivity to light (higher is better). Look at the images to the right. The image acquired had very high resolution (approximately 1” GSD). But when you zoom into the man lying in the grass, the details of his head can’t be discerned and the reality that he has a head is almost unclear. How can this be with 1” GSD? This is mostly due to poor dynamic range.



Chapter 8: A Plan to Integrate Drones Safely into the National Airspace Today



Published at [Aerial Services Inc]

Today anyone can strap wings on a pig, stick a GPS on its ear, call it a drone and go fly it. Of course, they have to fly it secretly, under the radar, because most uses are still prohibited by the FAA. In the current regulatory environment promulgated by the FAA and frustrating the nation, there are few regulations that positively promote the safe operation of small UAS (sUAS). An outright ban does nothing to positively promote safety. Manufacturing standards, for example, are needed now. I could fly a pig! Commercial uses must be allowed now.

The safety of the National Airspace System (NAS) is being increasingly compromised even though virtually no one can legally fly drones. For example, drone sales are at record levels this holiday season. Most of these drones are being sold to people unfamiliar with aviation rules and regulations and with little or no knowledge of basic concepts of "safe flying". There could be well over 50,000 drones aloft in the NAS now and virtually none are registered. Public safety is threatened today precisely because irresponsible drone use is encouraged.

We operate in a regulatory environment devoid of positive rules that promote safety. Current rules simply ban most legitimate uses. But pigs can fly! Drone operators are frustrated with the lack of direction and will fly because they can. This works against public safety. Additionally, there are now reports that there is growing Congressional pressure to marginalize FAA safety experts. Constituents want to green light the commercial operation of drones after enduring years of FAA bureaucratic inefficiencies.

Everyone is frustrated. The system is NOT working. We need not be in this predicament!

A sUAS integration plan is needed that fosters the immediate and safe use of drones in the

NAS. We can't wait for the lethargic FAA bureaucracy to act years from now only to impose restrictive rules that will not make sense to commercial, scientific, and recreational drone use.

I propose a plan here.

But first a disclaimer.

I don't pretend to be an expert on the NAS and FAA rules, but a system of rules that encourage the safe flying of drones by anyone is needed now. This proposal describes one such system. Experts will find holes in this proposal and I welcome a dialogue that establishes progress.

I offer this plan as starting point of that conversation.

The Plan
First, Congress must recognize that the NAS is "public land". Like our national parks, access and use is to be encouraged. It must be controlled. It must be safe. But unreasonable restrictions to access and use cannot be made. We can devise a system that responsibly balances access and use with public safety.

Next, Congress should pass legislation today that requires all drones sold in the United States adhere to basic standards of design, manufacture and safety. The aircraft must be comprised of materials and components compliant with safety standards. For example, the sUAS must be made of lightweight material and wings or rotors that will break off on impact. Rotors must be encased in some kind of protective shield so they cannot injure operators or the public. Or, better yet, certain aircraft (heavier, more lethal) are licensed to operate only in rural areas where the threat to people and property is less.

Operator License
A drone cannot be flown in the NAS without its operator being licensed. This license would not be a "pilot's license". Much like a driver's license, a new class of sUAS license is established that simply affirms the operator has some basic understanding of aviation safety and operating in the NAS. Even more like a driver's license, it must be renewed periodically and should require passing a standardized test.

All drones, like automobiles, must have a unique identification number. This number and the responsible owner/operator is recorded with the mandatory aircraft registration.

All drones must be constructed with GPS and a flight management system. The drone must know where it is at all times and know from where it came and to where it has been programmed to travel. If this system becomes dysfunctional when in operation, the flight management system must instruct the aircraft to land safely.

The Master Restricted Flight Area Database
All drones must be constructed with firmware that incorporates a database of restricted flight

areas. The firmware controls the flight of the aircraft and would prevent the operator flying the drone into these restricted areas. These systems would be designed so any attempt to bypass them would be difficult and traceable. This would deter tampering for the majority of users.

Some drones are already using similar systems. These systems have all airport locations programmed into their flight management systems to prevent the aircraft from penetrating these restricted areas. This “Master Restricted Flight Area Database” (let’s call it “MrFad”) would be similar but include any and all restricted flight areas.

Drones cannot fly in restricted areas.

All drone flight management systems must require a flight plan to be uploaded to the aircraft before each flight. Flight cannot occur without legitimate instructions that define the time(s) and location(s) the aircraft will operate. Uploaded with the flight plan is the identification of the operator and the registration number of the UAS. Once uploaded the firmware connects to MrFad and updates it with its new flight plan, aircraft identification, and operator ID. This flight plan becomes a new restricted area. Only this drone can operate in this area during the defined time. Simultaneously, the database-embedded firmware is updated with any other flight plans in the operational area. Conflicts with other flight plans are identified and resolved. Or, perhaps it makes sense for MrFad to allow some or all sUAS (but not manned aircraft) to fly in the same area at the same time.

The required cellular technology needed to make the connection to MrFad is inexpensive and lightweight. It should not be a technological or financial burden on drone design or cost. Because this is a key component for safe drone operation, the low additional cost is easily justified. If the drone’s flight management system cannot make a connection to the master database, the firmware will not allow operation in the NAS. Exceptions for operations within 500’ of its base station (lift off location) could be allowed so drones and onboard systems (like cameras, GPS, and lidar sensors) can be tested without filing a legitimate flight plan.

Once MrFad is operational, restricted flight areas of many types and sizes will be continually created and uploaded to MrFad throughout the U.S. Modern communications and database technology can easily support this level of complexity.

All areas within 5 miles of airports will be permanent no-fly zones. Any portion of the NAS above 400' above ground level will be permanent no-fly zones. One can easily imagine a system whereby an operator can request and be authorized to penetrate non-fly zones by an aviation authority.

But many other different types of restricted airspace can be defined and included in MrFad at any time. For example, the area around major (or minor) sporting events like football stadiums when filled with people may be defined. Areas around large parades and demonstrations may be defined as no-fly zones. The area around the Kodak Theater during the Academy Awards may be defined by local authorities as no-fly zones for a short time before, during, and after the event. These are good examples of no-fly zones that are transitory in space and time and used to guard the public safety. They define a specific area of "no penetration" but exist only for a defined length of time. When in effect, the drone cannot fly into these areas even if the operator instructs it to do so.

Restricted flight areas could be defined as block areas (a stadium, a quarry, a national forest, or a downtown area) or linear areas (following a pipeline or transportation corridor). All restricted areas will be defined geographically and temporally so they exist and cease to exist within a defined geographic space and time window. A drone operator may be prevented to fly over a crowded soccer field during the game, but could fly over it after the games are over and the people have dispersed, for example. A restricted area could be defined as permanent (The White House), temporary (over demonstrations), or recurring (whenever there is a football game in the stadium).

Important to MrFad is that every sUAS mission uploaded also becomes a no-fly zone for the duration of the flight of that drone. This will prevent drones from flying in the same geographic space at the same time. Special exemptions could be designed in MrFad to accommodate an operator using a swarm of drones in an area. Other exemptions could be designed so emergency management personnel get priority (and exclusive) access.

It is possible that some cities will define their entire metro areas as no-fly zones. This could be perceived as an unfair restriction of a public space. Public policies will need to be established that define who has authorization to declare some public space as a "restricted area". But this system allows for this type of flexibility. MrFad will record the identify of the person establishing the restricted area, contact information, and affirm they have that authorization. Some types of restricted areas will require higher levels of authorization than others. Non-drone operators, for instance, may require more authorization before they can restrict public airspace. The operator that wants to fly his sUAS over a new subdivision for mapping purposes has a level of authorization as an "UAS operator". But the Government or Emergency Management Official that wants to define some area as off-limits for some period of time, must have a higher level of

authorization to declare the area as restricted and remove it from the public airspace. Public policy can be established that defines what types of geographical areas can be designated as restricted areas and for what periods of time. This will prevent unjust or unwarranted declaration of areas as no-fly zones and ensure the predictability of the NAS and limit the undue restriction of commercial, scientific, and recreational drone operations.

A "for-profit" or "not-for-profit" firm should operate MrFad. The management, maintenance, and control of MrFad need not be a government agency. In fact, it is important that it NOT be a government agency. The federal government's role is best suited to regulating and overseeing the operation of the MrFad to ensure their standards are sound, reasonable, and safe. Firms exist today in the satellite, aviation, and geospatial fields that could easily manage this national database.

A "UL" for Drones

Much like the Underwriters Laboratories (UL), a new safety consulting and certification company will certify UAS firmware (and aircraft construction and components) as "in compliance" with technical and safety specifications. (Let's call this the UL-UAS). Much like the UL we are all familiar with, this could be an international standards for-profit or not-for-profit organization. This need not be a government agency. For the same reasons as MrFad, it is important that it NOT be a government agency. The federal government's role is best suited to regulating and overseeing the operation of the UL-UAS to ensure their standards are sound, reasonable, and safe. Much like electronic goods produced today, without the UL-UAS "seal of approval" the equipment could not legally be sold or flown in the United States. Any operator found to be operating an aircraft without this certification or operating an altered, non-compliant aircraft would be fined or jailed.

Insurance Requirements

Liability insurance must be required for all commerical operators. Any recreational operator using these aircraft in populated areas would also need insurance. The insurance could not be obtained unless the aircraft was certified as UL-UAS approved. The insurance industry is already creating products to mitigate UAS liabilities and additional products will be established.

Keeping Manned Helicopters and Civil Pilots Safe

Manned helicopter and civil aircraft (like agricultural applicators) regularly penetrate this 400' AGL portion of the NAS which is designated as a "fly zone" for drones. Without some policy changes, the manned systems could collide with drones flying in these areas. These collisions could cause serious harm or death. Therefore, new FAA policy is required so these types of operators are required to file a flight plan defining the geographical and temporal limits of their operations. These are then uploaded into MrFad and become restricted flight areas. Today, these operations are not always required to file detailed flight plans. This must change to ensure that manned and unmanned systems can safely operate in this increasingly congested portion of the NAS.

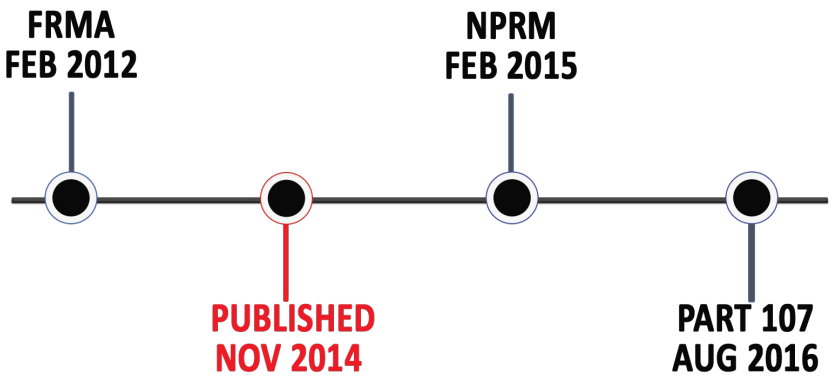
These proposed rules and systems will enable safe commercial and recreational operations

beyond the line of sight within this tiny portion of the national airspace. The plan is needed now to encourage the tremendous economic, scientific and recreational potential of sUAS.

The safe operation of sUAS is possible today with a system similar to the one described here without waiting for affordable sense and avoid technology. Waiting for the slow bureacratic rule-making of the FAA is not needed to establish a safe system.

Is this proposed system absolutely safe? No. There will be accidents. People will violate the rules and operate drones in unsafe, unprofessional, and irresponsible ways. However, good legislation, sound policy, aircraft standards, and insurance instruments will stigmatize and deter the would-be violator. There is some level of acceptable risk with every technology and system. It is impossible to eliminate all risk. This proposed plan balances the responsible, robust use of drones and public safety.

Chapter 9: Drones: Mapping the Future



Published at [Aerial Services Inc]

The clip at which Unmanned Aerial Systems (UAS) are maturing is rapid. Drones are the most important, most disruptive new technology in many decades especially for remote sensing and mapping. The FAA estimated just last year that there could be 30,000 Drones in the skies by 2020. But many estimate there are already that many in the skies … and they are not yet allowed for commercial use! One retailer in New York city sells 200 DJI Phantom quadcopters each day.

Drones will make the National Airspace accessible to everyone. They will be inexpensive. They will be safely operated with ease. This is their great disruptive influence.

UAS will drive down the cost and complexity of sophisticated remote sensing and mapping. Some sUAS now come equipped with built-in maps that prevent the drone from flying within "no fly zones" like airports. The first-generation "Model-T" systems have already accomplished this.

The FAA will limit their contributions in remote sensing and mapping to small areas within sight of the operator for now. But yet, their application in this context will remain important.

Transportation Engineering and Construction
Transportation Engineering and Construction will find many uses for UAS. Engineers will produce DEMs and orthophotography for small areas from the backseat of their car as needed. The mechanical / technological trappings needed today will fall away. Drone operators will not need experienced pilots, sensor operators, mapping specialists, and large planes. Small crews will conduct dangerous infrastructure inspection without ropes and out of harm's way. Engineers will get detailed photos and point clouds of structures in a matter of hours wherever

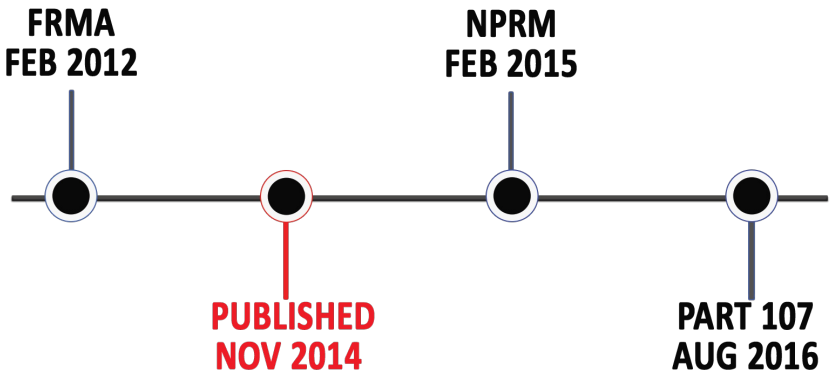
needed.

Remote Sensing and Aerial Mapping
Remote sensing and aerial mapping will also benefit, especially for projects covering small areas. Engineers will perform construction faster because 3D models of the earth will be available in hours not weeks. Today, sUAS make accurate, high resolution point clouds representing the “surface” of things. LiDAR sensors will become common in the next 1-3 years, and will produce high resolution point clouds of the earth, not only the surface of things.

Public Utilities
Public utilities will find enormous applications for UAS. Drones augment the response to emergency situations. Transportation to the scene and operation are easy. They will provide an immediate bird’s eye view of the incident to all responders. Responders will perform aerial inspections at will to locate the cause of power outages. Drones will enhance the reliability of the energy network and promote public safety. Inspections will be much easier in dangerous areas. Inspectors will not need the cumbersome safety procedures and gear when sending personnel.

The possible applications of drones to transportation, surveying, mapping, and public utilities are tremendous. After American entrepreneurs begin using these new mapping platforms daily rapid innovation will ensue. Many new applications to improve the life, health, and the economy will impact our daily lives.

Chapter 10: The Drone, the Founding Fathers, and Your Vote



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The Internet was formerly heralded as an "unprecedented tool of liberation and democratization". That Internet … is dead!

It was hijacked and is now a tool for the indiscriminate and global surveillance of you by the United States and much of the rest of the world. The premise that our government is of, by, and for the people has cancer. With its demise came a serious blow to the natural liberty of citizens in the United States. Citizens had no say in this sacrifice of their liberty at the altar of "security".

As Benjamin Franklin warned so long ago, "They who can give up essential liberty to obtain a little temporary safety deserve neither liberty nor safety."

Abraham Lincoln, too, understood the inestimable value of our precious liberty. He directed the brutal war that we had to win to save this young nation and the new liberty nursed within its borders. It cost Lincoln and our nation the blood of 620,000 lives. He understood that the preceding one hundred years of slavery, the ultimate contradiction to liberty, preceded this Great War and must end. He said, "Those who deny freedom to others, deserve it not for themselves."

Surveillance Drones & Liberty

Perhaps this is why the hair on the back of Americans' necks stands up when they hear that government and police may be flying Drones (Unmanned Aerial Systems-UAS) overhead. Perhaps this partly explains the national reaction we are witnessing against Drones and the protection of privacy. Drones are exceedingly capable flying spy machines! They will be abused and misused by our government to steal more of our precious liberty if we allow it. Drones will

rank up there with the telephone and the internet as technology that can be used to destroy our liberty.

But it doesn't have to be this way. At one time the government and the police needed a warrant before invading our privacy. They couldn't tap our phones or internet or email without first obtaining a warrant from the independent third branch of government, the judiciary. They needed good reason or the Judge, our guardian of personal liberty and property, would refuse. They had to show they had "just cause" to invade the target's space. The citizen was protected from "government" whose very nature is to grow and take from the governed. As it grows the only possible result is a great sucking sound of our liberty being swept away.

Protecting Our Liberty and Property

This loss of privacy can be avoided, but only if citizens are politically informed, meaningfully engaged, and do the hard work of pushing back against the incessant attempts of "government" to take liberty. Part of that work is being informed about issues and voting. Vote this week! But before you do, consider your liberty. Which candidate most respects your liberty? Stop voting because of what they promise to "give". With every "gift" from "government" is a "taking" of property and a loss of liberty. Vote for them because they promise to protect your liberty.

Governments age-old ploy is "let us take a little of your freedom to preserve your safety". Don't be fooled! History faithfully informs all who will listen.
James Madison, the Father of our Constitution said, "The advancement and diffusion of knowledge is the only guardian of true liberty."

John Adams, who authored the Declaration of Independence with Thomas Jefferson warned, "A Constitution of Government once changed from Freedom, can never be restored. Liberty, once lost, is lost forever."

Once lost, Liberty is gone. Look around the world and be thankful that some measure of our liberty is intact. Guard it with your vote.