WATTS ANTENNA COMPANY

....the Industry Leader in Advanced Instrument Landing System (ILS) Antenna Products and Development

Providing Precision Guidance in Difficult Airport Environments

Like most, we at Watts Antenna Company can't help coming away from the FAA's NextGen Implementation Plan amazed at the sheer scale of its ambition. One gets the sense everything is changing at once. And it is. No sphere of the aviation industry is left untouched. The FAA Plan lists the basic system transitions as the following:

- ***ground based to satellite-based navigation and surveillance.***
- ***voice communications to digital data exchange.***
- ***a disparate and fragmented weather forecast delivery system to a system that uses a single, authoritative source.***
- ***operations limited by visibility to sustaining the pace of operations even when impacted by adverse weather or difficult terrain.***

As the FAA points out, these key transitions are underpinned by an even more fundamental transition: *"moving from disconnected and incompatible information systems to a scalable, network-centric architecture…[so that] everyone using the system has easy access to the same information at the same time, when needed."*

The limitations of the current NAS are well-known. Capacity Needs in the National Air Space (NAS) (2007-2025) (FACT2) points to severe capacity shortfalls at numerous metropolitan areas even with planned airport expansions through 2025. Delays are at epidemic proportions and getting worse as reported regularly by the Research and Innovation Technology Administration (RITA). New paradigms must

be developed to address these chronic concerns. There is an awareness that airport throughput will have to increase without recourse to physical capacity expansion. In a March 2008 *Reason Foundation* paper, Increasing Airport Capacity Without Increasing Airport Size, we were heartened to see Viggo Butler ask this very question. Butler points out, correctly we feel, that runway capacity (as opposed to airspace efficiency or even terminal/gate expansion) is the real bottleneck:

"Adding a new runway of between one and two miles in length, spaced the required 4,300 feet from existing runways, typically requires large amounts of land, which many airports do not own."

But after correctly conceding the problem, Butler for the most part cites NextGen's technology advancements (Required Navigational Performance (RNP), Automatic Dependent Surveillance-Broadcast (ADS-B), Wide Area Augmentation System (WAAS), Continuous Descent Approach (CDA)), as holding the key to the solution. His most significant ILS reference is a negative one, referring to "the long straight-in approach which an ILS requires." No account is made for the advances in ILS technology of recent years, particularly in Watts Antenna Company's advanced ILS product line where our MODEL 201 HIGHLY DIRECTIVE LOCALIZER SYSTEM for example with its narrow RF beam dramatically reduces ILS's encroachment on airport real estate. Watts Antenna Company believes that delivering efficiencies in the navigational aspects of flight is tantamount to adding lanes to the interstate highway without expanding the exit ramps. The landing system is the exit ramp. Airspace efficiencies must be met with greater efficiencies on the ground.

Technology is an obvious productivity enhancer. By any standard, GPS and its myriad augmentations WAAS, LAAS, GBAS, ADS-B, are marvelous technologies. But are they marvelous *enough* to abandon redundancies and deliver our National

Air Space to a sole-thread, space-based navigational and precision landing model that in many essential features remains a theoretical, work-in-progress construct?

Is the current system truly all bathwater and no baby? Surely a system which, by next year will service approximately 900 million revenue passenger enplanements possesses some salvageable elements? Surely the resiliency of a complex rapidly evolving system might benefit from retaining some familiar anchor-points and pockets of stability?

Few observers would argue that there is an R&D bias in the system which encourages next-generation prognosticators to err on the side of irrational exuberance. Here and there, some sobering realities poke through. For example a recent GAO report <u>"Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities"</u> points out that the GPS II-F constellation (NextGen's navigational backbone) is three years late, $870 million over budget and plagued with design flaws. It's difficult to assess the impact to the nation's infrastructure were GPS service to experience even momentary outages. In the aviation realm, such disruptions, even for mere seconds, approach the unthinkable.

In all the excitement of the next-best-thing, silent workhorses often suffer unfairly in the comparison. Future technologies are not hemmed in by a track record. They live on promise and anticipation. Because Instrument Landing Systems (ILS) perform faithfully every day, no one talks about them. Reliability has, in some respects, worked tactically against ILS (though millions, perhaps billions, of safely landed passengers would surely disagree.) What works well can become invisible and underappreciated.

Watts finds an apt parallel in an entirely different infrastructural domain: GE's current multi-billion dollar proposal to build a "smarter" U.S. electric grid.

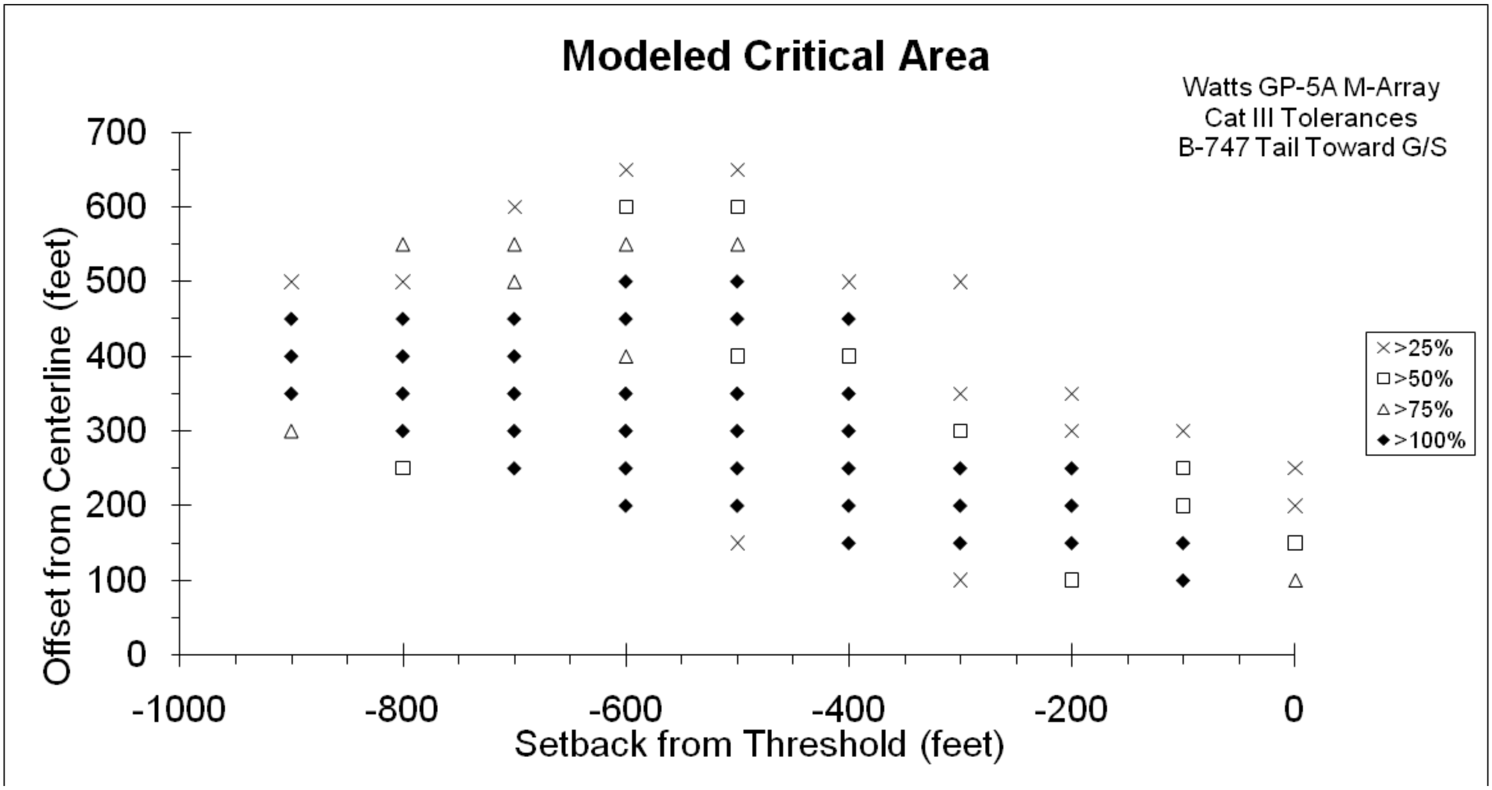
Speaking to the generic issue of complexity, power industry commentator Shannon Love reminds us that:

"Increasing complexity in any networked system increases possible points of failure. Worse, the more interconnected the system, i.e., the more any single component affects any other randomly selected component in the system, the faster point-failures spread to the entire system."

Love goes on to say that "The reason we should keep things dumb is that in engineering the word "dumb" has a different connotation. In engineering, "dumb" means simple and reliable."

Even as GPS and its myriad augmentation systems come across as terribly smart, Watts believes its advanced ILS products are dumb (in the best sense of that word of course) but with sensibly smart enhancements. Our products embody incremental enhancements that build on a venerable ILS technology tradition notable, among other things, for an unblemished safety record that spans seventy years. We should resists overlaying the inherent difficulty of the airport environment with complexity, merely for complexity's sake.

For example, the <u>Model GP-5A Wide Aperture Image Glide Slope Antenna Element</u> (pictured here), a Cat III system, utilizes an asymmetric radiation pattern providing greater use of all taxiways in the vicinity of the mast. The chart below shows the critical area when a B-747 tail is turned toward the GP-5A glideslope antenna.



The point is that complexity and novelty are never panaceas. In fact they often work to reduce system resilience and predictability – qualities our NAS aspires to first and foremost.

In certain respects, some NextGen navaid advances will only add to the precision landing system workload, taxing already overtaxed airport assets. For example, Automatic Dependent Surveillance-Broadcast (ADS-B) will be, in the words of the FAA, *"a crucial component of the nation's Next-Generation Air Transportation System."* ADS-B, should it succeed in supplanting traditional radar, will deliver aircraft more expeditiously to their destination points. But this only means more aircraft will be competing more aggressively for already-strained runway capacity.

As ATCmonitor.com asserts in its article *"Automatic Dependent Surveillance-Broadcast: A Primer and Arguments Why the FAA Should Maintain Airport Surveillance Radar"*:

"Reducing air-separation requirements to allow more planes per hour to approach an airport accomplishes nothing if there aren't enough runways for them to set down on…ADS-B will not allow significantly more closely timed or simultaneous landings than the current generation of Precision Runway Monitor (PRM) technology ."

Similar to other legacy system proponents, there is a contingent of traditionalists who feel the existing radar system isn't broken and thus shouldn't be fixed or at a minimum should be retained as a crucial redundancy system.

As for precision landing itself, one highly touted technology, the GPS-based local area augmentation system (LAAS) has not lived up to previous high expectations. As reported in the August 2005 issue of *Avionics* magazine *"LAAS was intended to replace ILS and enter nationwide service as the future precision approach guidance aid. Despite its promise, the system hasn't been able to overcome its technical difficulties, and FAA was forced to reassign it to research status."*

Though LAAS manufacturers Honeywell and GM Merc A/S have apparently ironed out the earlier signal reliability issues, even these advances would bring LAAS to Cat I capability; whereas ILS can accomplish Cat III landings today. WAAS is also capable of only Cat I landings. So we repeat: ILS *can accomplish Cat III landings today*. Estimates for Cat III LAAS range from 2015 to 2018. Given the chronic delays that plague large-scale aviation development, these dates are probably somewhat optimistic. NetGen 2025 is one thing. The immediate future must be considered as well. In an environment where, "the current system cannot handle the projected traffic demands expected by 2015," (according to Robert Sturgell, the FAA's deputy administrator, in a March 2007 Senate Committee on Commerce, Science and Transportation hearing), the future is, for all intents and purposes, already here.

No different from other RF systems (such as ILS), LAAS has its own multipath issues. However it adds another layer of--you guessed it--complexity due to its

GPS/space-segment reliance. Thus LAAS shares the traditional GPS vulnerabilities such as spoofing, jamming and satellite failure. LAAS also uses the ILS spectrum. So in some locations, spectrum-sharing with ILS (until such time as LAAS achieves the necessary accuracy) will be required. Watts believes that substituting ground-based RF with space-based RF applications multiplies complexity without delivering offsetting functionality or efficiency gains.

Moreover this crush of new technologies must be considered within the context of the aviation industry; for good reason, a conservative industry prone to slow adoption of mission-critical new practices. Using this conservative litmus, LAAS must still be viewed as an untested and non-operational technology. The jury is still out on LAAS.

In a June 2008 article “Landing Guidance”, *Avionics* magazine asks the obvious question: “With such remarkable performance, why should we need to replace ILS?” Another way to ask this question is how does NextGen foresee landing aircraft in limited visibility conditions in the absence of ILS and before the broad-scale acceptance and Cat II/III certification of LAAS? Somehow it seems like the good may be getting sacrificed to the perfect. This question is especially important given the capacity constraints (and inherent delay degradations) that even NextGen will be powerless to address out through its 2025 plan-period. The article attempts to answer its own question, citing ILS’s *“vulnerability to reflections off terrain and manmade structures and, particularly, other aircraft”* as the ultimate reason behind ILS’s eventual abandonment.

Respectfully, Watts Antenna Company begs to differ. The phenomenon *Avionics* refers to is *multipath*. ILS multipath propagation occurs when the localizer RF signal takes different paths when propagating from the antenna to the intended access point. While the signal is en route, structures, hangars, other aircraft, etc. can get in the way and cause the signal to bounce in different directions. Having

practically eliminated multipath as a mitigating issue, another key ILS advantage springs immediately to the fore. ILS instrumentation exists in virtually every cockpit in the world. This represents a huge sunk cost that a cash-challenged industry cannot afford to ignore, even with FAA incentives.

Indeed multipath has been the traditional Achilles heel of ILS, and a chief reason why the FAA considered the Microwave Landing System (MLS) as a potential ILS successor a few years ago. Even today, Transponder Landing System (TLS) industry literature cites multipath as a major ILS deterrent. The debate over the relative merits of ILS versus MLS or TLS has lost some of its competitive edge in recent years as all these systems, ground-based, have been overshadowed by NextGen's clear preference for a GPS-centric landing system.

That being said, in a system as complex and critical as the NAS, a winner-take-all approach is hardly the optimal strategy. On the contrary, redundant, dual or even triplicate thread systems are mandatory for airspace stability and efficiency. Biodiversity ensures the continued viability of any ecosystem. Complexity and risk mitigation require technical diversification. Thus when the Aircraft Owners & Pilots Association (AOPA) comes out in support of WAAS because, in their analysis, "the cost of installing a WAAS approach is less than 10 percent of an ILS", the question must be asked, what price is a fair one for a well-diversified, fully-redundant precision landing capability? The next question becomes, how can a reasonable apples-for-apples cost comparison be accomplished when one system won't even possess Cat III capability until 2015 at the earliest? When it comes to precision landing systems Watts Antenna Company believes that a Cat III ILS system in-hand is worth more than a Cat III LAAS system looming somewhere in the near or distant future if ever.

At Watts, we're making NextGen happen *now*.