



THE JOURNAL OF

Winter 2017 | VOLUME 59, NO. 4

# AIR TRAFFIC CONTROL

OFFICIAL PUBLICATION OF THE AIR TRAFFIC CONTROL ASSOCIATION, INC.

## NAS CONGESTION Who's to Blame?

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- LAANC is Coming Soon to an Airport Near You
- Review of SESAR and NextGen
- MH370: A Final Report
- The Life of Douglas  
"Wrong Way" Corrigan



# NAS Congestion

Who's to Blame?

By Michael Baiada, ATH Group, Inc.





**I**t seems that air traffic controllers get the lion's share of blame for airline delays and airspace/airport congestion and chaos, and they seem willing to shoulder this blame. The simple fact is that the air traffic control system has very little to do with delays and congestion. ATC simply deals with the hand they are dealt by the airlines.

So, if ATC is not the root cause of airline delays and airspace/airport congestion, what is? The answer is the variance created by the airlines' unmanaged, highly variant "day of" aircraft flows. The cause is not ATC, airports, runways, airspace, weather, or even airline schedules.

Could ATC do better? Of course. Do weather and other non-airline factors have an impact? Absolutely. But these are minor in comparison to the accepted, but totally unacceptable, amount of "day of" variation and randomness with the movement of the airlines' aircraft. Deal ATC a better "day of" hand and they would do a whole lot better.

Airlines and ATC need to understand that the airlines' refusal to track and manage their aircraft and customers from a "day of," flight-by-flight perspective, and coordinate with ATC in real time, produces a highly variant outcome. This is the root cause of most delays and

airspace/airport congestion. After all, this is about simple logistics. The outcome of any highly variant logistics process is chaos and queuing, as Figure 1 depicts.

Airlines, by implementing operational excellence, powered by Business Based Flow Management (BBFM) Exchange could prevent many delays, burn less fuel, reduce costs, and free up large amounts of airspace, but they don't. Why is that?

The answer lies in a quote attributed to Mark Twain: "It's what you know for sure that just ain't so that gets you in trouble." For example, airlines know "for sure" that:

- BBFM can't be done; there are too many variables.
- BBFM is too expensive; it's not profitable.
- ATC will prevent BBFM.

Unfortunately for passengers, shareholders, and taxpayers, airlines have a deeply rooted belief in the above false statements. Yet, as two universities (Embry-Riddle Aeronautical University [ERAU] and Georgia Tech), at three airports, (Atlanta [ATL], Charlotte [CLT], and Minneapolis [MSP]), proved in the FAA-funded Task J program, these so-called facts above "just ain't so."





**Background**

The Civil Aeronautics Administration (CAA) was created in 1938 and took over control of air traffic at en route ATC facilities and airports in 1942, until the FAA was established in 1958.

With no radar, transponders, and few radio navigational aids (navaids), it must have been quite a challenge to keep airplanes safely separated, especially with thousands of military airplanes swarming through the airspace in support of World War II. That system consisted of instrument flight rules (IFR) flight plans, airways, position reports, and clearances and is the basis of today's ATC system.<sup>[1]</sup>

This changed shortly after 1956 when a United DC-7 and a TWA Super Constellation collided over the Grand Canyon, killing everyone on board both vessels. Because of this, the government implemented Positive Control Airspace (PCA) in 1958. PCA ranges from 18,000 feet (FL 180) to 60,000 feet (FL 600). PCA airspace operation is in accordance with IFR, and the aircraft must be equipped with appropriate IFR instrumentation, including a Mode C altitude reporting transponder. The pilot must be instrument rated and an IFR flight plan is required. ATC is responsible for aircraft-to-aircraft separation.<sup>[2]</sup>

The next big changes were airline deregulation in 1978 and the controller strike of 1981. But, while many point to deregulation as the cause of airspace/airport congestion, deregulation simply enabled airlines to dramatically expand demand and build fortress hubs. And while highly variant demand was rapidly ramping up because of deregulation, the 1981 controller strike put an immediate clamp on capacity.

With the demand increase and capacity decrease, the FAA really had only one option: tight control of the "day of" movement of the aircraft, with tools like the Ground Delay Program (GDP) and miles-

in-trail (MIT). GDP held aircraft at their point of departure until the FAA felt the arrival airport's ATC system could handle the arrivals, while MIT spread the en route aircraft backwards at specified distances between aircraft.

Since the late 1950s, airlines have willingly abdicated control of their "day of" aircraft to the ATC system. Up until the mid-1990s, this was a necessity, as only the ATC system had the aircraft position data (radar) required to manage separation and sequencing. But with the FAA's release of the Aircraft Situation Display to Industry (ASDI), this changed, as anybody can see the position of any aircraft, except some military, within the United States.

In other words, even today, once off the gate, airlines have unnecessarily concluded that their \$100 million capital asset and customers are no longer their problem until the aircraft arrives at the destination gate. This presumption leads to a very simple question. In what business operational model does it make sense to turn over control of your primary production facility to the government? In fact, not only do airlines unnecessarily abdicate control of their aircraft to the government (ATC, privatized or not), airlines are actually lobbying the government to take over complete control of the movement of their aircraft through NextGen.

**ATC Enabling Airlines**

By accepting the blame for many airline delays and airspace/airport congestion, ATC enables the airlines to operate the same way they have for the last 50 years, i.e., abdicate control of the aircraft's movement – the airlines primary production process – to the ATC system. Unfortunately, this operational model hasn't worked out well for anyone (see Figure 2).

**So, if ATC is not the root cause of airline delays and airspace/airport congestion, what is? The answer is the variance created by the airlines' unmanaged, highly variant "day of" aircraft flows.**



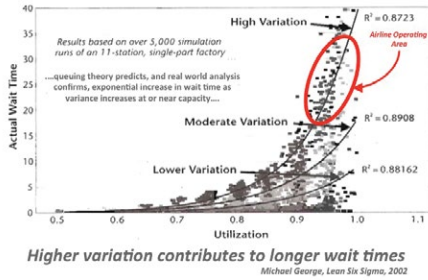


Figure 1.

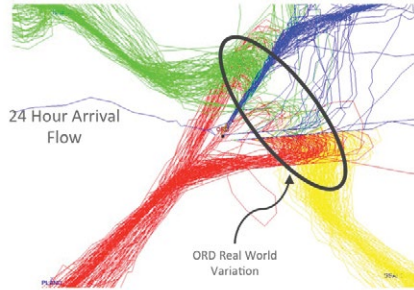


Figure 2.

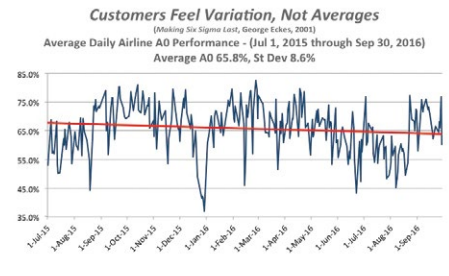


Figure 3.

In fact, the FAA and air navigation service providers (ANSP) have tried to fix airline delays and airspace/airport congestion, but have not reached the desired result.

For example, during the last 40 years, the FAA has spent billions on programs and initiatives like Microwave Landing System (MLS), Advanced Automation System (AAS), Initial Sector Suite System (ISSS), Global Positioning System (GPS), FreeFlight, Future Air Navigation System (FANS), Required Navigation Performance (RNP), Automatic Dependent Surveillance-Broadcast (ADS-B), Automatic Dependent Surveillance-Contract (ADS-C), and now NextGen, all with little improvement in efficiency, capacity, or throughput.

For passengers, who are spending more and more time in the aircraft, the result is a highly variant product, as seen in Figure 3. For airlines, the result is operational stagnation, as they have operated the same way for decades. Of course, airlines have new technologies, but they have shoehorned these technologies into the current, highly siloed, linear production process instead of building a new, more efficient system. This is the same mistake that General Motors made in the 1980s and 1990s, which took them 30 years to correct.

**Separation versus Sequencing**

Next, we come to a big misunderstanding: the difference between separation and sequencing.

According to the ATC Controller’s Handbook (FAA Order JO 7110.65W, 2015), “The primary purpose of the ATC system is to prevent a collision between aircraft operating in the system and to provide a safe, orderly and expeditious flow of traffic, and to provide support for National Security and Homeland Defense.”

Controllers do a fantastic job with the first part – “Prevent a collision between aircraft operating in the system.” – but less so with the second part – “Orderly and expeditious flow of traffic.” How can any flow of materials be “orderly and expeditious” when you have no idea what constitutes an expeditious flow and only work to sequence the flow in the last part of the process (last 200 NM)? Also, many believe that the “orderly and expeditious flow of traffic” is an ATC problem. But from my perspective, and as history has proved, there is no way that ATC, by itself, can provide an “orderly and expeditious flow of traffic.”

Separation is easy to understand: don’t let aircraft A hit aircraft B. But I would add the following to the definition of aircraft separation: don’t let aircraft A hit aircraft B in the next 20 minutes. After the 20-minute threshold, it enters the realm of sequencing.

Sequencing truly is the “orderly and expeditious flow of traffic.” But to do this properly, ATC needs a partner to identify the most efficient sequence, i.e., the “right” aircraft to move forward and the

“right” aircraft to slow down. That partner is the airline, pilot, or aircraft operator, as only they know the most expeditious flow. Therefore, airlines need to get into the game, as only the operator can know the most efficient “day of” solution for each aircraft, 24/7/365, which then must be coordinated with the ATC system, all in real time.

**ATC Privatization and NextGen**

We keep hearing ATC modernization arguments from both sides. Unfortunately for passengers, these arguments are based on many false assumptions.

Will ATC privatization reduce ATC and government costs? Perhaps. Will ATC privatization allow a better internally run ATC system? Probably. But these are not my areas of expertise. Will ATC privatization help airline delays, airspace/airport inefficiency, or passenger dissatisfaction? Absolutely not, and this is my area of expertise.



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**At its core, BBFM is a logistics solution that constantly applies pressure to move the right part to the right place at the right time. BBFM is a tactical, real time process that coordinates all of an airline's operational processes to move airlines back to the desired operational state.**

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We need to clear the air on many misstatements about ATC privatization and clarify its costs and benefits.

Consider the often-repeated inaccurate claims and arguments.

1. **Most US airlines support NextGen and ATC privatization because it will improve operations and airport throughput while reducing delays.** While not said specifically, this is the only reason why any airline would support such a wide-ranging change to the ATC system. Unfortunately, these improvements will be limited at best, since ATC cannot efficiently solve airline delays. The airline business model is simple: increase profits, improve quality, cut costs, and increase production efficiency by delivering the passenger where they were promised, when they were promised – something ATC can't and shouldn't be concerned about.
2. **Privatization is about modernizing our aviation infrastructure faster.** Actually, privatization is about taking over full control of the movement of aircraft faster. How is an outside organization controlling the airlines' primary production process good for passengers or airline production efficiencies?
3. **The US ATC system is antiquated.** This isn't entirely accurate, as much of the US ATC equipment (Standard Terminal Automation Replacement System [STARS], En Route Automation Modernization [ERAM], etc.) has been updated within the last 10 years.
4. **Aircraft still navigate using World War II era ground-based tools.** This is misleading since both radar and ground-based navigational beacons have been replaced many times. Further, almost all aircraft, especially commercial aircraft, use the ground nav aids as sensors to power sophisticated aircraft navigational computers in the same way these systems use satellites.
5. **The FAA has tried to upgrade complicated software/solutions in the ATC system for four decades, but fail because they aren't funded, staffed, or capable of implementing.** Since delays/congestion are not ATC's fault, the FAA's failure to "fix" delays and airport congestion has nothing to do with ATC staff, capabilities, or funding.
6. **The FAA is poised to switch from ground-based radar to GPS surveillance.** This assumes that all aircraft are equipped with the avionics to receive and transmit GPS to the ATC system, which is simply not the case. Additionally, given that GPS is easily jammed, radar will still be a significant part of the US surveillance system for decades to come. For example, imagine a single source GPS separation/navigation solution being jammed around New York City at 5 p.m. Even when all aircraft are GPS equipped, the US military will require radar for security reasons to prevent losing aircraft position in case of GPS failure.

7. **The FAA's existing flight tracking system is broken and antiquated.** This is completely inaccurate. The ATC system's structure is inefficient but not broken. This inefficiency is a symptom of the highly variant aircraft flows. Historically, ATC's only solution has been highly restrictive linear, nose-to-tail structure. However, this problem would ease if airlines focused more on real-time aircraft time management and ATC coordination.
8. **Privatization will fix NAS delays.** If we are only trying to reduce government inefficiency, privatization may have merit. But if we are trying to reduce airline inefficiency, as is often stated, neither privatization nor NextGen will make a difference. Only airline operational excellence can do this.

#### **What is BBFM?**

From the 1970s-1990s, Toyota leapfrogged the competition with an operational solution that dramatically improved quality, reduced costs, and increased throughput.<sup>[3]</sup> BBFM is that same approach for airlines and ATC – a real-time airline supply chain and ATC-coordinated solution that allows an airline to leapfrog the competition.

Aircraft arrival flows, especially hub and spoke or congested flows, represent a flow of materials problem, i.e., an interdependent logistics problem. And, as any production manager knows, in any interdependent material flow problem, having the right part in the right place at the right time is critical to the operation's efficiency, profitability, and success. The system can easily collapse if even one element is overlooked.

Further, to achieve operational excellence, one must start with a different perspective of aircraft arrival congestion. For example, we must view the aircraft arrival process as a geographically dispersed, interdependent logistics process.

Ensuring each element hits its optimal target every time requires a system-oriented process that actively manages the elements in real time from a system perspective. This process must not only determine a more optimal arrival time for each aircraft schedule, connections, gate availability, crew legality, etc., it must coordinate this arrival time with ATC to ensure equitable access of runway capacity, departures, weather, etc.

My points are simple:

- With the right vision and leadership, airlines can quickly and dramatically improve quality and profits while reducing delays.
- Airspace/airport congestion is mostly a symptom of an unmanaged, highly random aircraft flow and the decades-old, linear, nose-to-tail, localized sequencing process.
- While ATC must partner with airlines to implement BBFM, ATC by itself cannot significantly improve airline delays and wasted airspace.



Figure 4. Airline ops – Negative static stability.

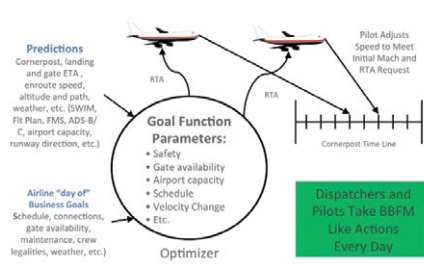


Figure 5. BBFM ops concept.

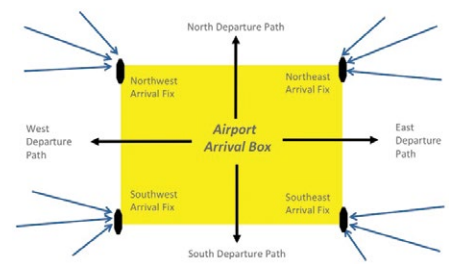


Figure 6. BBFM prevents overloading the box.

At its core, BBFM is a logistics solution that constantly applies pressure to move the right part to the right place at the right time. BBFM is a tactical, real time process that coordinates all of an airline’s operational processes, to move airlines back to the desired operational state – on time zero.

But like any major change, one must pick a starting point. The aircraft’s movement is the obvious choice because it’s the customer’s highest value proposition and the airlines’ highest cost and stress inducer. Further, as can be seen in Figure 4, today the aircraft’s movement is dynamically unstable, in that delays are additive. Airlines will point to this graph and use it to justify their “depart on time, or else” policy, but I would disagree with their assertion because:<sup>[4]</sup>

1. Airlines provide little to no real time input into the movement of their aircraft.
2. The airline schedule simply maps the historical, highly variant, actual block time and uses this to adjust schedules.

But by constantly applying “day of” speed/time pressure to the aircraft, hours prior to landing, BBFM stabilizes and improves the aircraft flow from a system perspective. For example, why fly fast en route if the gate is unavailable? Not only does this waste fuel en route, it congests the arrival fix, delays other aircraft, takes up a valuable landing slot which should be used for a late aircraft, congests the ramp, and leads to increased taxi times as early flights wait for their gate. Additionally, the airline has ramp workers, fuelers, and other secondary processes “standing by,” wasting time and money. One action produces lower quality with numerous highly variant and costly effects.

Unfortunately, to date, airlines have very little interest in providing real time, tactical business input into their “day of” aircraft sequencing, a task that is critical to their operational performance, passenger experience, and profitability. Operationally, sitting on the “day of” sidelines makes no business sense.

With BBFM, the airline has the ability to tactically choose and execute the most profitable business-based, system outcome and coordinate it with ATC in real time. Unique aspects of BBFM Exchange, which separates it from other metering systems, include:

- Ready to deploy today (operational at ATL for Delta Air Lines for eight years, as well as MSP, DTW and CLT).
- Improves on time performance.
- Provides benefits to passengers and airlines immediately.
- Reduces aircraft generated emissions.
- Reduces airline/ATC costs.
- Reduces ATC workload.
- Expensive, yet to be developed technology or changes to the ATC system are not required today, but creates benefits for these technologies tomorrow.

- Improves airport arrival efficiency by moving the entire arrival queue forward in time.
- Eliminates the need for precise trajectory modeling for prediction.
- With pilot involvement provides a much higher probability of meeting the plan.
- Allows more advanced planning, providing enhanced optimization.
- Inherently multi-center, easily crosses the flight information region and sector boundaries and can easily be extended to the ground.
- When using BBFM Exchange, system optimization/decision engine allows real time consideration of multi-user airline arrival flow business goals.
- Builds a bridge to NextGen to help propel modernization benefits for all users.

**BBFM Implementation and Benefits**

Clearly, ATC, FAA, and airlines need a win. Airlines need to get more involved in the operational, real time, “day of” game, airspace/airport throughput must be increased, and passengers need to be treated better.

The en route BBFM solution is the only available solution that simultaneously meets all of these goals. As FAA proved and independently validated, the en route BBFM exchange solution can be implemented at the top 30 US airports within 36 months, with the first BBFM airport online within six months, at a cost of approximately \$2 million per airport, including three years of operation.

The en route BBFM solution, implemented with the required time of arrival (RTA) process, is the only long range air traffic flow management solution that is operationally implemented, and independently validated by FAA’s Task J program, ERAU, and CLT/MSP, providing real time coordination between airlines and ATC.

The aircraft BBFM solution constantly monitors arrival flow hours before landing, calculates small time/speed adjustments, and then coordinates the airline’s business needs with ATC (see Figure 5). After ATC’s electronic, real-time coordination is complete, the BBFM optimization engine electronically sends the RTA to the aircraft as a suggested Mach or cornerpost time.

The RTA process is a 30-year-old, rarely-used, onboard Flight Management Computer (FMC) function that allows the pilot to enter a time at a specific fix, like an arrival fix, and then the FMC automatically adjusts the throttles to achieve that RTA.

BBFM simultaneously gives ATC a win, brings airlines into the real time “day of” game, and provides near-term benefits from advanced technologies, which in turn improve the customer experience.

Independently proven benefits of the en route BBFM RTA solution are that it:

- Easily crosses ATC sector and flight information region

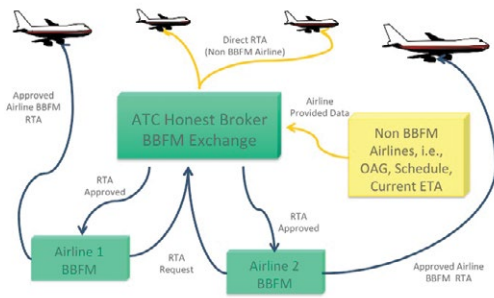


Figure 7. BBFM exchange process overview.

boundaries, a real problem with locally-based time based flow proposals.

- Does not require any new ATC equipment on the ground or in the aircraft.
- Improves on time performance.
- Saves fuel.
- Reduces greenhouse emissions.
- Reduces airspace complexity.
- Does not increase controller workload.

Further, as proven by FAA’s Task J program, using en route BBFM to pre-sort the arrival flow and ATC’s Traffic Management Advisor (TMA), and Terminal Sequencing and Spacing (TSAS) tools to fine tune the flow within 200 NM of landing increases the benefit to the user and ATC system.

BBFM builds beneficial time flow processes that will quickly incorporate new technologies. In other words, users can use the current tools to perfect the time-based flow process, and advanced tools to gain even more benefit. Also, by using the RTA as the ATC system’s universal unit of currency, everyone knows what each aircraft wants without providing the underlying business elements of that RTA.

Initially, given the accuracy of the RTA process today (+/- 30 to 40 seconds), the BBFM solution works as a density allocation process, managing the arrival flow to close or slightly above actual capacity. This allows time-based sequencing to the current arrival fixes (30 to 40 NM from the airport) at higher density airports and idle descents to a 5 NM final at smaller airports (see Figure 6).

In the future, with an enhanced RTA process (+/- 5 to 10 seconds), the BBFM time-based flow solution can be upgraded to a slot allocation process. With this increased RTA accuracy and a computerized conflict probe the idle descent to a 5 NM final can be expanded to higher density airports.

En route BBFM Exchange is a rapidly deployable solution that provides a more efficient, organized, and predictable aircraft flow. BBFM simultaneously helps passengers, airlines, and ATC in real time by coordinating what airlines want for each aircraft with ATC.

**ATC Acting as the BBFM Broker**

Today, each aircraft in the arrival flow is managed independently, without regard to system effects, and left for ATC to deal with at the end. Each arrival flow consists of hundreds of independent decisions and ensures a highly variant, random flow. This arrival flow “randomizing” can lead to queuing and chaos, and forces ATC to work harder, resulting in variance and cost.

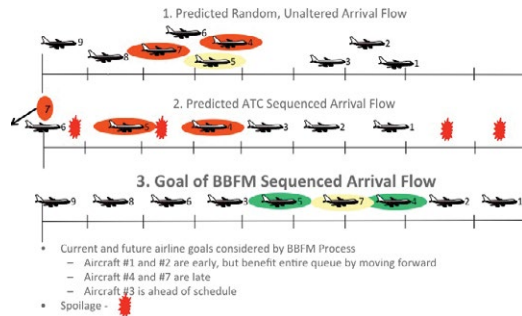


Figure 8. BBFM moves the arrival queue forward.

Fortunately, the ANSPs and airlines already have the data to utilize BBFM. The only thing they’re missing is the BBFM Exchange process to correctly use the data.

The BBFM Exchange process starts with the user determining a better arrival solution (RTA) for each aircraft based on the individual user’s business needs. Once a more optimal solution is determined, BBFM automatically sends the RTA request to ATC. Once verified by ATC, the approved RTA is sent back to the airline, which then sends a message (i.e., ACARS, etc.) with RTA target times to each pilot in the arrival flow. BBFM Exchange then continuously monitors the arrival flow and adjusts accordingly (see Figure 7).

**Smoothing the Flow**

The goal of BBFM is to deliver an efficient, business driven, pre-coordinated aircraft flow to the airport. Below are a few examples. Consider two aircraft at the front of a tightly packed 30 aircraft arrival queue. By identifying and speeding up the first two aircraft by two minutes, the entire arrival queue moves forward. This, in turn, saves two minutes for every aircraft in the queue. This creates what Dr. Clark of Georgia Tech labeled the “draft effect,” thus dropping 60 minutes of flight time and delay from this one arrival queue alone (see Figure 8).

Another example was my flight from Portland (PDX) to Chicago (ORD). That day, the tailwinds were in excess of 180 knots, which would have put me into ORD 30 to 40 minutes early. The PDX agents wanted to shut the door 10 minutes early and “push” the aircraft to ORD since everyone was on board the aircraft. I prevented this and left on time. Next, I taxied slowly and cruised at a low speed for better fuel mileage, to the point that MSP Center asked why I was flying so slowly. When I arrived into ORD, I landed 16 minutes prior to schedule, instead of 30 to 40 minutes like the other arriving aircraft.

Of course, when so many aircraft land 30 to 40 minutes early at a hub airport, the gates are still full from the previous arrival bank. This forces ATC to temporarily park and manage aircraft anywhere they can, to the point that as I exited the runway, I couldn’t talk with the overwhelmed controllers for several minutes. Once I finally received clearance and entered the alley, my gate was open, but it was blocked by five other departing aircraft awaiting taxi clearance.

That day, ORD devolved into complete gridlock, overwhelming the ATC system and airport. I sat for 30 minutes looking at my empty gate 200 yards ahead, but couldn’t get to it. Of course, like everyone else who landed 30 to 40 minutes early, I was also late to the gate (20 minutes), even though I landed 16 minutes early.

Could ATC and the airport handled this better? Probably. But the real solution was for the airlines to manage their departures by “pulling” the right aircraft from their departure gate so as to not over-



**Table 1.** Independently validated benefits.

	US Airways-CLT		Delta Air Lines-MSP	
	Active Phase 1	Active Phase 2	All Observations	Representative Days
<b>Total System Costs</b>	\$1,587,458	\$4,337,458	\$1,553,530	\$1,553,530
<b>System Monetized Benefits</b>	\$1,232,774	\$5,649,473	\$12,328,152	\$5,242,340
<b>System Benefit/Cost Ratio</b>	0.78	1.30	7.94	3.37
<b>Total Participant Costs</b>	\$1,587,458	\$1,587,458*	\$1,553,530	\$1,553,530
<b>Participant Monetized Benefits</b>	\$1,130,337	\$3,127,668	\$3,330,214	\$1,373,975
<b>Participant Benefit Cost Ratio</b>	0.71	1.97	2.16	0.88

(\* ) One Airline Attila™ system

load the ORD ATC system or airport in the first place. Clearly, if I, as a simple line pilot, recognized the problem hours prior to landing, an airline should have done the same and prevented the problem from developing in the first place.

We often hear the airline delay and congestion problem expressed in terms of the printed schedule, i.e., “You can’t schedule 10 aircraft to land at 8 a.m. and expect everyone to be on time.” Of course, if all 10 aircraft showed up at exactly 8 a.m., this would be true, but that is rarely the case, since airlines usually deliver more than 80 percent of their aircraft off schedule (some early, some late), the potential of actually having all the aircraft arrive at 8 a.m. is very low.

But the real answer to making the schedule work is for the airlines to tactically manage the aircraft so the first one lands at 7:51 a.m. (assuming a 60/hr. arrival rate), the second at 7:52, the third at 7:53, etc. Airlines currently have all of the necessary data and control to accomplish this.

Next, let’s look at airport capacity. I, for one, have never landed at a “full” airport. Of course, airports are over capacity at certain times (even Boise is over capacity when two aircraft want to land at the same time), but this doesn’t preclude reducing delays and congestion and realizing an improved on-time arrival performance.

Instead of waiting for ATC to de-peak the actual arrival flow backward in time (at around 200 NM from landing), an airline could proactively pull its aircraft off the arrival queue’s front end (at 500-1,000 NM from landing, or more), which would increase airport throughput and improve reliability. By speeding its aircraft at the front of the arrival queue and moving the aircraft forward a couple of minutes, the entire arrival queue moves forward.

When optimizing an expeditious and efficient “day of” flow, only the airline, in coordination with ATC, can do the job efficiently. ATC should never make these business decisions.

Airline delays/congestion is a simple system logistics problem, which starts by the airline precisely tracking and managing their aircraft. Instead, airlines wait for ATC to manage (i.e., slow) the arrival flow locally (last 200 miles), with limited flow data and no business data. The result is that congestion will continue until airlines begin to track and manage their aircraft in real time.

**FAA Task J BBFM Validation**

Every independent analysis of ATH’s en route BBFM solution has reached the exact same conclusion: BBFM works and provides significant benefits to airlines and ATC.

From 2010-2012, the FAA, in conjunction with ERAU, validated the BBFM Exchange process which they called Aircraft Arrival Management Systems (AAMS) in Task J at Charlotte and Minneapolis airports (see Table 1). They found the following benefits:

- Time-Based Flow Management (TBFM) provided evidence of

system-wide and airline-specific benefits that can be attributed to the assessed systems.

- \$12.3 million system and \$3.1 million airline (MSP, first year), \$5.6 million system and \$3.1 million (CLT, first year), annually, at modest levels of pilot compliance, which are easily improved.
- 2,100 flight hours and 4,400 slots for a fuel savings of over \$4M a year (ATL, steady state).

Further, logistical flow and time management has consistently proven that variance is extremely costly and reducing variance allows the reduction of both set up time and production time, i.e., gate and block time.

Additionally, FAA, ERAU, and ATH Group completed an analysis of the before and after airspace complexity and distance flown:

- AAMS Exchange operations produced a benefit outside of the cornerpost.

Continued on page 26

**ATM SYSTEMS DESIGNED TO PROVIDE HARMONIZED AND INTEROPERABLE SOLUTIONS**



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# IT'S TIME FOR A NEW APPROACH TO ATM





With the ever-growing amount of traffic in the sky, air traffic management (ATM) is a critical priority that requires continuous progress. Working together with industry and government organizations, Boeing is committed to an ATM transformation that improves safety, efficiency and the environment for all. At the core of Boeing's ATM solutions are secure network-centric operations that will incorporate the capabilities of modern airplanes, as well as ensure global interoperability and real-time access to critical information. The time is now, and Boeing is ready to help.





# En Route BBFM RTA Path to NextGen/SESAR

## Present Day (within three to five years)

– Requires no new aircraft equipment or ATC equipment

- Current ATC procedures, separation, and safety standards.
- User driven, ATC coordinated, en route BBFM, based on RTAs to current arrival fixes, issued once airborne, 300 NM to 1,000 (or more) from landing, inputs business criteria into the aircraft arrival flow .
- Integration of en route BBFM RTA and TMA/TSAS/AMAN processes, allowing en route BBFM Exchange to pre-sort the arrival flow so that the local ATC TBFM process can more accurately fine tune the arrival sequence (FAA Task J proved a combined BBFM/ TMA system increased benefits above what each of them provide separately).
- Required Time of Arrival (RTA) as Universal Unit of Currency within ATC system.
- ATC to act as the Exchange solution, to equitably merge competing BBFM RTAs from users (i.e., airlines, and GA) at the top airports.
- Density allocation process.
- Transition from GDP/MIT/CFMU operations to RTA-based BBFM/ AMAN operations.
- Slow removal of structure around airports by moving the arrival fixes closer to the airport.
- FMS to meet RTA, +/- 30 second accuracy.
- RTA process to allow constant descent to 5 NM final at small, less busy airports.
- RNP/PBN for approach and landing precision.
- Expand BBFM time horizon such that the arrival BBFM Exchange RTA is coordinated prior to departure, second RTA coordinated and issued shortly after takeoff to a point 30 NM from airport, and third RTA coordinated and issued (if required) one to two hours prior to landing for fine tuning the arrival flow, based on constantly updating the business criteria, winds, airport configuration, etc.
- Best Equipped, Best Trained, Best Served using easily measured RTA compliance metrics.

## Future (within five to eight years)

– Requires NextGen technologies

- Enhanced ATC procedures and separation standards.
- 4D trajectory based operations (RTA plus 3D path equals TBO) using RTA as the universal unit of currency within the ATC system.
- Reduced separation standards for operators who equip and train (Best Equipped, Best Trained, Best Served), based on aircraft specific RTA/PBN/RNP and comm capabilities.
- Equip aircraft with NextGen/SESAR avionics based on rapid ROI using proven processes.
- New FMS, +/- 5 to 10 second RTA accuracy, real time winds, new wind grid (especially for descent).
- Slot allocation process.
- ADS-B position and intent.
- Computerized conflict probe for ATC controllers to identify all 4D conflicts (i.e., provide angular separation during climb and descent).
- RTA-based, constant descent arrival to five NM final.
- PBN/RNP for approach and landing precision.

- ATH's "day of" metrics, as measured by the ATH BBFM Statistical Tool, compare very closely to the results of ERAU's Dwell Time savings results when excess distance is calculated.
- The airspace complexity was significantly lower in the terminal areas' inner sectors (32 NM radius from the airport) when the AAMS was active.
- The combined (lateral and vertical) measures at MSP's inner sector were significantly lower during the AAMS active period, while cruise segments were not affected.
- ERAU analysis complied with ATH Group's data.

## Airline Operational Excellence

But BBFM is only the first step for airlines. With BBFM in place, airlines must then jump to the next level: operational excellence (85 percent on time zero arrival, less than three percent daily A0 standard deviation, and an eight to 10 minute scheduled block/gate time reduction).

To reach operational excellence, airlines must move beyond local optimization and independent action for all of their processes, to a fully integrated, real time, system-based solution, where all of the airline's assets, starting with the aircraft, are tactically driven to the most profitable, real time solution. The steps necessary to reach operational excellence include:

- Adopt operational excellence as the airlines' overriding system goal.
- Make the aircraft movement stable and predictable and driven to a better business solution with BBFM.
- Assign gates three to five hours prior to landing, based on the predictable aircraft landing time.
- Manage all other "day of" assets to the highly predictable aircraft gate package.

## Conclusion

An airline-managed, ATC-coordinated BBFM solution has been independently proven to consistently reduce cost and flight time and improve system reliability by numerous independent studies.

BBFM is also the first critical step towards airline operational excellence. But to reach Operational Excellence, airlines/ATC must move beyond local optimization and independent action to a fully integrated, real-time, system-based solution, where airlines' assets, starting with the aircraft, are tactically driven to the most profitable solution in real time and coordinated with ATC.

Working together, implementing the commercial off the shelf BBFM solution will reduce ATC airspace complexity/costs and move hundreds of millions of dollars to the airline industry's bottom line by rapidly increasing product quality and aircraft utilization while reducing scheduled block/gate time. ✈️

## Sources

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