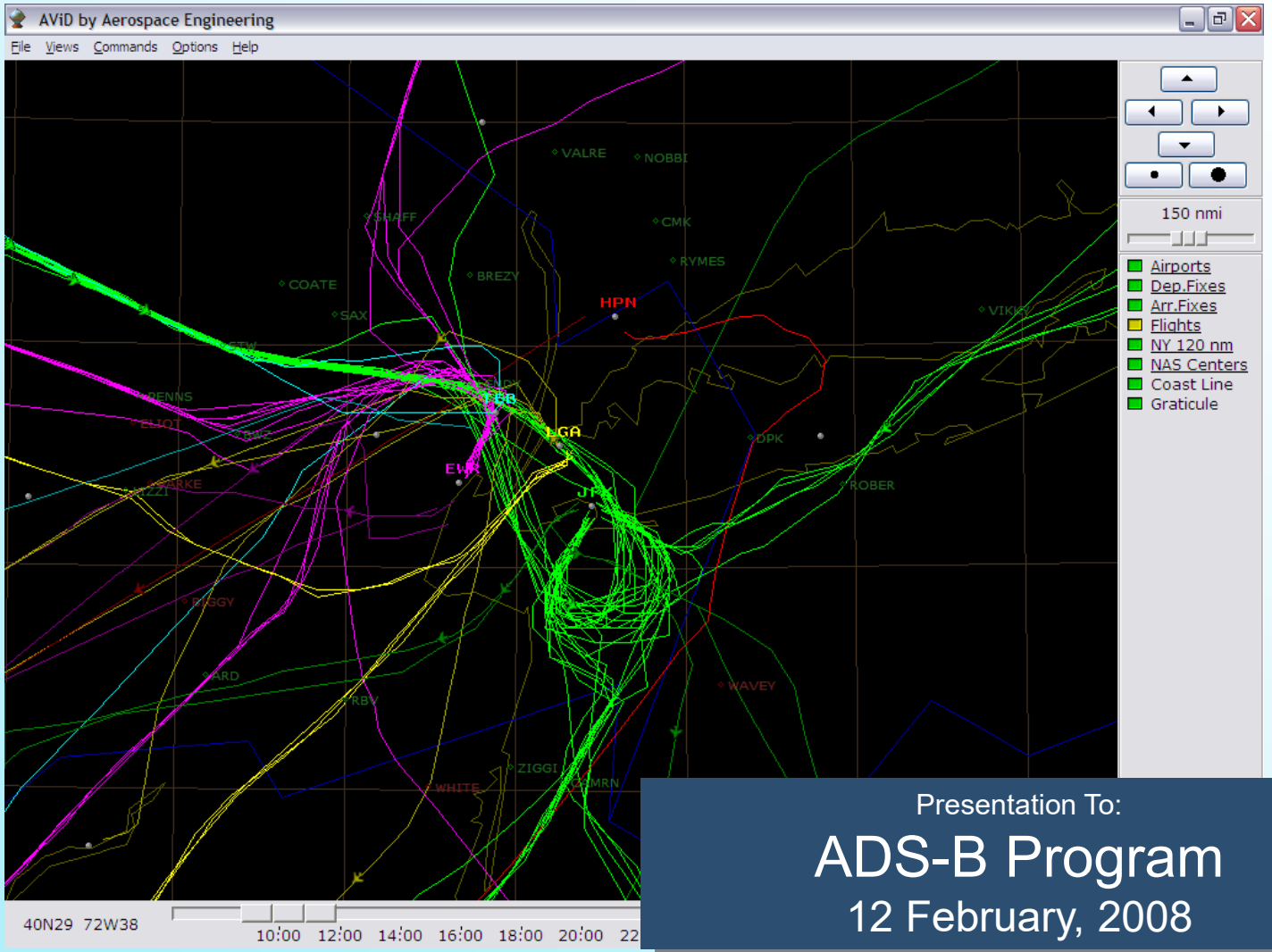
New York Metroplex Baseline



Presentation To:

ADS-B Program

12 February, 2008

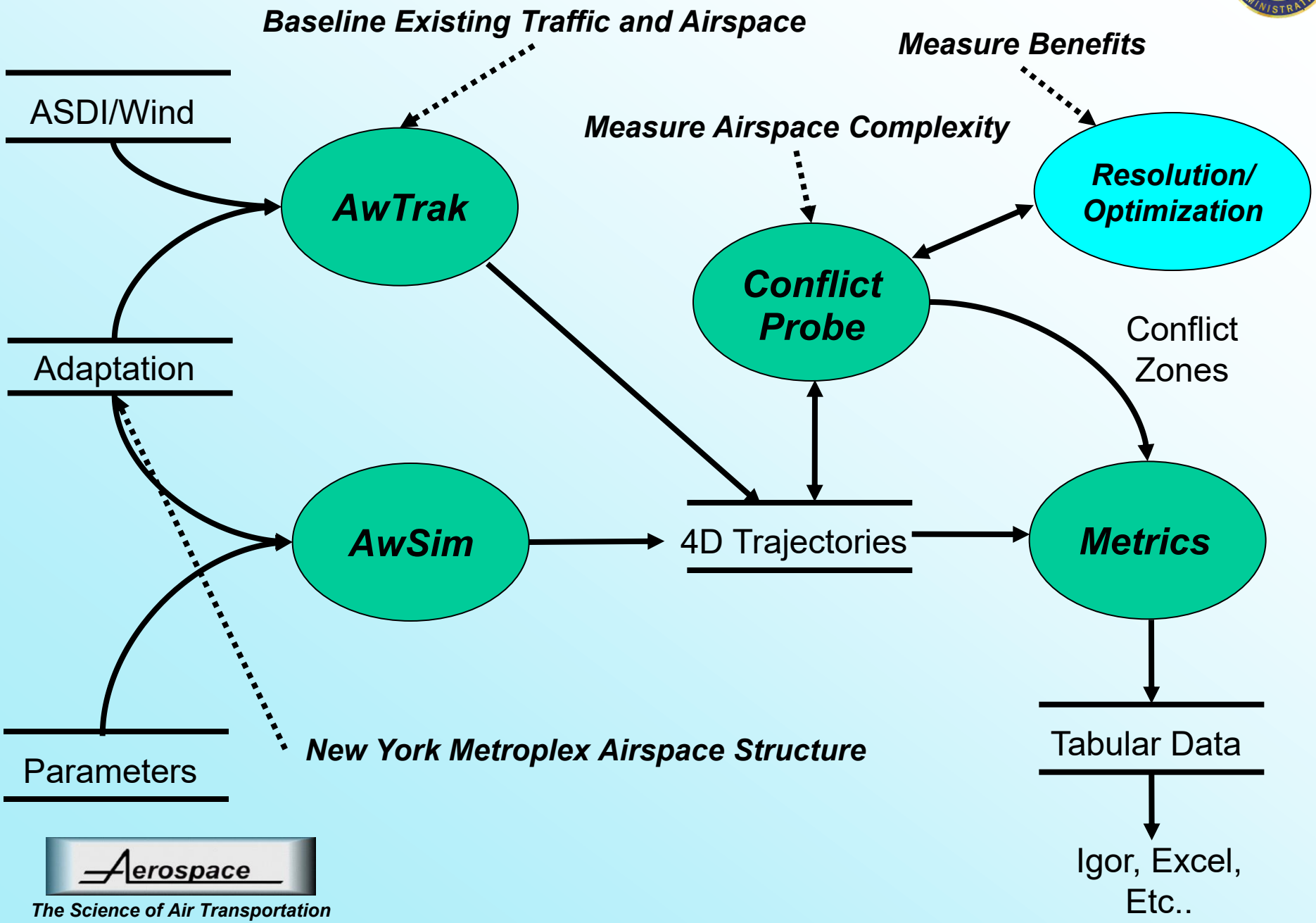
Aerospace

The Science of Air Transportation

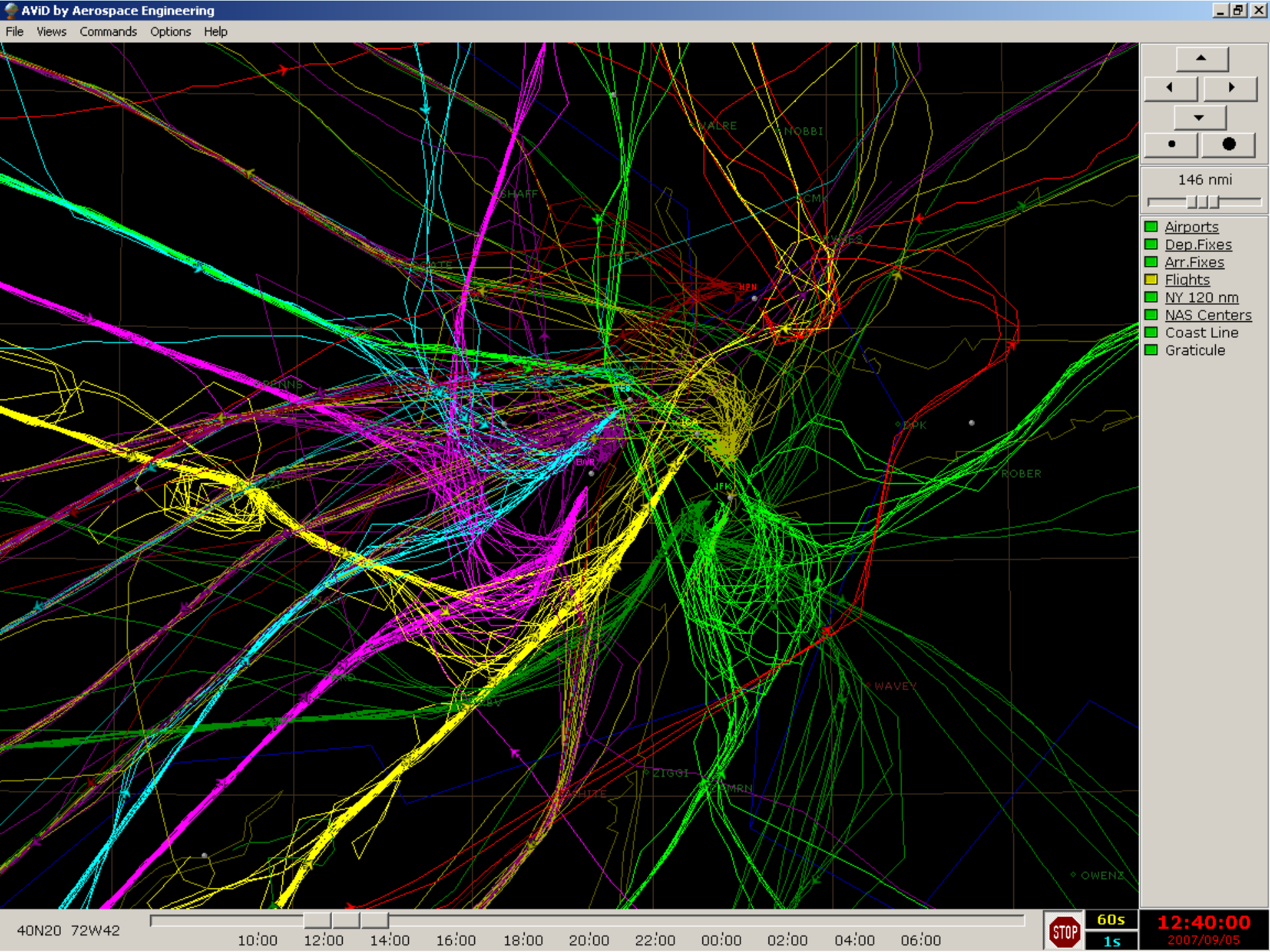
Briefing Outline

- *Adapt AwSim™ for New York Metroplex*
- *Establish Baseline*
  - *Good Days and Bad Days*
- *Baseline Current System*
  - *Flows over arrival and departure fix points*
  - *Excess Distance*
  - *Airspace Complexity*
  - *Airport Capacity*
- *New York JFK Simulation*
  - *Measure Existing Miles in Trail Impact*
  - *Simulate ADS-B Spacing in Mixed Equipage Environment*
- *Demonstration*

Adapt *AwSim*™ for New York



Aerospace
The Science of Air Transportation

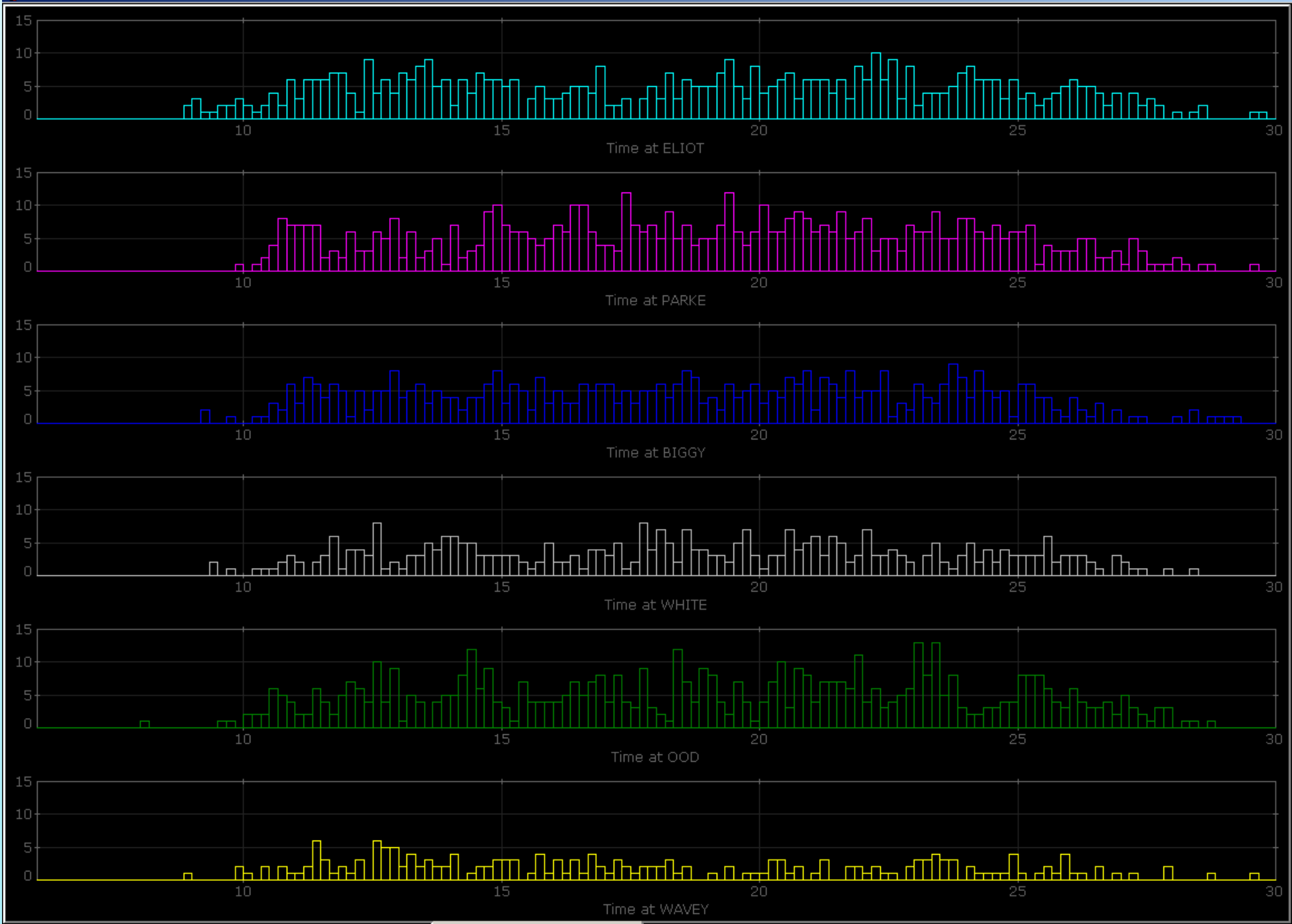

AVID by Aerospace Engineering
File Views Commands Options Help
HALRE
NOBBI
CMK
HPN
LGA
JFK
BWR
ROBER
WAVEY
ZIGGI
MRN
OWENZ
146 nmi
Airports
Dep.Fixes
Arr.Fixes
Flights
NY 120 nm
NAS Centers
Coast Line
Graticule
40N20 72W42
10:00 12:00 14:00 16:00 18:00 20:00 22:00 00:00 02:00 04:00 06:00
STOP
60s
1s
12:40:00
2007/09/05

Baseline Current System Efficiency Related

.. days are described as “good” or “bad” depending on the amount of terminal delay as measured by PDARS. Days were also selected for similar amounts of traffic, and non weekend (Geoff Shearer AJP- 33) ..

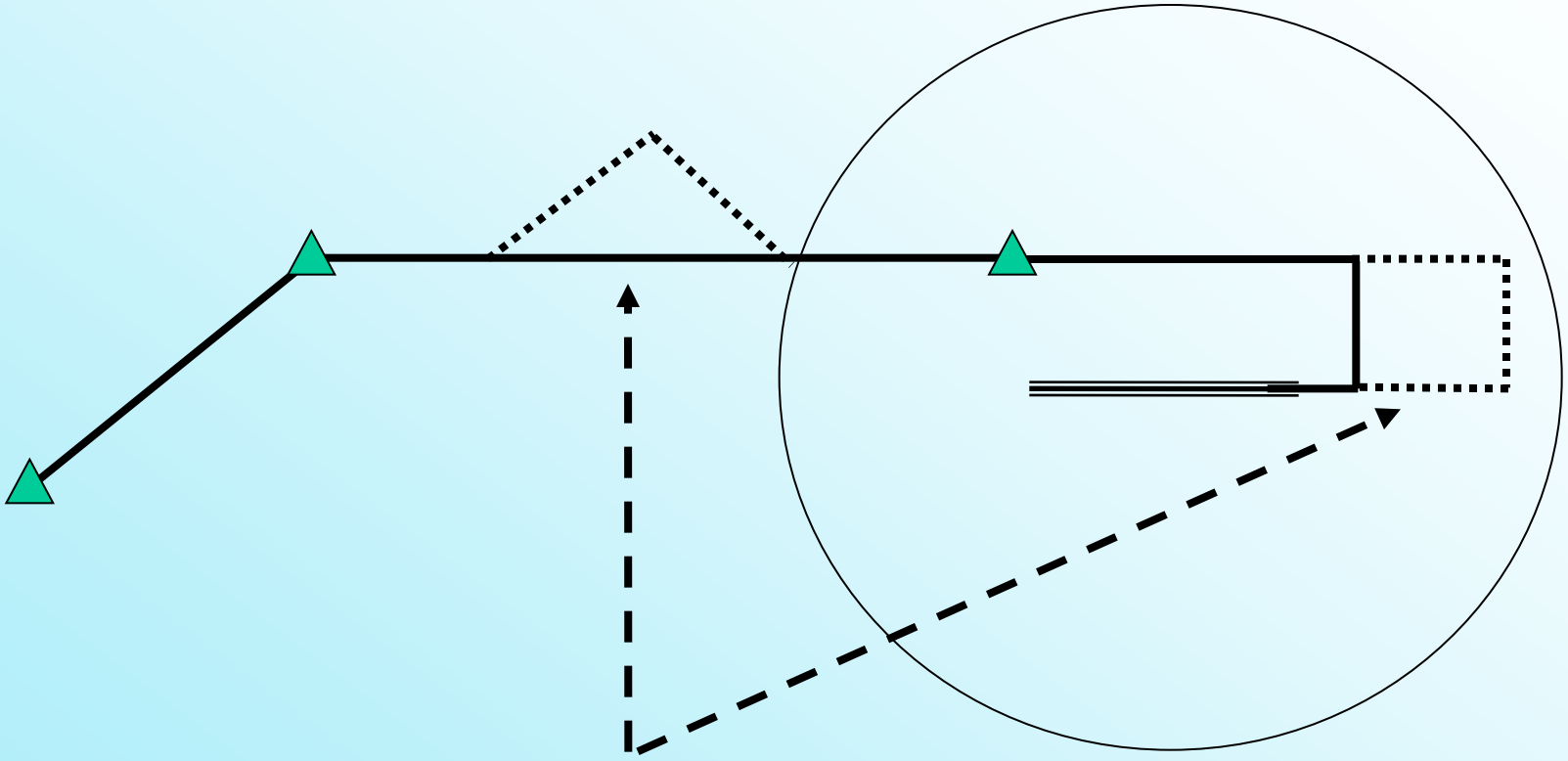
- **Good Days**
  - 9/19/07
  - 10/29/07
  - 10/30/07
- **Bad Days**
  - 9/05/07
  - 11/05/07
  - 11/07/07

StatMaster: ny.tpp#070905.fev.tev



Departures | Arrivals | **Departure Fixes**

Baseline Current System Efficiency Related

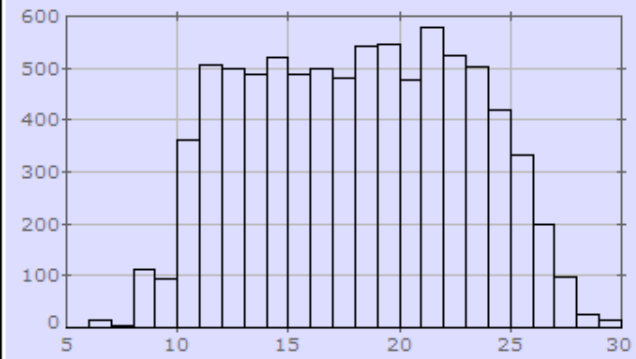


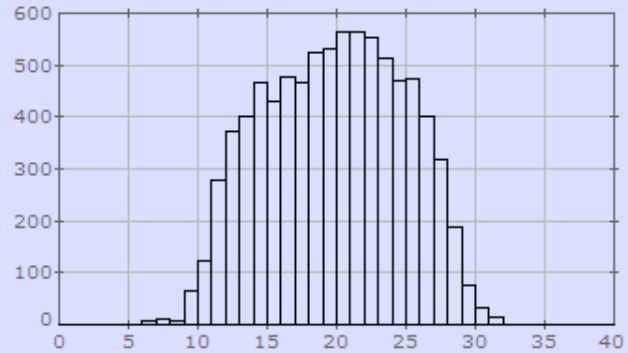
Increased capacity is measured by simulating ADS-B policy and increasing traffic load using bootstrap sampling

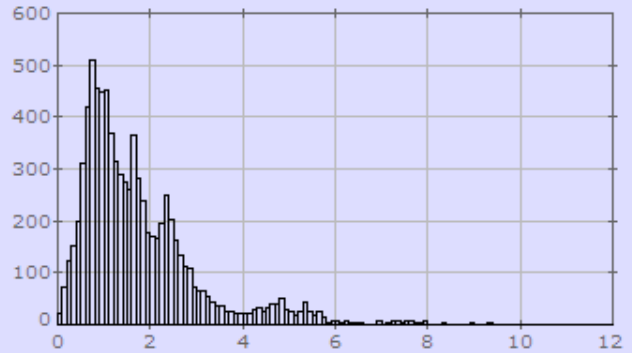
Baseline Current System Efficiency Related

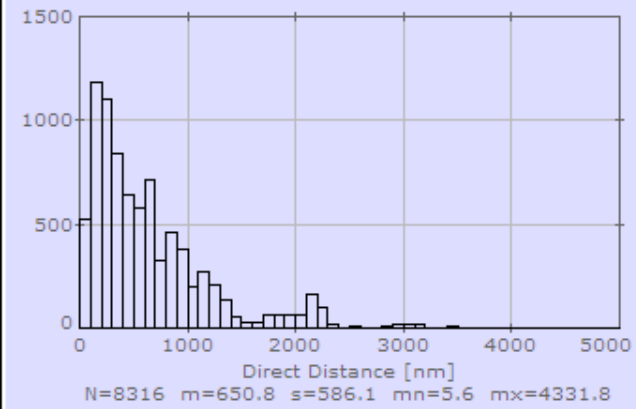
- Inbound Phase
  - Excess Distance - available
  - On average flights operating into the New York Metroplex had about 45 nm excess distance
- Outbound Phase
  - Excess Time – “off” gate to departure fix – need off times

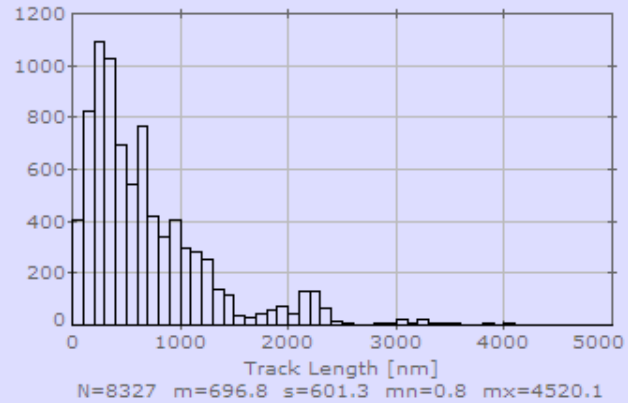
StatMaster: ny.tpp#070919.trs

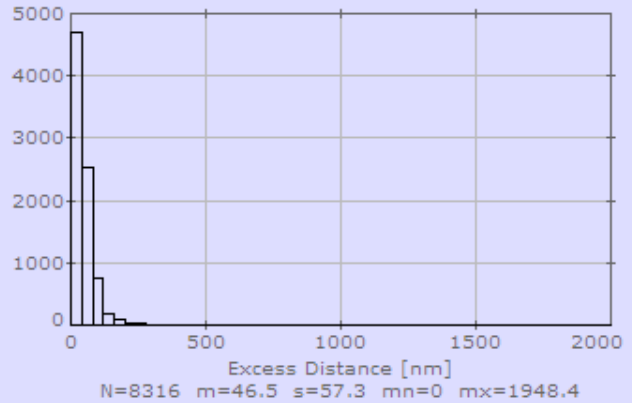


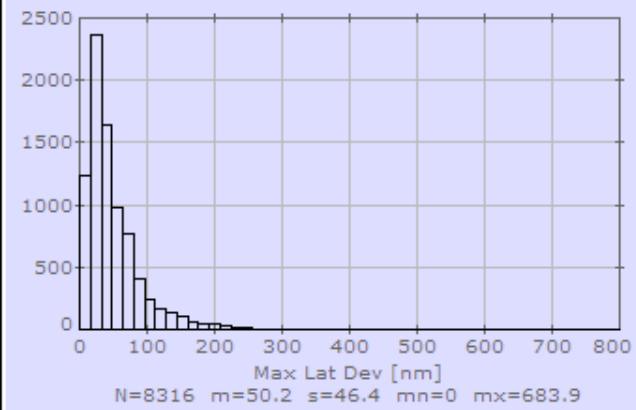


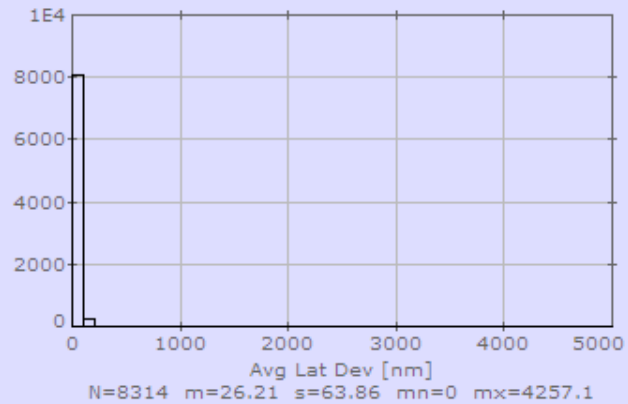


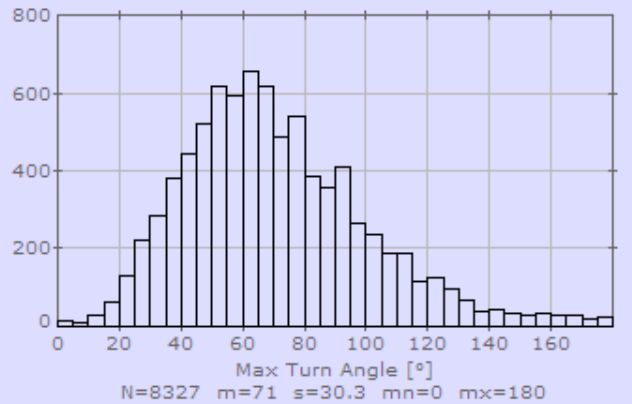












Trajectory | Cruise | Dep/Arr | Correlations

Thursday, December 20, 2007

start | Microsoft Power... | FlightScope | statmaster | 9:35 PM

Baseline Current System
Airspace Complexity

- This baseline is established by measuring the "complexity" of an airspace
- Complexity is a measure of how difficult it is to de-conflict a particular traffic pattern
- Since existing traffic is by definition de-conflicted by controllers, this is measured by computing "proximity" of aircraft in the airspace

Baseline Current System Airspace Complexity

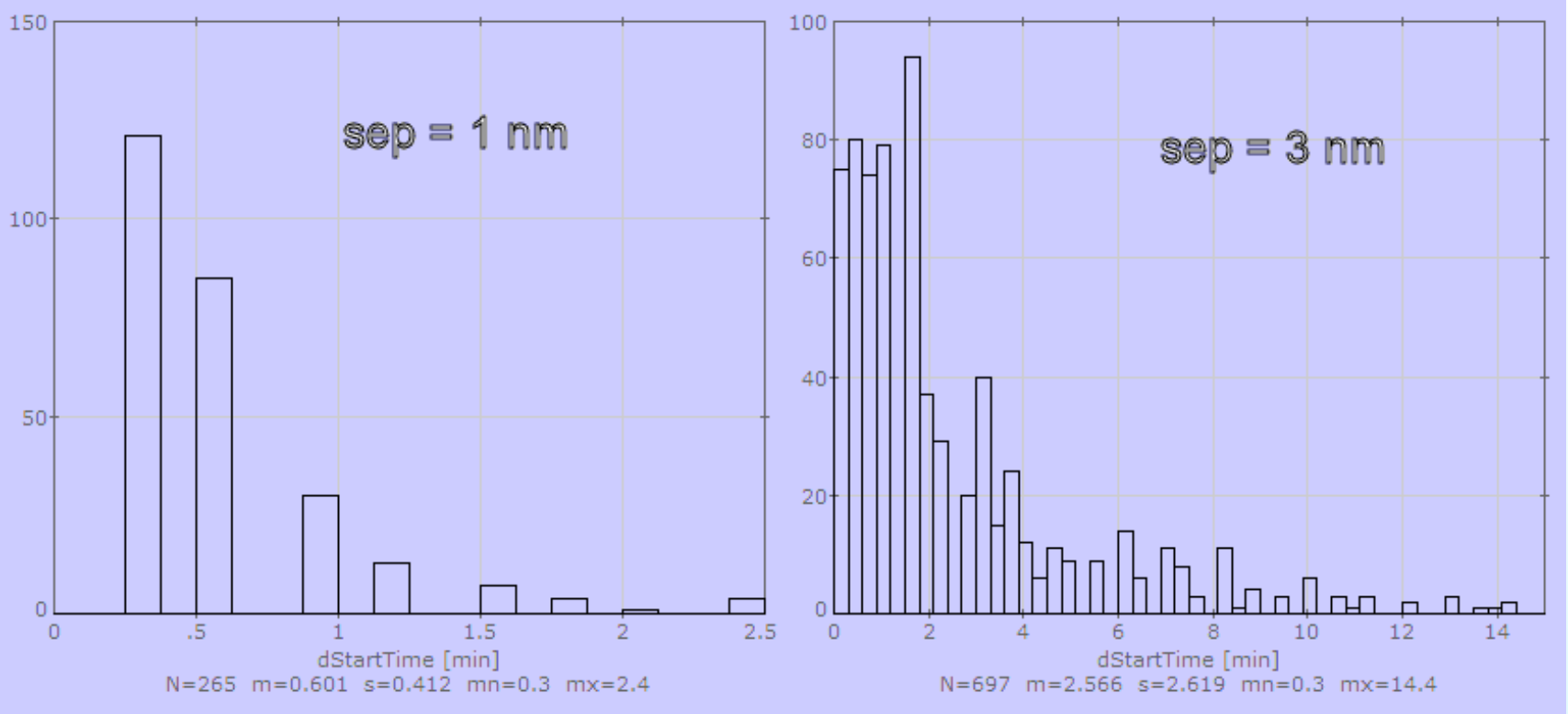
Aerospace Complexity: CONUS, JFK, ATL, ORD; 12:00 to +1:00 GMT								
			3/11/2007	3/11/2007	3/11/2007	3/11/2007		
			CONUS	JFK-120	ATL-120	ORD-120		
A	Area in Nautical Miles Square		2983989	45239	45239	45239		
FL	*Flight Load		3874.4	196.22	165.25	153.19		
FLA	FL per 1000 sq.nm		1.298	4.337	3.697	3.386		
PL	*Proximity Load		3174	366.27	284.05	272.72		
PLA	PL per 1000 sq.nm		**1.064**	**8.096**	**6.279**	**6.028**		
Flight load is a measure of traffic in the area at any given time								
Proximity load is number of aircraft within 4000 ft of altitude and 20 nm, within the area, at any given moment								

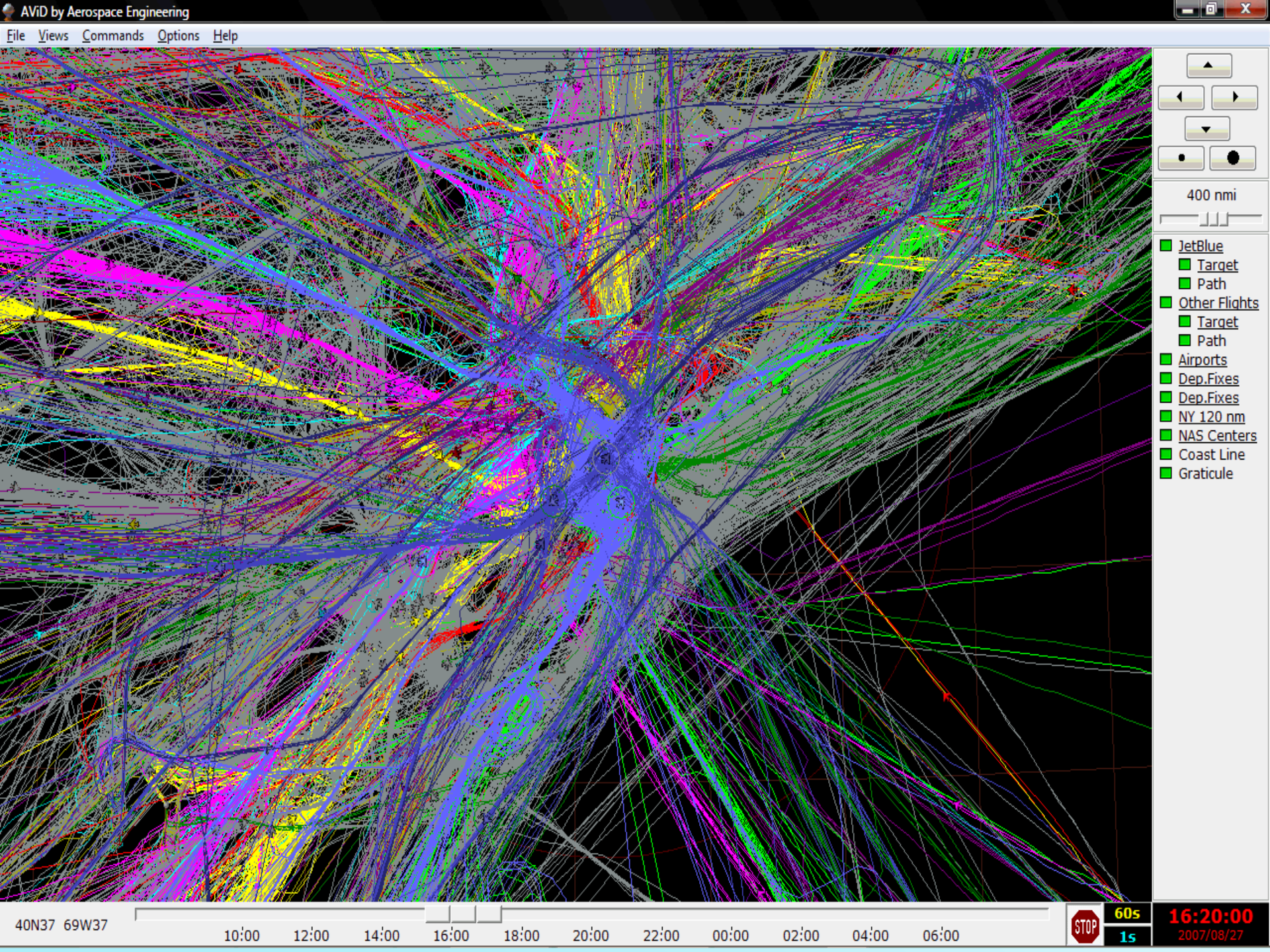
Baseline Current System
Airport Capacity

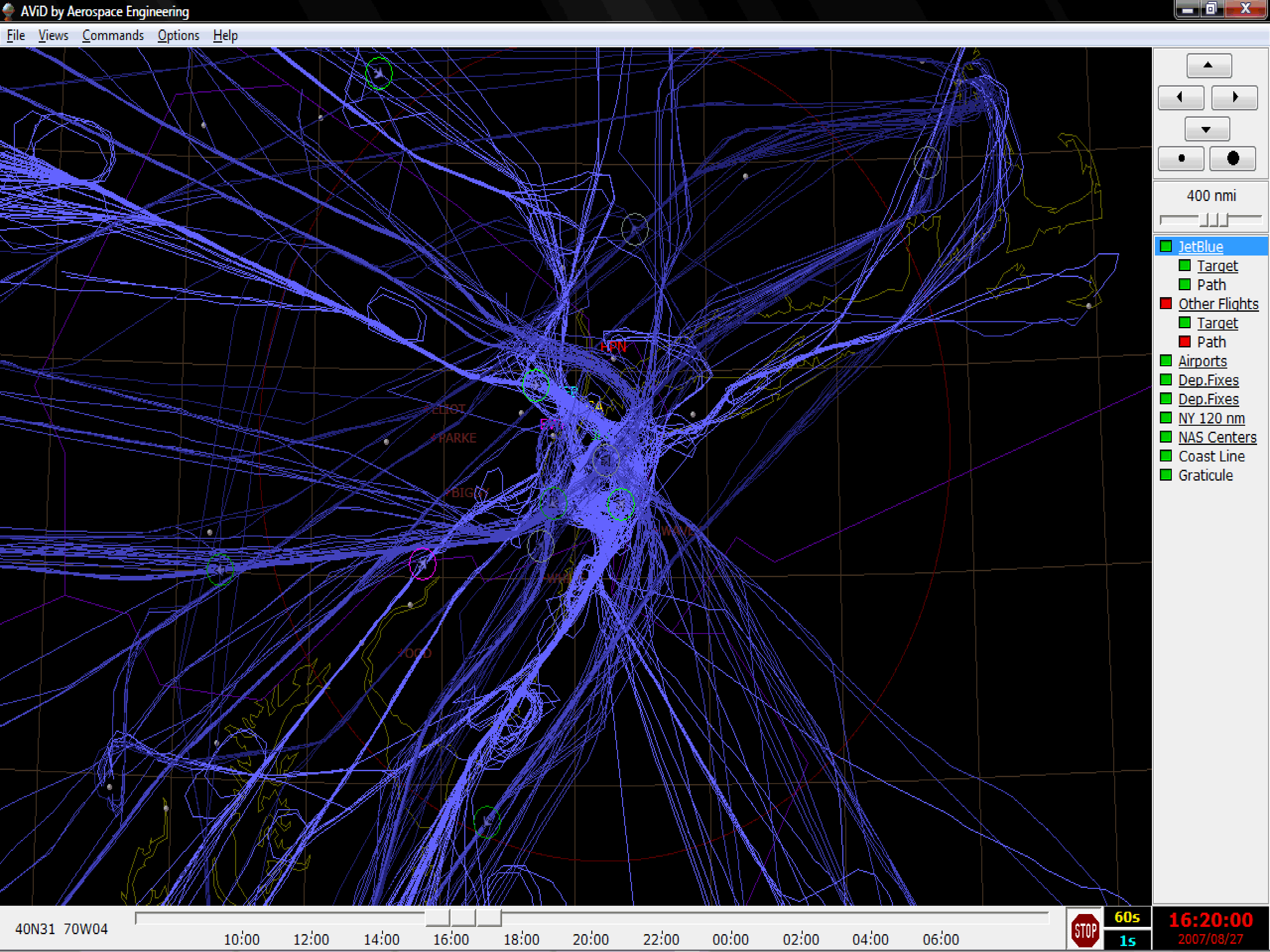
- Select Jet Blue flights as a separate layer for display and measurement purposes
- Assume the constrained resource is the arrival capacity at the 5 Metroplex airports
- Assume the capacity is less than or equal to IFR capacity
- Apply Merging and Spacing and/or CAVS policy by adjusting ETA time to simulate spacing
- Measure number of unresolved conflicts in the airspace

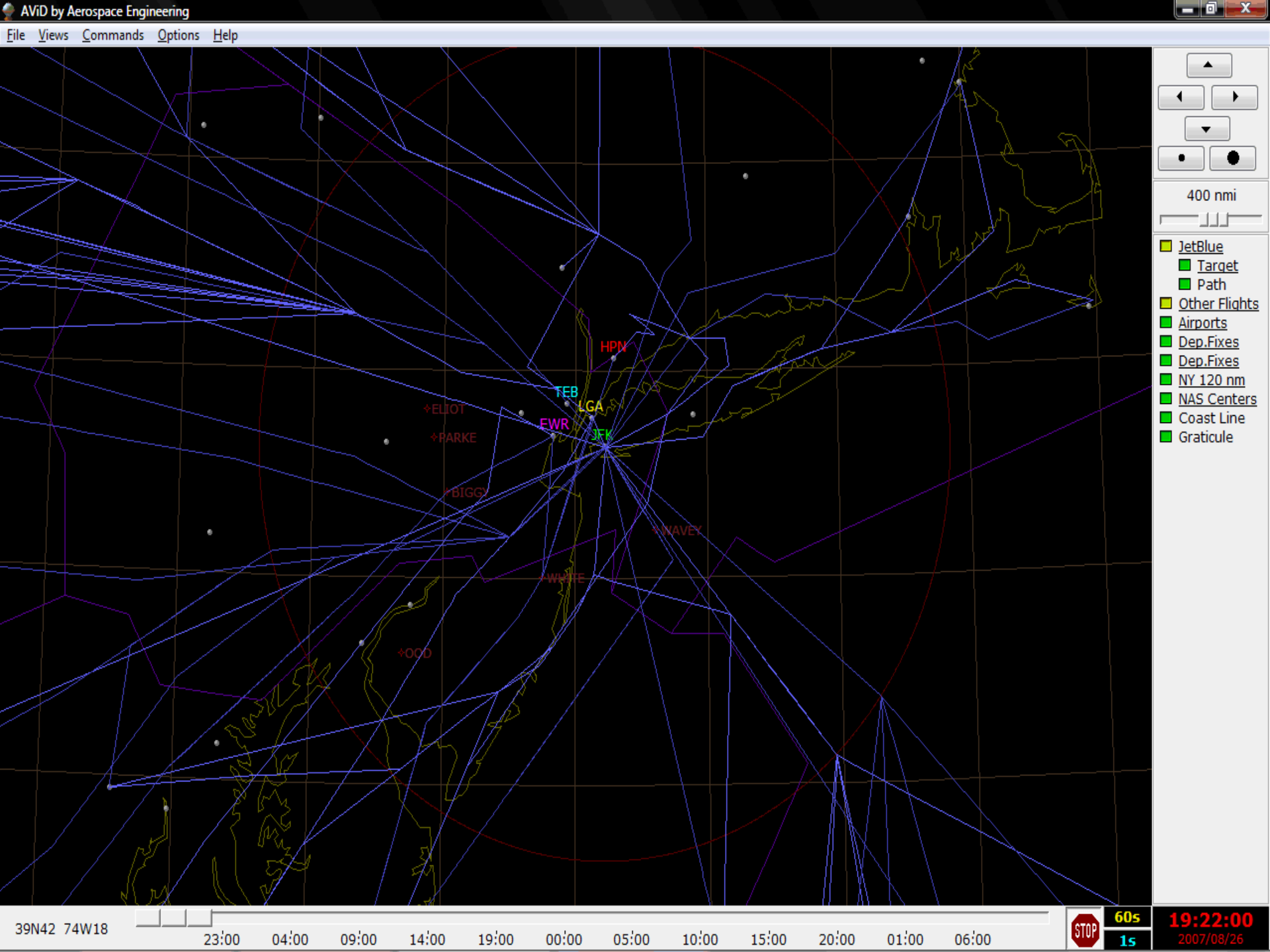
Baseline Current System
Airport Capacity

- Time period 24 Hours
- Total number of flights 4715
- Maximum airport capacity 60/Hour
- Mean change 0.6 minutes


sep = 1 nm
150
100
50
0
0
.5
1
1.5
2
2.5
dStartTime [min]
N=265 m=0.601 s=0.412 mn=0.3 mx=2.4
sep = 3 nm
100
80
60
40
20
0
0
2
4
6
8
10
12
14
dStartTime [min]
N=697 m=2.566 s=2.619 mn=0.3 mx=14.4


AViD by Aerospace Engineering
File
Views
Commands
Options
Help
400 nmi
JetBlue
Target
Path
Other Flights
Target
Path
Airports
Dep.Fixes
Dep.Fixes
NY 120 nm
NAS Centers
Coast Line
Graticule
40N37 69W37
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
02:00
04:00
06:00
STOP
60s
1s
16:20:00
2007/08/27


AViD by Aerospace Engineering
File
Views
Commands
Options
Help
HPN
ELIOT
PARKE
BIGGY
400 nmi
JetBlue
Target
Path
Other Flights
Target
Path
Airports
Dep.Fixes
Dep.Fixes
NY 120 nm
NAS Centers
Coast Line
Graticule
40N31 70W04
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
02:00
04:00
06:00
STOP
60s
1s
16:20:00
2007/08/27


AViD by Aerospace Engineering
File
Views
Commands
Options
Help
HPN
TEB
LGA
EWR
JFK
ELIOT
PARKE
BIGGY
WAVEY
WHITE
OOD
400 nmi
JetBlue
Target
Path
Other Flights
Airports
Dep.Fixes
Dep.Fixes
NY 120 nm
NAS Centers
Coast Line
Graticule
39N42 74W18
23:00
04:00
09:00
14:00
19:00
00:00
05:00
10:00
15:00
20:00
01:00
06:00
STOP
60s
1s
19:22:00
2007/08/26

NY-JFK Simulation

- AwSim adapted with NY airspace data
- Actual traffic data captured for multiple days
- Flight plan trajectories with start time adjusted to actual time of departure generated
- These FP trajectories were the basis for the simulation experiments. These represent the demand on the airport.

NY-JFK Simulation

- Apply policy at arrival fix (ROBER CAMRN LENDY ZIGGY OWENZ) and at runway
- Measure delay resulting from policy
- Change policy to represent technology change
- Measure resulting changes in delay

NY-JFK Simulation

- Policy #1 – require 8 miles in trail spacing at arrival fix (ROBER CAMRN LENDY ZIGGY OWENZ)
- Policy #2 – require 4 miles in trail spacing at arrival fix for qualified aircraft (requires 2 qualified aircraft for reduction to be applied)
- Sep. 19, 2007 data used

NY-JFK Simulation

Policy #1 – All flights require 8 miles spacing at arrival fix, airport arrival rate = 60, total flights = 660

Flights requiring delay for fix spacing	243
Total minutes of delay applied for fix	459
Flights requiring additional delay for landing	335
Total minutes of additional delay applied for airport	397

NY-JFK Simulation

Policy #2 – Qualified flights require 4 miles spacing at arrival fix, airport arrival rate = 60, total flights = 660
Run A – only Jet Blue flights are qualified (173 flights)

Flights requiring delay for fix spacing	230
Total minutes of delay applied for fix	428
Flights requiring additional delay for landing	319
Total minutes of additional delay applied for airport	369

NY-JFK Simulation

Policy #2 – Qualified flights require 4 miles spacing at arrival fix, airport arrival rate = 60, total flights = 660
Run B – all flights are qualified (660 flights)

Flights requiring delay for fix spacing	131
Total minutes of delay applied for fix	88
Flights requiring additional delay for landing	158
Total minutes of additional delay applied for airport	53

Demonstration