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# Overview of Operational Inefficiencies and Opportunities for Improvement over the NAT (*Operators Perspective*)

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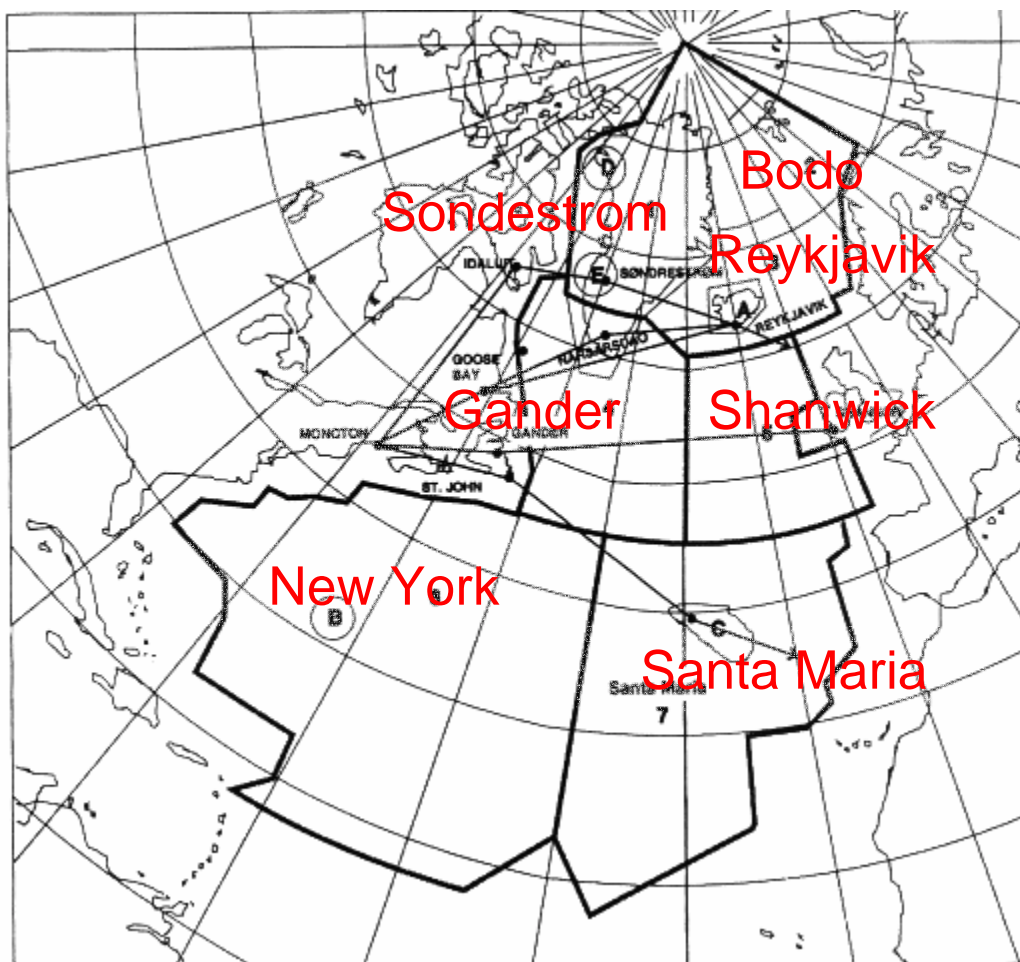
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***MIT International Center for Air Transportation***

*March 2008*



# North Atlantic Flight Information Regions (FIRs)

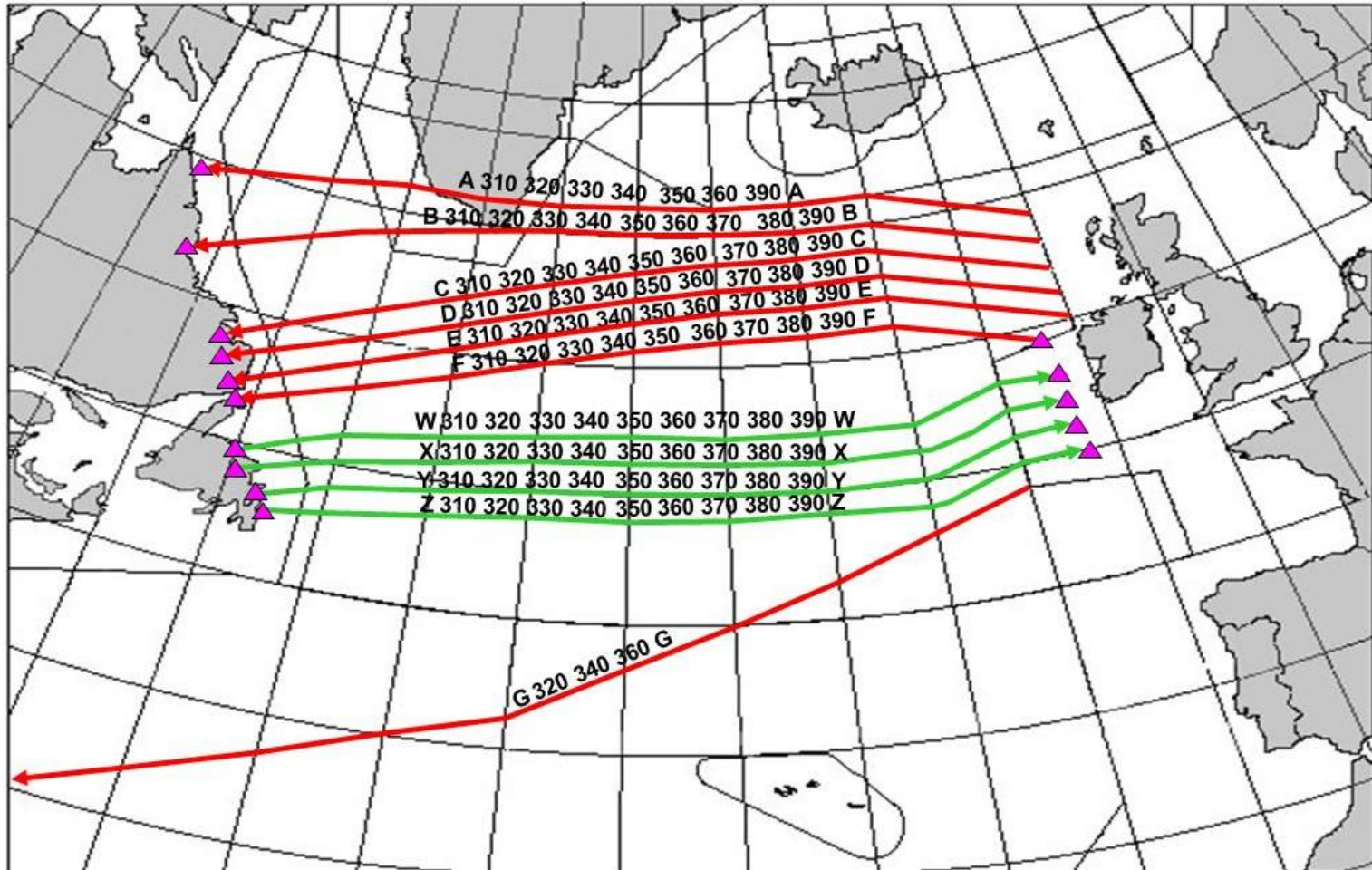


Source: ICAO, "North Atlantic International General Aviation Manual," Third Edition, 2004





# North Atlantic Organized Track System (OTS)

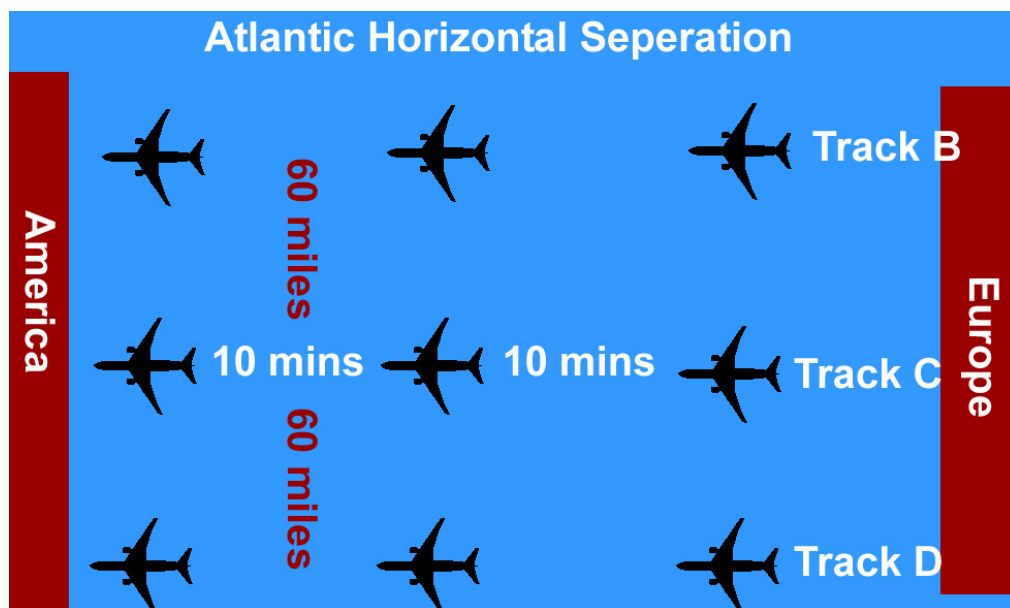


Source: jetplan.com

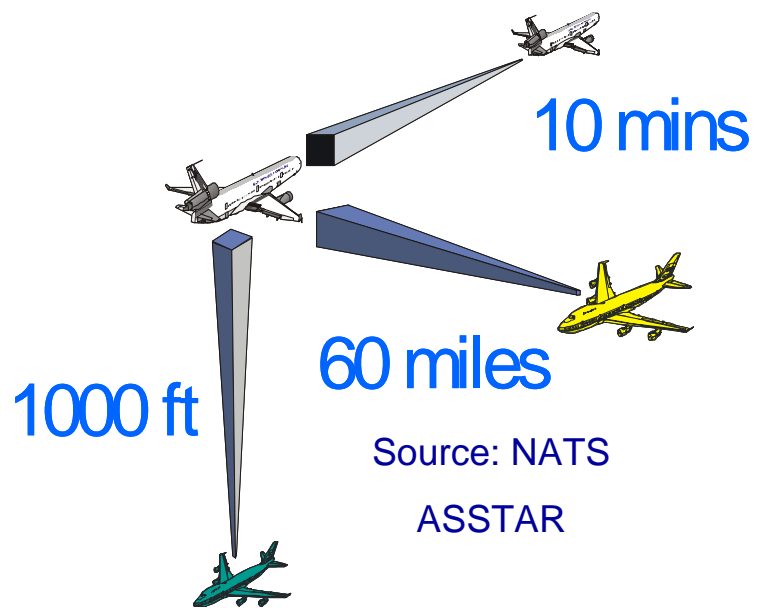




# Separation Standards



Source: bcavirtual.com





# NAT Operators Survey - Overview

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- ❑ Survey objective
  - Determine the best strategy for increasing efficiency of operations in the NAT and promoting the adoption of data link communications
  
- ❑ Research areas
  1. Operational inefficiencies and opportunities to improve service in the NAT
  2. Value distribution of data link costs and benefits for the users of the system
  3. Sources of uncertainty in the adoption of data link
  4. Current and projected data link equipage in the NAT
  5. Strategies that could incentivize data link adoption
  
- ❑ Target population and subject description
  - NAT system users (airlines)
  - Senior level airline captains with extensive experience in NAT operations
  - Managers in areas of operations, planning, communications, and air traffic





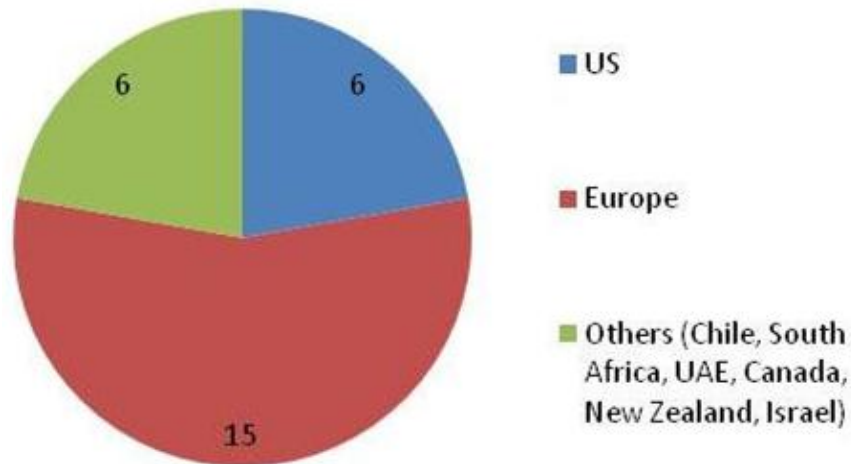
# Airline Interviews Conducted (March – August 2007)

Airline	Country
Air Canada	Canada
Air Europa	Spain
Air France	France
Air New Zealand	New Zealand
Austrian Airlines	Austria
British Airways	UK
Brussels Airlines	Brussels
Continental Airlines	US
Czech Airlines	Czech Republic
Delta Airlines	US
El Al Israeli Airlines	Israel
Emirates Airlines	United Arab Emirates
FedEx	US
Flyglobespan	UK

Airline	Country
Iberia	Spain
Icelandair	Iceland
KLM	Netherlands
LAN	Chile
LTU	Germany
Lufthansa	Germany
Northwest Airlines	US
Scandinavian Airlines System	Sweden
South African Airways	South Africa
Swiss International Airlines	Switzerland
United Airlines	US
UPS	US
Virgin Atlantic Airways	UK

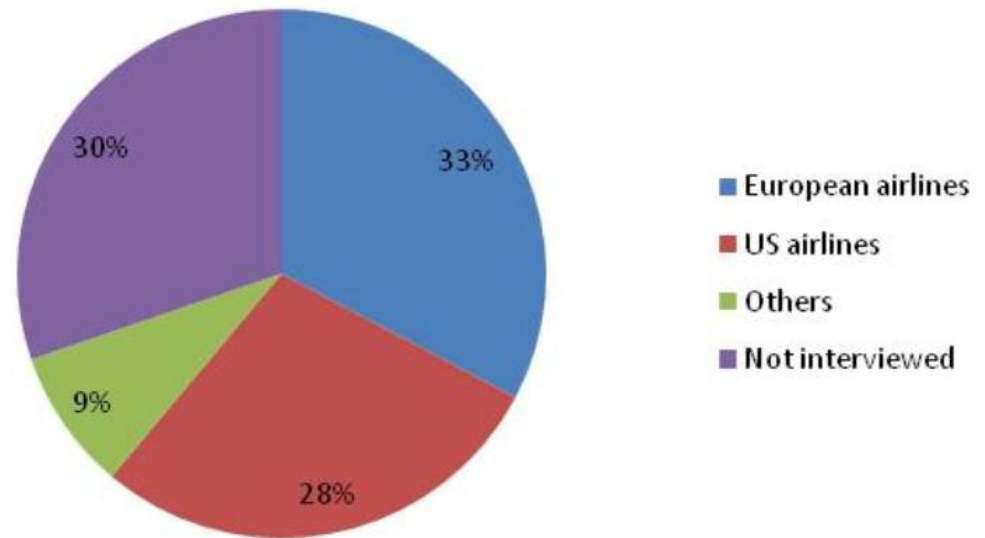


# Airline Interviews Conducted (Details)



## Geographic Distribution

## Representation of NAT Traffic

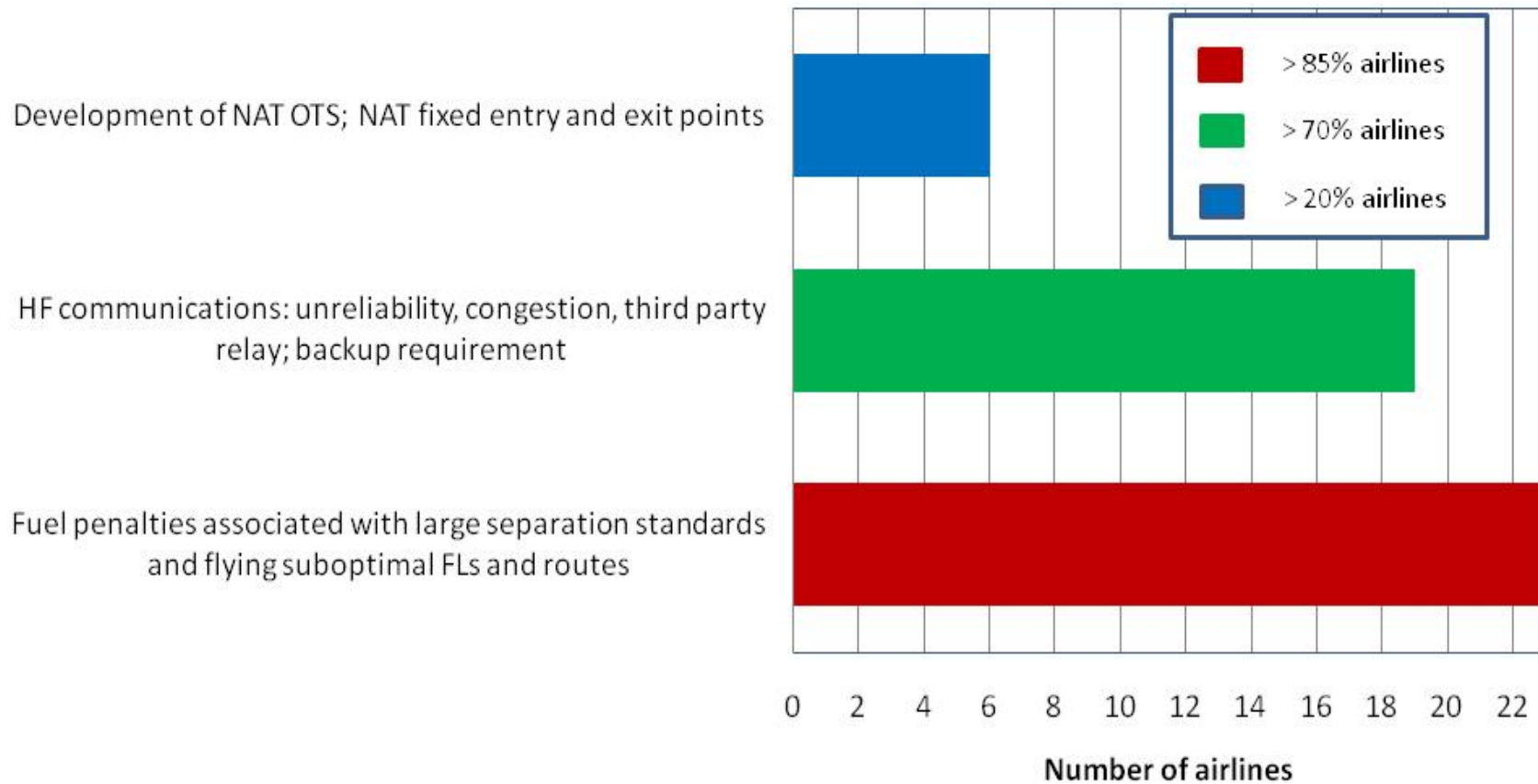


Based on BTS T100 Segment Data  
(Departures across NAT from Jan 01 to Dec 31, 2006)





# 1. Operational Inefficiencies in the NAT (Summary of Findings)

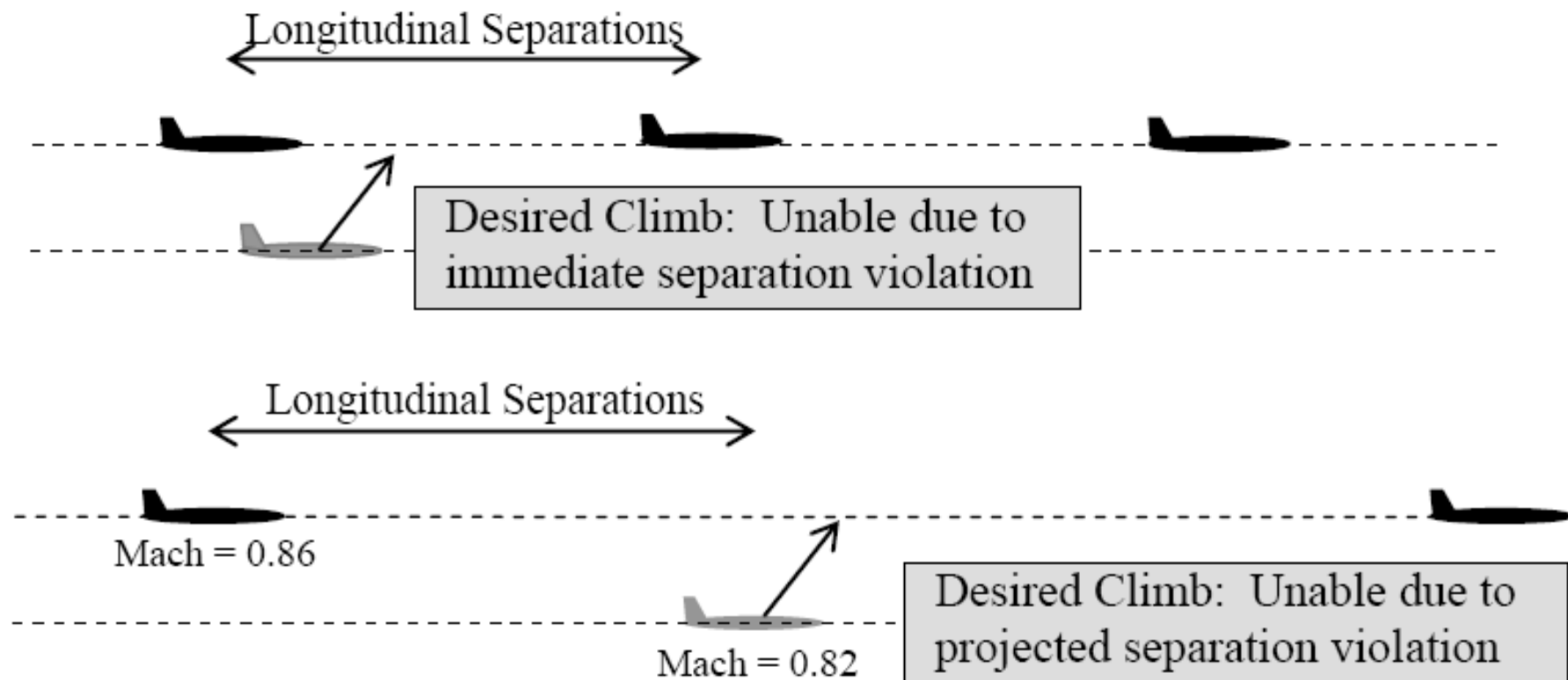


Survey Question: Do you think there are any operational inefficiencies in the NAT?

# 1. Operational Inefficiencies in the NAT (Survey Details)

- Flying less than optimum flight levels and routes

Example of Aircraft Unable to Climb due to Nearby Traffic



Source: Williams, A.R., "Benefits Assessment of Reduced Separations in North Atlantic Organized Track System," CSSI Inc. Advanced Programs – Report Prepared for NASA Glenn Research Center, August 2005.



# 1. Operational Inefficiencies in the NAT (Survey Details)

- Flying less than optimum flight levels and routes

Example of Economic Penalties due to Inefficient Oceanic Routes

	Most Fuel Efficient Route*	Fuel Efficient Route Shifted 100 NM	Difference
Distance	5,770.7 NM	5,778.5 NM	7.8 NM
Average Headwinds	52 knots	66 knots	14 knots
Time	772 minutes	799 minutes	27 minutes
Pounds of Fuel	330,146 lbs.	338,071 lbs.	7,925 lbs.
Gallons of Fuel (1 gal. = 6.78 lbs.)	48,694 gals.	49,863 gals.	1,169 gals.
Cost of Fuel @ \$1.20/gal (Feb 2003 ATA testimony)	\$58,433	\$59,836	\$1,403 ↓

\*Using forecast winds and temps, fuel efficient tracks are built between city pairs \$2,563

Sep 07 price aviation fuel: \$2.18/gal

Global average price price

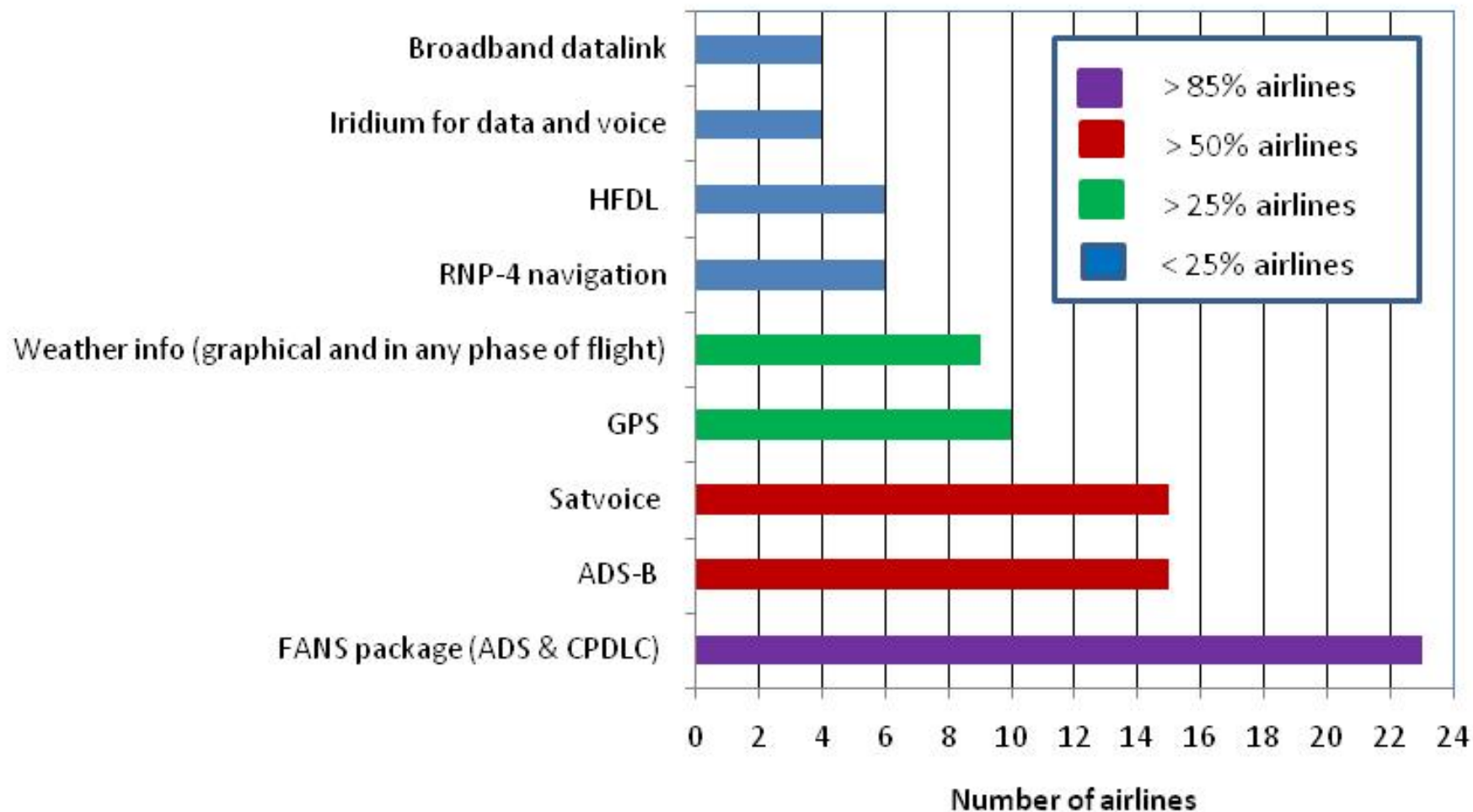
Source: IATA

(Sep 07 fuel cost)

Source: Kerczewski, R., et al,  
 "Communications, Navigation, and Surveillance  
 for Improved Oceanic Air Traffic Operations,"  
 2005



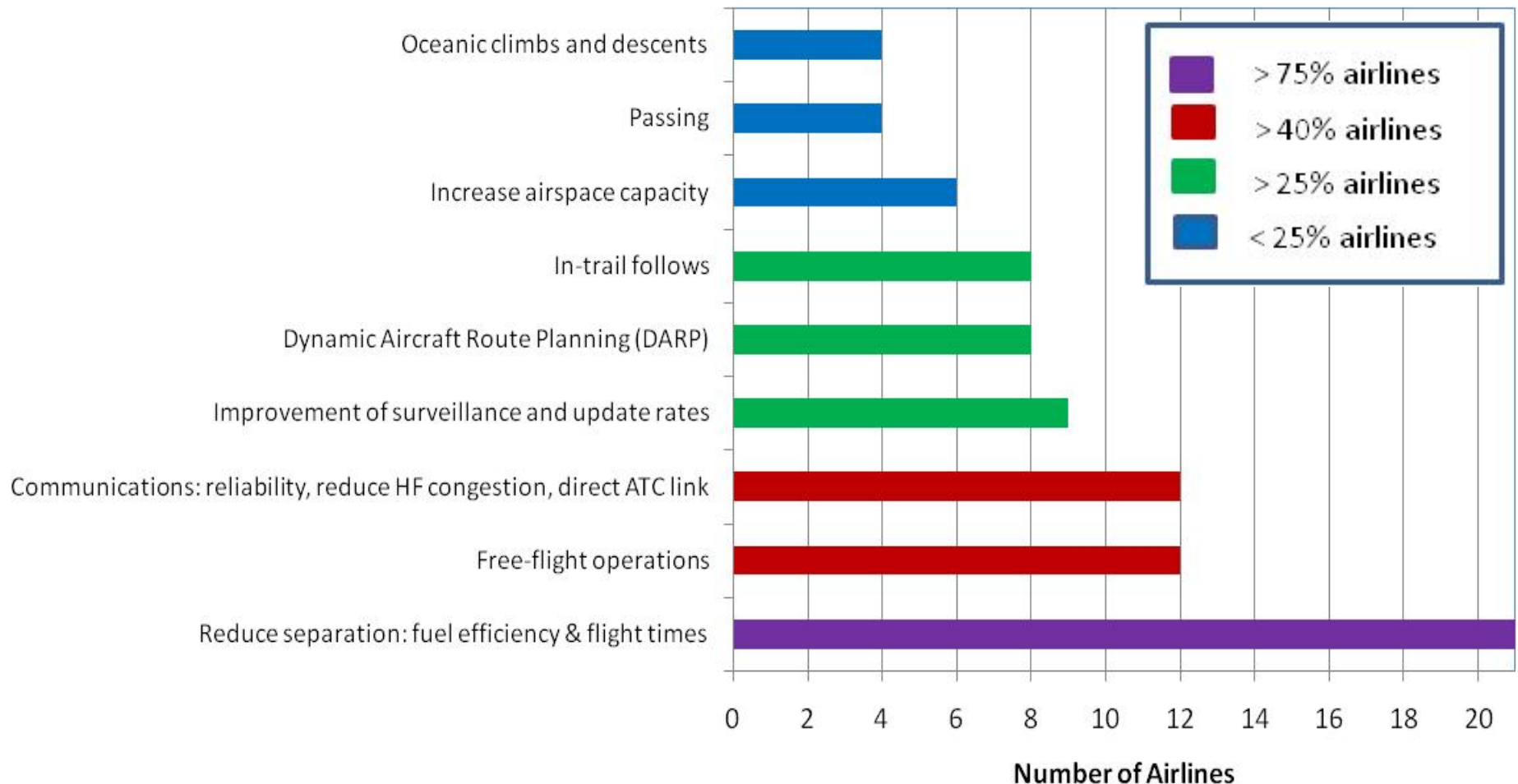
# 1. Opportunities to Improve Service: Technologies (Summary of Findings)



Survey Questions: What capabilities or services would you like to have over the NAT?  
Do you think that technology plays a role in allowing you to achieve those capabilities?



# 1. Opportunities to Improve Service: Applications (Summary of Findings)



Survey Question: What do you see as the near, mid, and far term potential applications of data link communications and what data link alternatives do they depend on?



## 1. Opportunities to Improve Service: Applications (Survey Details)

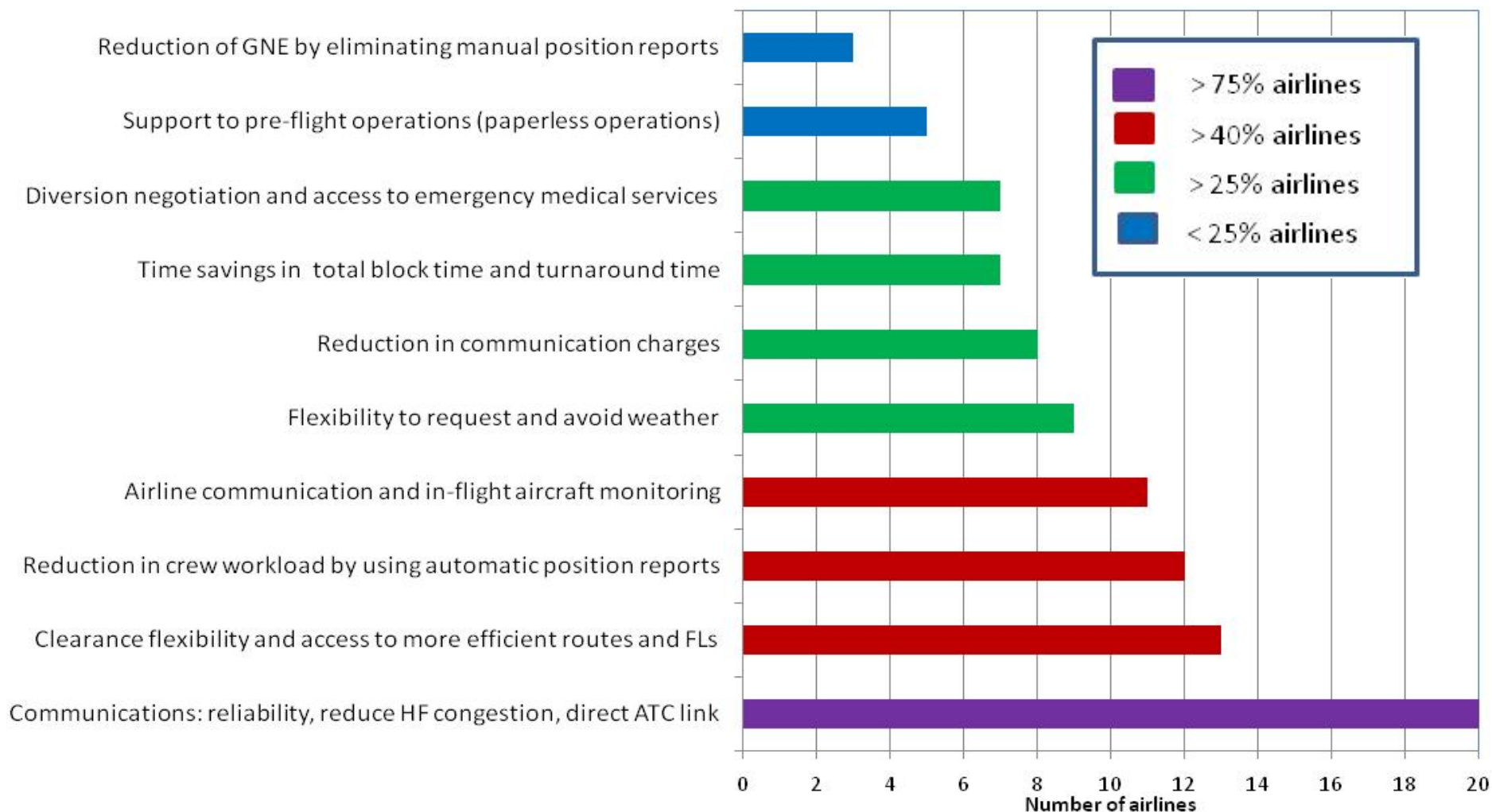
- Reduction in separation standards (CNS requirements)

Separation (Lateral/Longitudinal)	Communication and Controller Intervention Time	Navigation Performance	Surveillance (Update/Latency)
30nm/30nm	6 minutes	RNP-4	14 min./1 min. (ADS)
20nm/20nm	6 minutes	RNP-4	1 min./15 sec. (ADS)
10nm/10nm	3 minutes    Direct Voice	RNP-2	15 sec./3 sec. (ADS)

Source: Kerczewski, R., et al, "Communications, Navigation, and Surveillance for Improved Oceanic Air Traffic Operations," 2005



## 2. Value Distribution: Current Data Link Benefits (Summary of Findings)

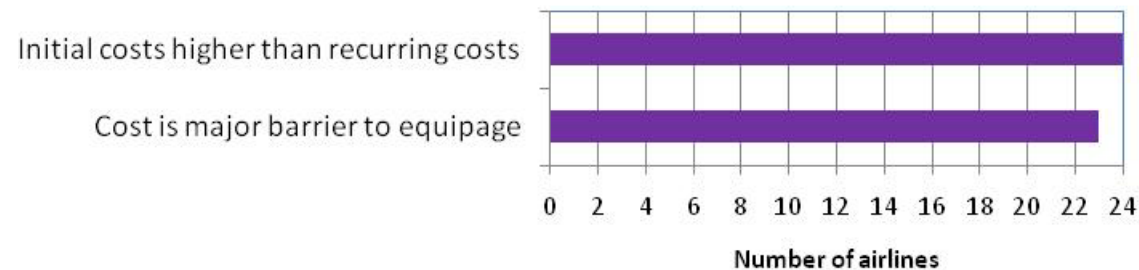
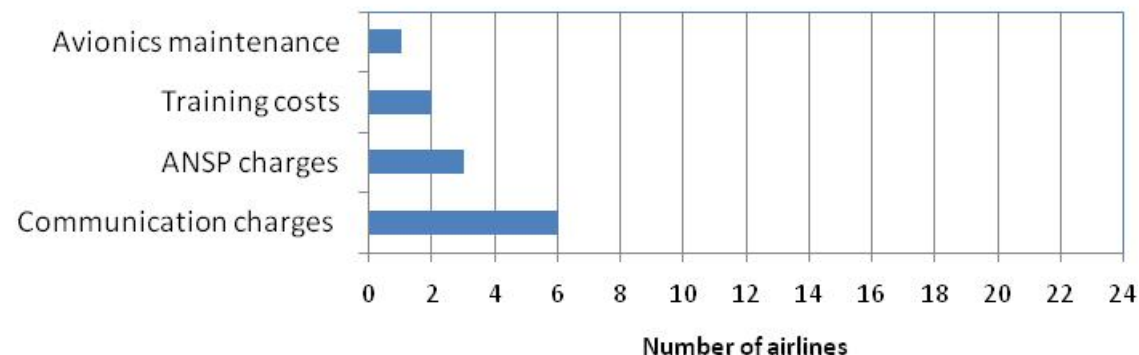
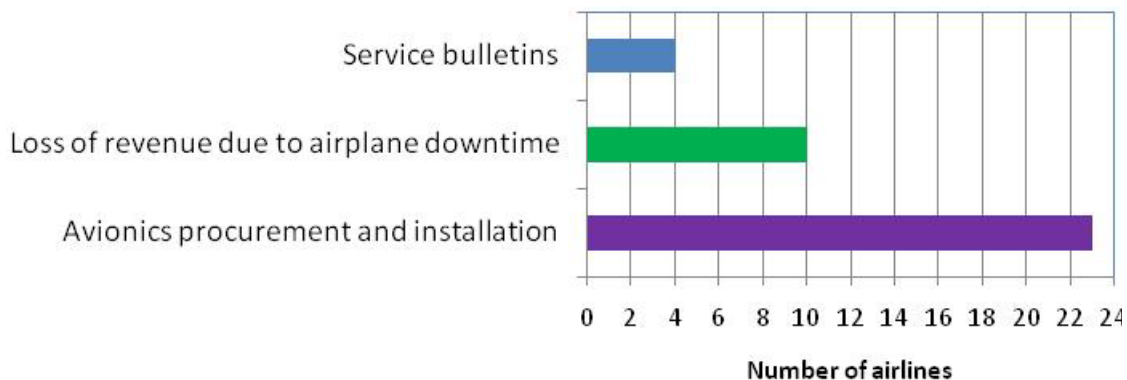


Operational Benefits **greater than** Economic Benefits

Survey Question: Are you currently receiving any benefits from data link?

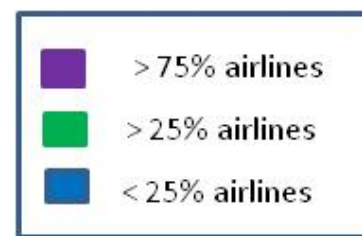


## 2. Value Distribution: Data Link Costs (Summary of Findings)



### Initial Costs

Survey Question: What initial costs would most negatively affect your decision to equip with data link?



### Recurring Costs

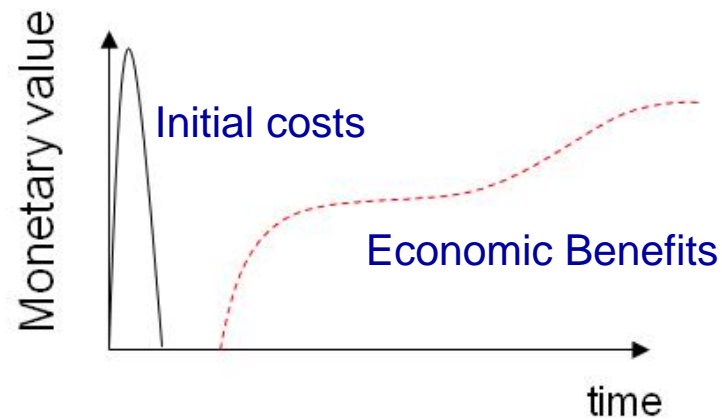
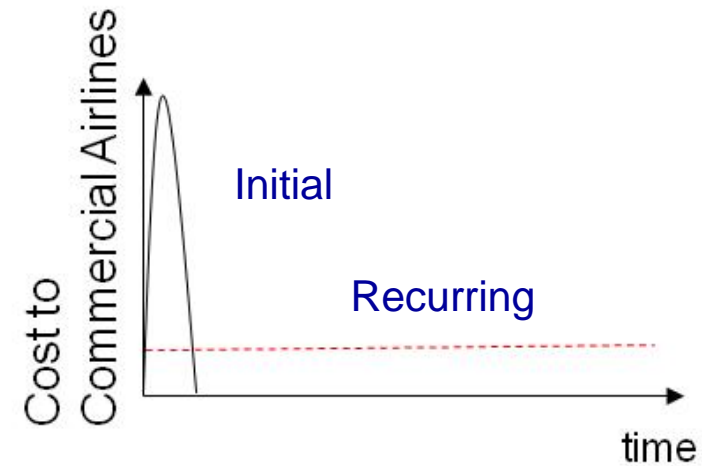
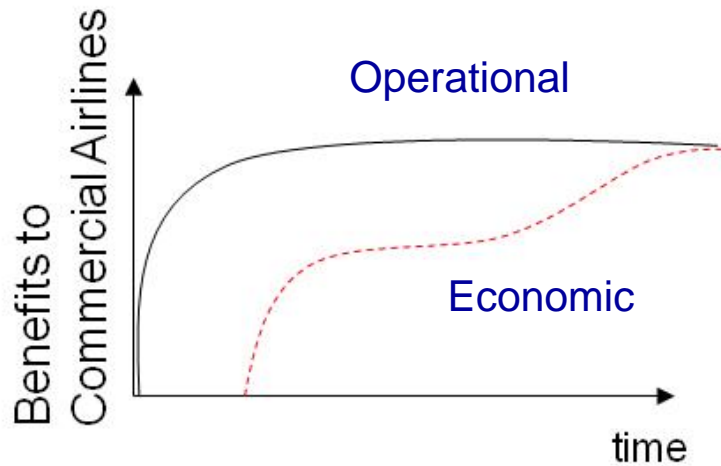
Survey Question: What recurring costs would most negatively affect your decision to equip with data link?

Survey Question: How would initial and recurring costs compare in the way they affect your decision to equip?





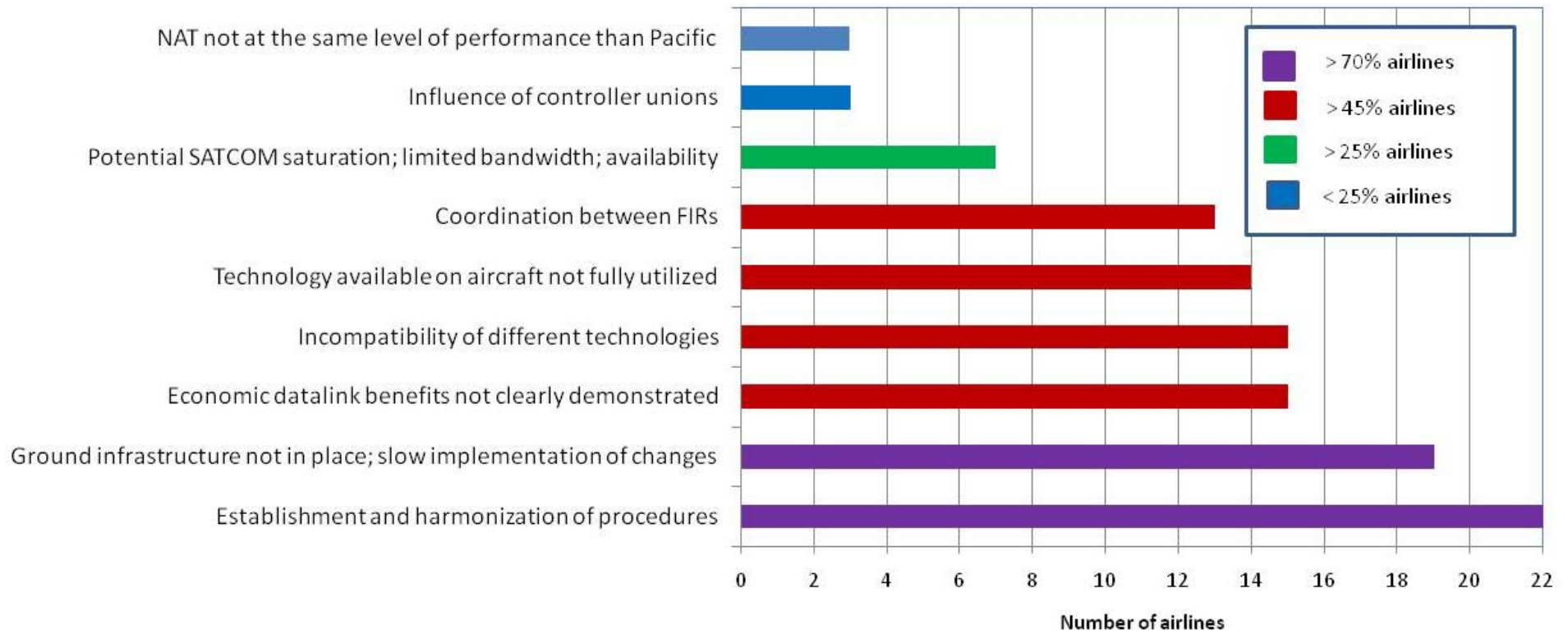
## 2. Data Link Value Distribution of Costs and Benefits to NAT Users



Adapted from Marais, K. and Weigel, A. (MIT), "Encouraging and Ensuring Successful Technology Transition in Civil Aviation"



### 3. Sources of Uncertainty in the Adoption of Data Link (Summary of Findings)

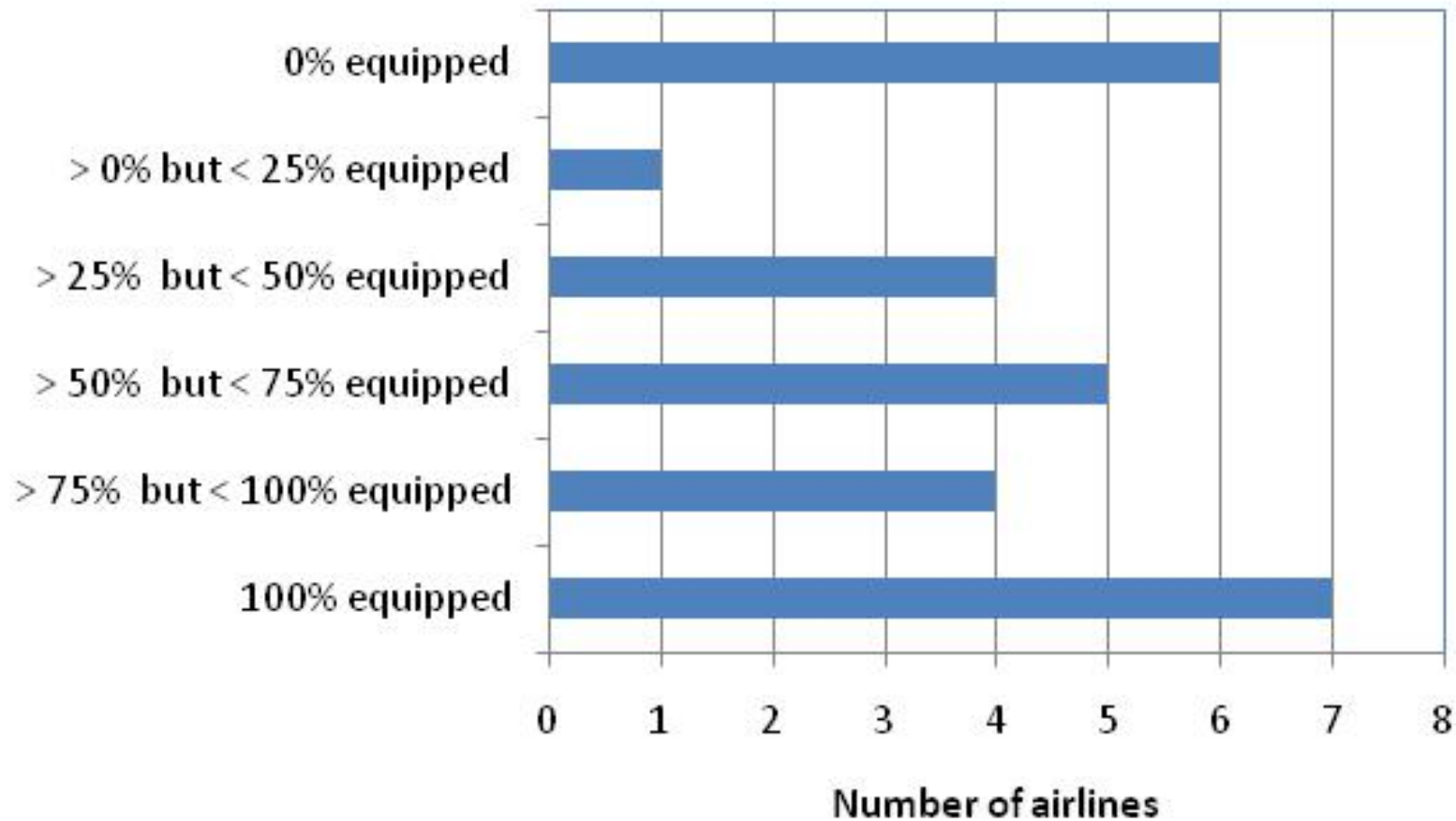


Several questions informed this section



## 4. Current Data Link Equipage in the NAT (Summary of Findings)

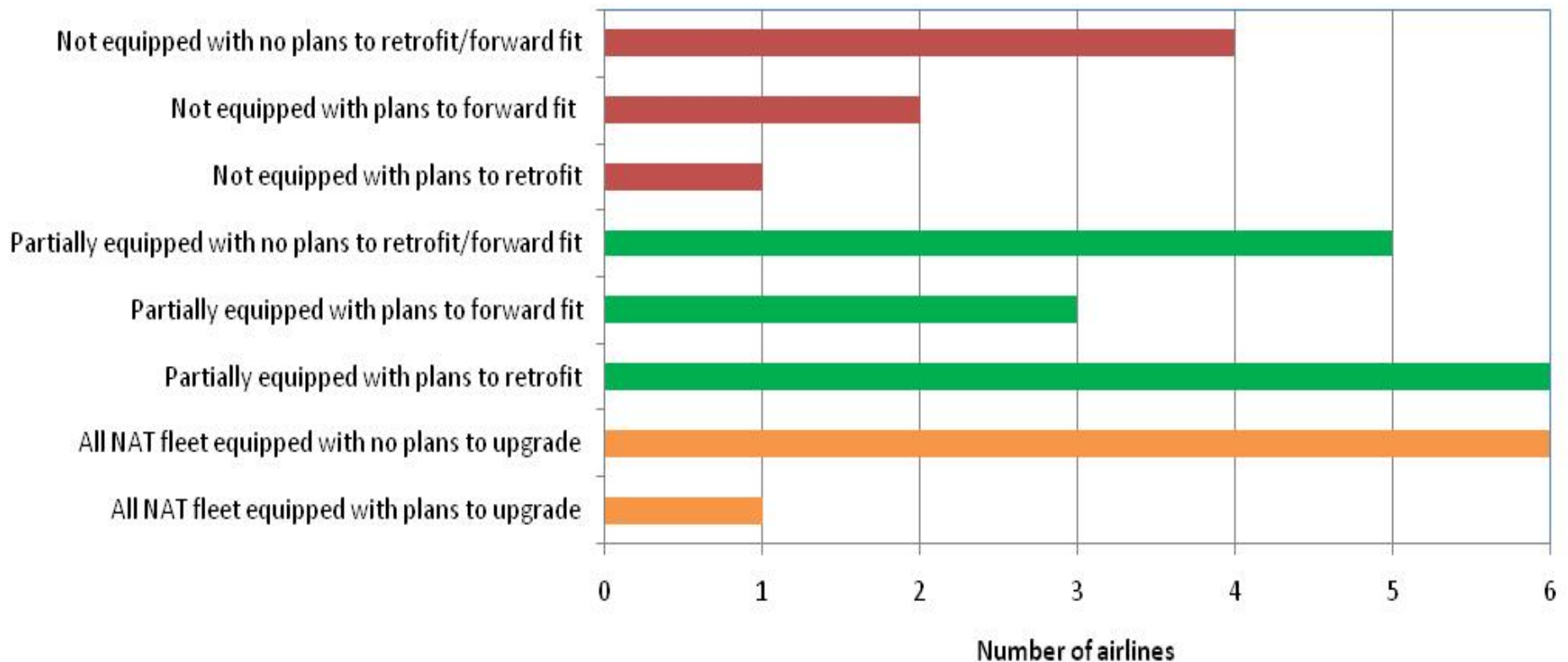
### FANS-1/A





## 4. Projected Data Link Equipage in the NAT (Summary of Findings)

### FANS-1/A Retrofit Plans

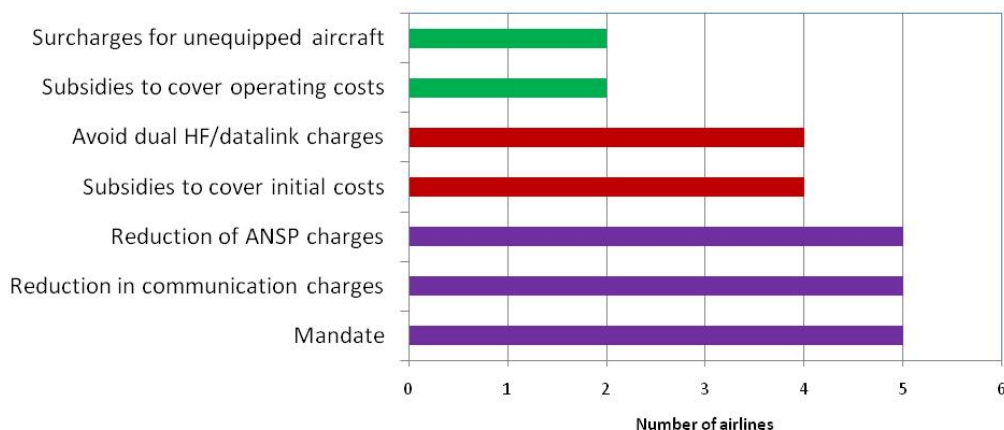


Survey Question: Do you currently have plans to increase the data link avionics equipage of your NAT fleet?

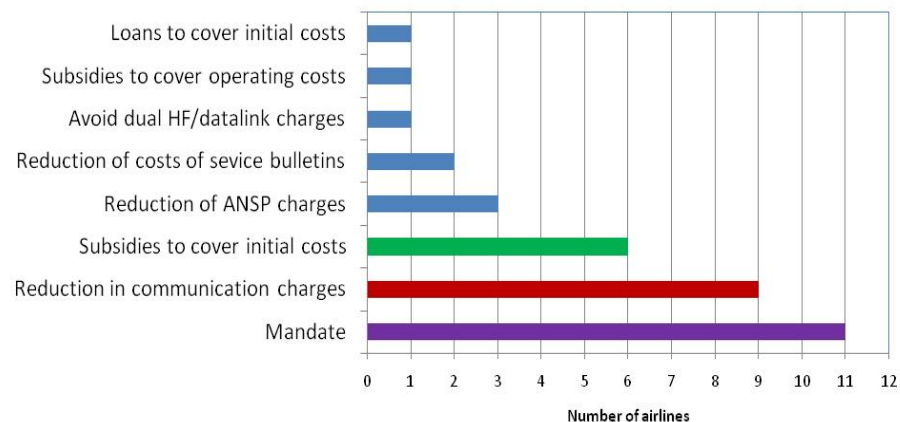


# 5. Strategies to Encourage Data Link Adoption (Summary of Findings)

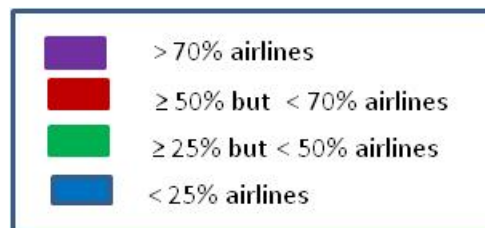
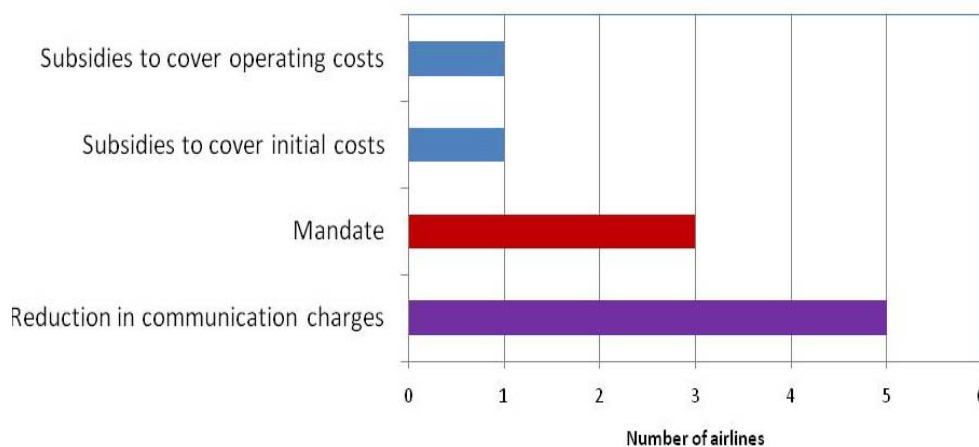
Strategies according to airlines 100% equipped with FANS-1/A (7 total)



Strategies according to airlines partially equipped with FANS-1/A (14 total)



Strategies according to airlines that are not equipped with FANS-1/A (6 total)



Survey Question: What applications, incentives or mandates would be most effective in encouraging your fleet to equip?



# Conclusion

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- ❑ Survey objective
  - Determine the best strategy for increasing efficiency of operations in the NAT and promoting the adoption of data link communications
  
- ❑ Key findings
  - Poor surveillance results in procedural separation, which leads to higher fuel burn rates and delays derived from inability to fly preferred routes and FLs. Sub-optimal communication capabilities contribute to this effect
  
  - Data link is perceived as enabler to improve efficiency of operations. However, operational benefits are currently higher than economic
  
  - Initial cost is major barrier to equip with data link. Other barriers include uncertainty in the establishment and harmonization of procedures and technologies that could prevent maximization of data link economic benefits
  
  - A combination of operational, financial and regulatory strategies may be necessary to leverage costs vs. benefits and encourage operators to equip