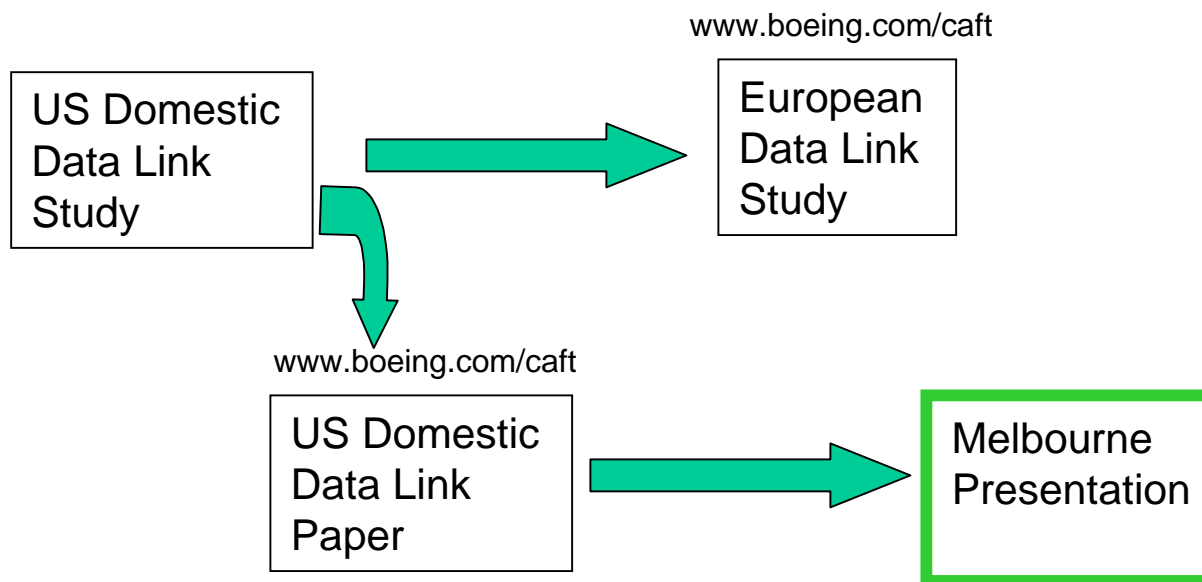


# C/AFT All Airline Meeting Melbourne

Data Link Focus Group

# Historical Perspective



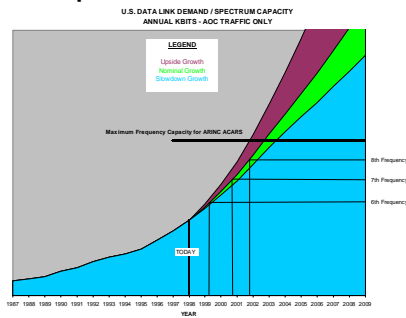
- Purpose:
- 1) Explain the process
  - 2) Summarize results
  - 3) Get you to read the papers

# Data Link

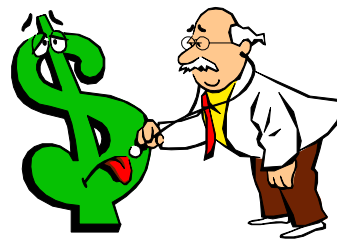
- Data Link = automatic or pilot initiated data communication with airline flight planning or air traffic control authorities
- Data Link Pathways
  - VHF (over land)
  - Satellite (oceanic and remote areas)
- Applications
  - Airline Flight Operations
  - Airline Maintenance data
  - Air Traffic Control (ATC)

# Converging (Conflicting?) Factors

## Spectrum Issues

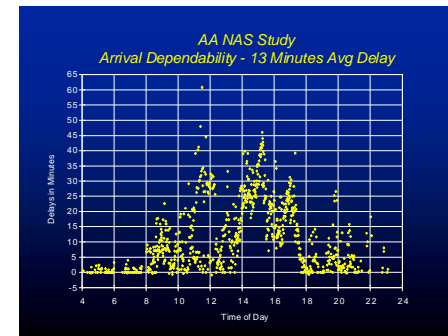


Immediate,  
Lower Risk  
Cost Avoidance  
Requirements Complete  
Affects data link aircraft



**Limited Investment Capital**  
Airlines  
Infrastructure  
Airframe Manufacturers

## Air Traffic Improvement



Intermediate,  
Higher Risk,  
Cost Avoidance  
Requirements Incomplete  
Affects all aircraft

# What are we using today?

- Aircraft Communication Addressing and Reporting System (ACARS)
  - Character based transmissions
  - 2400 bps transmission speeds
  - In use since 1977
- Current statistics (ARINC)
  - Service provided through 196 stations
  - 58 carriers with over 6,000 aircraft
  - ARINC handling 14M messages per month
  - 1987 - 1,700 per a/p per month
  - 1998 - 2,700 per a/p per month
- System is reaching it's capacity in U.S./Europe

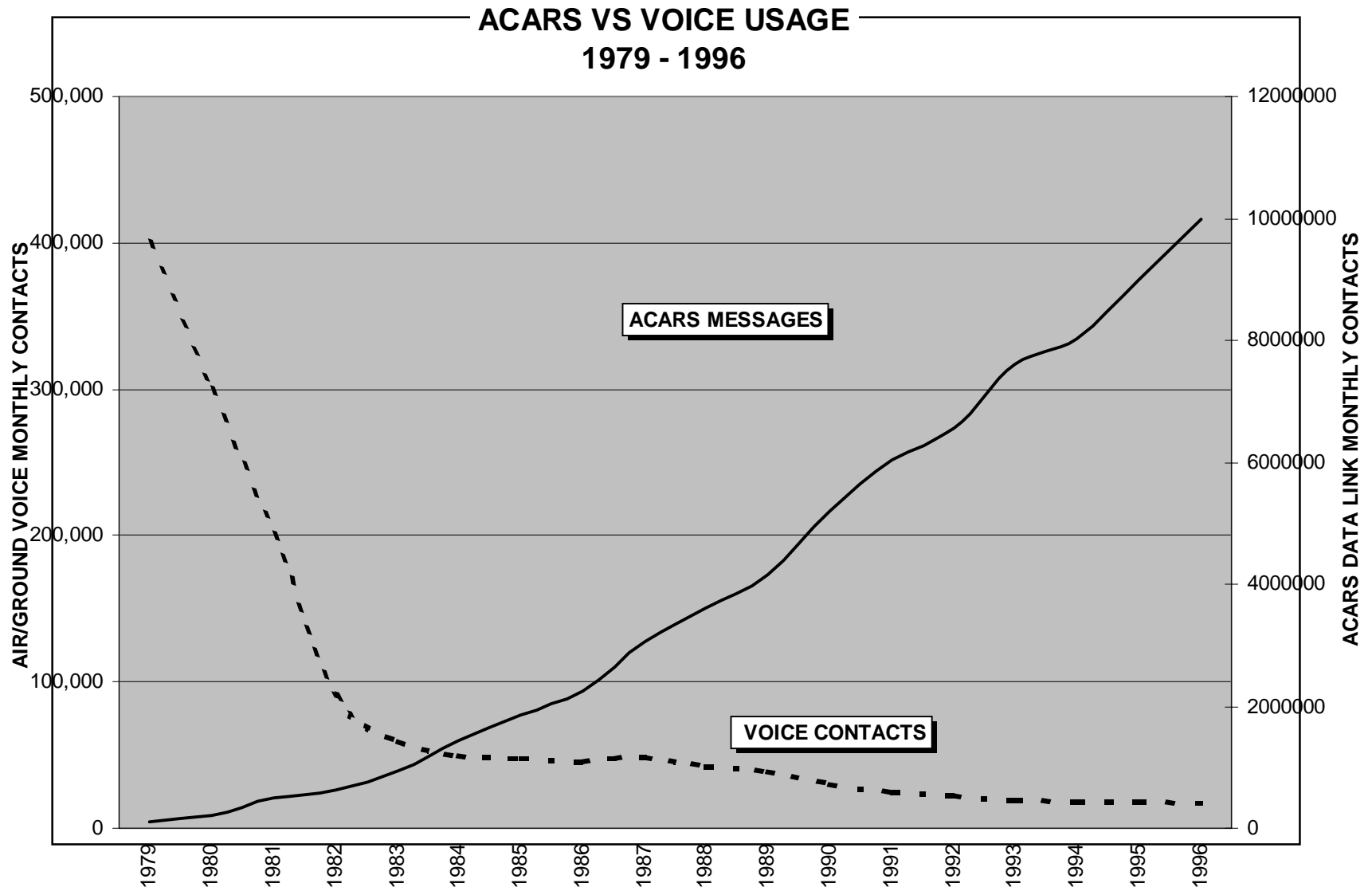
# C/AFT Task

- Determine Economic business cases associated with changes to data link
  - Address AOC changes
  - Address ATC changes
- Analyze individual and combined business cases
- Address available technology
- Target Audience: Chief Financial Officers

# Airline Operational Control

Airline Dispatch Operations  
Impact of Frequency Congestion

# Voice vs Data Message Traffic



# Airline Operations Control

## Increasing U.S. Demand for Service

- Growing number of ACARS aircraft in U.S.
  - Today: Approx. 5600 U.S. + 1500 Non-U.S. = 7100 total
  - Future: Up to 1200 more over next 3 to 5 years
- Potential new demand from new participants
  - Civil: Large Scheduled (Regional), Cargo, and Business
  - Military: Non-Tactical Aircraft, Air National Guard
  - Estimated potential at more than 4500 additional aircraft
- Increasing number of data link applications
  - Aircraft Performance
  - Crew Management
  - In-flight Operations



# Spectrum Issues

## Congestion and Availability

- New applications is the primary reason for increasing demand for ACARS.
- New data link users entering service is the secondary reason for increasing demand for ACARS.
- Many areas of US already already experiencing congestion on en route frequencies.
- Other industries are looking and petitioning for available spectrum.

Managing spectrum congestion and availability will be a growing and continuing concern for the airline industry.

U.S. DATA LINK DEMAND / SPECTRUM CAPACITY  
ANNUAL KBITS - AOC TRAFFIC ONLY

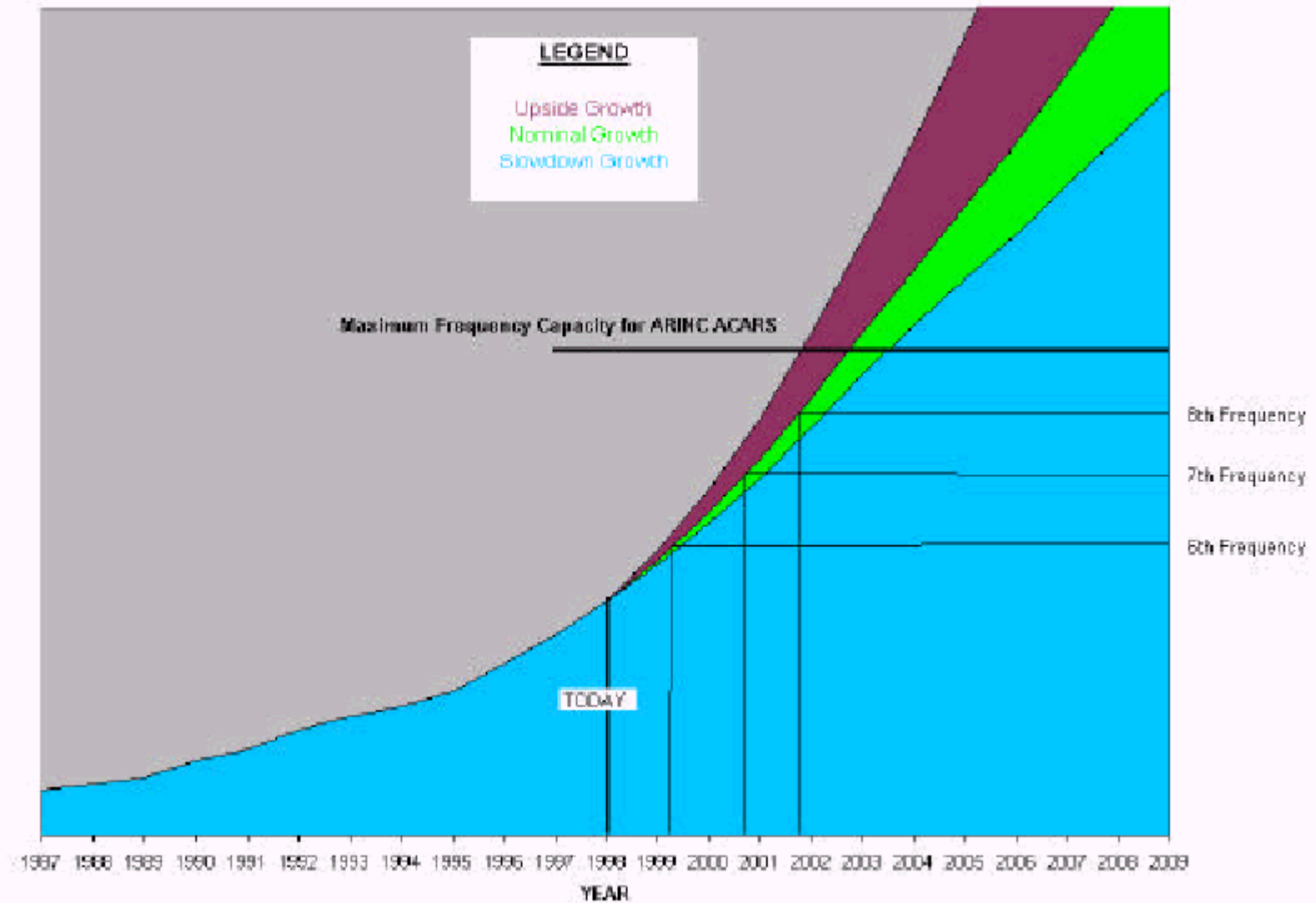
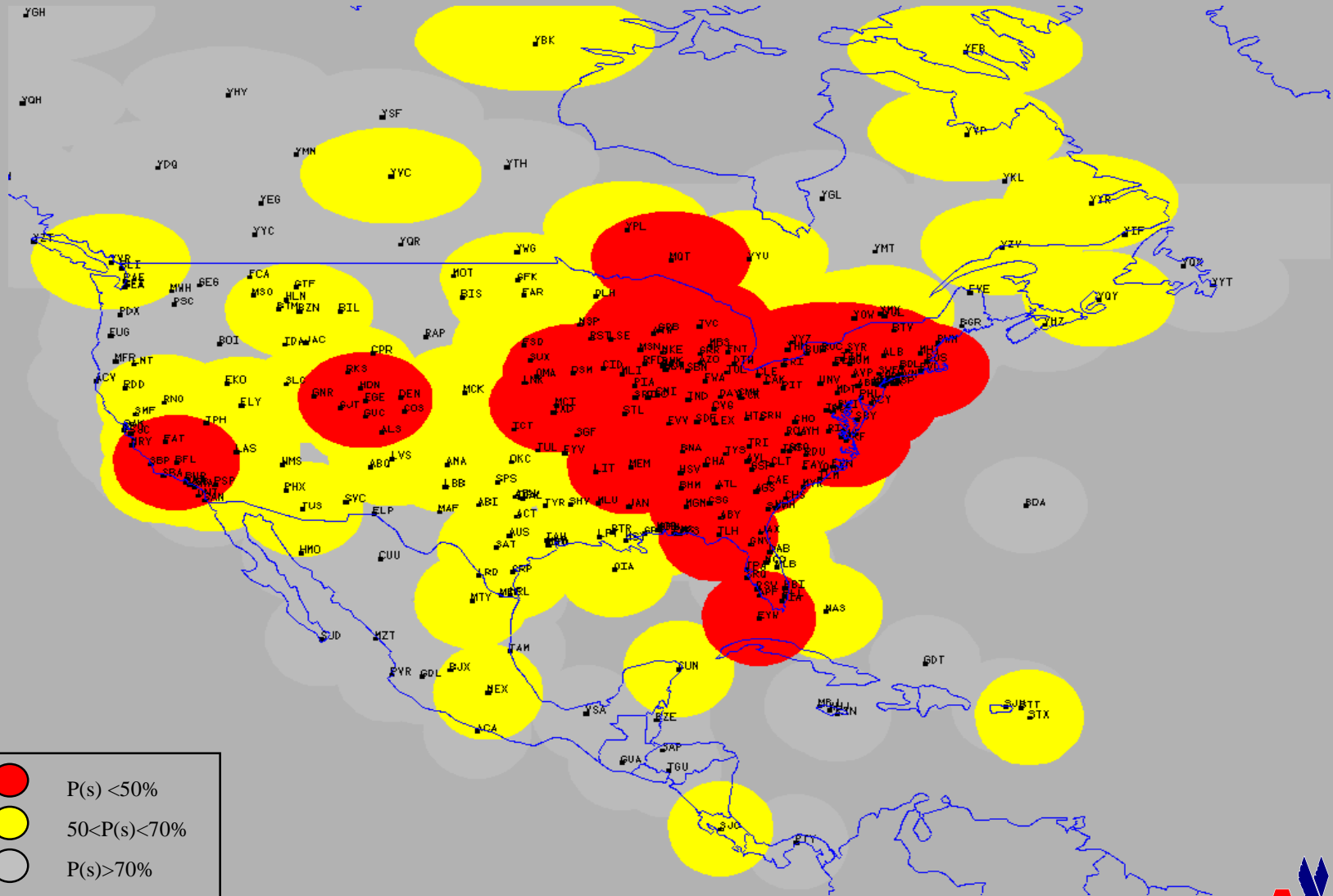


Figure 3.0-1. US Data Link Demand / Spectrum Capacity

# Current Composite ACARS Congestion



- $P(s) < 50\%$
- $50 < P(s) < 70\%$
- $P(s) > 70\%$

Filter: Up-links >10  
Frequency: Base

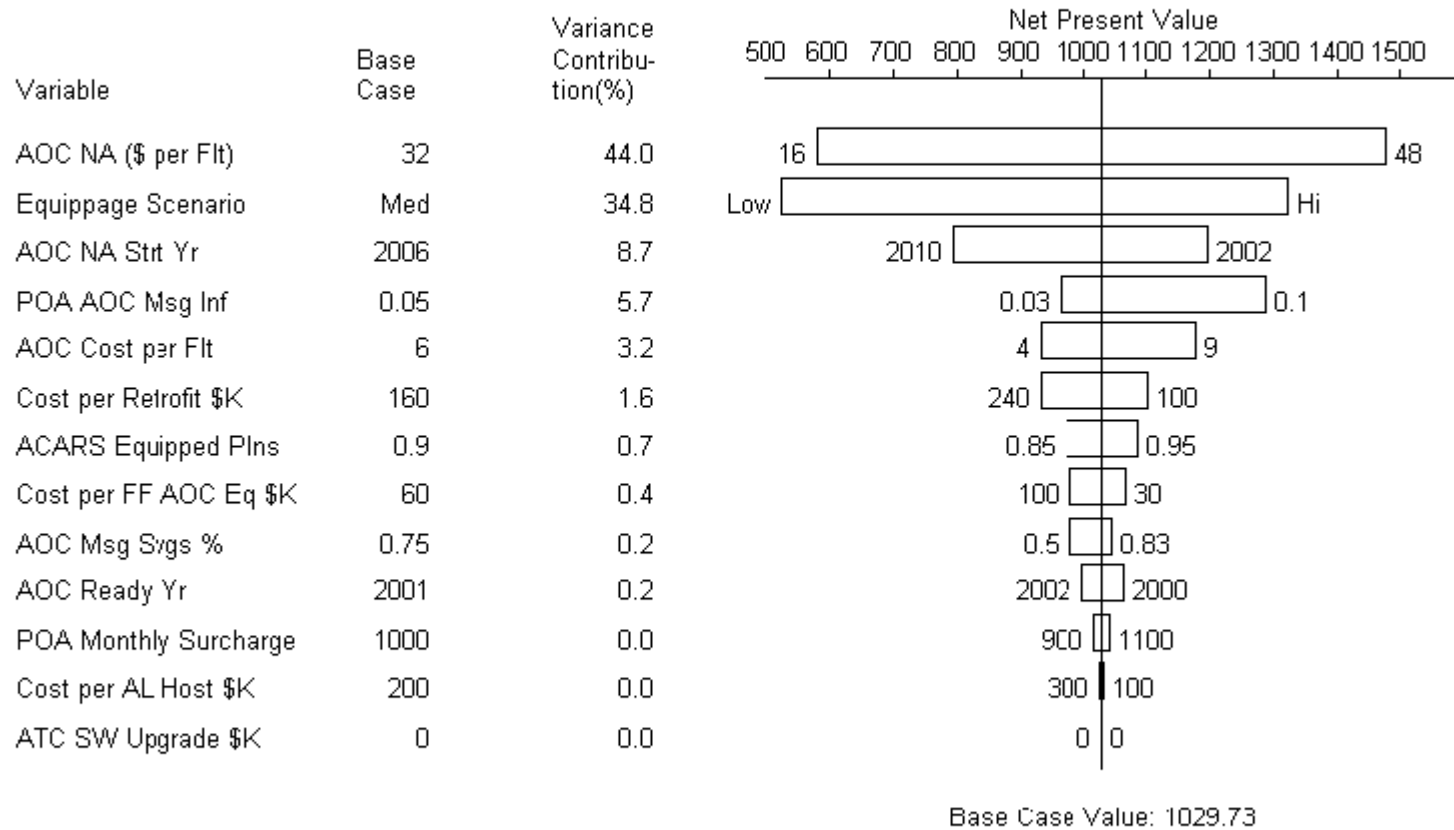
ARINC CONFIDENTIAL



# AOC Solution

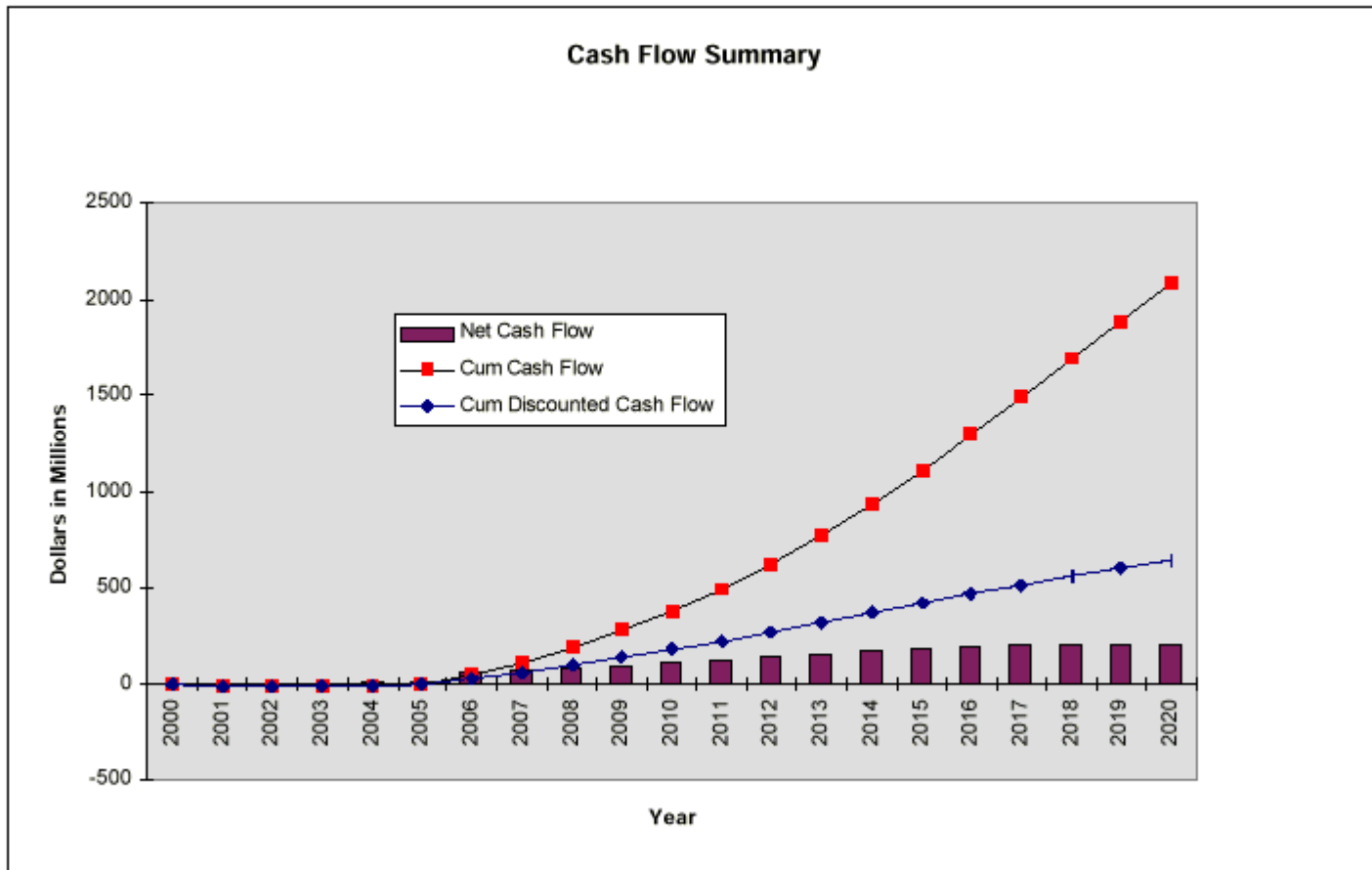
- New protocol
- Faster Transmission speed (31.5 KPS)
- Common Network Service Provider solution
- No airline host changes required
- Airplane changes required
  - New Communications Management Unit
  - New VHF Data Radio
- Infrastructure changes
  - Network Service Provider ground station modification

## AOC Only Deterministic Sensitivity



**Figure 5.3.1-3. AOC Only Deterministic Sensitivity**

# AOC Only FF--Cash Flow Summary



# ATC Modernization

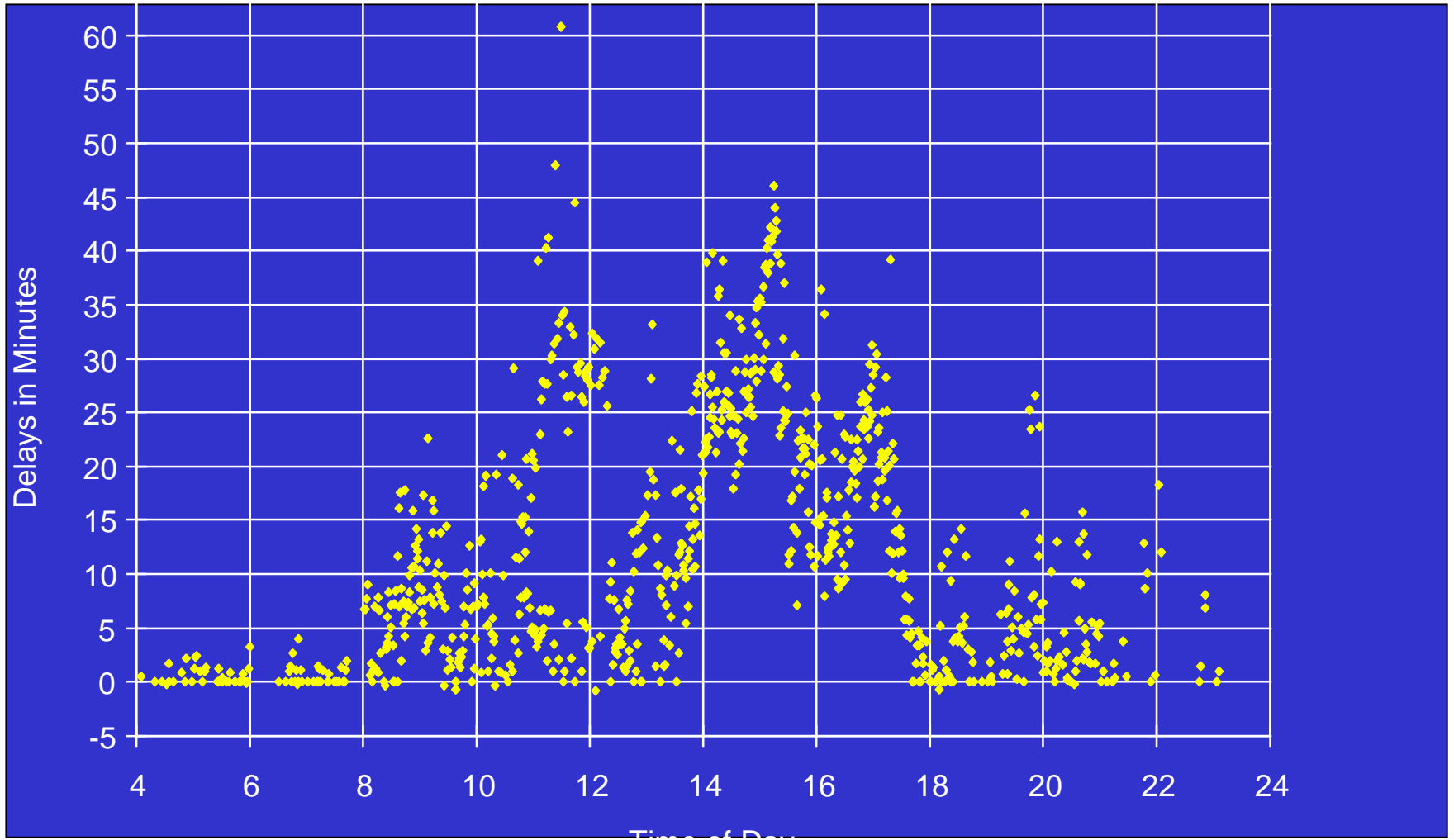
Growing Airspace Congestion  
New ATC Applications

# The Need for ATC Data Link

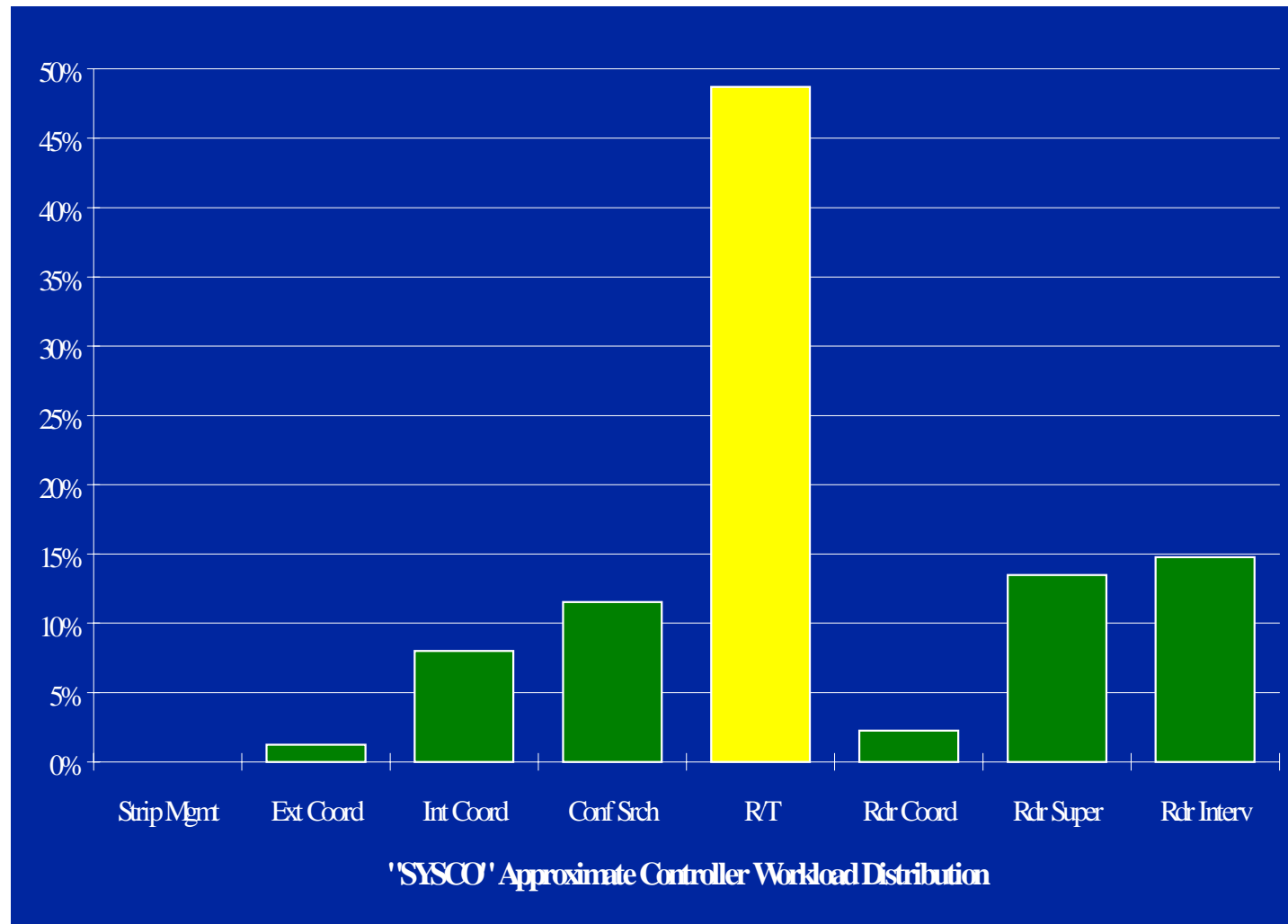
- Addresses growing airspace congestion
  - First Step: Reduced Controller Communications Workload
- Common enabling element for new follow-on applications in airspace management.
  - Controller Automation Tools, Surface Movement, etc.
  - Some Existing Studies and Examples

# AA NAS Study

## Arrival Dependability - 13 Minutes Avg Delay



# The First Step: Controller Communications Workload



# Benefits Estimate for Surface Improved Sequencing, Scheduling, and Routing

- Detroit Digital Taxi Clearance
- ACARS used to provide expected taxi clearance
- Reduces VHF Voice Congestion
- Delay Reduction,
  - 1.3 minutes/flight on taxi out
  - 0.3 minutes/flight on taxi in

Source: Conversation with Duane Edelman, Northwest Airlines

# Full Datalink

## Deterministic Sensitivity

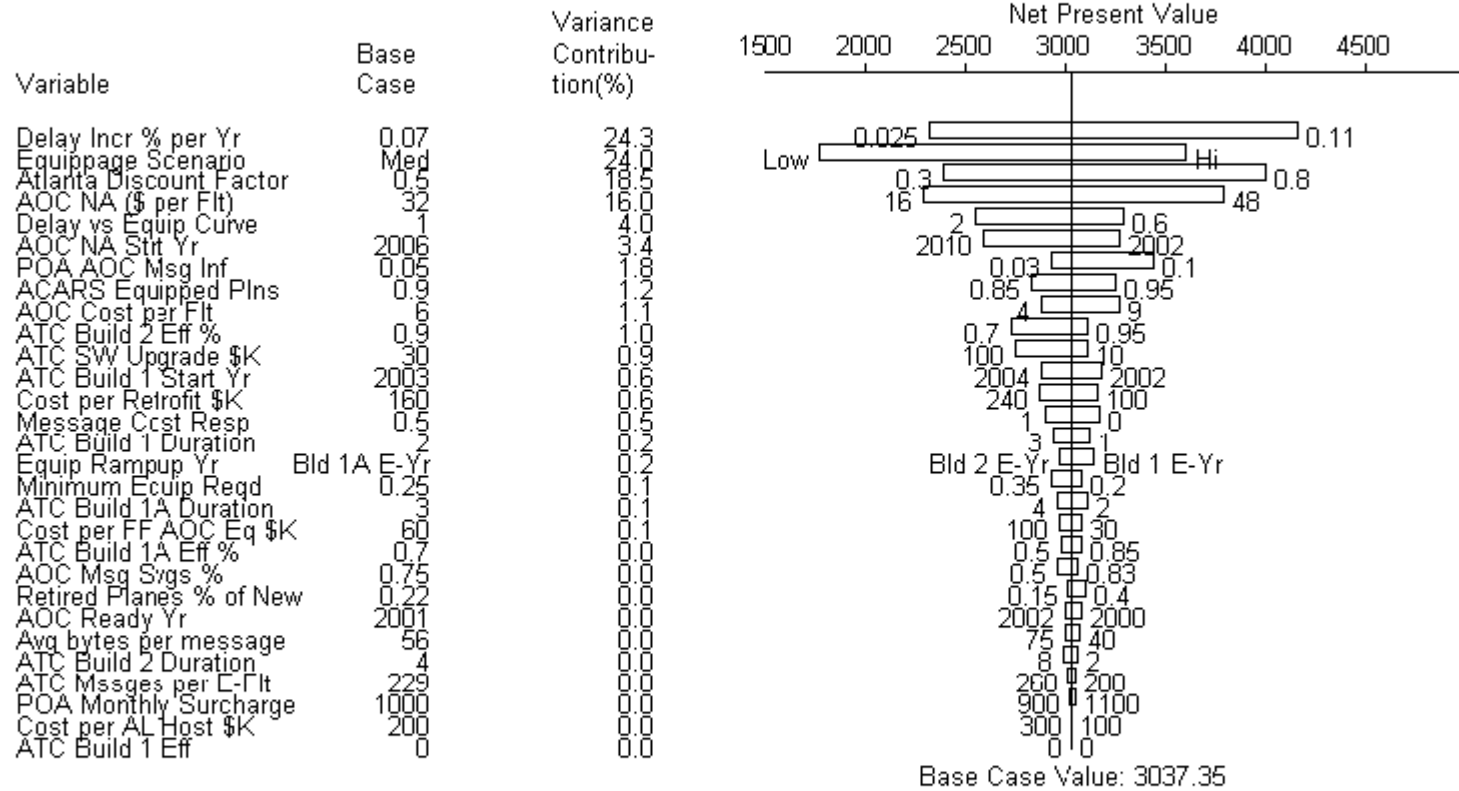


Figure 5.3.2-3. Full Data Link Deterministic Sensitivity

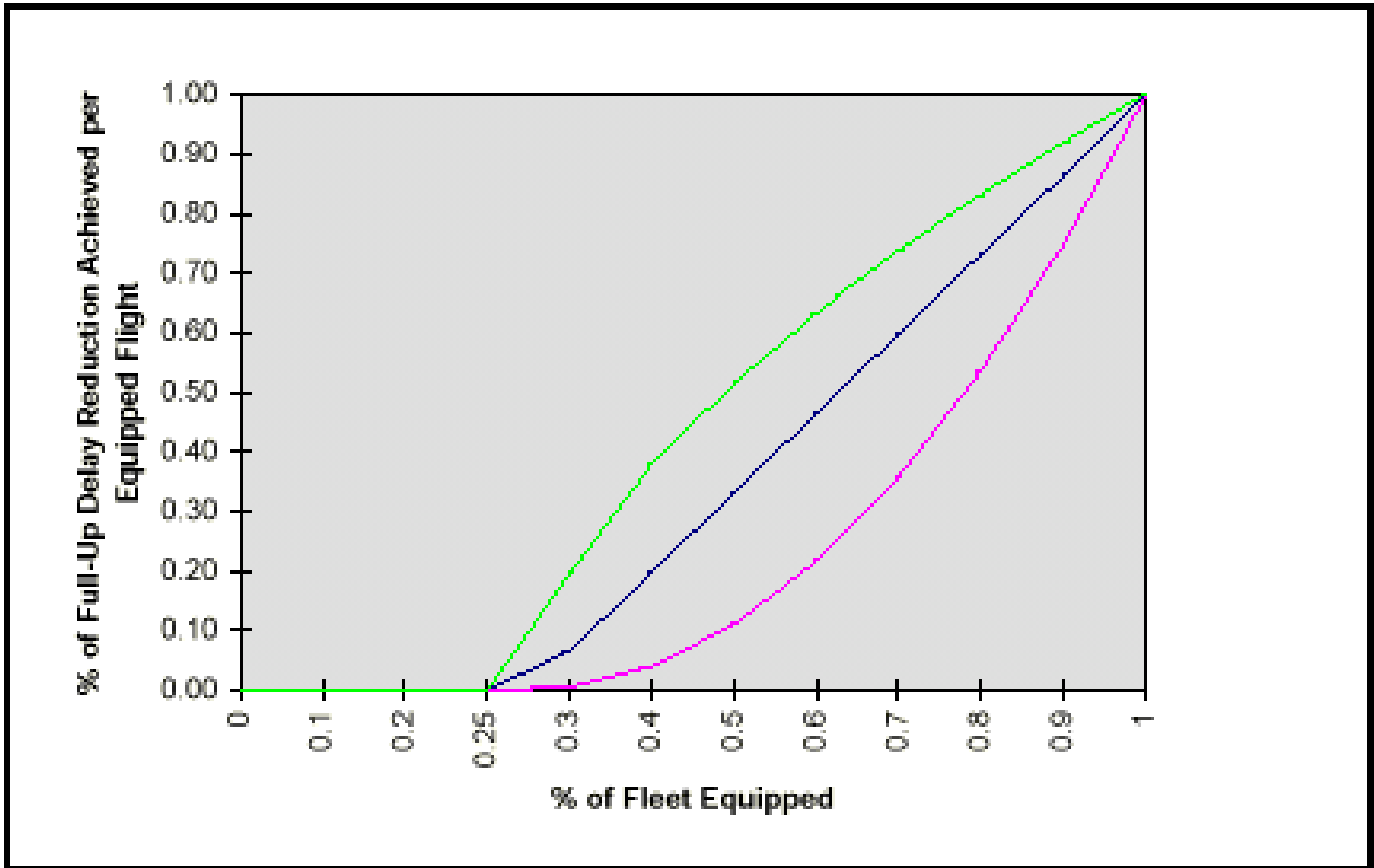


Figure 5.2.6-1: Delay vs. Equipage Curve

# ATC Only Retrofit--Cash Flow Summary

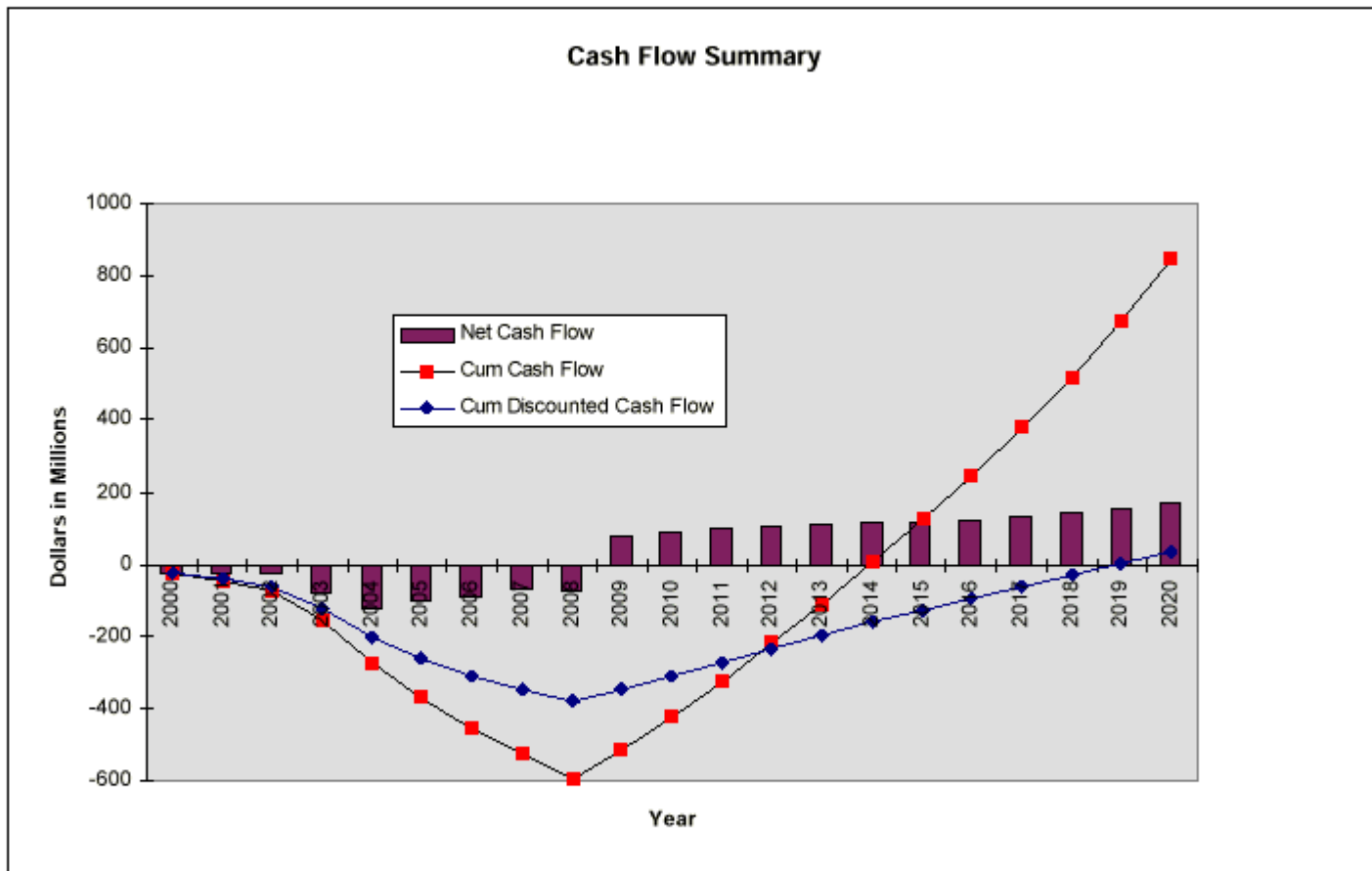


Figure 5.3.3-6. ATC Only Retrofit Cash Flow Summary

# Full Datalink--Cash Flow Summary

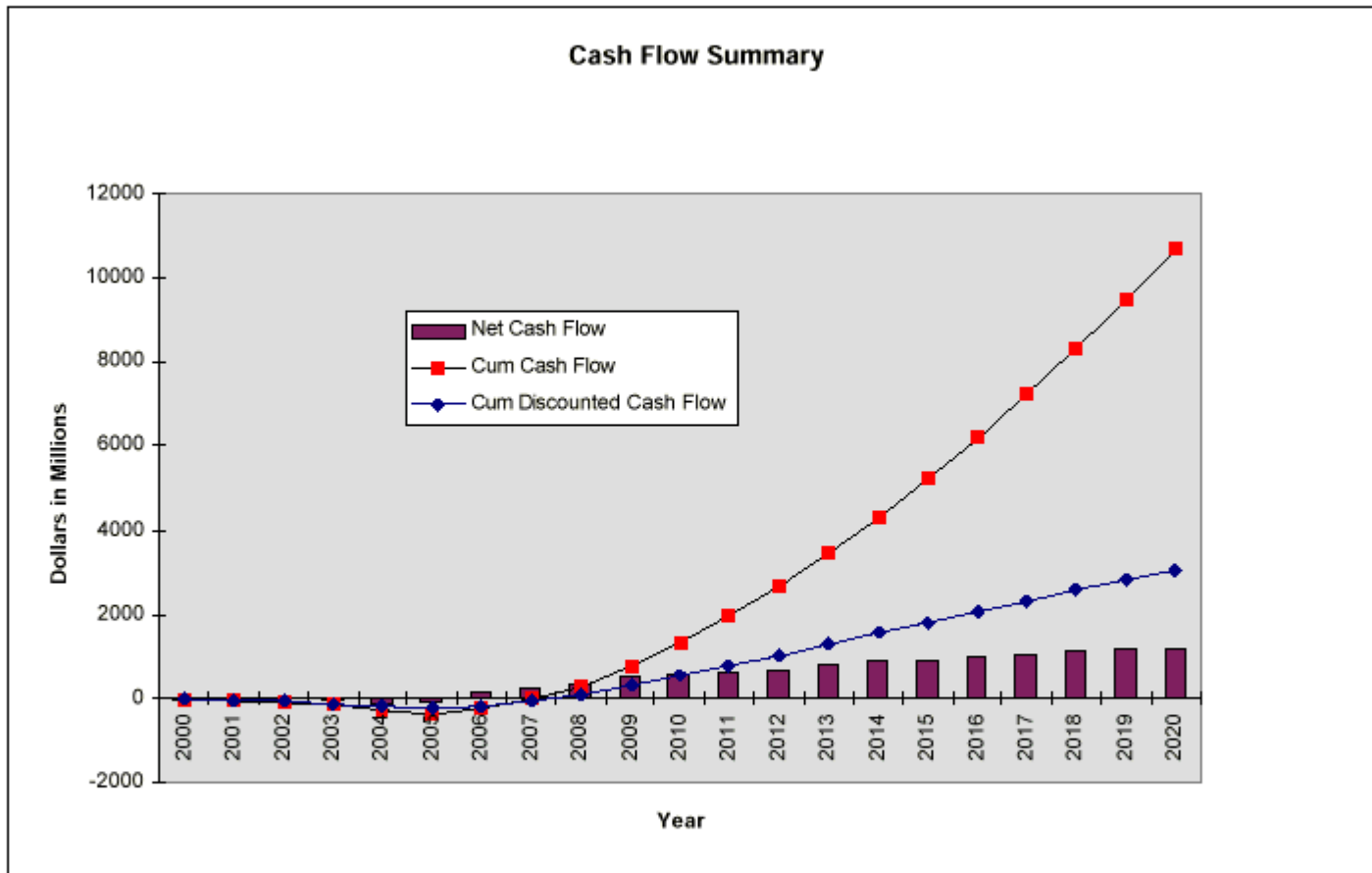


Figure 5.3.2-5. Full Data Link Cash Flow Summary

## ROI's for Datalink Scenarios

| Scenario    | End<br>Equippage<br>%* | Expected<br>NPV | Expected<br>Productivity<br><small><math>\frac{\text{Net Expected Benefit}}{\text{Net Expected Inv.}}</math></small> | IRR * | Breakeven<br>Year*<br><small>(Cum Discounted<br/>Cash Flow)</small> |
|-------------|------------------------|-----------------|--|-------|---|
| AOC Only    | 50%                    | \$1019M         | 4.8  | 41%   | 2007  |
| Full        | 78%                    | \$2932          | 6.3  | 46%   | 2008  |
| ATC Only    | 78%                    | \$824           | 2.4  | 24%   | 2013  |
| AOC Only RF | 25%                    | \$401M          | 2.9  | 30%   | 2009  |
| Full RF     | 39%                    | \$1179          | 3.4  | 36%   | 2009  |
| ATC Only RF | 39%                    | \$31            | 1.1  | 12%   | 2019  |
| AOC Only FF | 27%                    | \$603M          | 9.2  | 62%   | 2006  |
| Full FF     | 39%                    | \$1000          | 7.7  | 57%   | 2007  |
| ATC Only FF | 39%                    | \$85            | 1.6  | 16%   | 2018  |

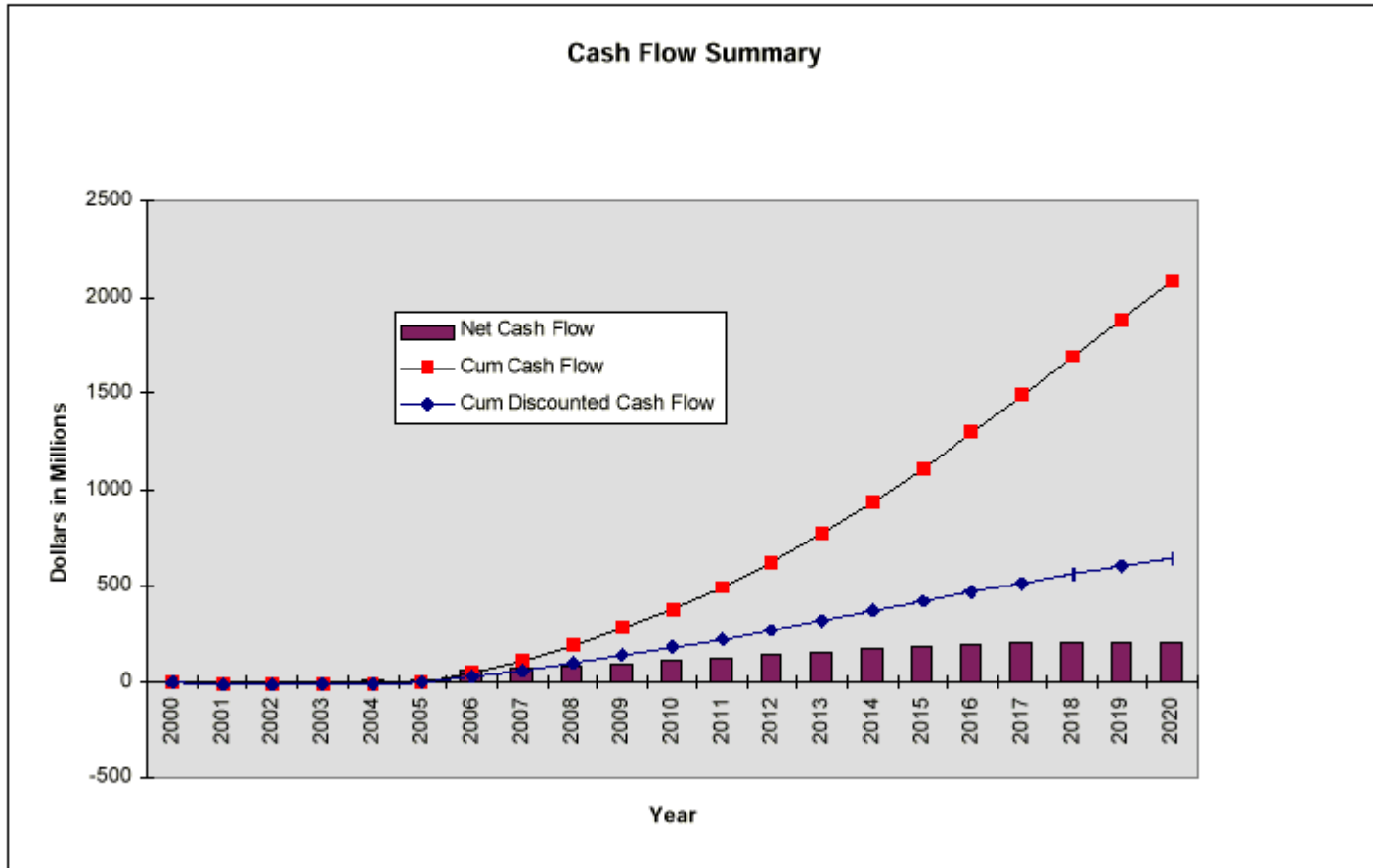
\* Based on Base Case Values

**Table 6.0-1: Data Link Scenario Summary**

# Conclusions

- Forward fit for AOC applications is cost effective
- Forward fit for ATC has a reasonable business case but is more risky:
  - Dependent on equipage levels
  - ATC Benefits are dependent on other infrastructure improvements
- This study supported implementation of new AOC data link equipment
- This study also highlighted the need for an integrated analysis of infrastructure improvements

# AOC Only FF--Cash Flow Summary



# ATC Only Retrofit--Cash Flow Summary

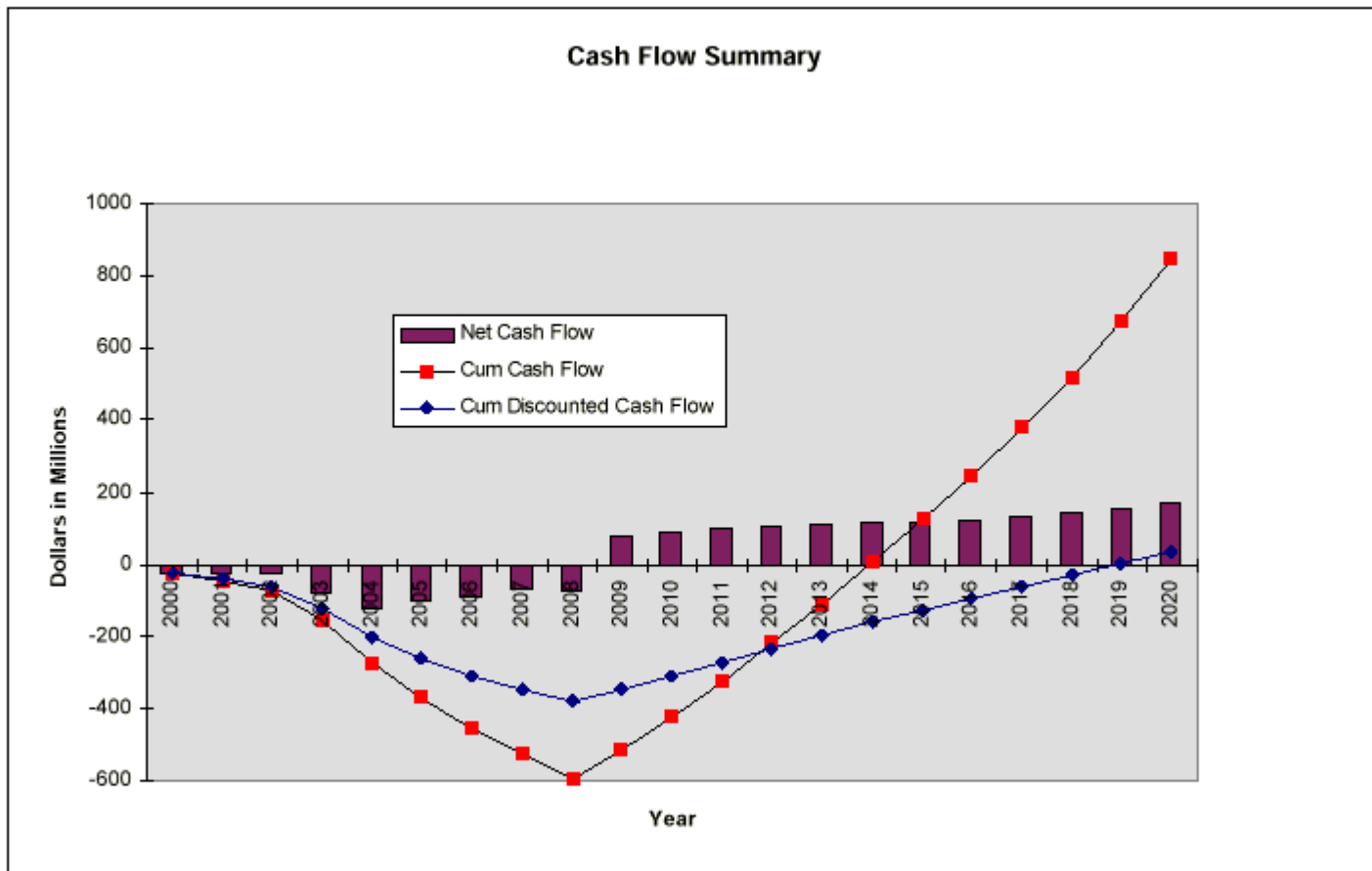


Figure 5.3.3-6. ATC Only Retrofit Cash Flow Summary

# Full Datalink--Cash Flow Summary

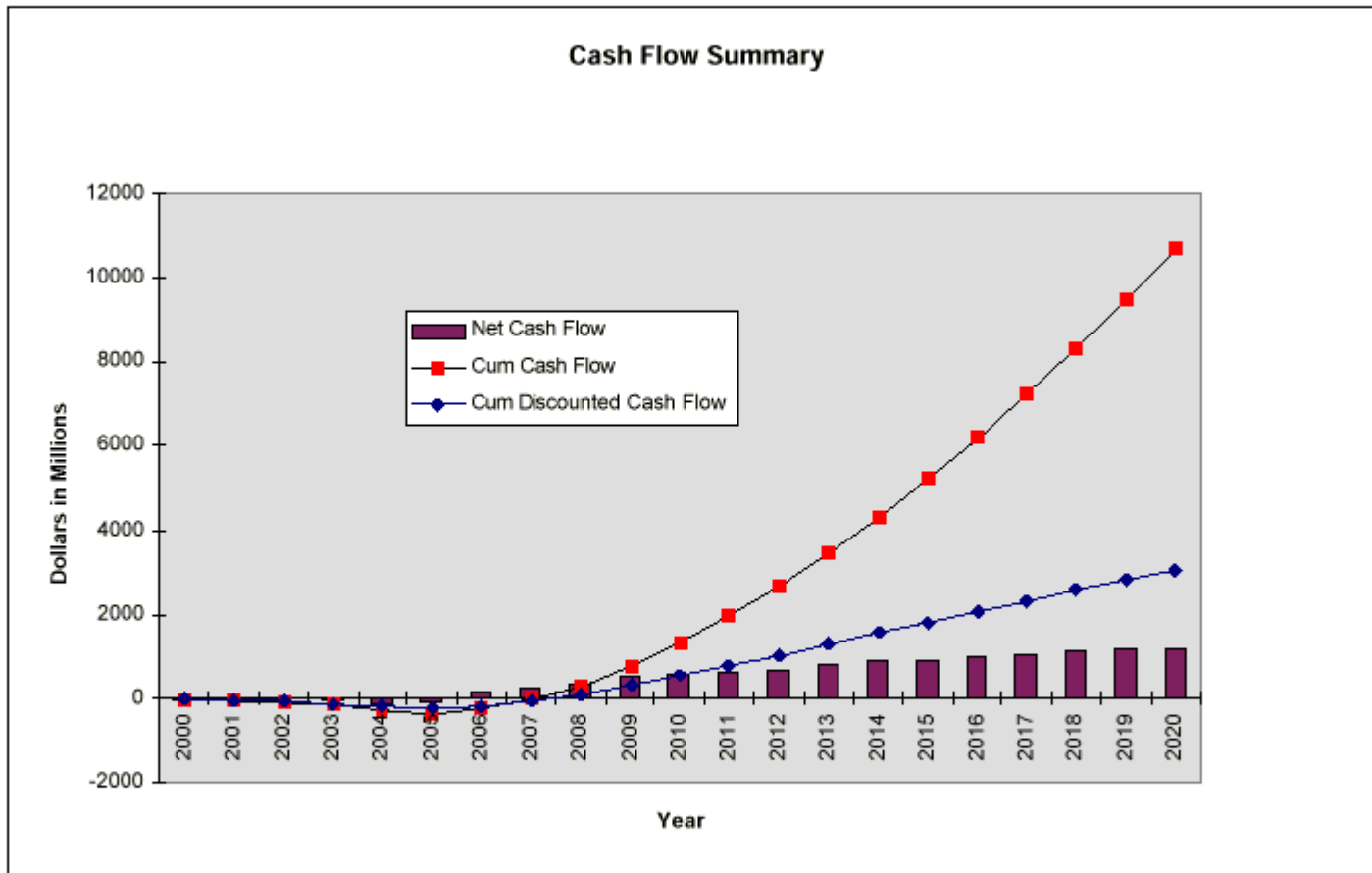


Figure 5.3.2-5. Full Data Link Cash Flow Summary