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# The Economic Importance of Adequate Aeronautical Telemetry Spectrum



**73<sup>rd</sup> MORS Symposium**  
**West Point**

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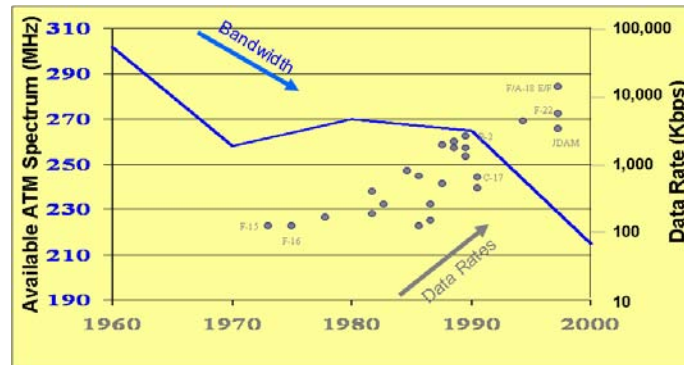
# Outline



- Introduction
- Context & scope
- Overview of economic model
- Methodology
- Preliminary results

# Introduction

- The flight test community faces a telemetry spectrum crunch
- Amount of spectrum now allocated for ATM is not sufficient to meet needs and requirements have been steadily growing



- ATM spectrum is vital to both commercial and military flight testing
- There are economic implications associated with the allocation of spectrum for ATM
- Economic considerations are important to the proposal currently before the ITU
  - Agenda Item 1.5 of WRC 2007 calls for the allocation of additional spectrum for wideband ATM in the 3-30 GHz band

# Context & Scope

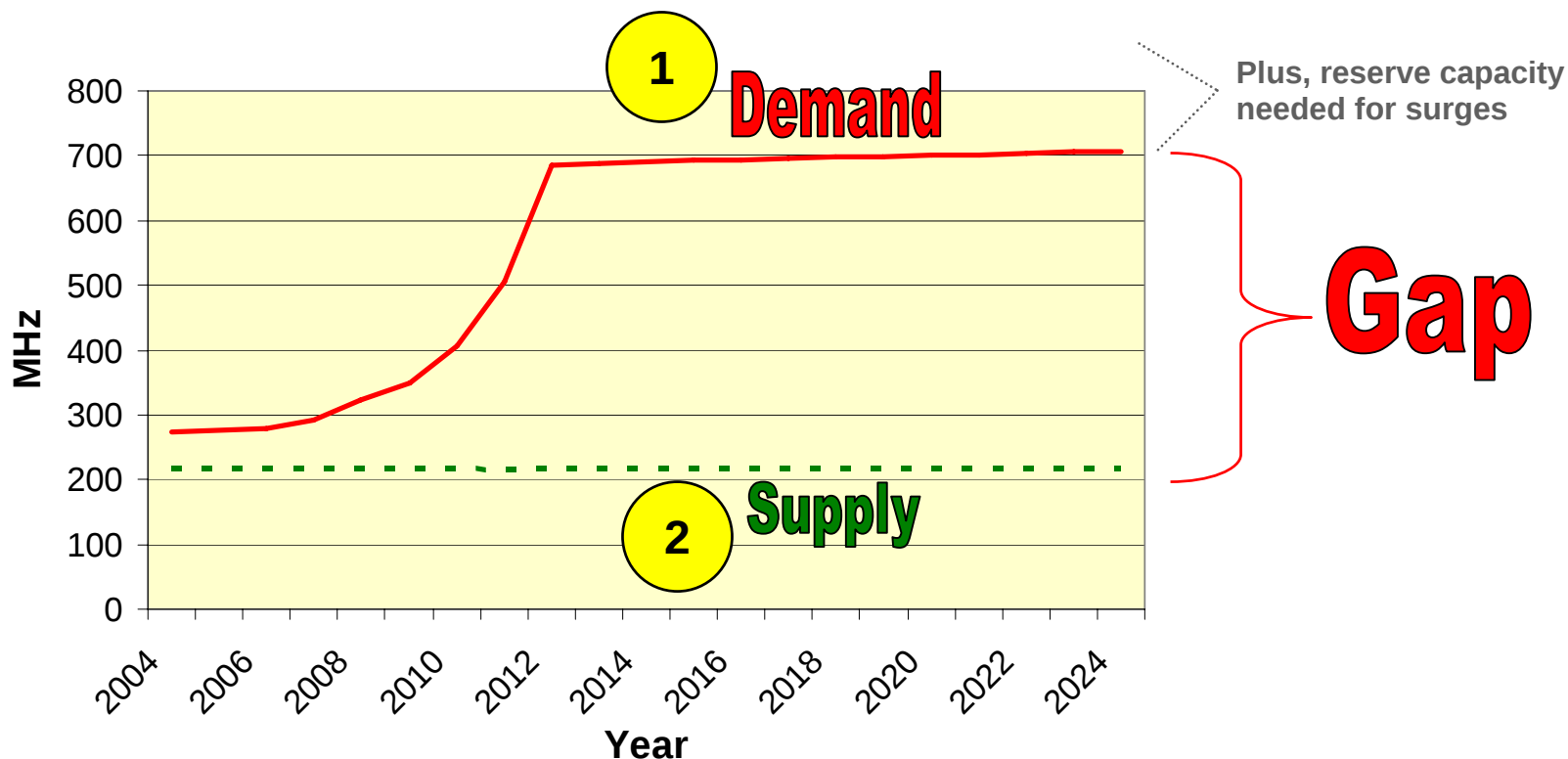


- MITRE tasked to build a model to evaluate the economic importance of having adequate accessibility to ATM spectrum
- MITRE team developed robust economic analysis methodology to forecast future scenarios
  - Exercised conservatism in modeling costs



# Overview of Economic Model (1 of 2)

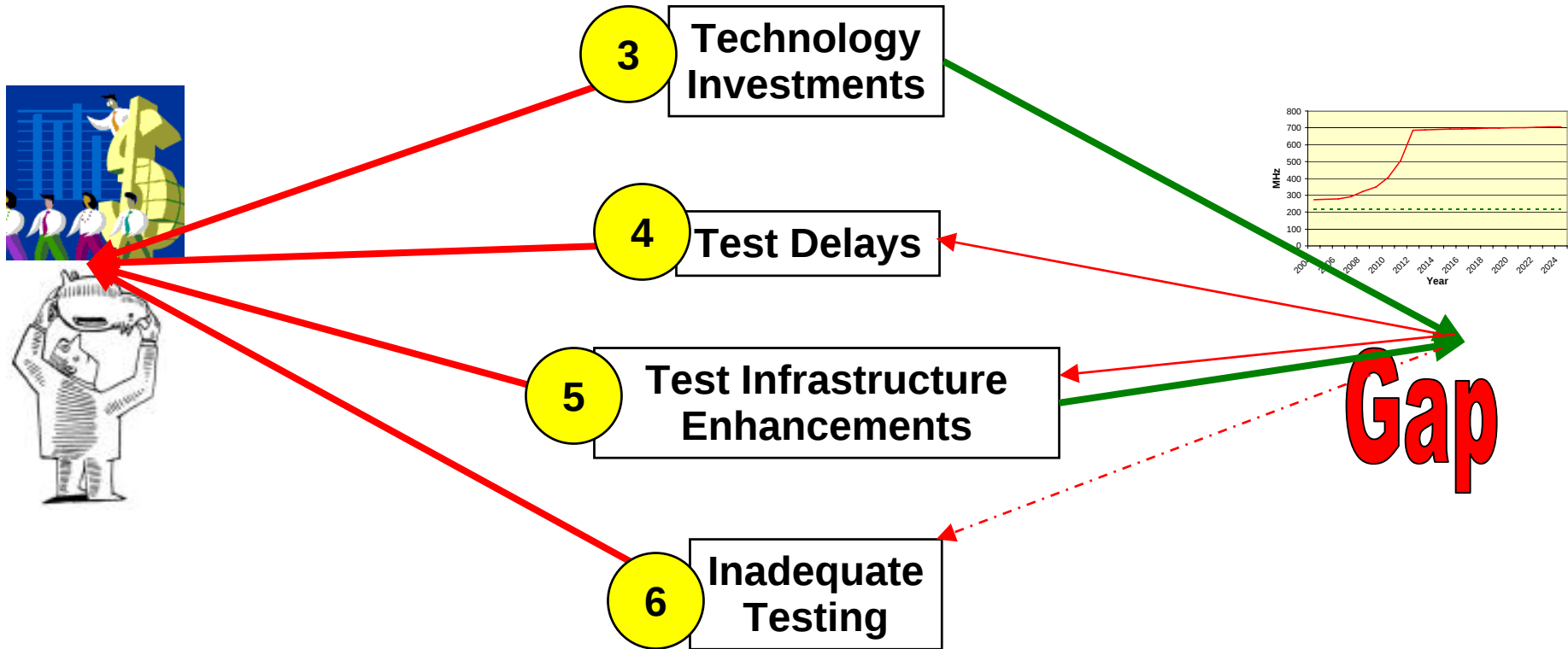
- MITRE team established probable future scenarios on a test range over a twenty year period (2004-2024)
- Current supply and estimated demand of ATM spectrum on a range on an annual basis over 20 years
  - Calculated the resulting “gap”



# Overview of Economic Model (2 of 2)

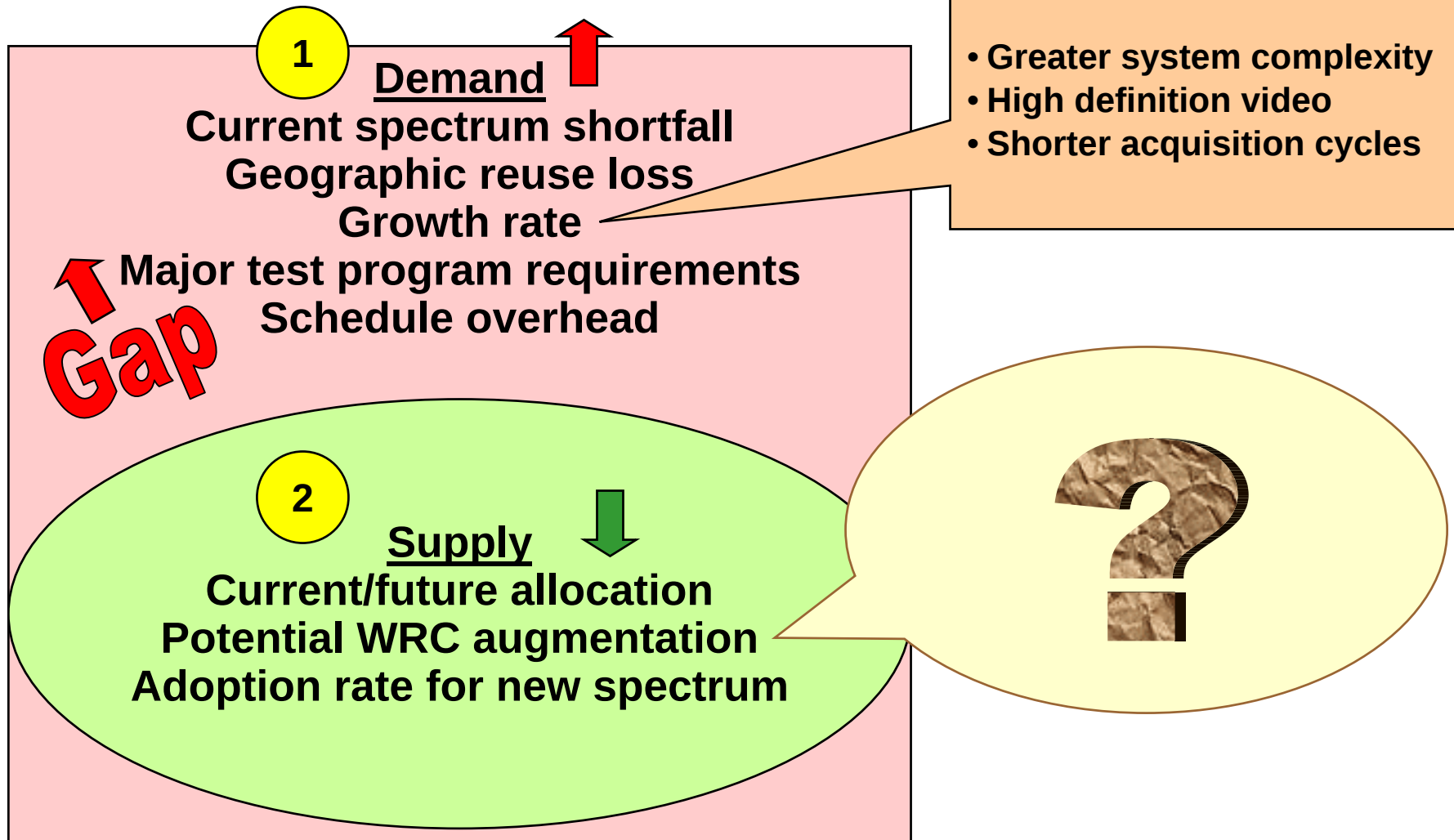


## ■ Identified and estimated cost impacts of the Gap

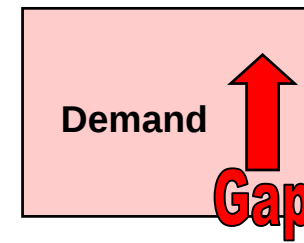


## ■ This insight substantiates the criticality of spectrum augmentation

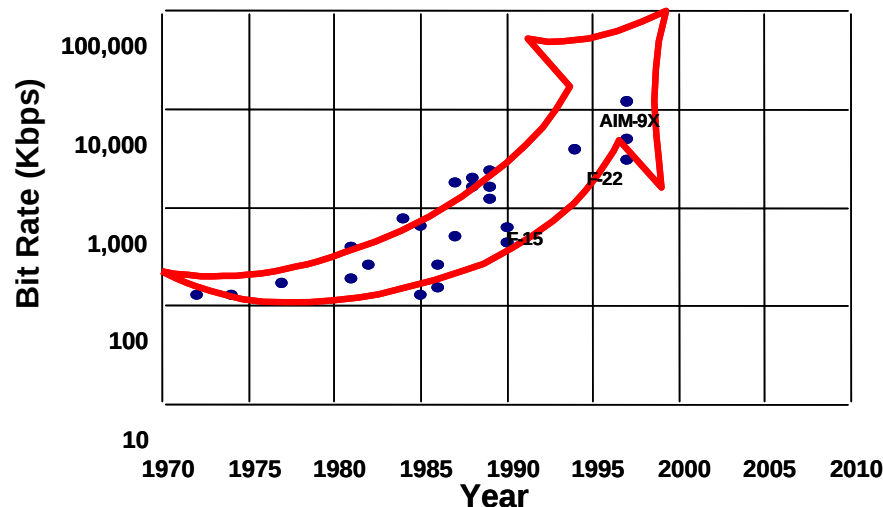
# Methodology – Demand & Supply



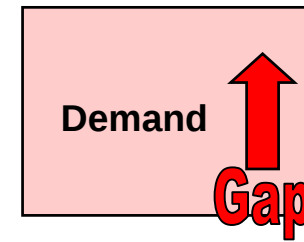
# Methodology – Demand (1 of 2)



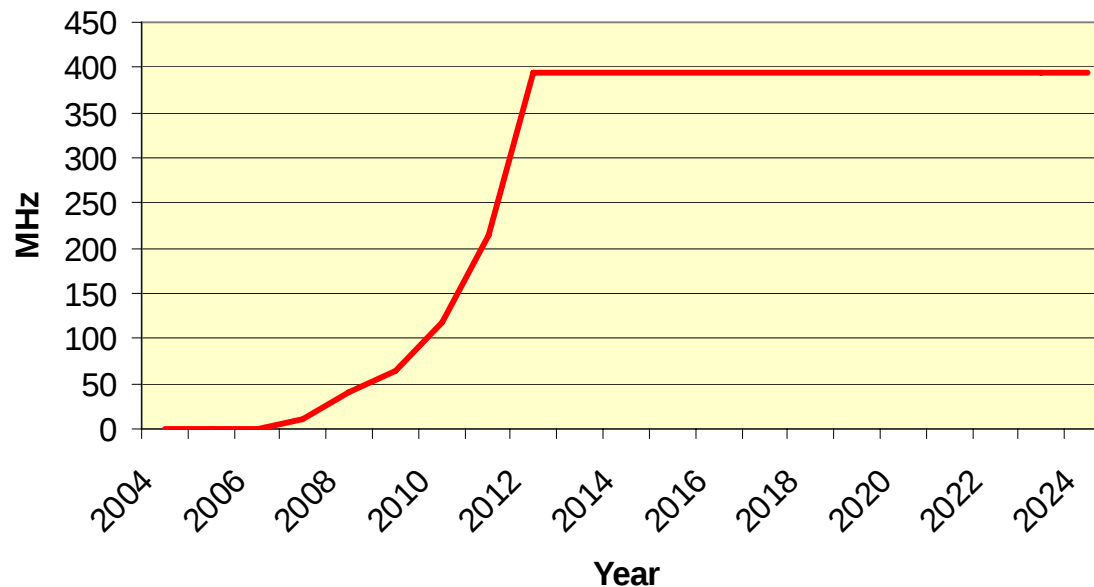
- Demand is defined as requirements for ATM spectrum
- Model applies well-accepted projections
  - Current ATM shortfall in spectrum-congested area is 17%\*
  - Geographic reuse loss in spectrum-congested area is 8%\*
  - ATM spectrum growth has and will continue to follow Moore's Law



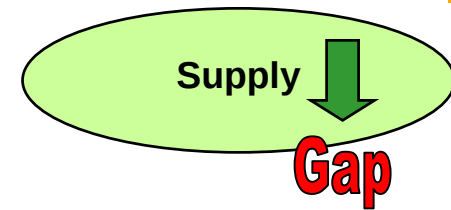
- Step-wise growth estimates incorporate benefit of technology investments



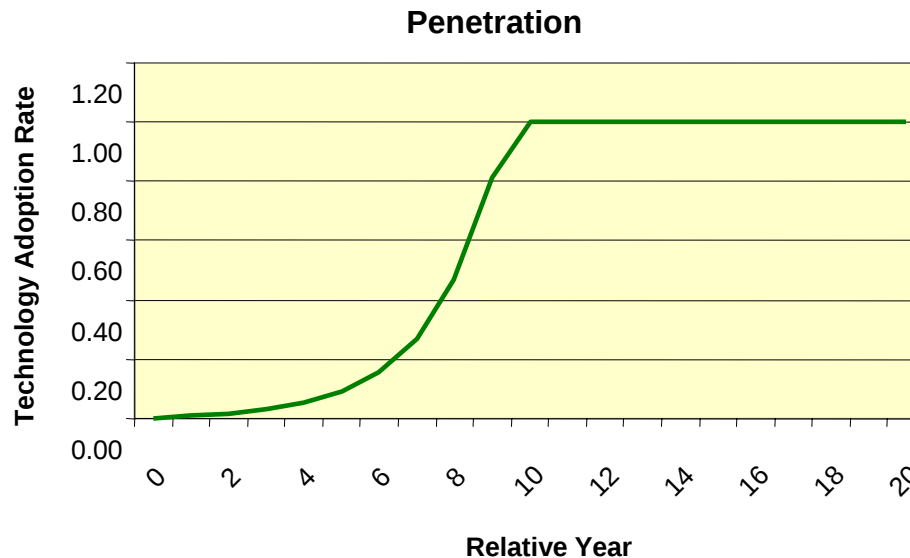
- Model incorporates new (conservative) demand findings
  - Schedule overhead of 10%
  - Major test program requirements:



## Methodology - Supply



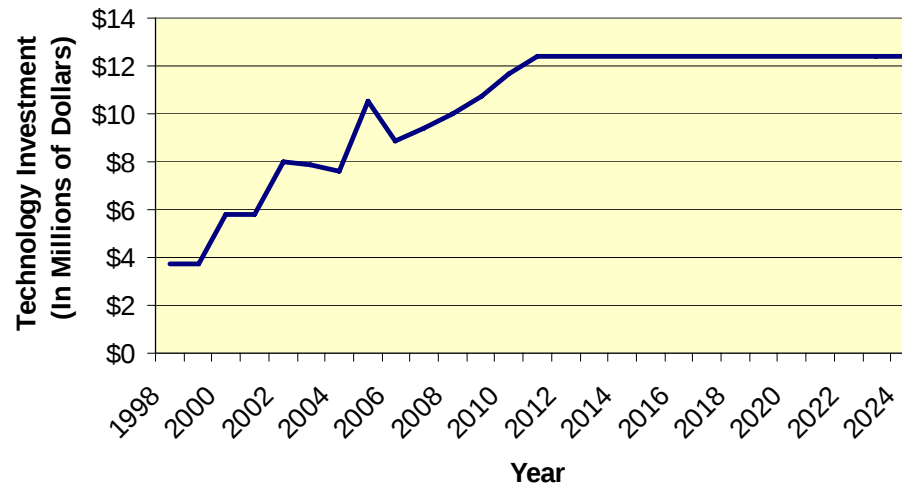
- Supply is defined as spectrum that may be used for ATM
- Current allocation of 215 MHz
- Developed scenarios to evaluate potential spectrum augmentation from WRC (0 to 650 MHz)
  - New technologies needed to access additional spectrum
    - Adopted over time by range and program managers



# Methodology – Technology Investment



- There are costs and potential benefits of investments in technology research initiatives
- Estimated annual investment costs for ARTM, Tier 1 & 2 technologies, iNet, use of very high frequency bands (e.g., 8 GHz), and other unforeseen, promising technologies



- Potential benefits (e.g., improved efficiencies) of these investments are incorporated within growth rates of demand data

## Methodology – Cost of Delays



- There are costs associated with unplanned test delays due to insufficient ATM spectrum access
- There are unplanned delays on a test range today
  - One large test delay per week costs \$1M
  - Three small test delays per week cost \$50K x 3 = \$150K

- Today, test delays due to insufficient ATM spectrum access cost \$60M per year!

## Methodology – Test Infrastructure Enhancements



- Examined cost to provide new or additional range resources for flight testing in different geographic areas
  - Huge cost to programs and national economy
- Issues remain:
  - Are there alternative ranges available far enough away from existing ranges to allow for spectrum reuse?
  - Will legal, environmental, and political consent be given to provide new range resources far enough away from existing ranges accessing ATM spectrum to allow for spectrum reuse?

■ In the present environment, these are not realistic options!

# Methodology – Inadequate Testing



- Model incorporates cost of inadequate testing
- Lack of access to ATM spectrum leads to test point shedding which leads to reduction in test quality
- At some point, not testing results in catastrophes and fatalities
- Based on specific cost of inadequate testing case

- **30 lives lost!\***
  - GAO: in part due to inadequate test & evaluation\*\*
    - To meet cost and schedule targets, actual testing conducted was less than a third of that originally planned
- **\$1.6B per incident!\***

# Preliminary Results



- Costs are significantly mitigated by:
    - Reducing testing delays (via spectrum augmentation and/or test infrastructure enhancements)
    - Decreasing inadequate testing
  - Model does not incorporate the risk of depending on test infrastructure enhancements
    - Legal, environmental, political, and large upfront investment hurdles may not be overcome
    - In present environment, **not a realistic option**
- WRC spectrum augmentation of 650 MHz is only scenario in which requirements are met
- Our choices today will determine how we will flight test in the future
  - **Will we be able to efficiently develop innovative aerospace products?**

# Back-Up

# Scenario Definitions

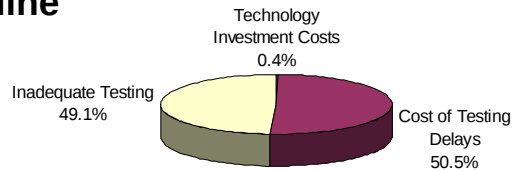


| Scenarios | Year Requirements Are Met | Mitigated Year 2024 Gap | New Range Resources | Yearly Accident Rate | Schedule Overhead | Adoption Rate | Spectrum Augmentation |
|-----------|---------------------------|-------------------------|---------------------|----------------------|-------------------|---------------|-----------------------|
| Baseline  | Never                     | 491                     | No                  | 1.00                 | Yes               | Med           | 0                     |
| WRC 0     | Never                     | 31                      | Yes - 2             | 0.50                 | Yes               | Med           | 0                     |
| WRC 60    | Never                     | 108                     | Yes 1               | 0.45                 | Yes               | Med           | 60                    |
| WRC 200   | Never                     | 146                     | No                  | 0.35                 | Yes               | Med           | 200                   |
| WRC 650   | 2016                      | (159)                   | No                  | 0.00                 | Yes               | Med           | 650                   |

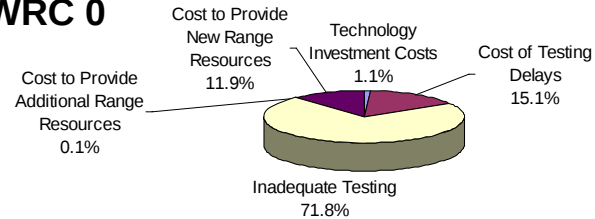
# Cost Components



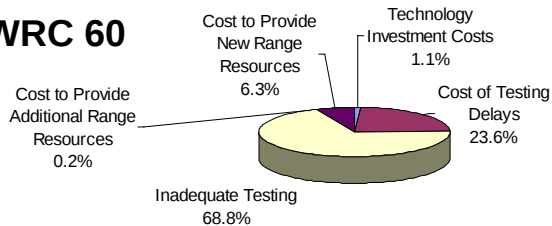
## Baseline



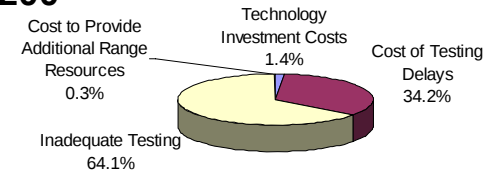
## WRC 0



## WRC 60



## WRC 200



- Dollar value of tech investment costs remain constant
- Baseline: roughly equal split of remaining costs
- In WRC cases:
  - Cost of testing delays: 15.1% to 50.5%
  - Cost of additional range resources: 0.1% to 0.3%
  - Cost of new range resources: 6.3% to 11.9%
  - Inadequate testing: 0% to 49.1%

## WRC 650

