

# AEROSPACE 2050

## The Future of Aviation & Space

18th April 2013

### HAMBURG



Prof Graham Roe  
Fellow of the RAeS



# Aerospace 2050

## CONTENTS

- Introduction
- Military
- Commercial
- Space
- Questions



# Aerospace 2050 - Introduction

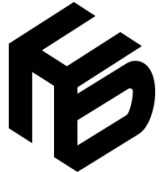
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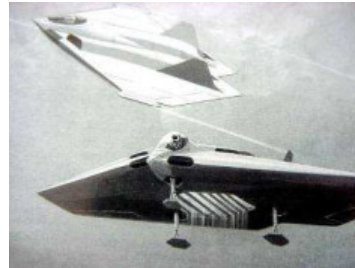


# Aerospace 2050 – My Background

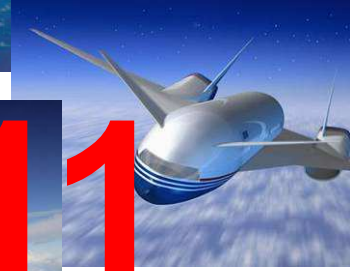


**Blackburn**  
AIRCRAFT

HAWKER SIDDELEY



**BAE SYSTEMS**



**RETIRED 2011**



**BRITISH AEROSPACE**



**BOEING**  
**EADS** **LOCKHEED MARTIN**

## Aerospace 2050 – The Sum of my Career!

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**45 years =**

- **17 aircraft types**
- **9 Prime contractors in 6 countries**
  - **1 000 000+ air miles**
  - **500 000+ hotel points**

# Aerospace 2050 - Military

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➤ Introduction

➤ **Military**

➤ Commercial

➤ Space

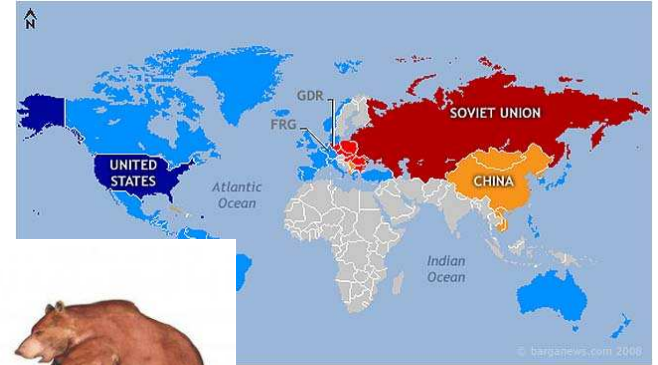
➤ Questions



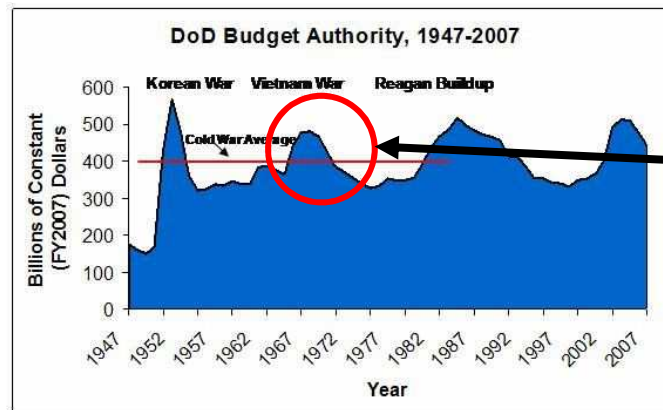
# Aerospace 2050 – Military 1970



Vietnam



Cold War



1970

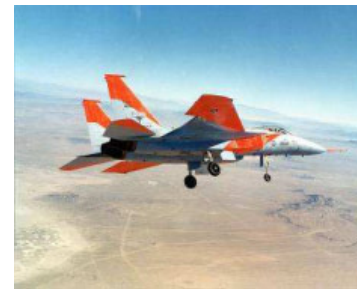
# Aerospace 2050 – Military 1970 Aircraft



**In Service**



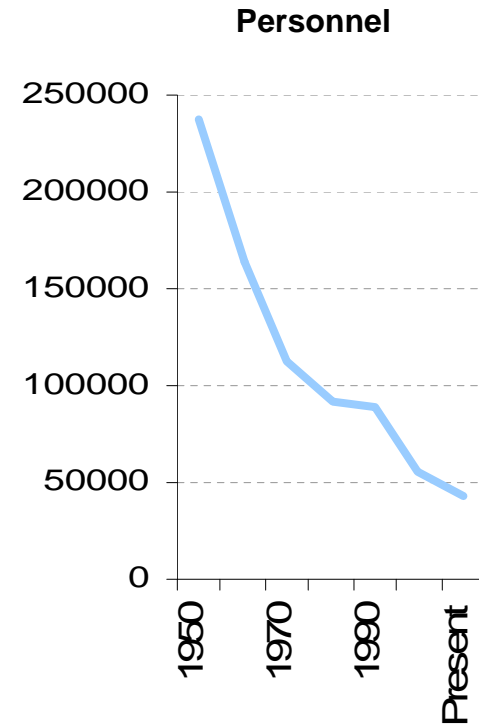
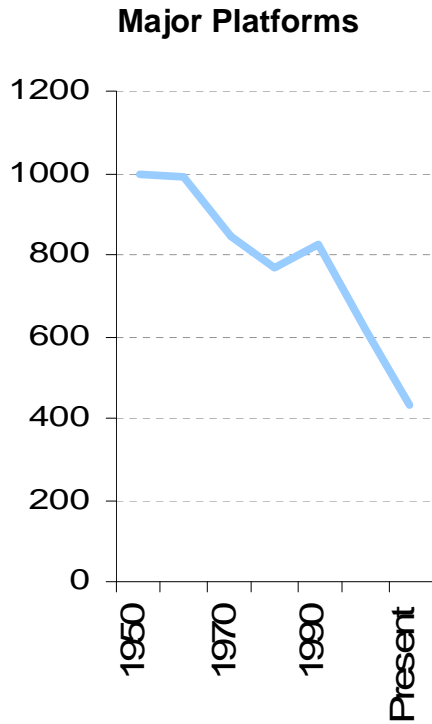
**Just Launched**





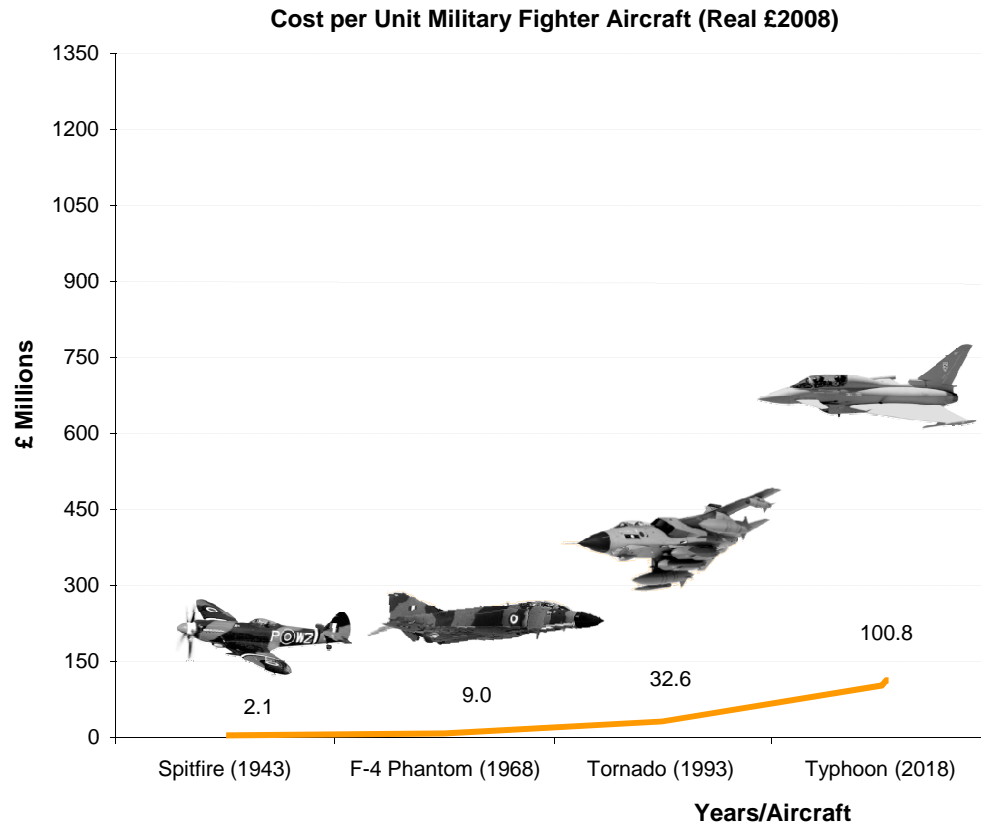
# Aerospace 2050 – Military 1970 to 2010

## The Royal Air force 1970 to 2010



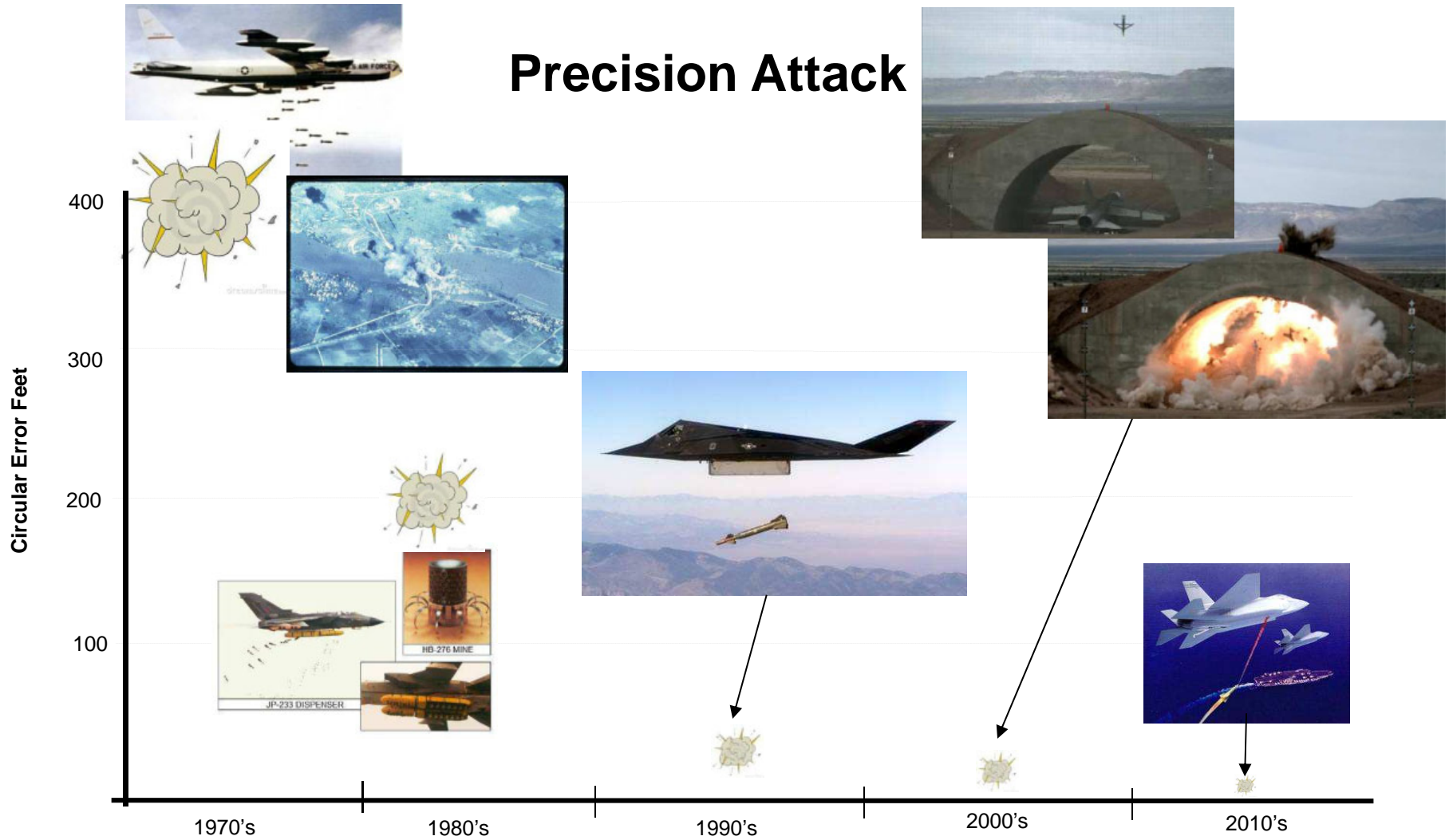
# Aerospace 2050 – Military 1970 to 2010

## Combat Aircraft



# Aerospace 2050 – Military 1970 to 2010

## Precision Attack



# Aerospace 2050 – Military 2010

- Annual Sales of Aircraft \$15bn
- GDP of CYPRUS \$15.4bn
- Annual Sales of Weapons \$7bn
- GDP of GABON \$7.2bn
- 1995-2010 - 3750+ Fighter Aircraft built worth £170bn
- 173 countries have Air Forces
- There is a current active inventory of 27000+ Military Aircraft in the World



# Aerospace 2050 – UK Military Air Operations 2010



**Expeditionary**



**Maritime**



**Protection of  
UK Airspace**

# Aerospace 2050 – UK Military Post SDSR 2010



**Expeditionary**



**Maritime**



**Protection of  
UK Airspace**

# Aerospace 2050 – Military 2010 Business Trends

## Multi Activity Contracts



**TLCM**

## Service Provision

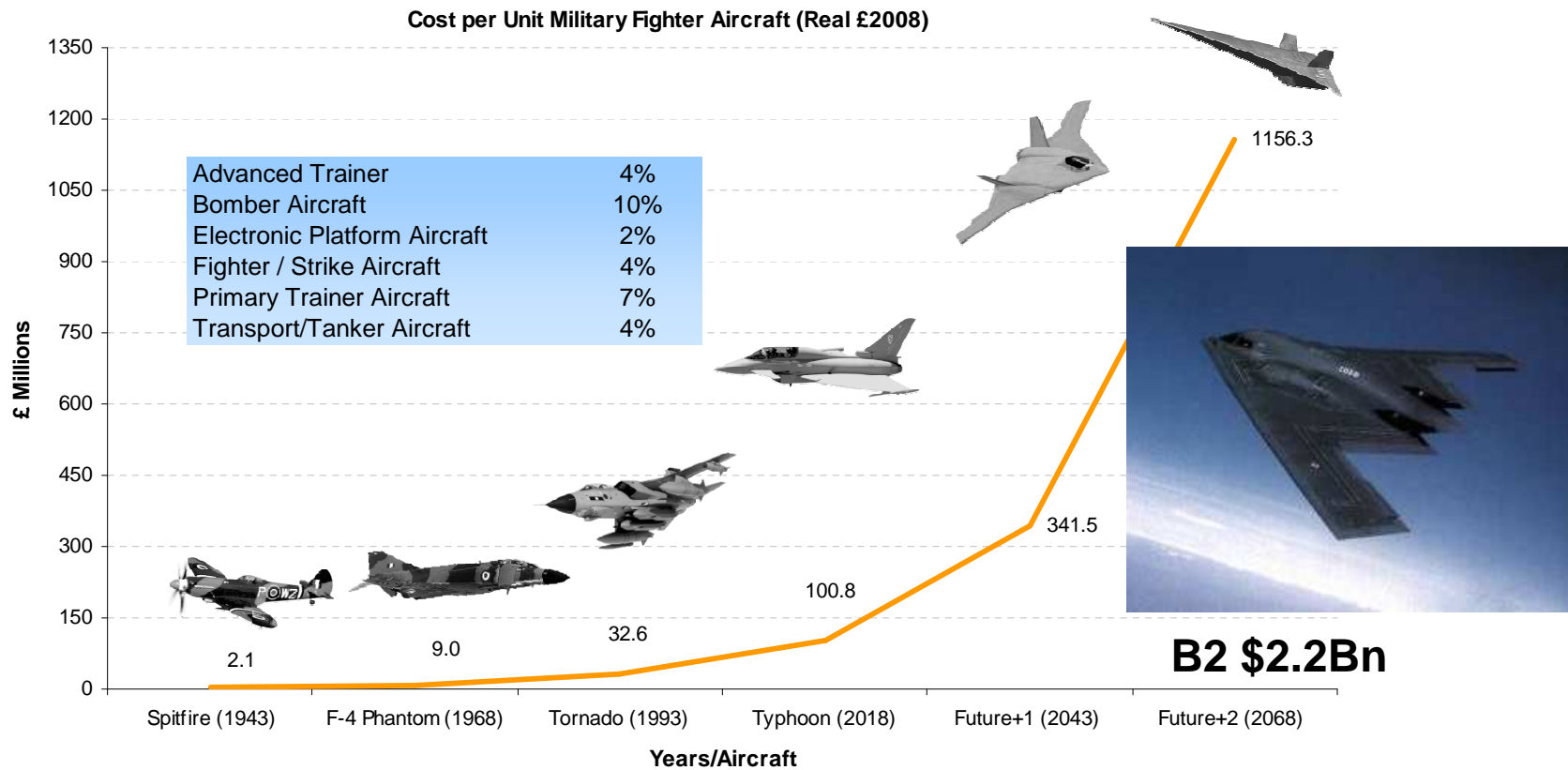


**Offset**



# Aerospace 2050 – Military 2010 -2050

## The Price of Combat Aircraft





# Aerospace 2050 – Military 2010 -2050 Threats

## TECHNOLOGY



## NEW APPROACHS



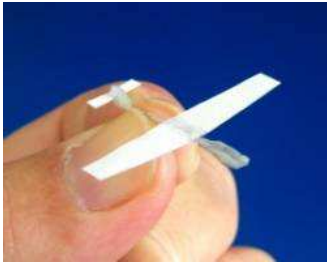
## GLOBAL WAR ON TERRORISM (GWOT)



## FAILED STATES



# Aerospace 2050 – Military 2010 -2050 Technology



**Smaller**



**Signature control**



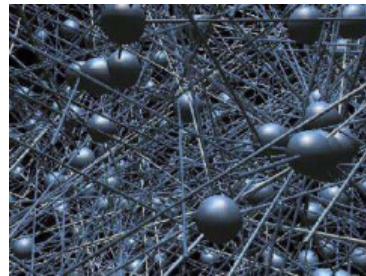
**Autonomy**



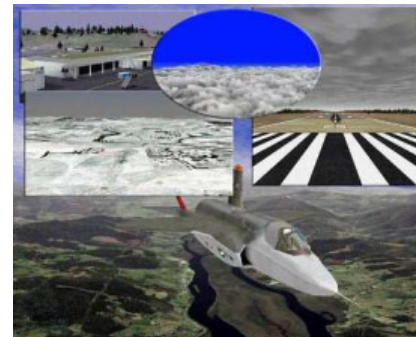
**Global reach**



**Upper Atmosphere**



**Network**



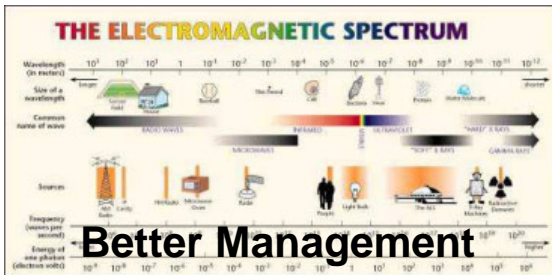
**Simulation**



**Remote Power**



**Instant effect**



**Better Management**



**Less**

# Aerospace 2050 – Military 2010 - 2050 Market Trends

Global Accessible Combat aircraft market (new builds & upgrades)



# Aerospace 2050 – Military 2050 - UK



Transport



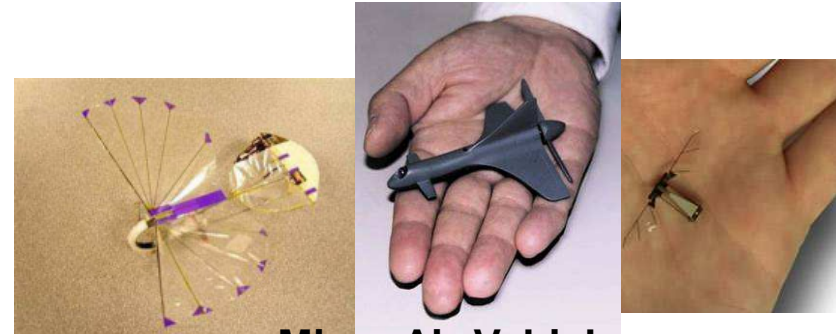
Strike



ISTAR



# Aerospace 2050 – Military 2050



# Aerospace 2050 - Commercial

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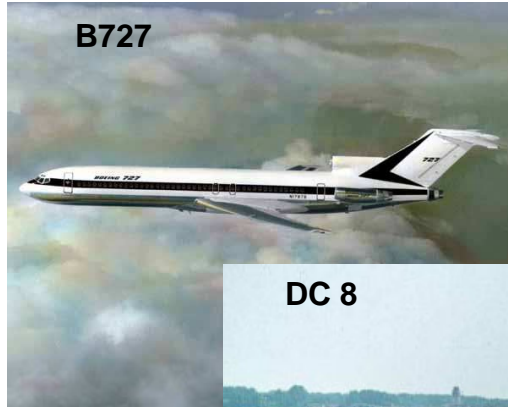
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## ➤ Commercial

- Space
- Questions



# Aerospace 2050 – Commercial 1970 - In-service



**USA**

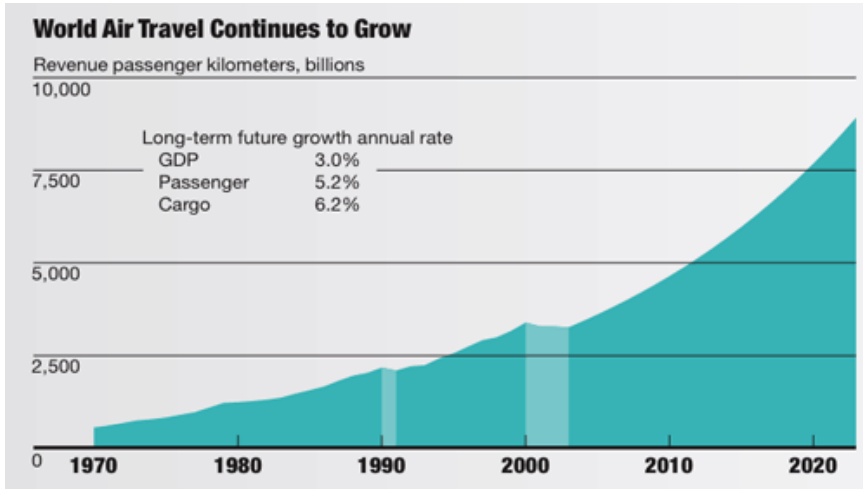
**EUROPE**

# Aerospace 2050 – Commercial 1970 – First's

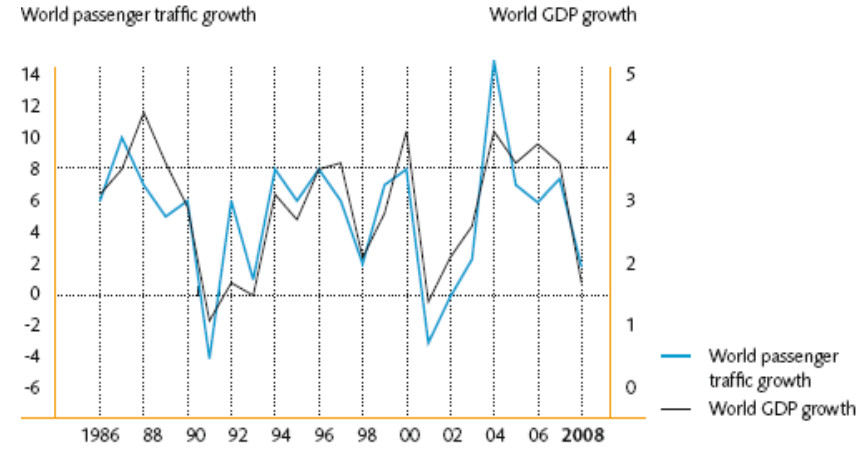




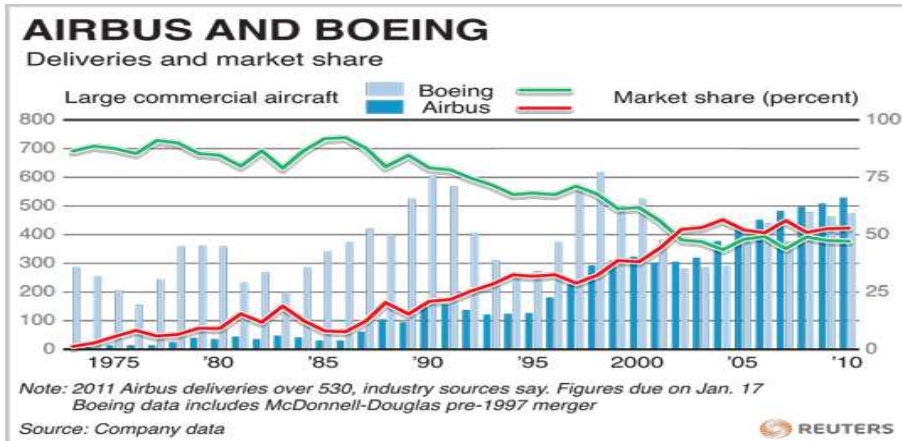
# Aerospace 2050 – Commercial 1970 to 2010



Air travel correlates with world Gross Domestic Product (GDP) (in %)



Source: Global Insight, IATA, OMC, IMF, Airbus



# Aerospace 2050 – Commercial 2010



- **Annual Airframe Sales** \$40bn
- **GDP of United Arab Emirates** \$41bn
- **16000 Commercial Aircraft in World-wide use**



- **Approx 3000 Commercial Aircraft parked!**

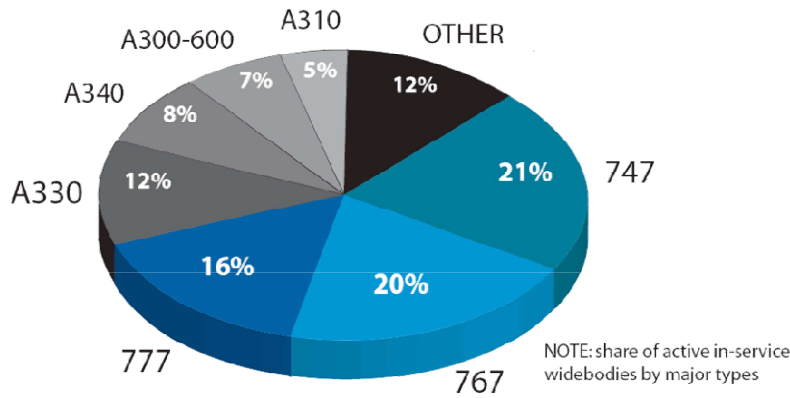


- **New Aircraft delivered in 2010 - >1000**
- **160+ Airlines World-wide**
- **72 Civil Airports in the UK and over 8000 Globally**
- **4.9 trillion RPK flown in 2010 or approx 3.5k return trips to the Sun**



# Commercial Aerospace Sector - 2010

**WORLDWIDE MARKET SHARE  
ACTIVE WIDEBODY FLEET  
(01/01/2008)**



**3000+ Aircraft**

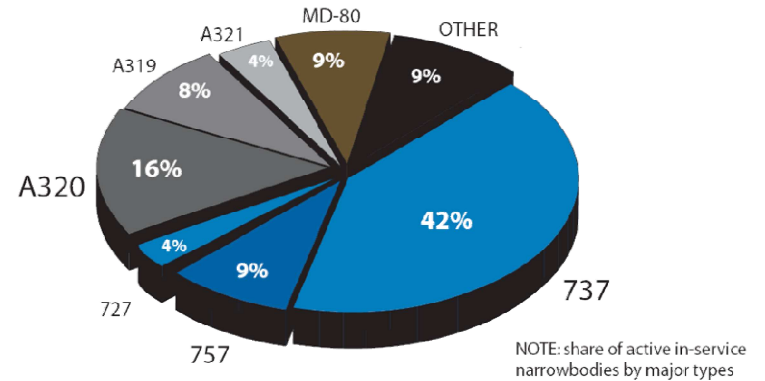


Un B747-400 d'Air France  
An Air France B747-400

Photographe / Photographer : Ph DELAFOSSE Ref : 012169  
Tout usage sauf publicitaire / Not for advertising purposes



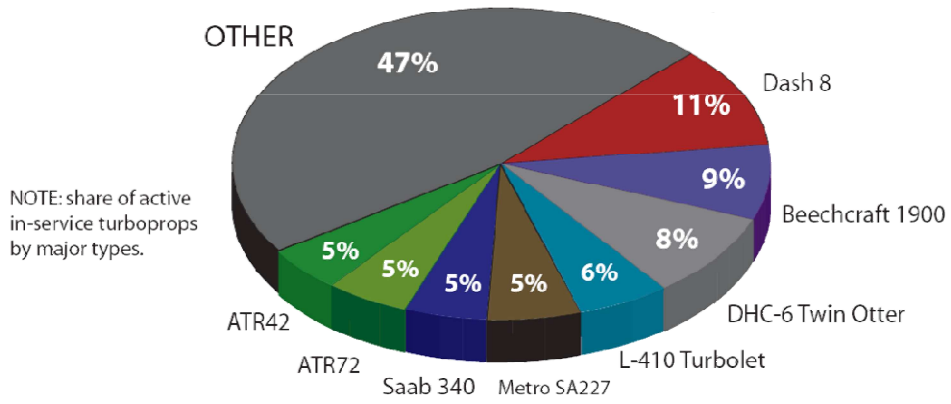
**WORLDWIDE MARKET SHARE  
ACTIVE NARROWBODY FLEET  
(01/01/2008)**



**9000+ Aircraft**

# Commercial Aerospace Sector - 2010

### WORLDWIDE MARKET SHARE ACTIVE TURBOPROP FLEET (01/01/2008)



**3600 Aircraft**



# Commercial Aerospace Sector – 2010 to 2050 In Transition?

## Low Cost Operators



## Single Type Fleets



## Fleet Restructuring



## Point to Point Routes



# Commercial Aerospace Sector – 2010 to 2050

## The market Drivers



**VS**



## Issues

- **Passenger Growth**
- **Route Structures**
- **Value of time**
- **Economics**

**VS**



# Commercial Aerospace Sector - 2010 to 2050

**Congestion**



**Operational Impacts**



**Tilt Rotors**

**Land Side Growth**



**High Speed Trains**

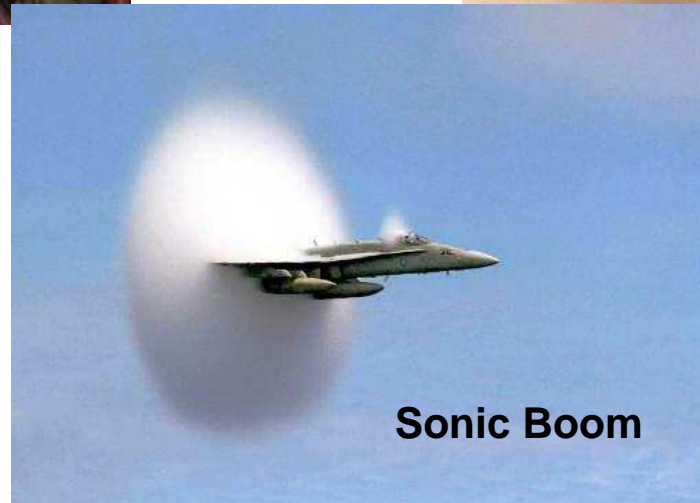
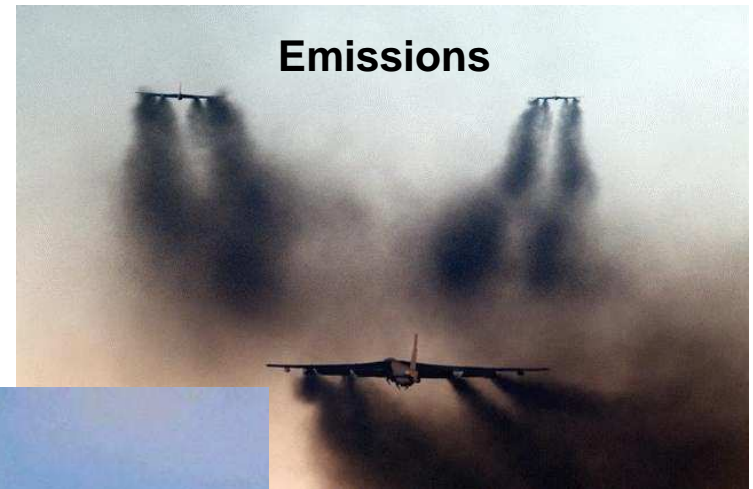


**Ultra Large Aircraft**



# Commercial Aircraft Sector - 2010 to 2050

## Environmental Considerations





# Commercial Aerospace Sector – 2010 to 2030

Aircraft in Service		
Size	2010	2030
Large	491	1800+
Twin Aisle	2400	7000+
Single Aisle	9000+	19000+
Regional	3600+	5600+
<b>Total</b>	<b>16000+</b>	<b>33400+</b>

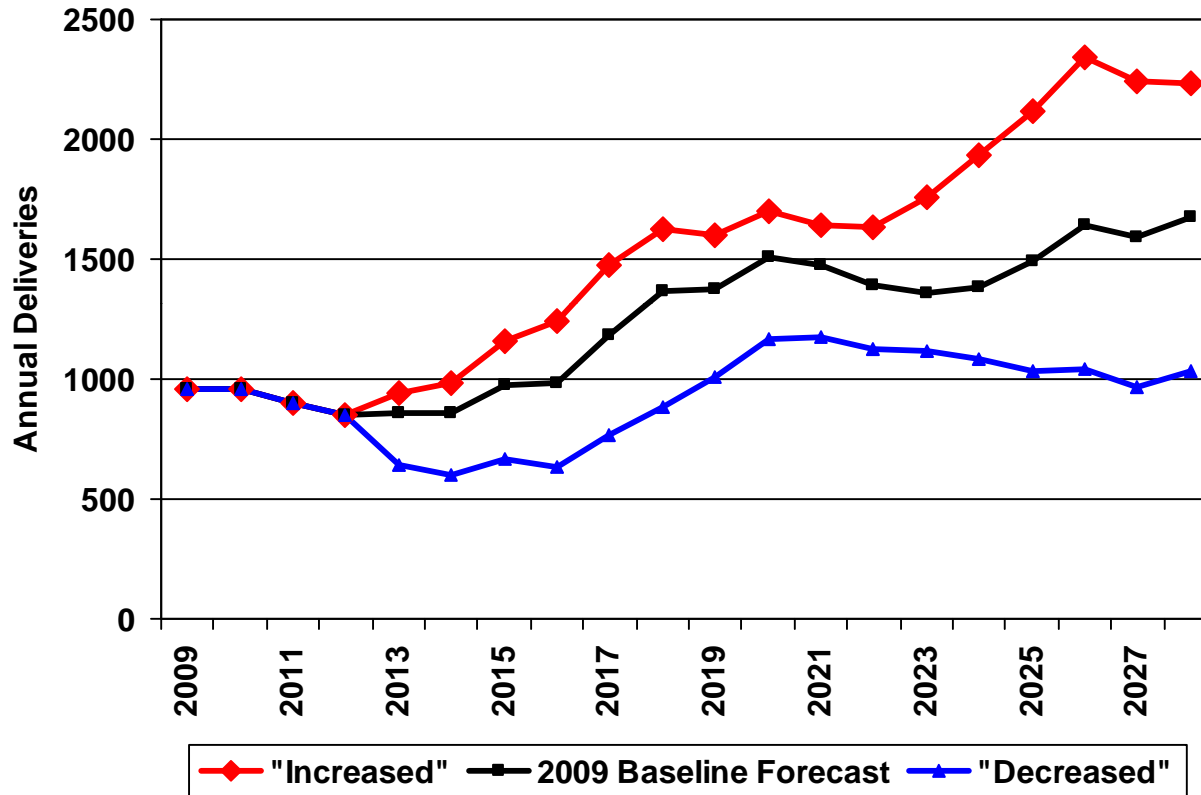


Source Airbus / Boeing

20 Year Aircraft Demand by Size		
Size	New	Value (\$bn)
Large	1800	530+
Twin Aisle	7000+	1600+
Single Aisle	19000+	1300+
Regional	2100+	70+
<b>Total</b>	<b>29900+</b>	<b>3500+</b>

# Commercial Aerospace Sector – 2010 to 2030

## Forecast Deliveries



**Total Air Transport Aircraft Demand for 2009 - 2028**

Increased: 30,299  
 Baseline: 24,787  
 Decreased: 18,600

**Marco Economic**

“Increased”: Low Oil World GDP Growth

Baseline: Oil \$50

“Decreased”: High Oil Depressed GDP

# Commercial Aircraft Sector - 2050 New Configurations



# Commercial Aircraft Sector - 2050 New Operations



Source ACARE Out of the Box 2008

# Commercial Aircraft Sector - 2050 Extended Ranges



Source ACARE Out of the Box 2008

# Aerospace 2050 - Space

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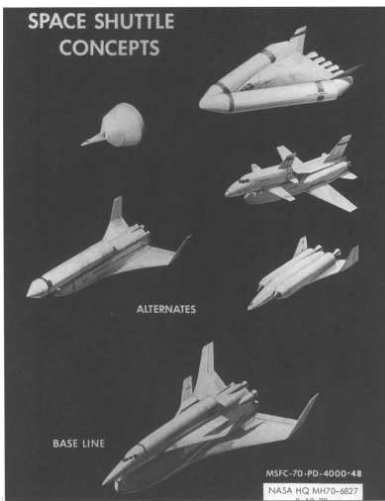
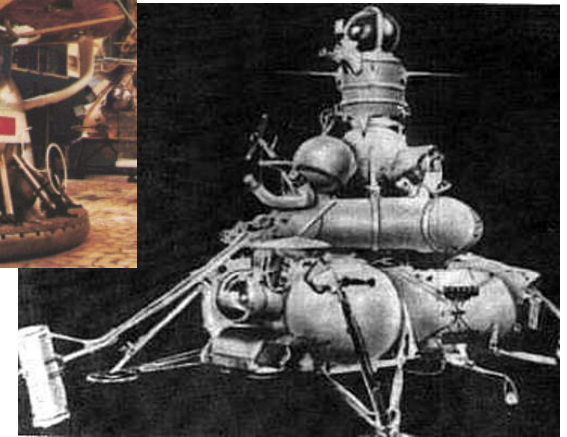
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## ➤ Space

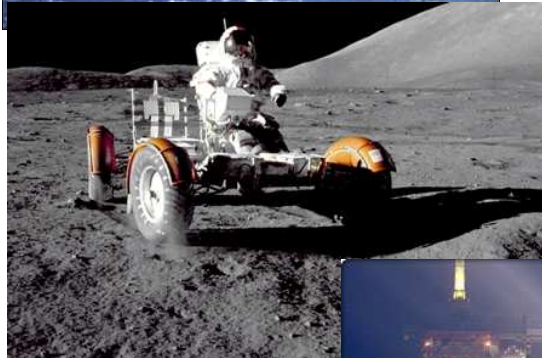
- Questions



# Aerospace 2050 – Space 1970

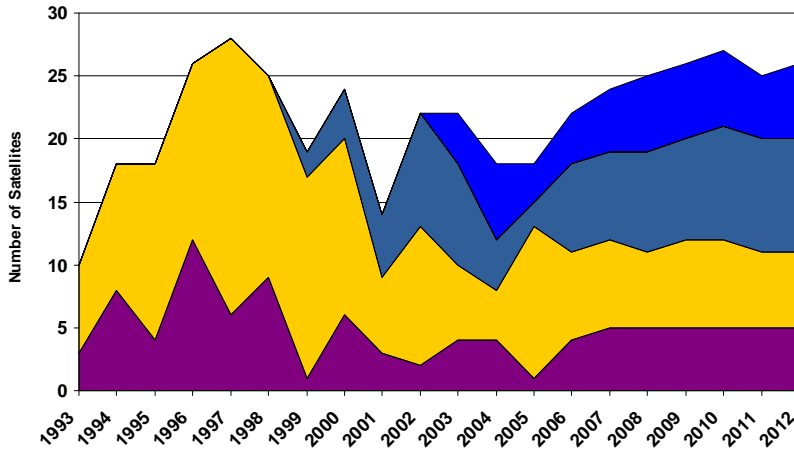


# Aerospace 2050 – Space 1970 to 2010





# Aerospace 2050 – Space 1970 to 2010

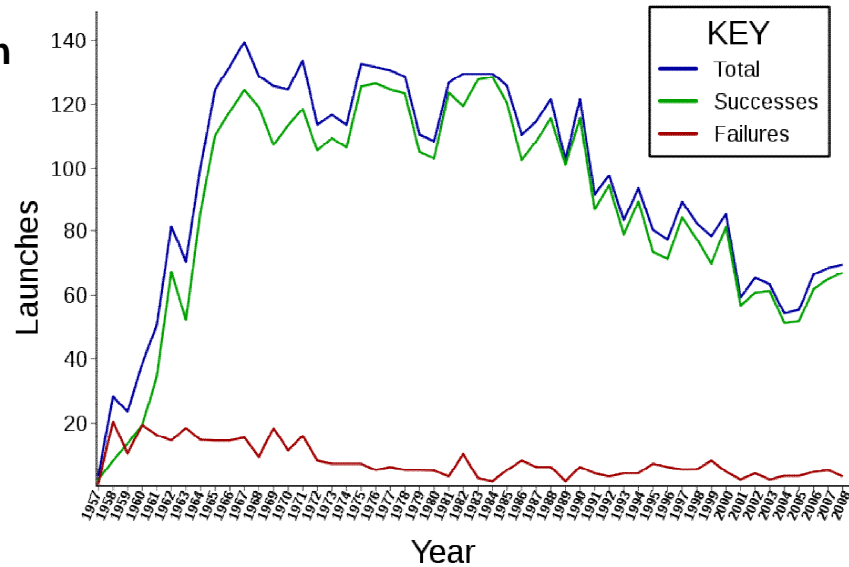


Over 5,400kg  
 4,200 to 5,400kg  
 2,200 to 4,200kg  
 Below 2,200kg



Launches 1957 to 2008

Trends in GSO Satellite Mass Distribution

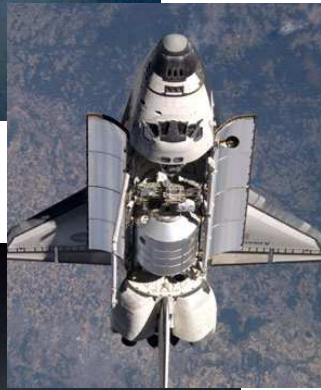


# Aerospace 2050 – Space 2010

- Annual Global Space dependent business \$55bn
- GDP of Belarus \$55bn
- Annual Satellite Sales \$9bn
- Jamaican GDP \$8.9bn
- Annual Launch Services \$12bn
- 42 commercial Companies operate 210+ Satellite Systems
- Over 4000 launches since 1950
- 60+ means of getting into space



# Aerospace 2050 – Space 2010 Back to the Future



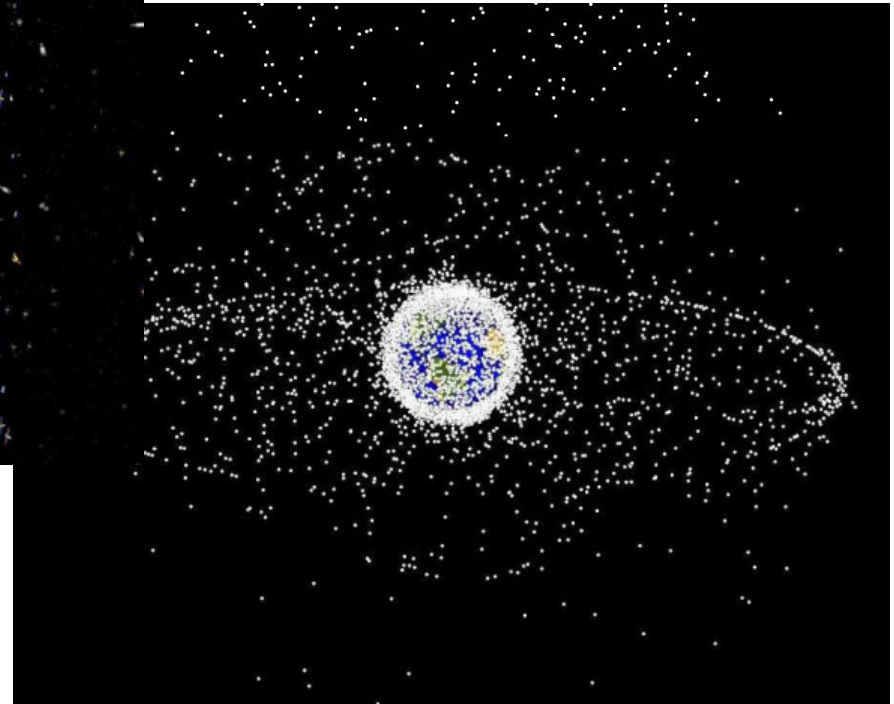
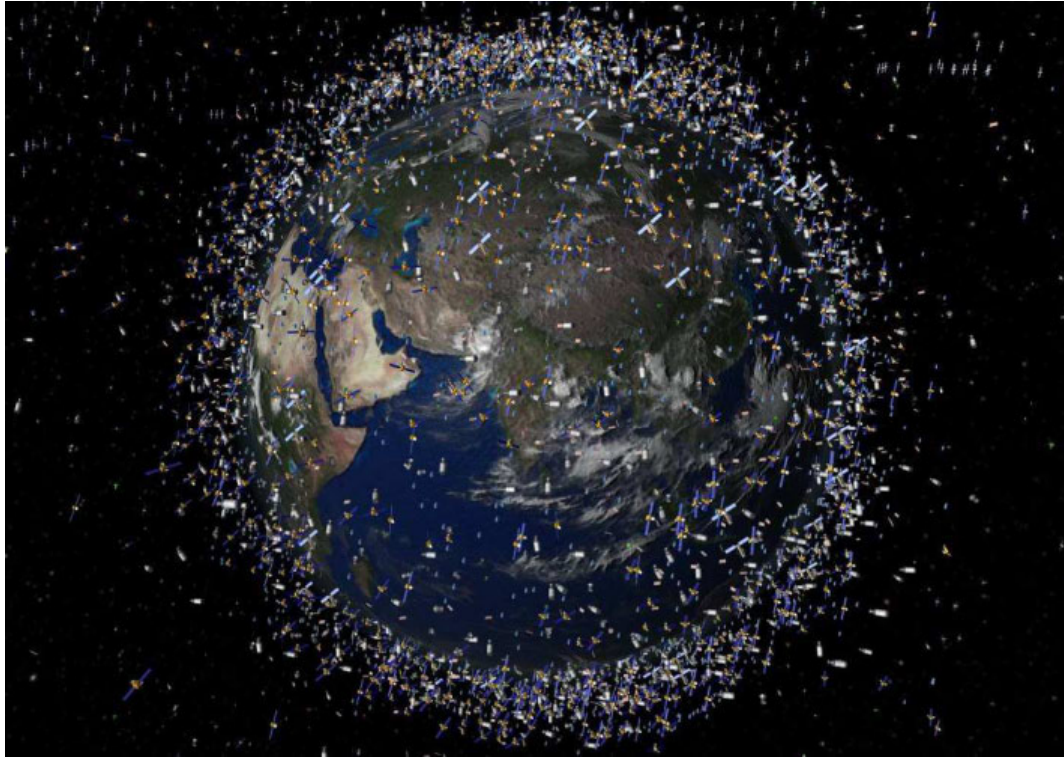
**Space Shuttle OUT**



**Spacex  
Falcon / Dragon**

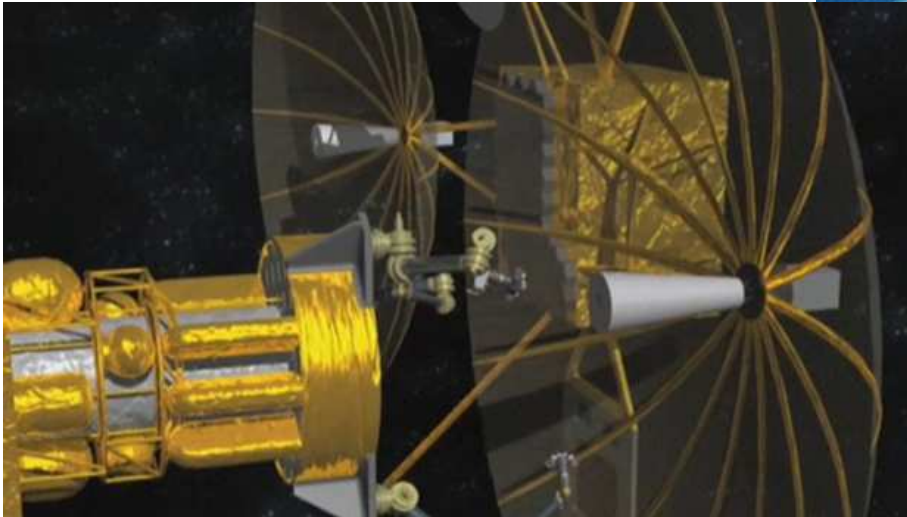
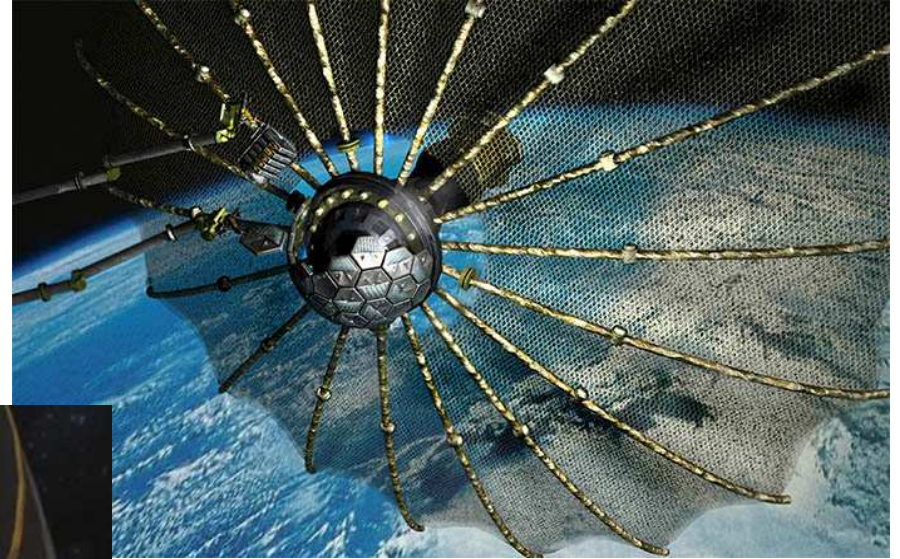


# Aerospace 2050 – Space 2010 – Parking is Difficult!



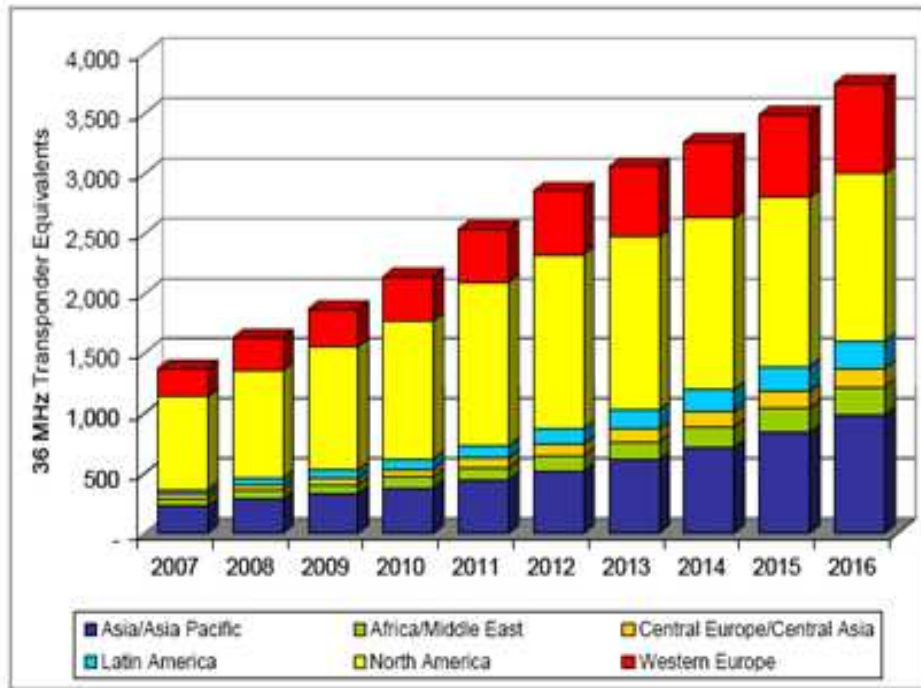
# Aerospace 2050 – Space 2010 – But there is a Plan!

## DARPA - PHOENIX

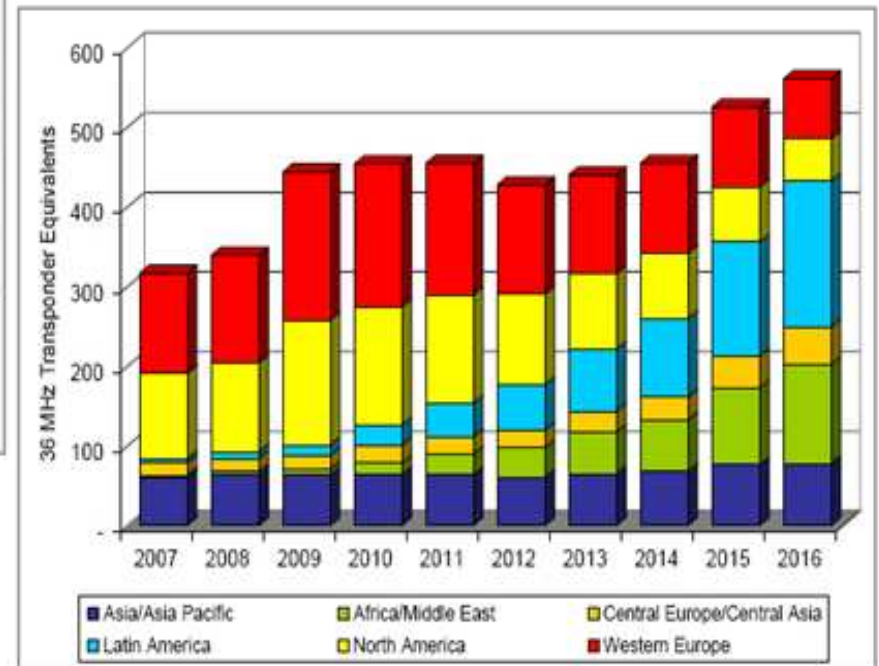


# Aerospace 2050 – Space 2010 to 2050 Commercial demand

## Broadcast



## Two Way



Typically 32 Transponders / Satellite

# Aerospace 2050 – Space 2010 to 2050 Commercial demand

## Logistics Tracking



## Tele Medicine



## Financial Transactions



## Multi Media



# Aerospace 2050 – Space 2010 to 2050 Military demand

## Rapid Access



## Leverage Commercial Assets



## Contractor Provided Services



## Global Strike





# Aerospace 2050 – Space 2050



**Mission to Mars**

**Commercial access**



**Space Liner**



# Aerospace 2050 – Concluding Remarks

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- **The Global Aerospace Sector has a future.**
- **The Military Aerospace is Global**
- **The Military Aerospace going Autonomous**
- **The Commercial Aerospace Customer are changing their Demands**
- **The Commercial Aerospace Sector is going Greener**
- **The Space Sector searching for cheaper ways to “BOLDLY GO”**
- **The Space Sector is focused on commercial ways to access space**