



# SPACE DEBRIS

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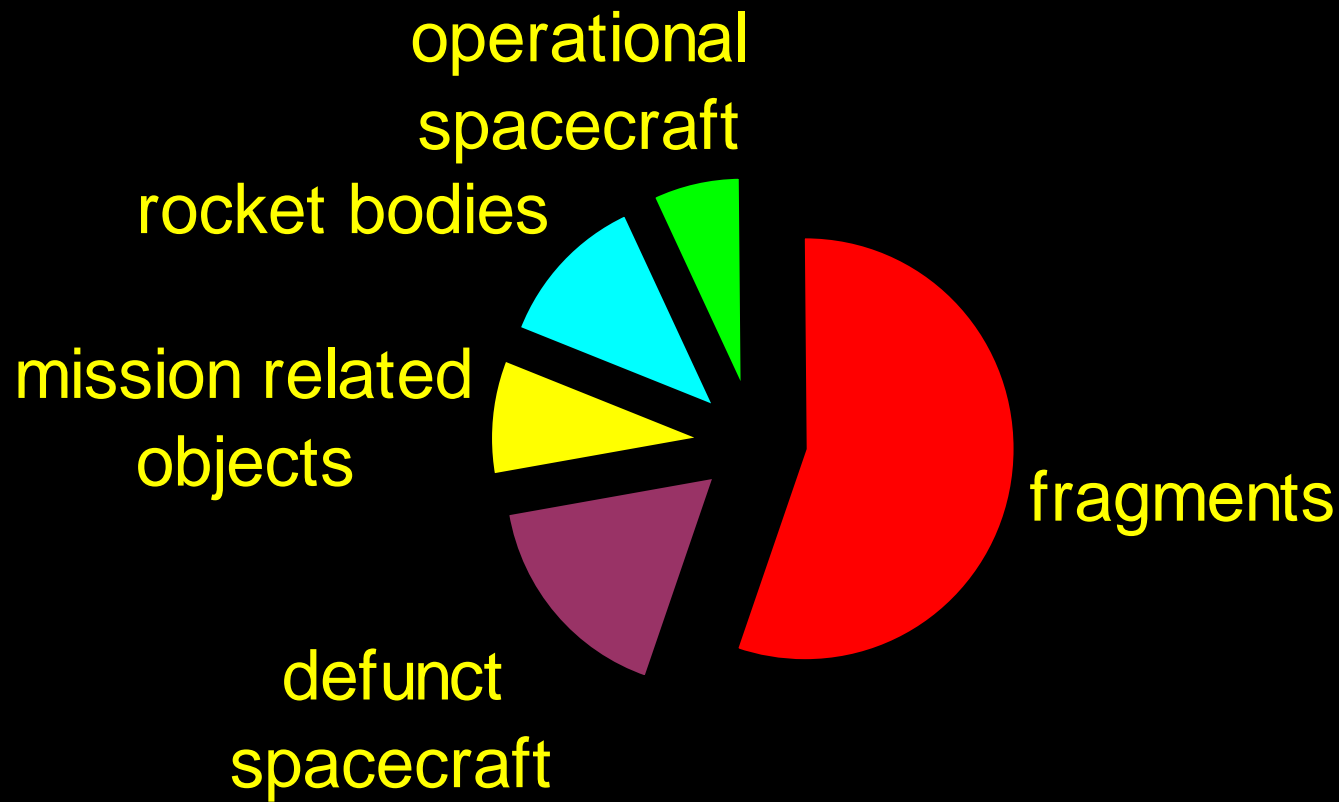
# Outline

- **What is in orbit around the Earth?**
- **How much space debris is there?**
- **What is the future for space debris?**
- **What is the solution to space debris?**

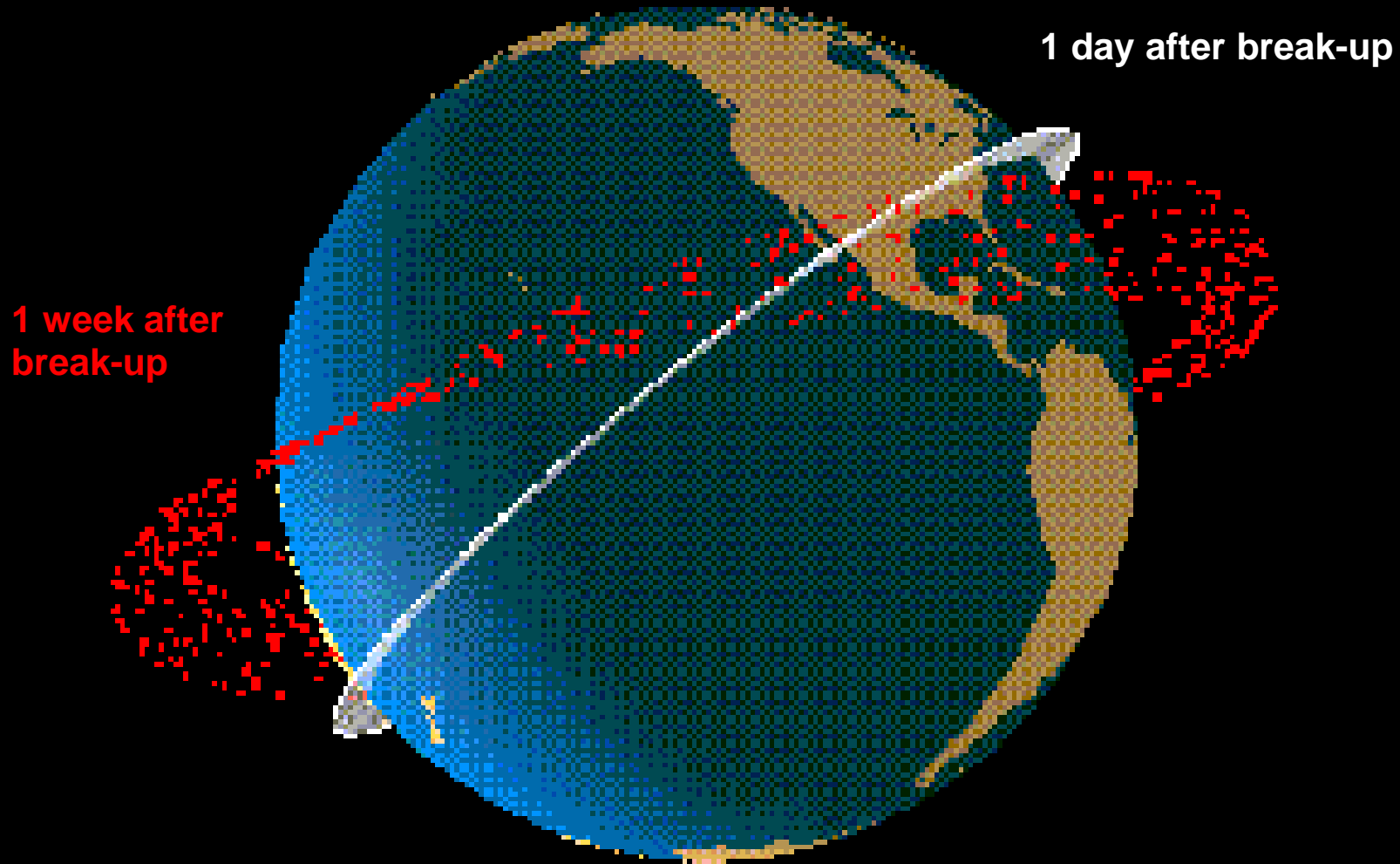
**WHAT IS IN ORBIT AROUND  
THE EARTH?**

**near-Earth satellite population reflects use of space**  
**>16000 catalogued objects concentrated in distinct orbits**  
**with unique characteristics**

# CATEGORIES OF CATALOGUED OBJECTS

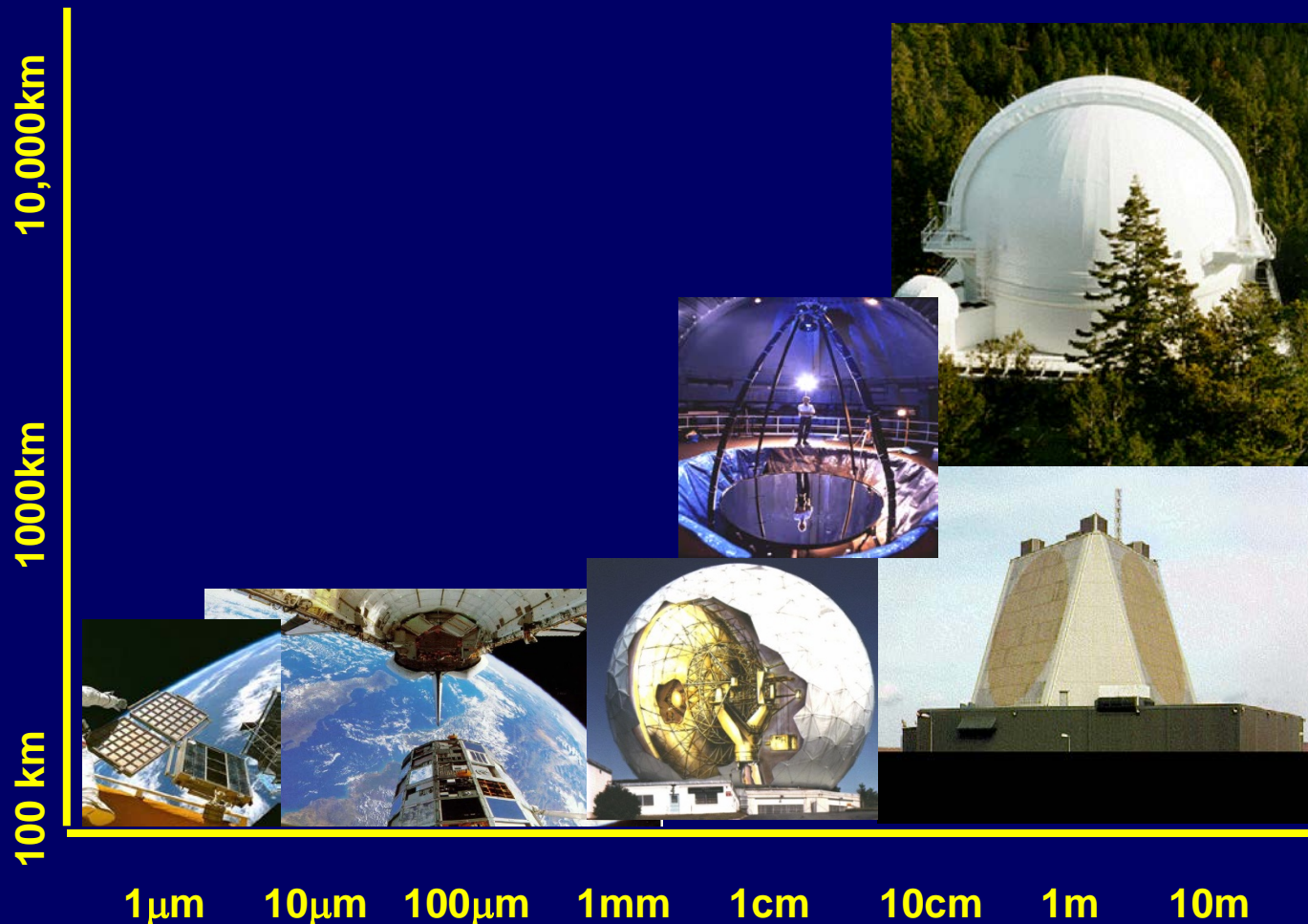


# FRAGMENTS FROM BREAK-UP QUICKLY DISPERSE



**HOW MUCH SPACE DEBRIS  
IS THERE?**

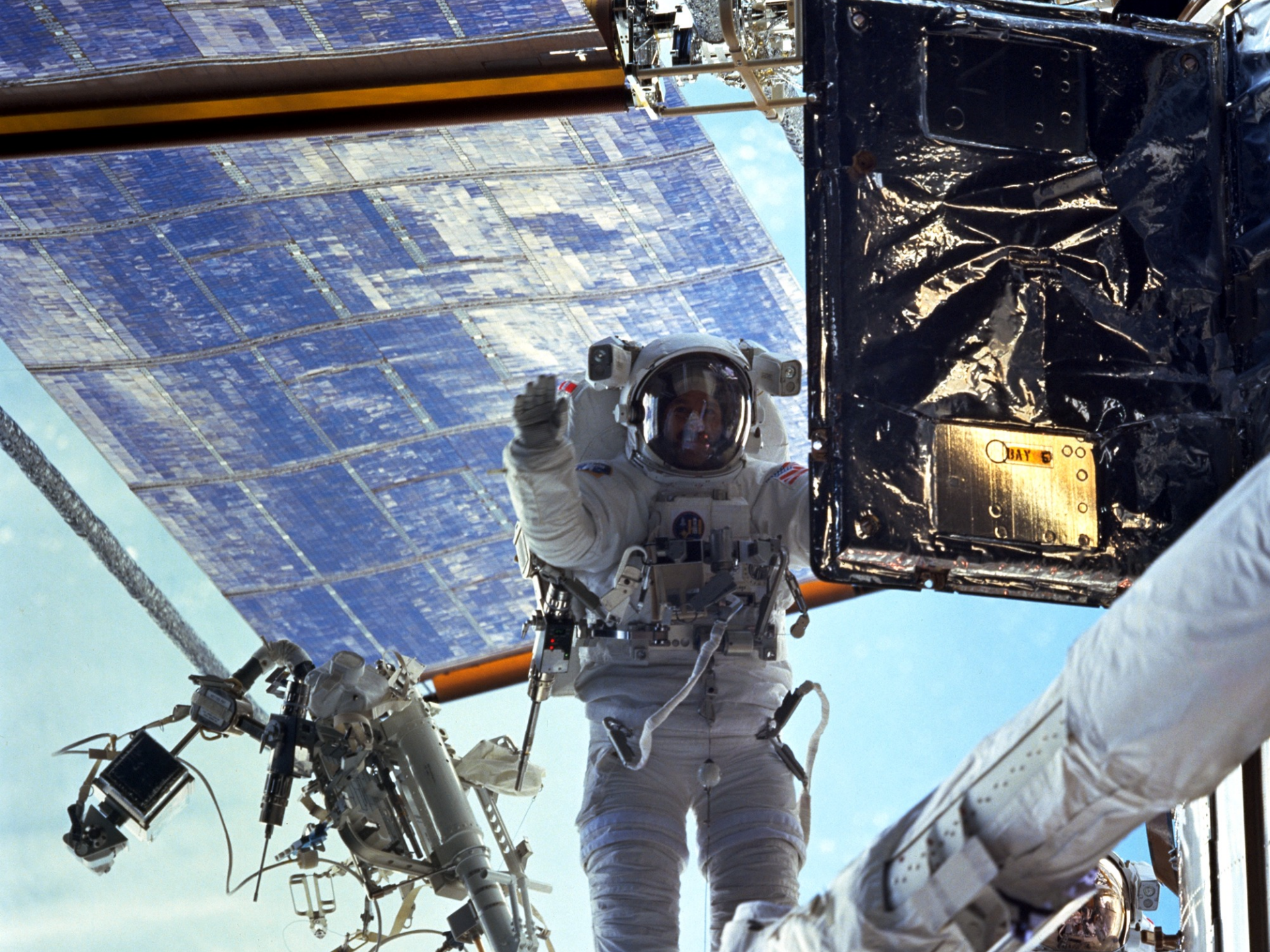
# Estimating the debris population















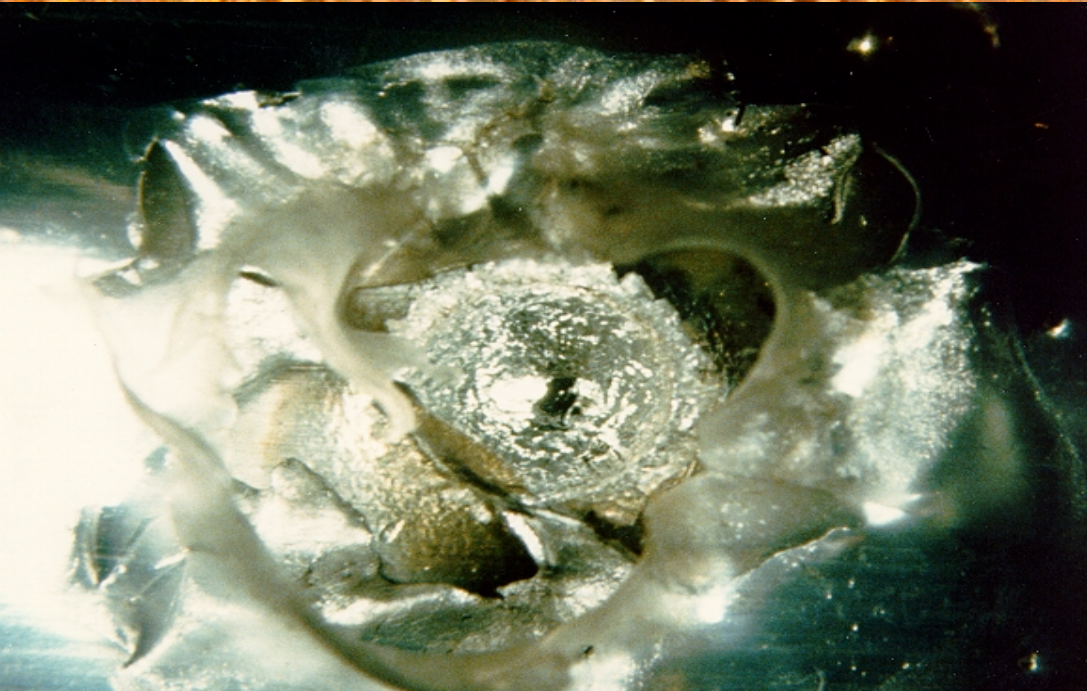
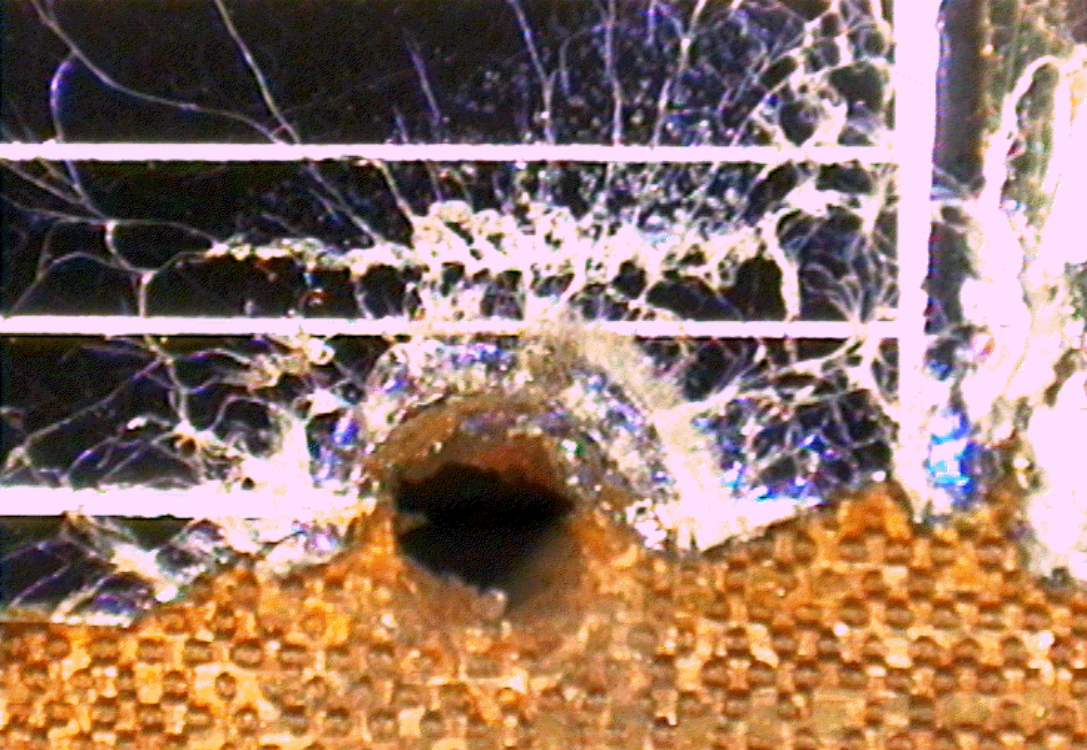
T180-38 T180-2 T180-5 T180-7 T180-41 T180-9 T180-10 T180-11  
T180-1 T180-40 T180-3 T180-4 T180-6 T180-8 T180-43 T180-44  
T180-39 T180-4 T180-6 T180-45  
T180-13 T180-14 T180-15 T180-16 T180-17 T180-18 T180-19 T180-20  
T180-46 T180-47 T180-36 T180-18 T180-49 T180-25  
T180-21 T180-52 T180-48 T180-22 T180-23 T180-24 T180-25  
T180-51 T180-26 T180-59 T180-27 T180-53 T180-54 T180-29 T180-55  
T180-58 T180-30 T180-37 T180-60 T180-28 T180-30 T180-30  
T180-61 T180-62 T180-34 T180-63 T180-64 T180-30 T180-30  
T180-67 T180-68 T180-35 T180-69 T180-33 T180-65 T180-32  
T180-68 T180-35 T180-69 T180-33 T180-65 T180-32

150

-V3

180







# Estimated Debris Population

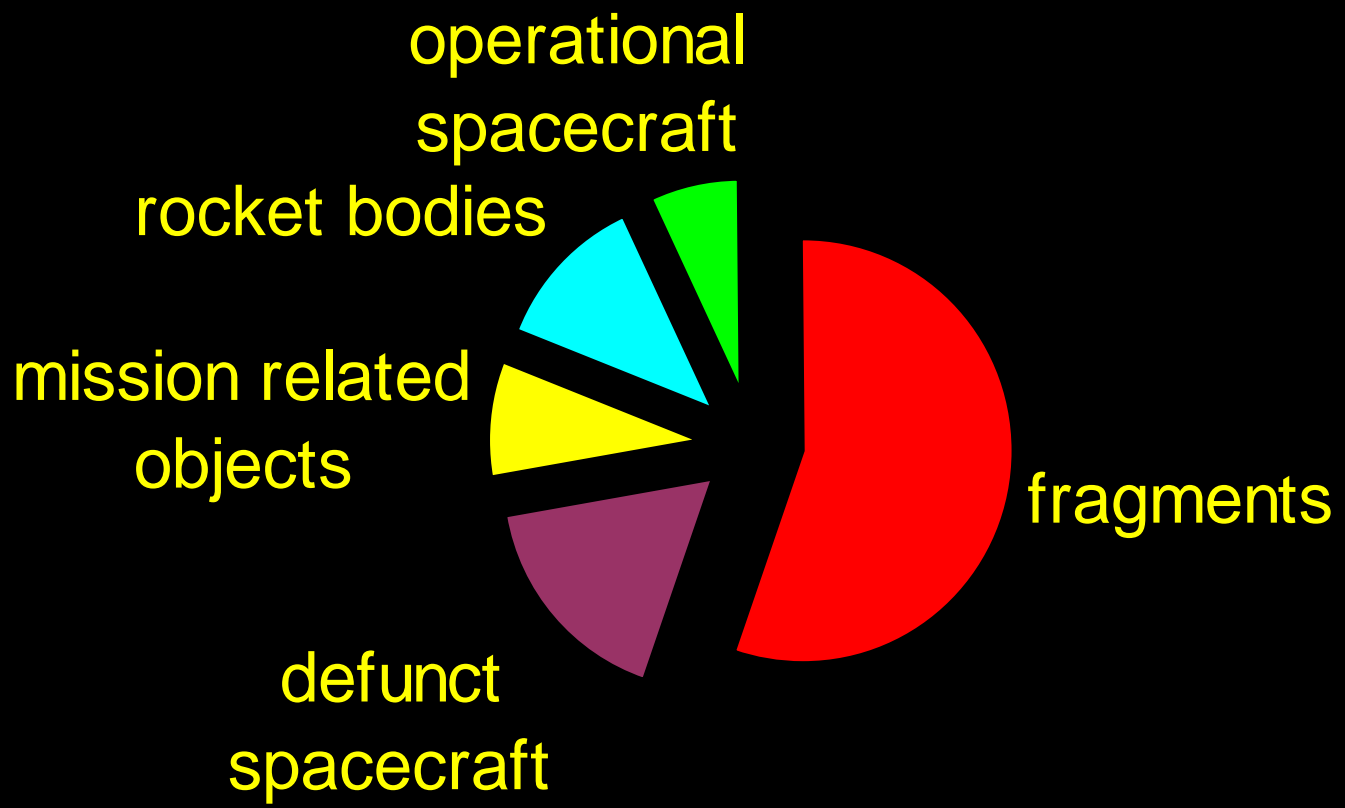
<u>Size</u>	<u>Number</u>	<u>% Mass</u>
>10 cm	>20000	99.93
1-10 cm	>500,000	0.035
<1 cm	>50,000,000	0.035
<u>Total</u>	<u>&gt;50,000,000</u>	<u>&gt;5,000 tonnes</u>

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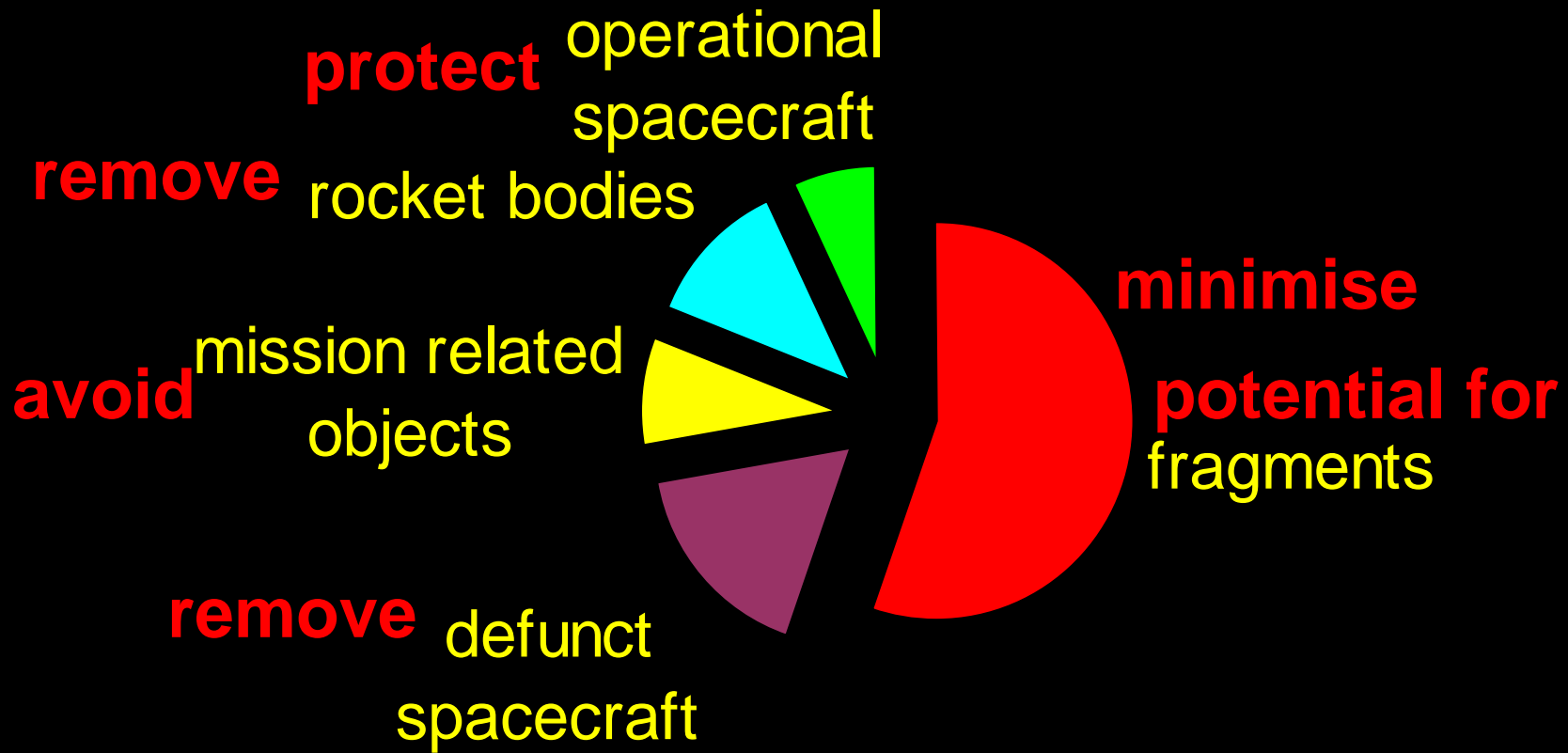
**WHAT IS THE SOLUTION  
TO SPACE DEBRIS?**

# MITIGATION OBJECTIVES





# MITIGATION OBJECTIVES



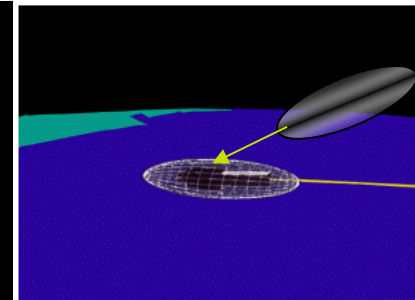
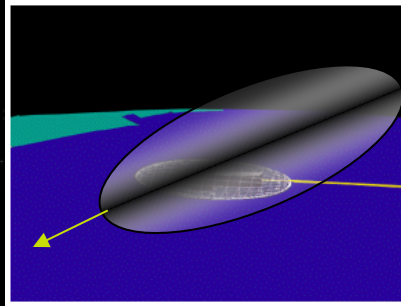
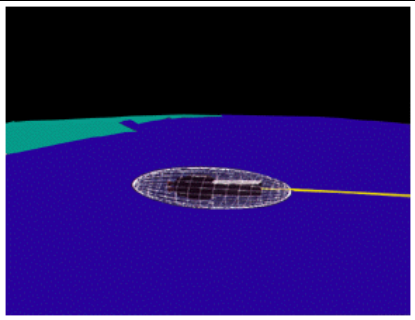
V 503

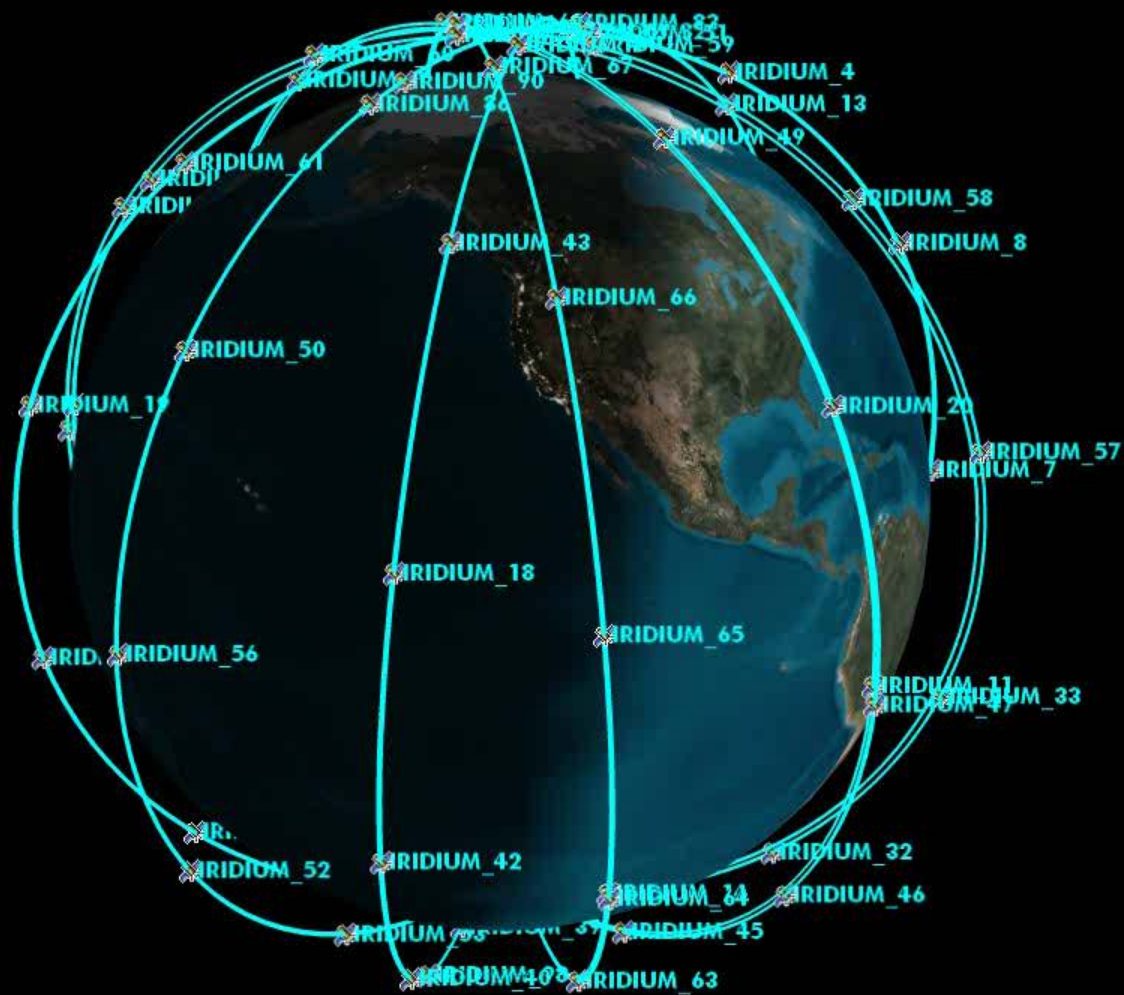
00:43:14.10

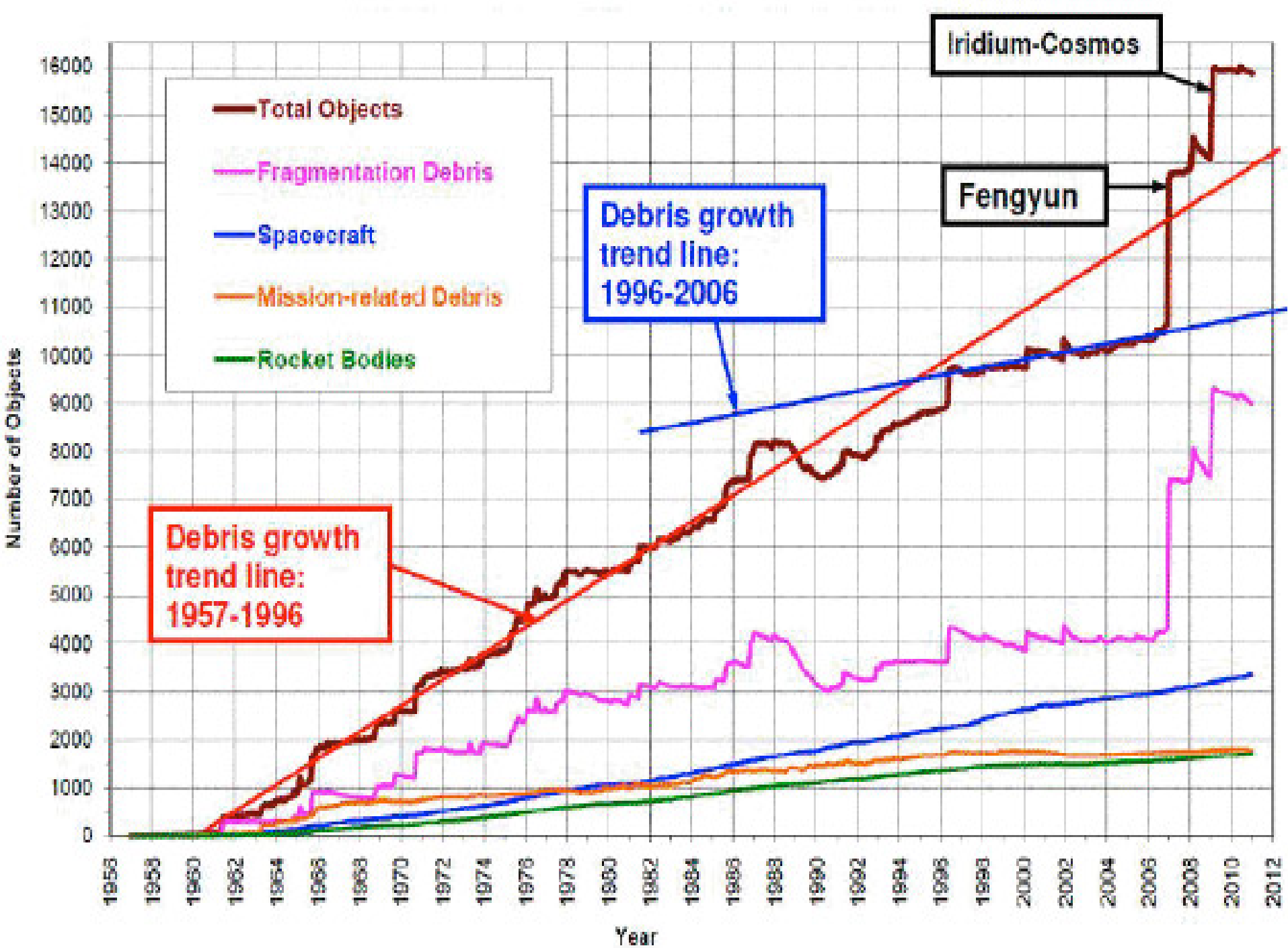
V 503

00:43:14.10

# Collision Avoidance







# Debris Mitigation

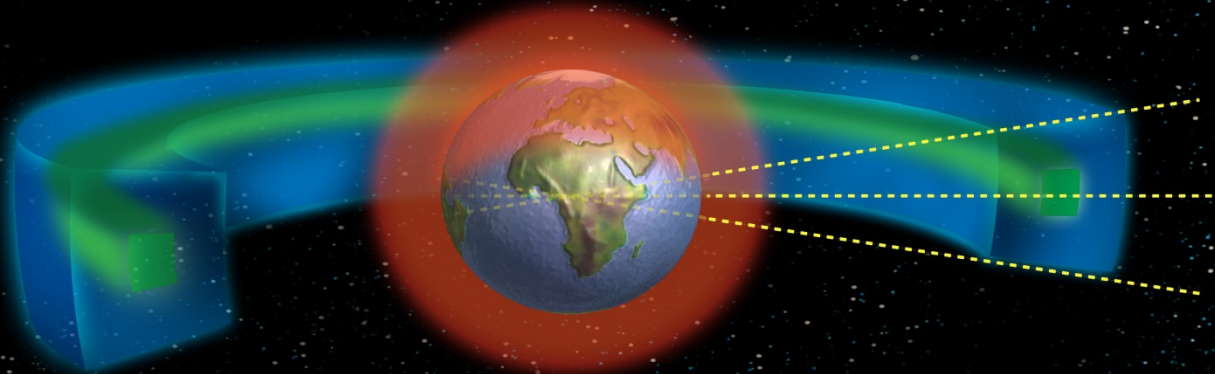
- **Managing the debris environment does work**
- **Requires information of orbital population**
- **Need to share experience between operators**
- **Effectiveness of measures can be demonstrated**
- **Need comprehensive implementation to be effective**
- **Increasing reflected in national legislation**
- **Regulators need to assess compliance**

# Definition of Protected Regions

- **Activities in space should recognise the unique nature of 2 regions in space:**

## LOW EARTH ORBIT REGION

Earth surface up to 2000 km



## GEOSYNCHRONOUS REGION

Geostationary altitude +/- 200 km

Equatorial latitude +/- 15 deg











# Lessons Learnt

- Need to focus efforts on “cause” rather than just “effect”
- As environment deteriorates, cost impacts will increase significantly for all users of space
  - Loss of systems
  - Loss of fuel budget and lifetime due to increased manoeuvres
  - Increased demands of space surveillance
- Active management will be necessary
- Best practice needs to become common practice