



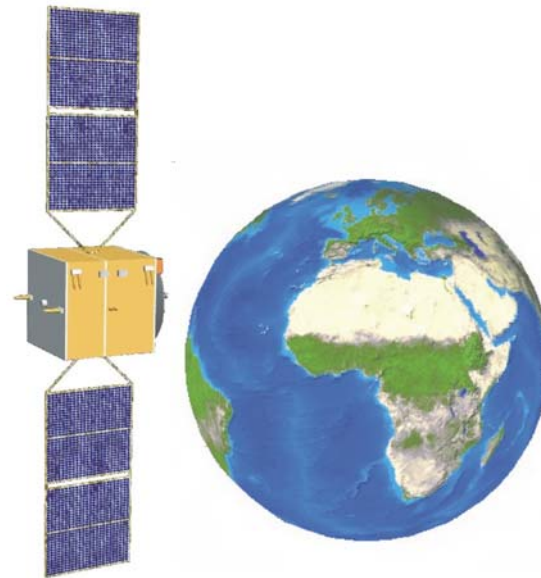
Low Cost Constellations to Assist the Warfighter

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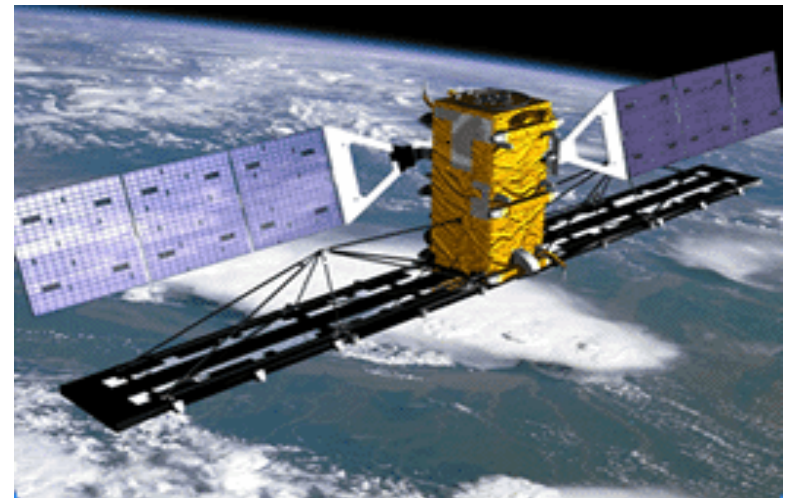
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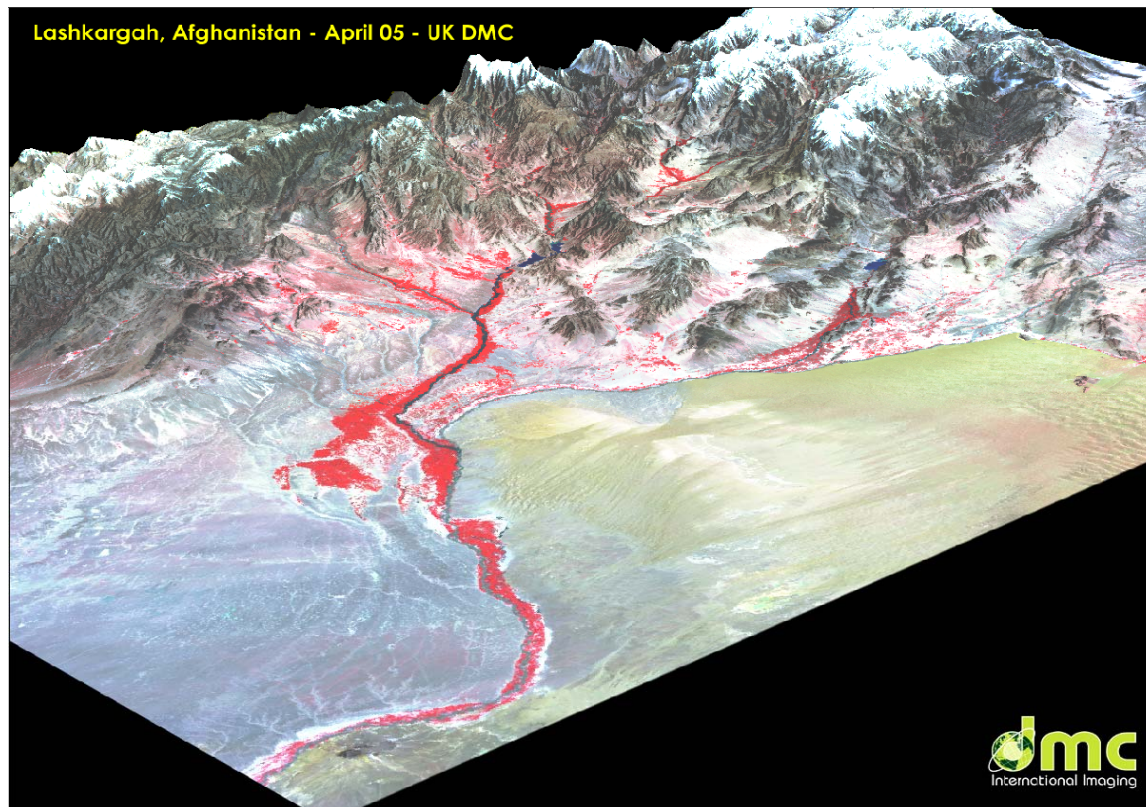
- Requirements and CONOPS Discussion
- Meet the Homunculus
- Small Satellite Solutions
- Conclusions



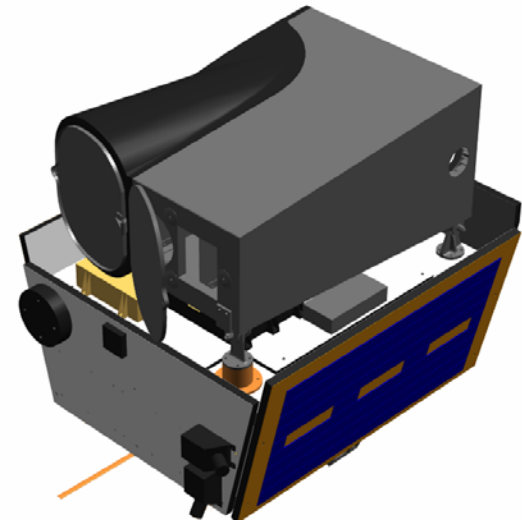
- Access to wide, deep areas that are increasingly denied to other surveillance assets
- Persistent surveillance, including the ability to stare
- Increased tempo for information delivery



- Specified areas for surveillance coverage extend from point targets of 1 x 1 km to maritime regions measuring 2,000 x 2,000 km
- Region size related to the areas of intelligence interest at particular levels of command



- Time lines for data delivery range from near-real time, (a persistent “staring” requirement), to yearly updates for some strategic requirements
- Responsive space focuses on timescales of a few days at most, and (probably) a few hours at least



- “Information” delivery also includes the exploitation time required to turn raw data into intelligence, as per the TCPED cycle.

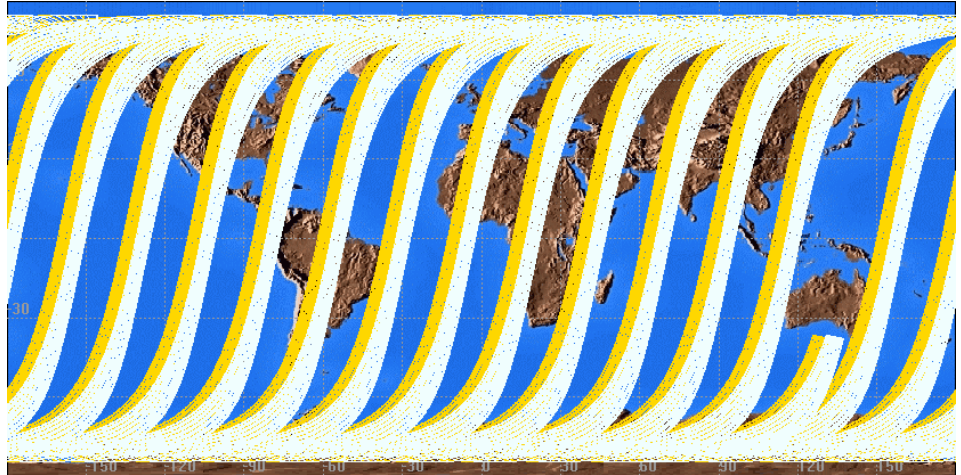
Tasking-Collection-Processing-Exploitation-Dissemination

- Demands for increased tempo will continue to shorten these information delivery requirements

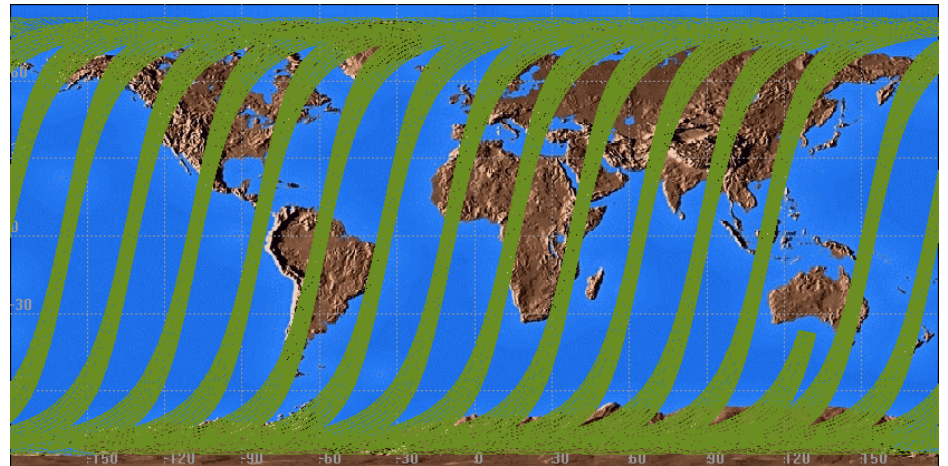


- Satellites can:-

1. provide global coverage



2. follow repeating ground tracks, increasing the revisits over particular points

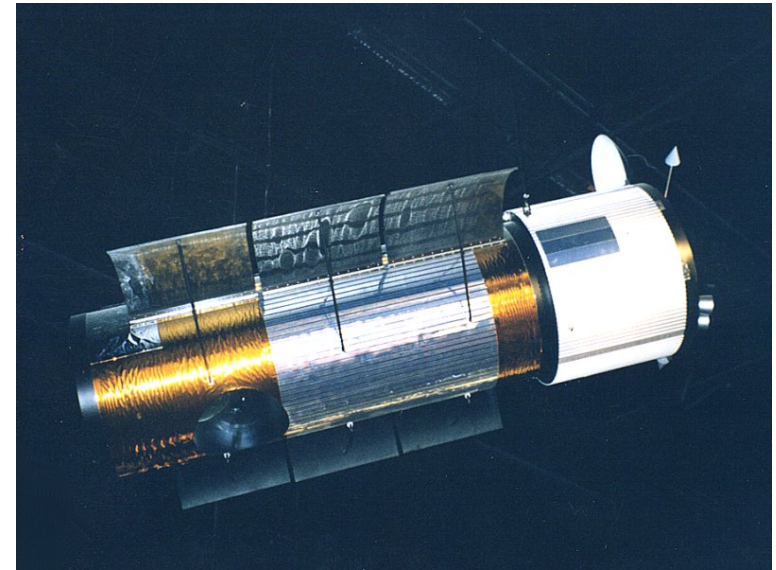


It is possible to manoeuvre between these options in a time of crisis

- **Advantages**
 - Increased numbers of passes
 - Less predictable pass times
 - Varied viewing angles
 - Greater payload masses
- **Disadvantages**
 - Variable target lighting
 - More variable power generation
 - More variable thermal environment
 - Lack of global coverage

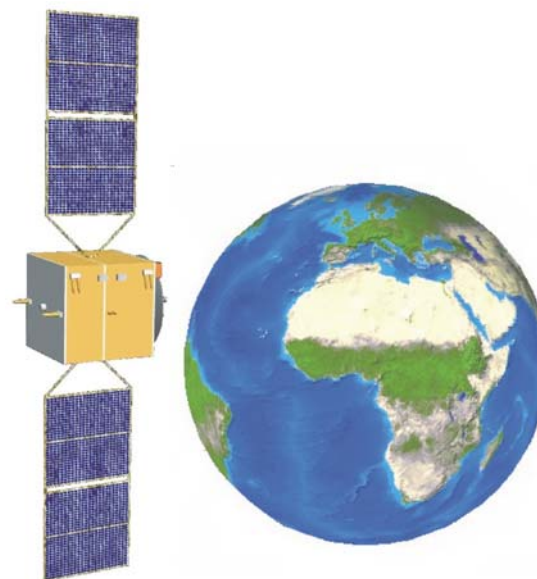


Allied capability



Enemy Capability

- Requirements and CONOPS Discussion
- Meet the Homunculus
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- The homunculus is a human drawn in proportion to the density of nerve endings in different parts of the body
- Note the emphasis on sensing the external environment, rather than internal processes
- For the military, as a corporate body, ISTAR, (RISTA), is the eyes, ears, touch, etc.
- Evolution's experiments over millions of years can thus be used to guide decisions on an appropriate mix of long range and short range sensors
- Space can provide the long range eyes and ears

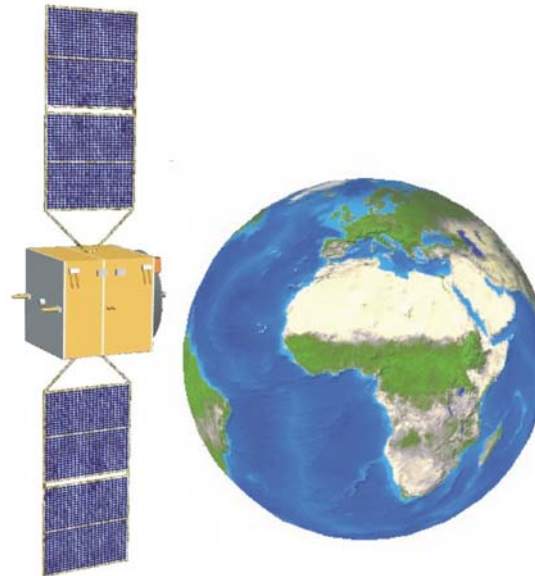


- Multiple-source collection is required to counter CC&D and improve the quality of decision making
- To provide benefit, data fusion must:-
 - a) Improve the quality of decision making appreciably (you can get 50% of yes/no decisions right simply by tossing a coin!)
 - b) Not lead to extensive delays waiting for a second source of data
 - c) Not lead to confusion through data deluge
- To be effective, multi-source collection must be collocated, contemporaneous and comparable
- Implies a need for more than one collection system....

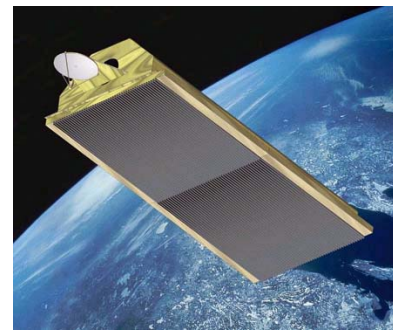
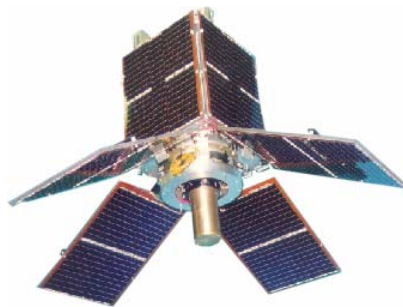
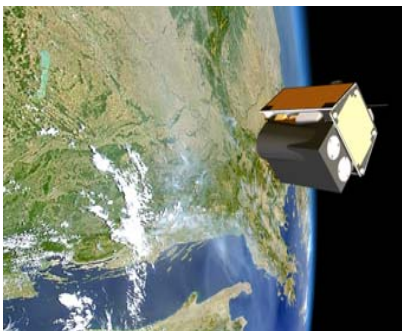
- Overflight is currently not a constraint for satellite systems, so they can achieve long range collection, like a human's senses of sight and hearing
- Aircraft and UAVs provide the ability to loiter, collecting high resolution data over small regions, like a human's touch, taste, and smell
- Conclusion: The future surveillance component is likely to involve increasing reliance on a range of unmanned platforms



- Requirements and CONOPS Discussion
- Meet the Homunculus
- **Small Satellite Solutions**
- Conclusions



- A system of systems with complementary capabilities to perform Electro-Optical (EO), SAR and SIGINT collection
- Providing the capability for collocated, contemporaneous, comparable collection when required
- Performance parameters specified with complementary fields of view to facilitate cueing and fusion of data



Existing EO satellites provide

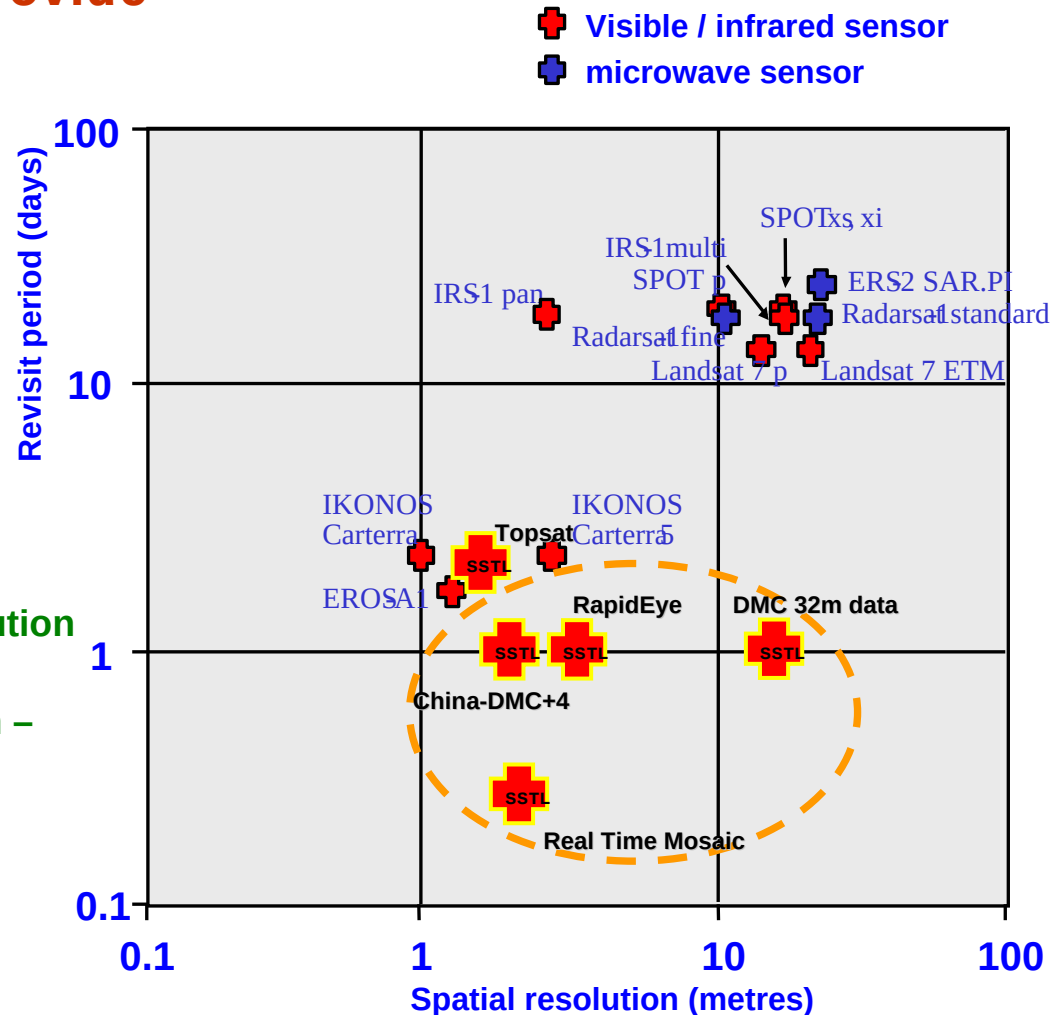
- High spatial resolution
- Good spectral discrimination

but

- Poor temporal resolution
- Very high cost

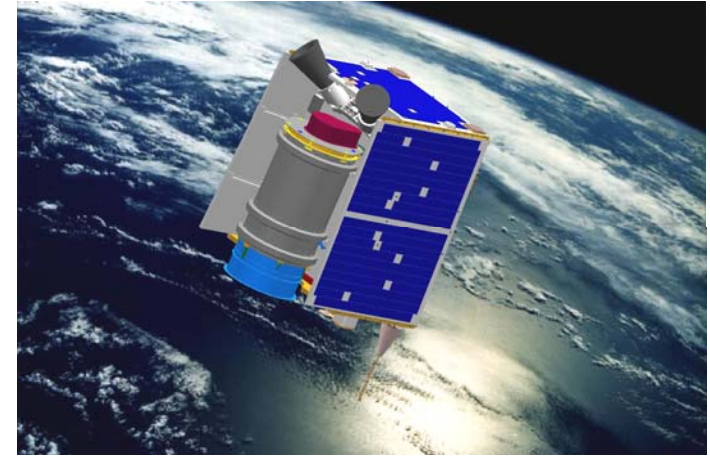
Small Satellites

- Very low unit cost
- Constellations of EO satellites become affordable
- Capable of medium spatial resolution and spectral discrimination
- Enables high temporal resolution – new data source

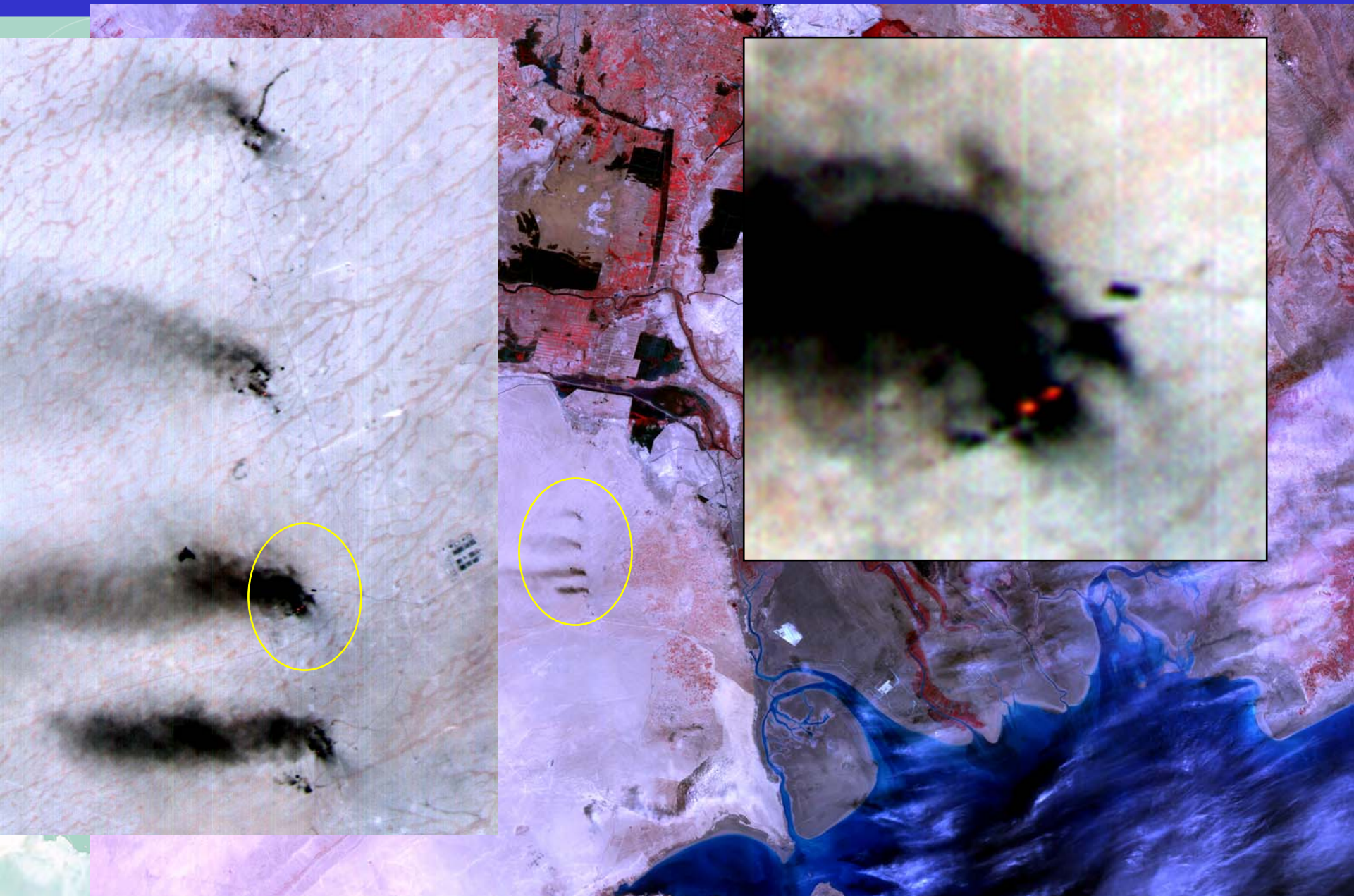


Enhanced capabilities relative to TOPSAT

- Roll angle 45 degrees
- 1 – 1.5 m resolution
- Image numbers 30-60 per day
- Two images per pass
- Improved geolocation accuracy
- Propulsion capability to permit orbit phasing
- Wide area camera system like Disaster Monitoring Constellation

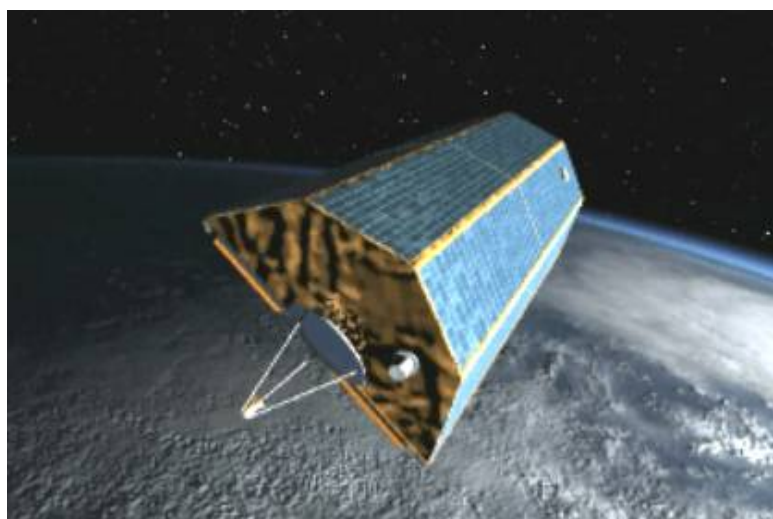
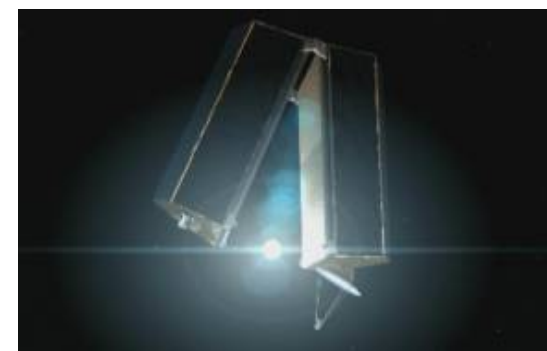
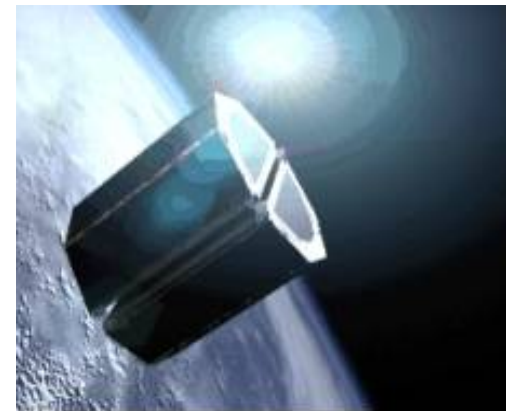


Basra Oil Fires (12 Apr 2004)

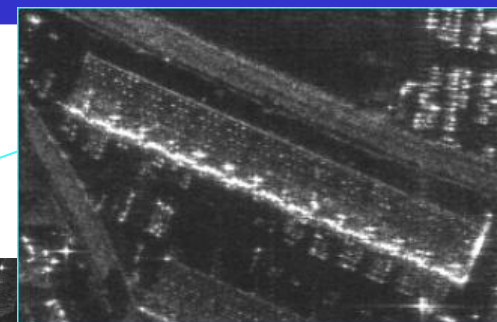
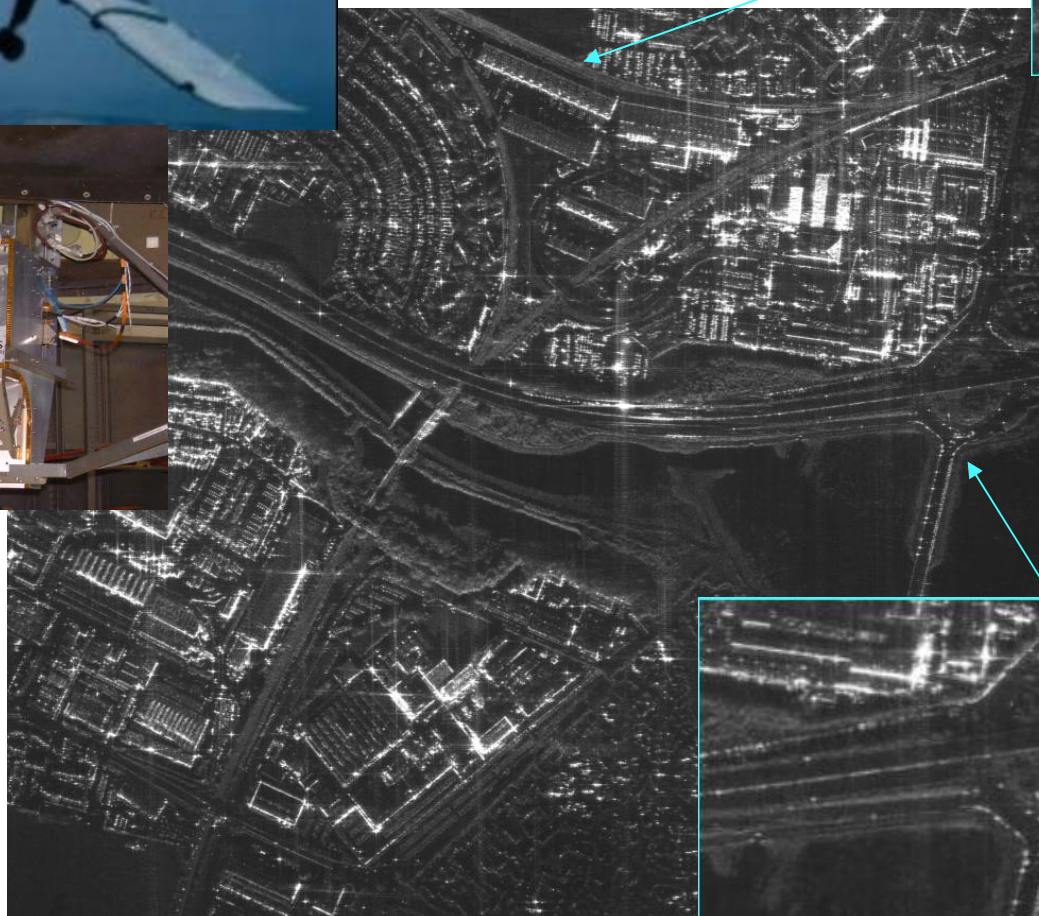
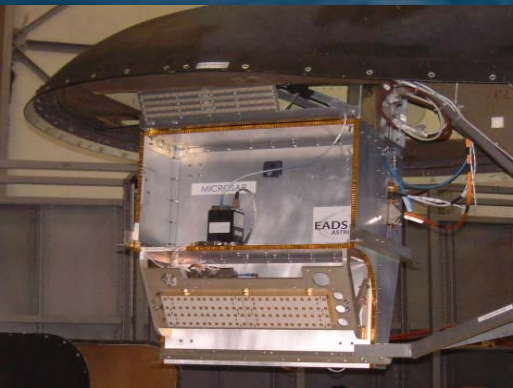




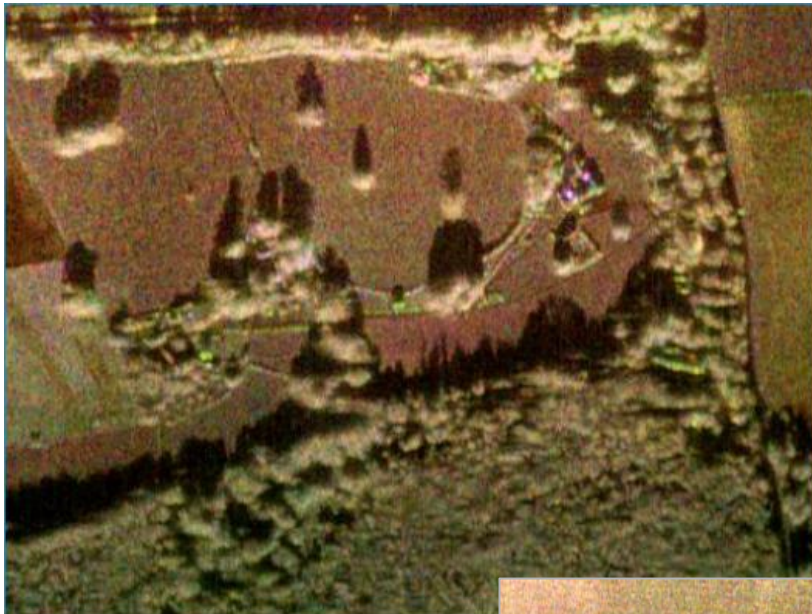
- Capabilities
 - Wide-area mode – 10's of km swath with 30 m resolution
 - Detailed mode – 15-20 km swath with 3-5 m resolution
 - Access swath ~ 1,500 km
 - Duty cycle – 4 minutes per orbit (~1,600 km strip)



Example radar images



MicroSAR Airborne
Demonstrator
X-Band HH, 0.85m
resolution
Image acquired Sept
2004
Broad Oak Business
Park and Portsmouth
Creek



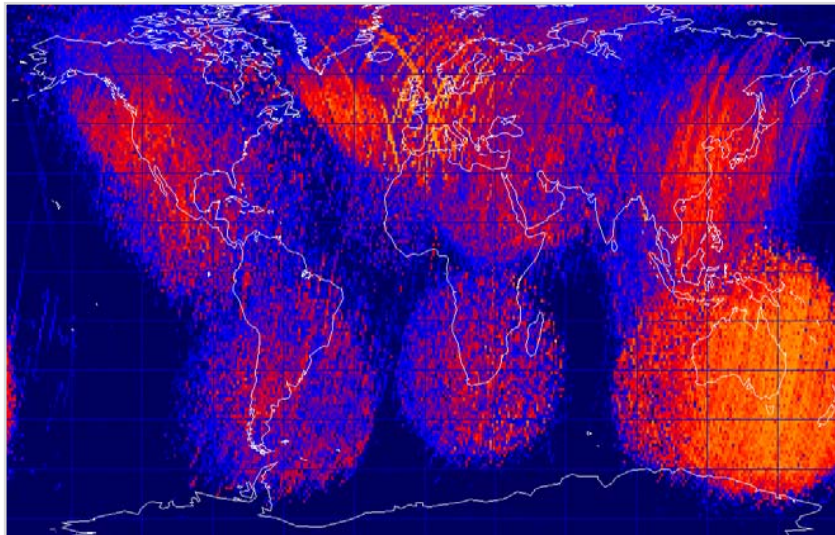
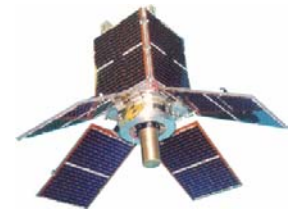
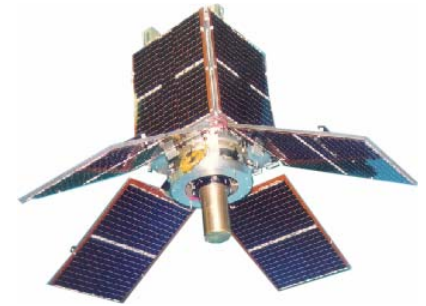
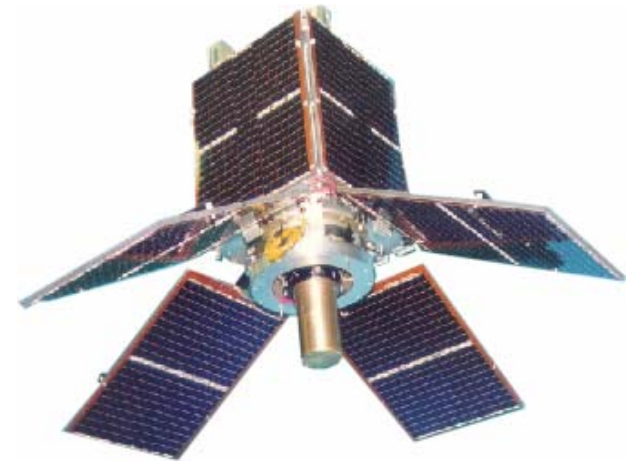
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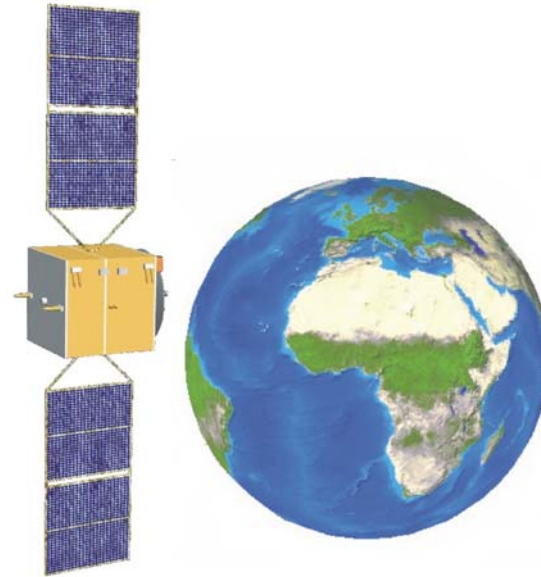


- Capabilities

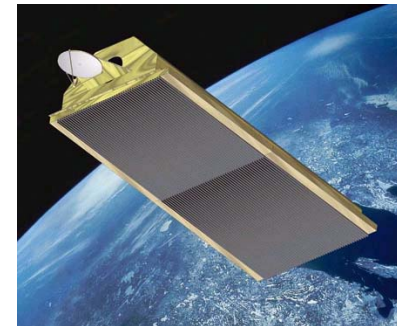
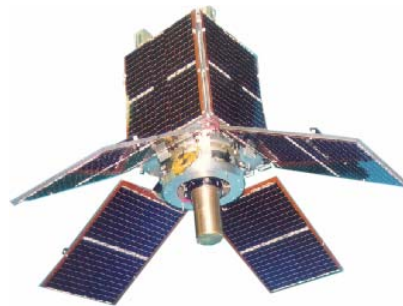
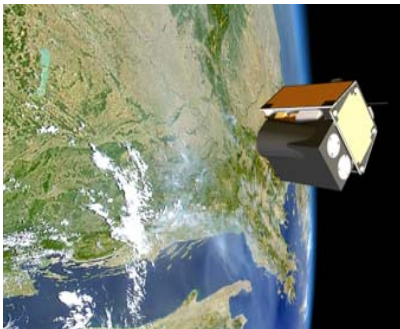
- Access Swath $\rightarrow$ 2,000 km swath
- Geolocation accuracy – A few km, commensurate with cueing requirements
- Cueing Timeliness – Near real-time
- Sensitivity and frequency bands - TBD



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- Improving the responsiveness of the surveillance component means increasing the number of assets and diversifying their capabilities e.g. you need both eyes and ears
- Increasing the number of assets within a fixed budget means reducing the size of the individual platforms
- In the space domain, this driver dictates a move from a small number of large satellites to a constellation of small ones



Thank you



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