

Mobile Observatory Network

Dr Muhammad Akbar Hussain

Founder, Southern Cross Outreach Observatory Project

Co-Founder and CEO, Mareekh Design



Southern Cross Outreach Observatory Project

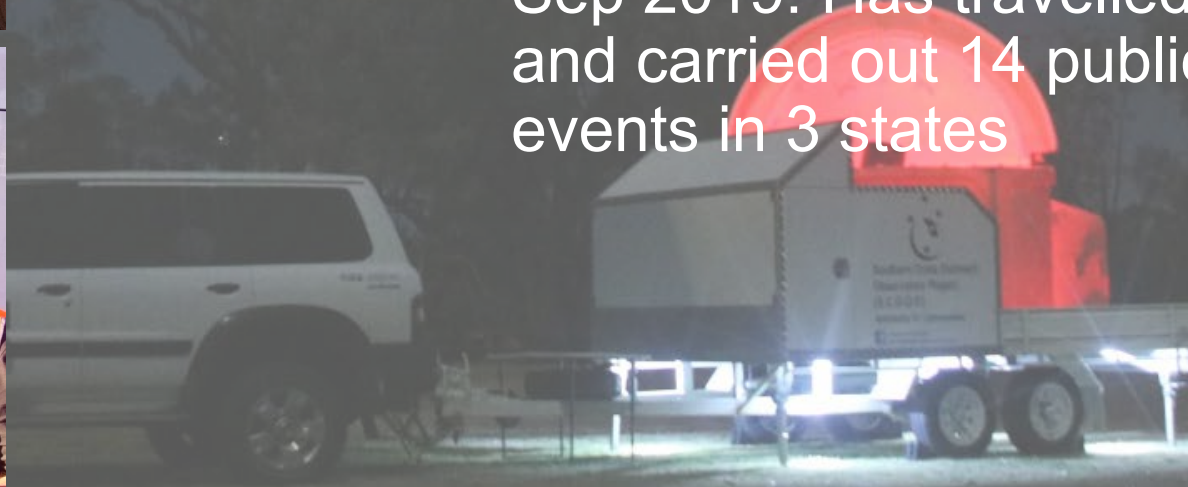


- A not-for-profit community science initiative.
- Based in Adelaide
- Key people:
 - Dr Muhammad Akbar Hussain (Co-founder, Mareekh Design)
 - Muhammad Mehdi Hussain (Co-founder, Mareekh Design)
 - Padraic Koen (PK Imaging)
- Affiliated with
 - Space Industry Association of Australia (member)
 - Previously associated with National Science Week (2017 – 2019)

Our Story



- Mar 2015: Conceived the idea
- Jun 2016: Completed construction and road test
- Aug 2016: First public astronomy outreach
- Sep 2019: Has travelled 7000 km and carried out 14 public outreach events in 3 states



The design



- **Observatory Unit:**

- A 2.3m observatory with a dual-axle trailer built around it.
- Dimensions: W 2.4m, L 3.6m (excluding drawbar), H 3.0m

- **Towing Vehicle:**

- A standard SUV with sufficient towing capacity



Applications of a mobile observatory



- An important public science engagement tool
- Professional astronomers and university students
- Space industry innovators, businesses and entrepreneurs

Are there any existing mobile observatories in the world?



NISSAN NAVARA DARK SKY

Image source: www.caradvice.com.au



EXPLORER-1, NASA Solar System Ambassador

Image source: scienceheads.org

- Very few
- Mostly private and run by amateurs
- Few are engaged in public outreach
- No dedicated network of mobile observatories exists...yet!

How a space organization can benefit from a mobile observatory network



- **Astronomy outreach and education**

- Investing in young minds and harnessing their potential in space sector is our best investment.

- **Public ambassador**

- Promotion of space industry initiatives and awareness in general public.

- **Advertisement and sponsorship**

- Can serve as an attractive platform for advertisements for interested companies like astronomy equipment manufacturers and businesses.

How a space organization can benefit from a mobile observatory network



- **Remote applications**

- Capable of rapid deployment in remote areas.
- Can be operated by operator with remote assistance.
- A variety of equipment can be utilized (Optical, infrared, radar, imaging and astrophotography etc.)
- A network of mobile observatories can be remotely linked to each other to create one large instrument.

- **Data collection**

- A useful tool for astronomical data collection

- **Space Situational Awareness**

Space Situational Awareness

- **Space debris**
 - A rapidly emerging problem
 - Can exponentially worsen
 - Significant threat to satellites and human space missions
- **Space Situational Awareness programs**
 - Aim to track space debris and their orbits/trajectories and create comprehensive database for safety of space missions

How a mobile observatory network can participate in SSA?

- **Remote deployment**

- A network of mobile observatories can be deployed in remotest locations with dark and stable skies

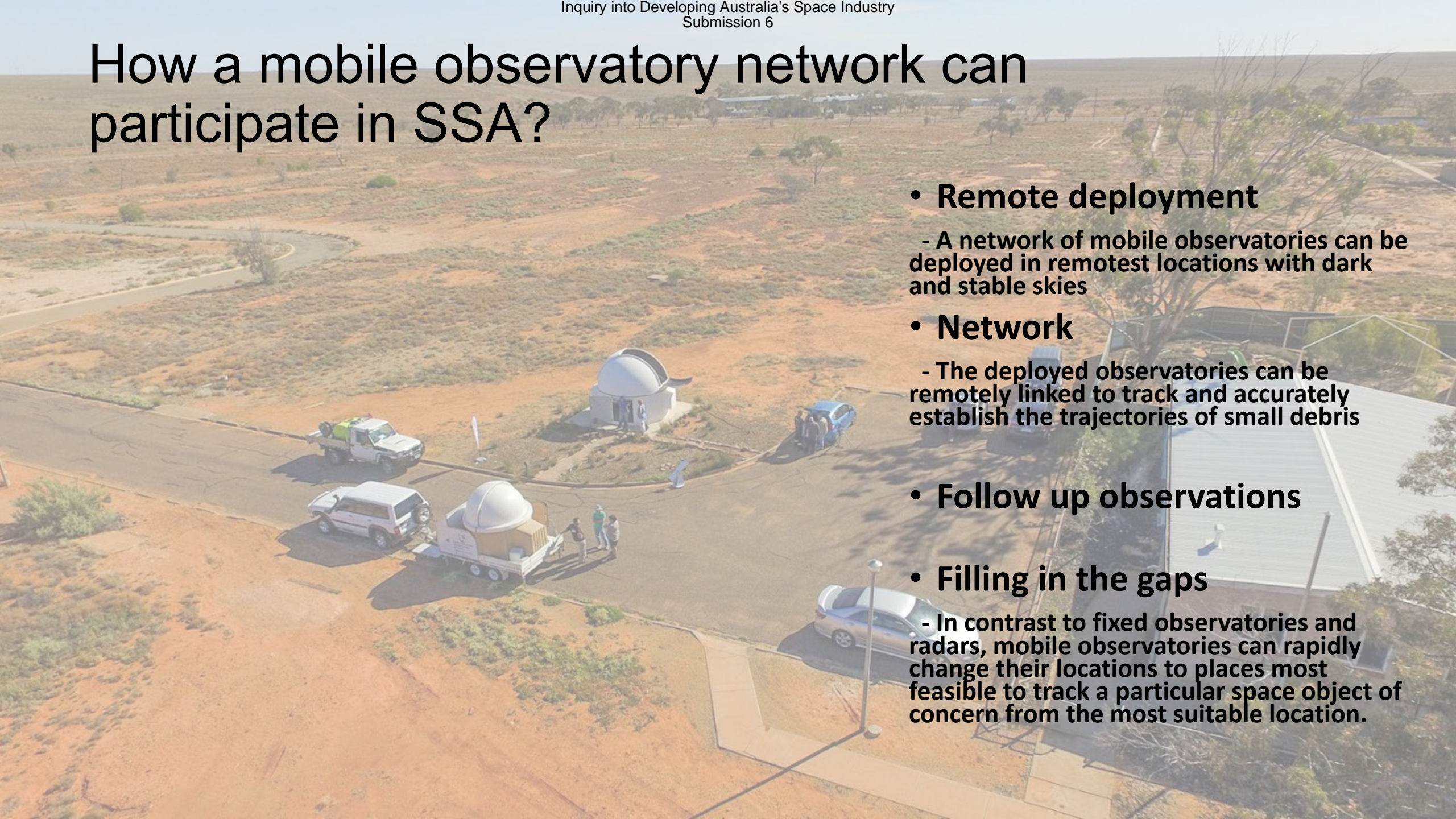
- **Network**

- The deployed observatories can be remotely linked to track and accurately establish the trajectories of small debris

- **Follow up observations**

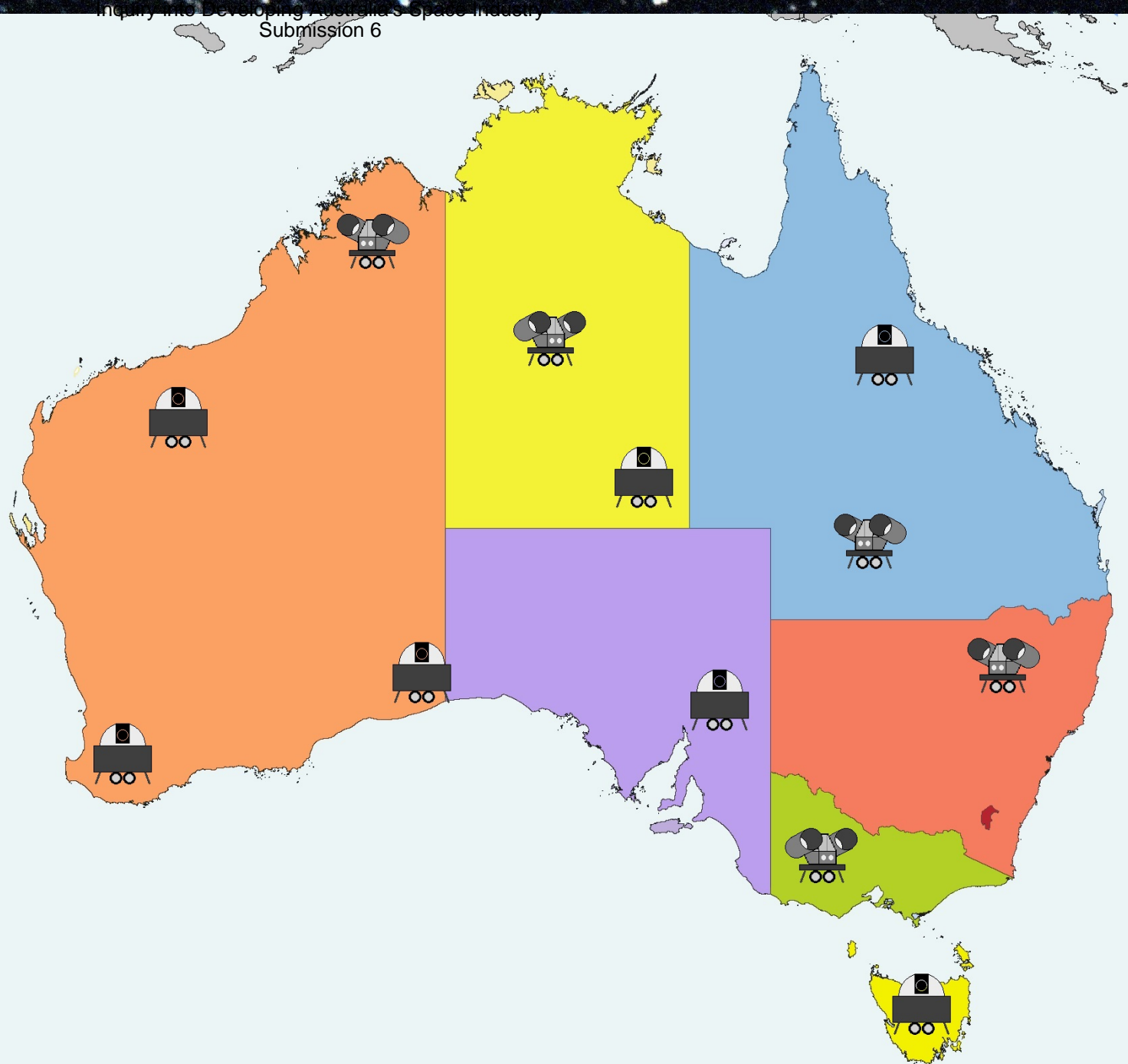
- **Filling in the gaps**

- In contrast to fixed observatories and radars, mobile observatories can rapidly change their locations to places most feasible to track a particular space object of concern from the most suitable location.



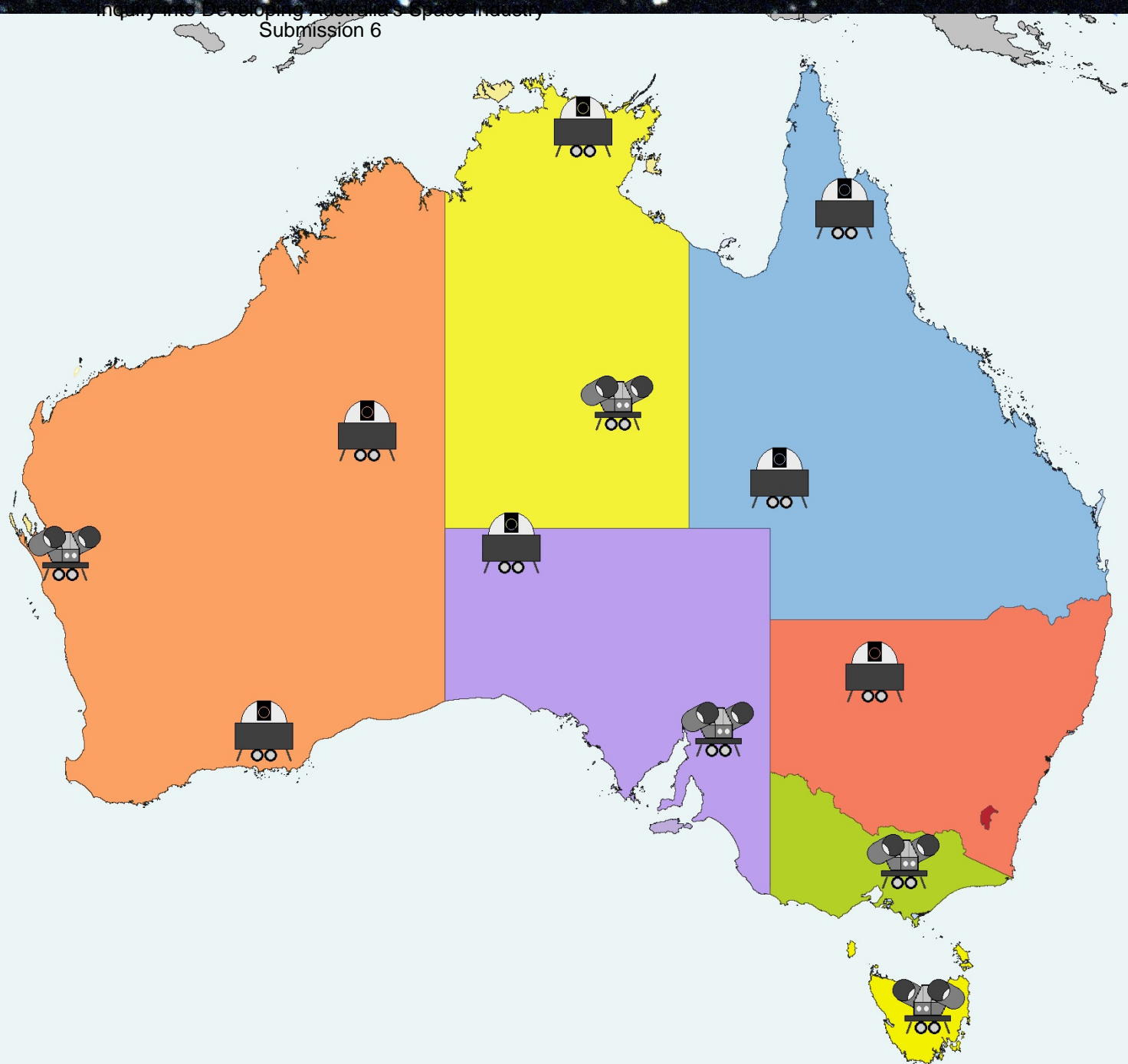
Deployment

Rapid deployment in
different remote
locations



Deployment

Rapid deployment in
different remote
locations



Our proposal

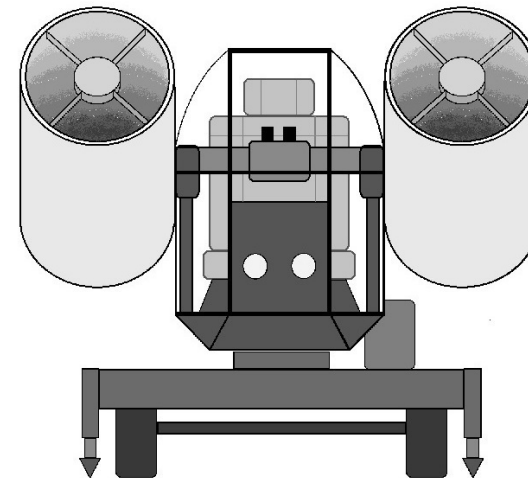
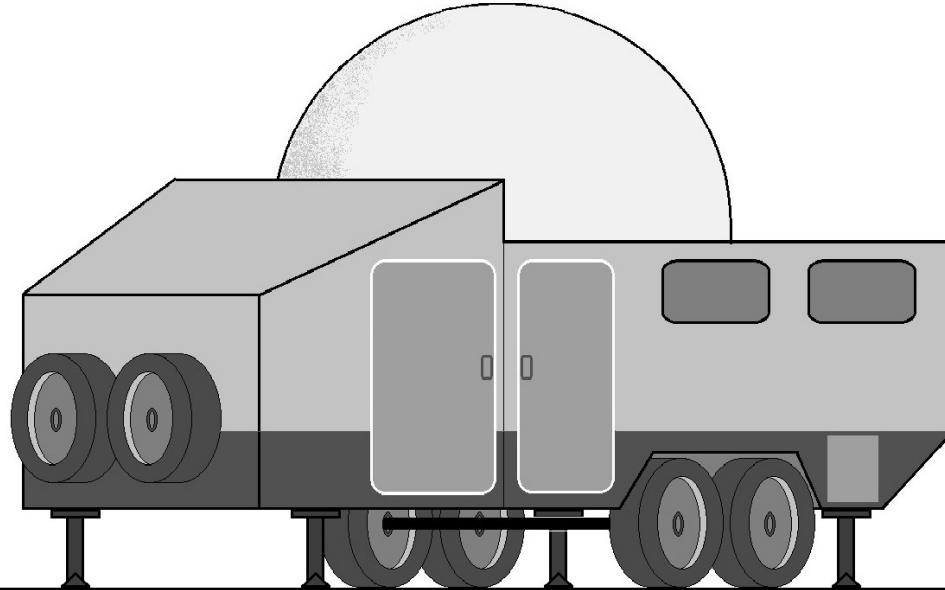


Image source: ESA
[www.esa.int/ESA_Multimedia/Videos/2019/02/Distribution_of_space_debris_in_orbit_around_Earth/\(lång\)](http://www.esa.int/ESA_Multimedia/Videos/2019/02/Distribution_of_space_debris_in_orbit_around_Earth/(lång))

Australian Space Situational Awareness Survey Network (ASSASN)

A network of special purpose mobile observatories capable of rapid deployment in remote areas to visually track space debris and develop a comprehensive and accurate database of their orbits and trajectories.

- Regular mobile observatories (upgraded version of current SCOOP concept) with crew habitation.
- Longer deployment to conduct observations from locations with favourable forecast over several days.
- General sky survey for basic data collection of larger debris.
- 20" Nasmyth-Cassegrain binoculars.
- Capable of short-term rapid deployment in extremely remote locations for precision tracking of debris of interest.
- Generating high-accuracy trajectory data to enable effective deorbiting of debris using laser.
- Follow-up observations to confirm clearance.



Why a network of mobile observatories is important?



Why a network of mobile observatories is important?

- Space debris is a growing problem.
- Worsening at an exponential rate with entry of new global players.
- Enormous impact on safety of current and future space missions.
- Kessler Syndrome may already have started!
- It is time to act NOW and act FAST

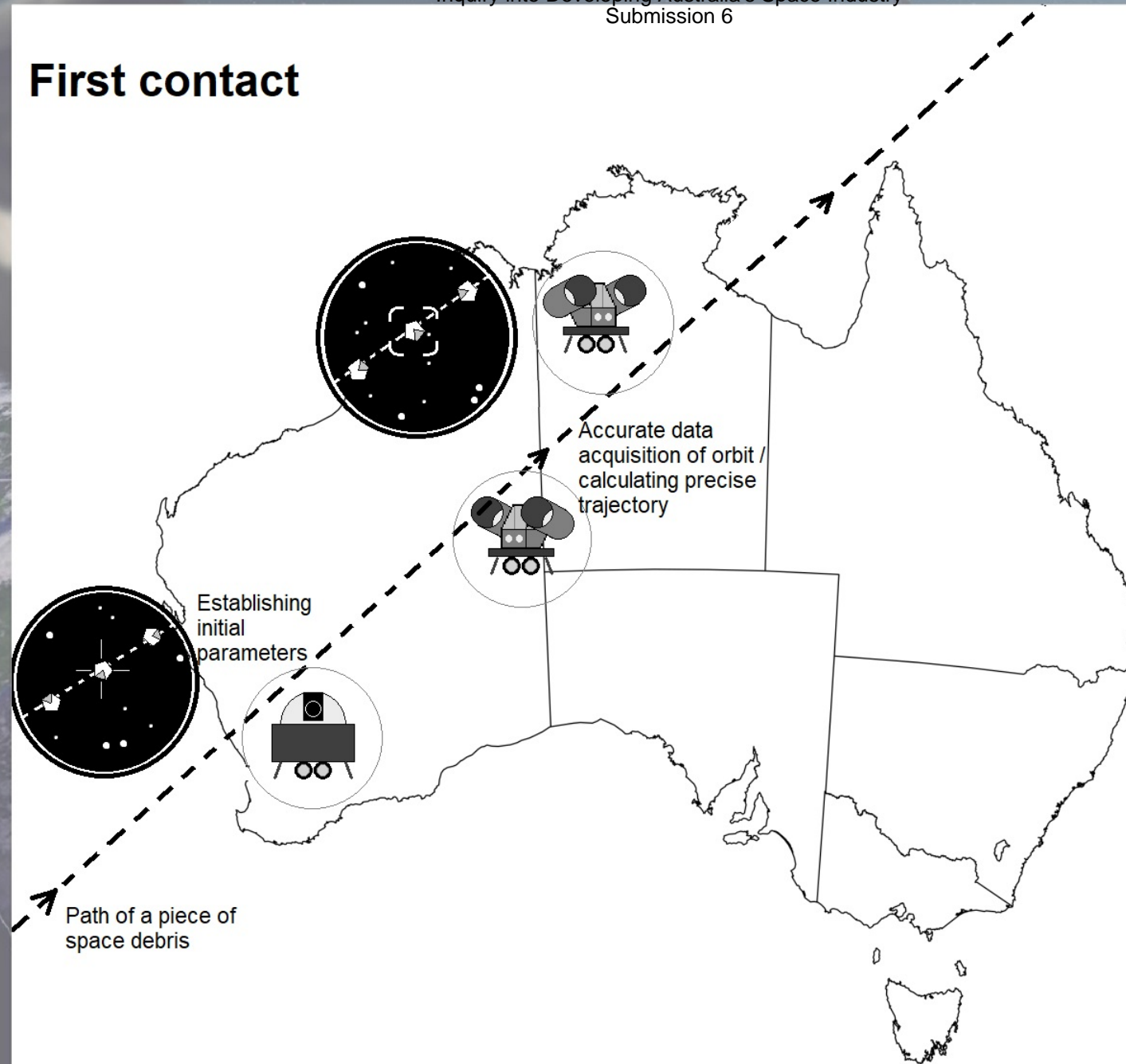
Why a network of mobile observatories is important?

- Space debris is only visible from ground within a narrow window in a 24 hr day; shortly before sunrise and after sunset.
- Debris in LEO is more numerous, faster and visible for even shorter window and from a small area.
- Visual detection of space debris in LEO is vital for accurate location and tracking to help generate an accurate database.
- Observation of a debris of interest may be needed over multiple passes to generate enough reliable data of desired precision.

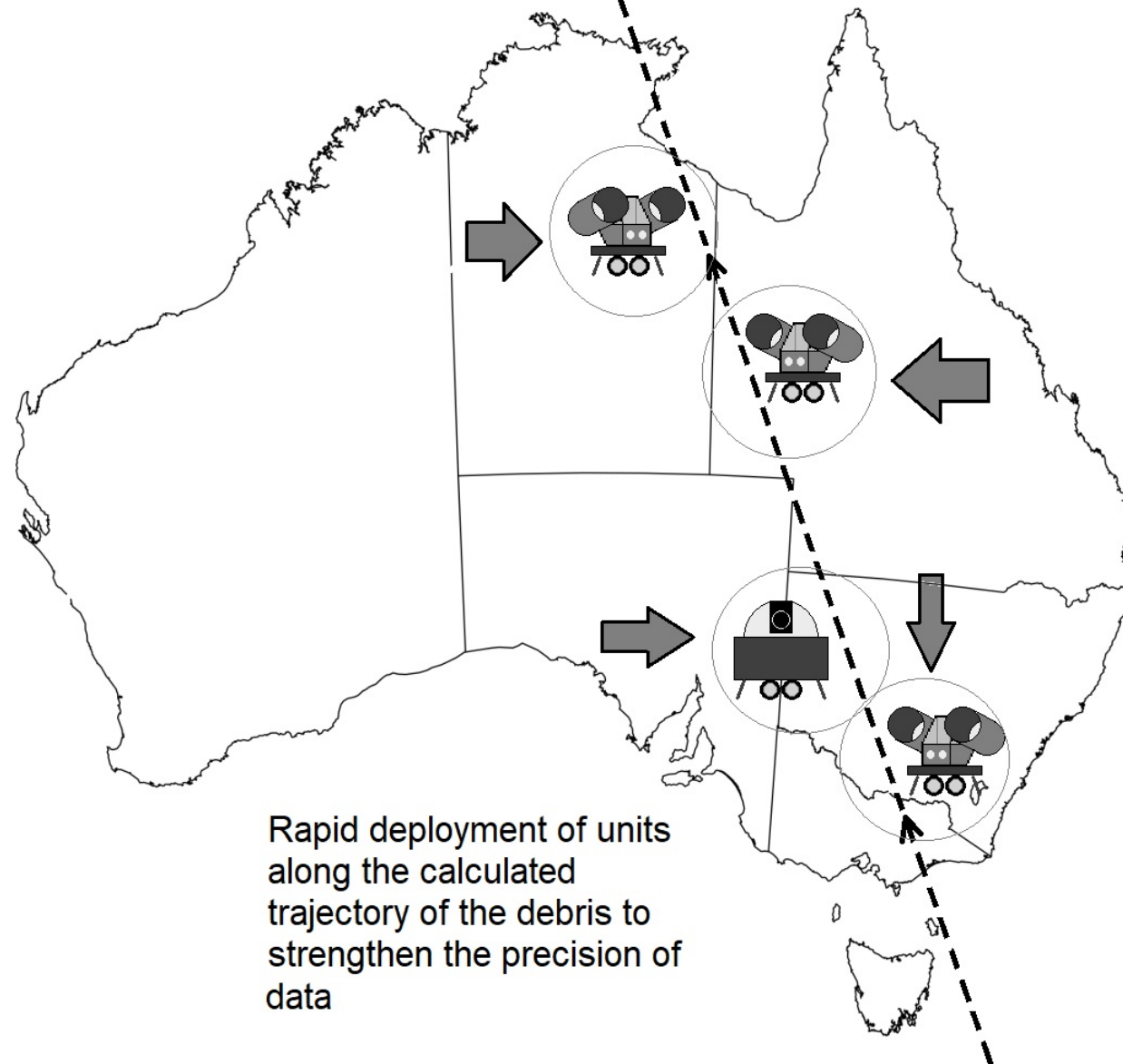
Why a network of mobile observatories is important?

- Generating this data using fixed infrastructure will be too slow to be practical.
- A network of mobile observatories capable of rapidly deploying in remote locations can exponentially increase this capability at a lower cost.
- Australia's unique geography, dry and mostly stable climate, low population, low light pollution and flat topography puts it in a very strategic position for the establishment of such a network.

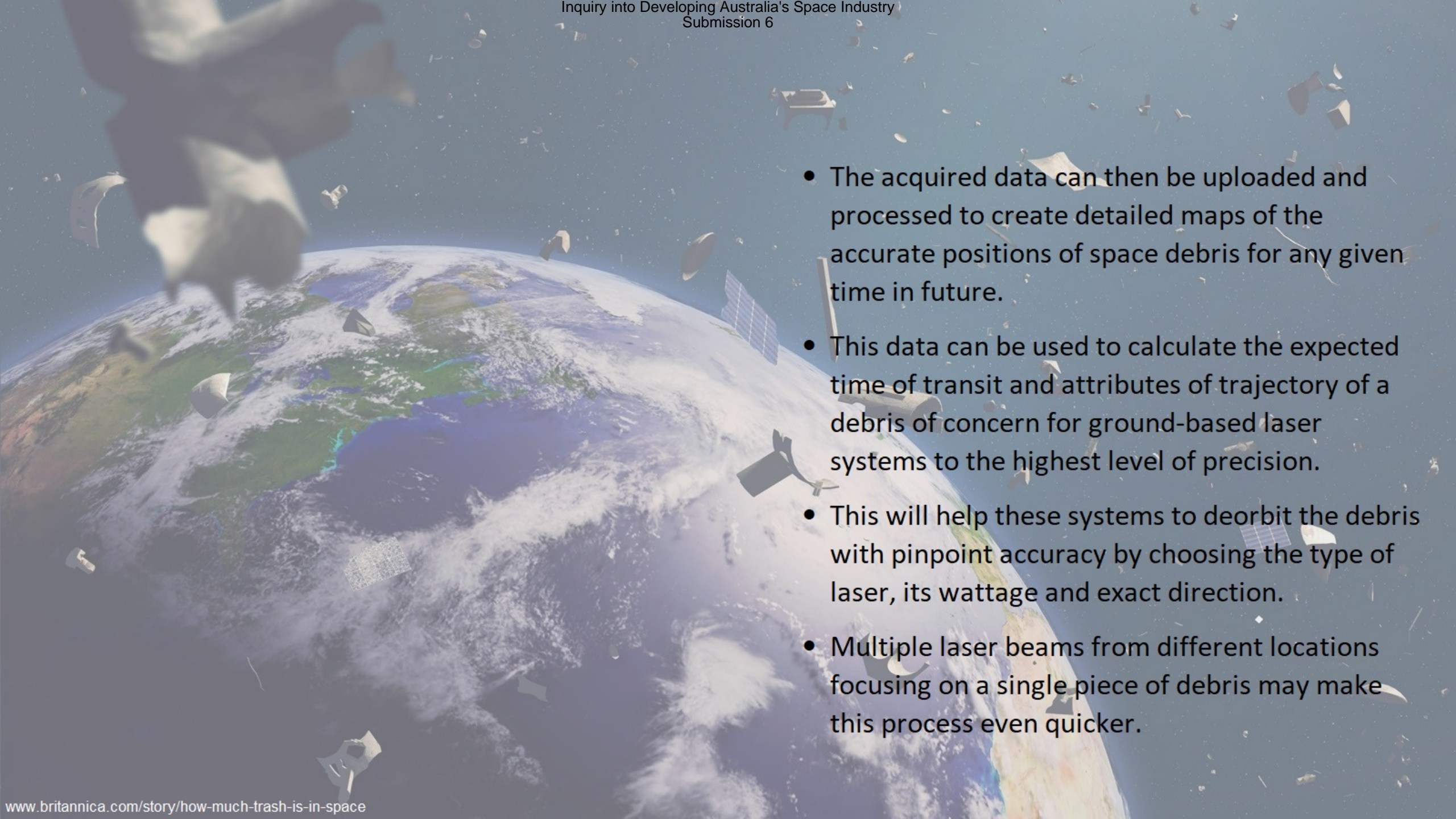
First contact



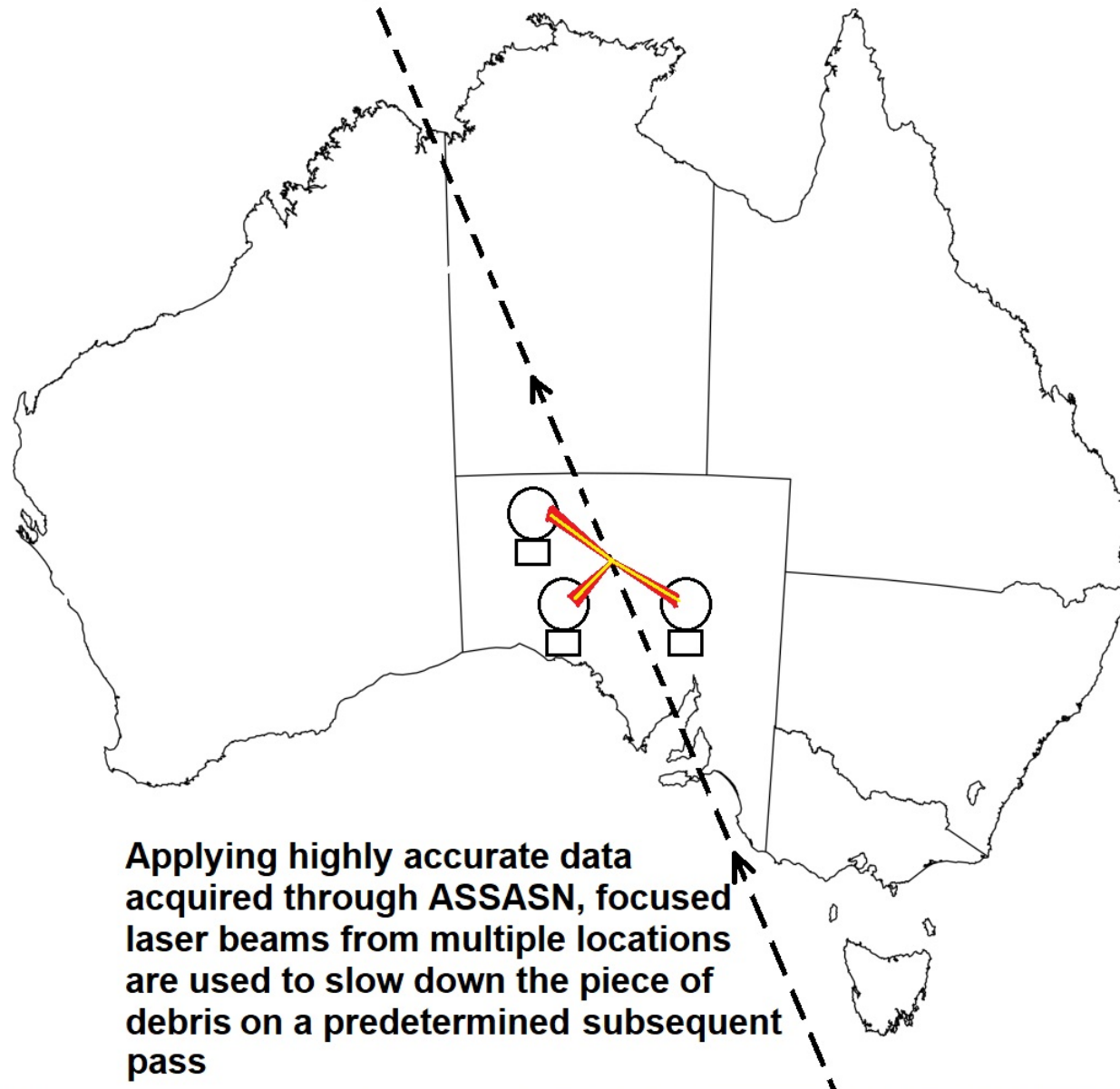
Second twilight transit



Rapid deployment of units
along the calculated
trajectory of the debris to
strengthen the precision of
data

- 
- A satellite with solar panels is shown in orbit above the Earth. The Earth's surface shows continents and clouds. The space around the satellite is filled with numerous pieces of space debris of various shapes and sizes, including fragments of metal, plastic, and larger objects like a deflated balloon and a small structure. The scene illustrates the problem of space debris and the need for monitoring and removal.
- The acquired data can then be uploaded and processed to create detailed maps of the accurate positions of space debris for any given time in future.
 - This data can be used to calculate the expected time of transit and attributes of trajectory of a debris of concern for ground-based laser systems to the highest level of precision.
 - This will help these systems to deorbit the debris with pinpoint accuracy by choosing the type of laser, its wattage and exact direction.
 - Multiple laser beams from different locations focusing on a single piece of debris may make this process even quicker.

De-orbiting of debris



Summary

- A network of mobile observatories based on a similar design and principle as Australian Southern Cross Outreach Observatory Project bears many useful applications and prospects for any space agency or organization venturing into newer ideas and innovations in the field.
- We have valuable experience of successfully designing, constructing and executing the operation of a mobile observatory for astronomy outreach in remote areas. This experience can be harnessed into a wider array of applications and exploration of new vistas in astronomical research and space industry.



THANK YOU

