SURREY SATELLITE TECHNOLOGY LTD

Changing the economics of space

A first step towards a lunar communications system

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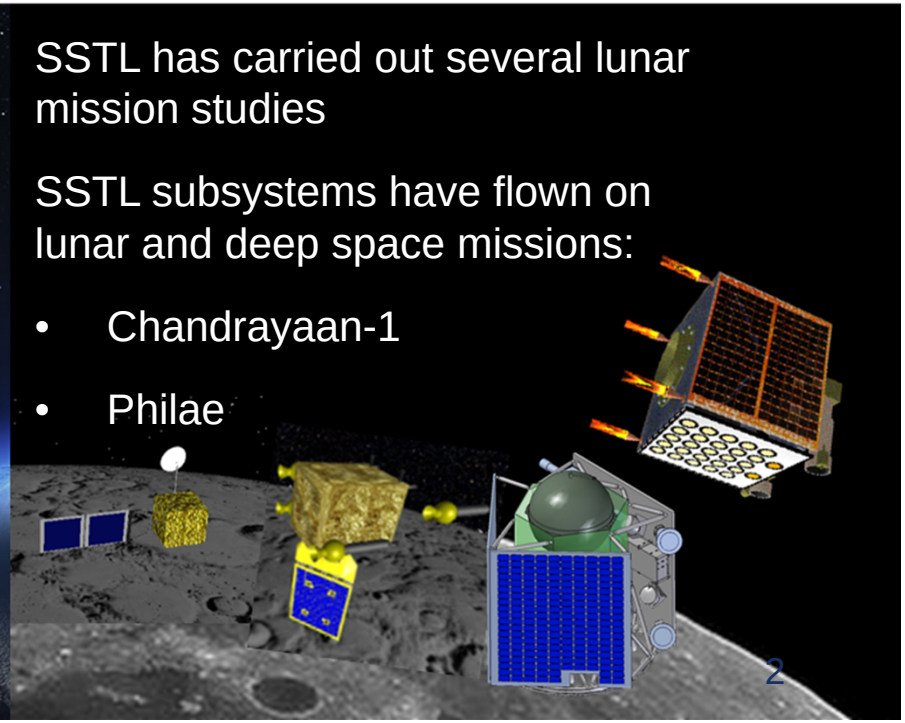
Surrey Satellite Technology Ltd

- Since 1981 SSTL has built and launched 47 satellites
- Pioneer of low cost satellites
- Focus applications, innovation and value
- Complete end-to-end solution
- Proven ability to design, build and test in rapid timescales
- Partnership approach to deliver low cost, high value capability

SSTL has carried out several lunar mission studies

SSTL subsystems have flown on lunar and deep space missions:

- Chandrayaan-1
- Philae



Why is there a need?

- In recent years there has been new or renewed interest in lunar exploration from several space agencies as well as many private companies.
- The moon will prove valuable for rapidly developing technologies and competencies for further exploration of the solar system
- We are beginning to see the development of lunar missions with low cost approaches leveraging advances in the Nano to Small satellite market but there are still many hurdles, such as:
  - Communications systems
  - Ground segment availability
  - Launch opportunities
- The proposed lunar communications system would:
  - Enable Small Low Cost Missions to the Moon
  - Enable communications with the lunar far side southern hemisphere and the Lunar South Pole
  - Enable increased data throughput and utilisation for large missions

Lunar Communications System

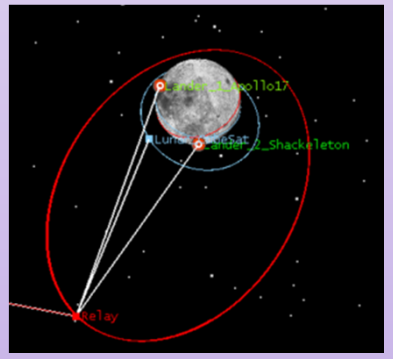
Space Segment

Transfer to Cis-Lunar space from GTO

- Lowest cost launch approach
- Provides numerous launch opportunities per year

Highly Elliptical Lunar Orbit

- Long duration visibility of the Lunar Southern Hemisphere (~10hrs)
- Short revisit time (2-3hrs)
- Long duration visibility of ground station
- Stable orbit



Ground Segment

Goonhilly Earth Station

- Goonhilly-6 32m antenna dish
- Being upgraded for use with the Orion Capsule for Cis-Lunar missions
- Will be visible ~8 hour per day

Internet based distribution

- Users will be able to command and receive data from their spacecraft via a web based interface
- Removes the need for users to acquire and maintain their own ground station

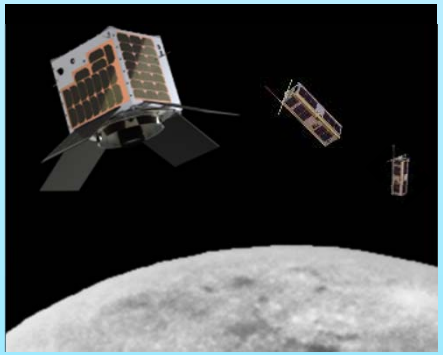
User Segment

Passenger Payloads

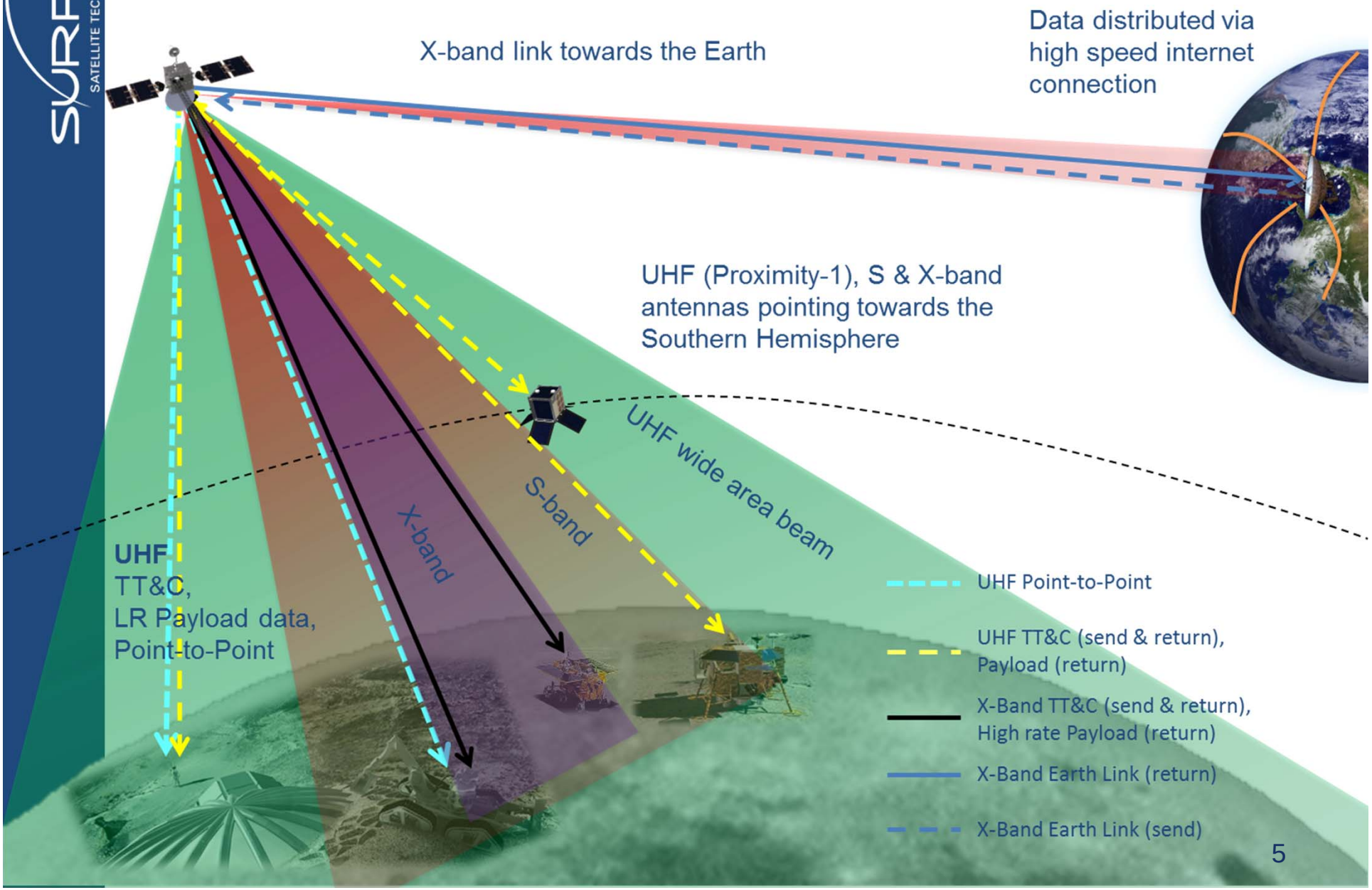
- Initially fleet of NanoSat users will be taken with the Lunar Comms spacecraft
- Can be placed into LLO
- Demonstration phase

Other users

- Once demonstrated the service can be user by other Institutional and Commercial missions
- Services will be as transparent to the user as possible

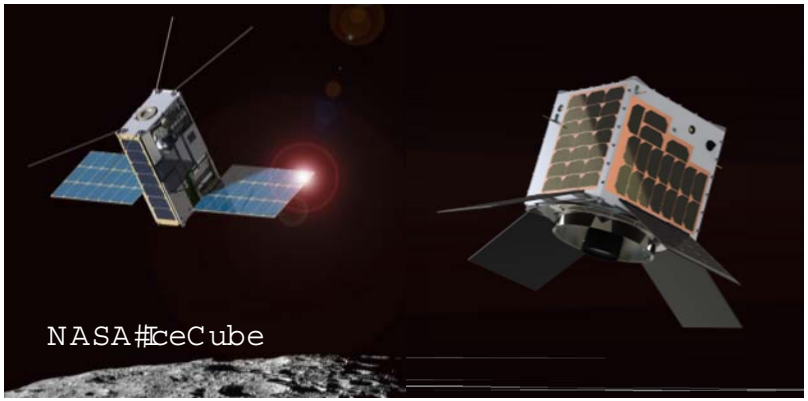


CONOPS


X-band link towards the Earth
Data distributed via high speed internet connection
UHF (Proximity-1), S & X-band antennas pointing towards the Southern Hemisphere
UHF wide area beam
S-band
X-band
UHF
TT&C,
LR Payload data,
Point-to-Point
UHF Point-to-Point
UHF TT&C (send & return), Payload (return)
X-Band TT&C (send & return), High rate Payload (return)
X-Band Earth Link (return)
X-Band Earth Link (send)

Passenger Payloads

- NanoSats can now support fairly high performance payloads but are fundamentally limited by power and size, meaning that their communications performance is poor, especially beyond LEO
- The Lunar Comms Orbiter will provide a ride to LLO for a collection of nanosats
- The relay orbiter will provide the NanoSats with the same level of service that they would expect around Earth
- Containerised Payload Accommodation
  - Simplifies integration, protection and deployment
  - It is assumed that there will be a range of different sized Nano satellites on the manifest.
    - This will allow for missions with varying capabilities and budgets
    - Sizes from 1U to 27U can be accommodated
  - Larger spacecraft could be accommodated but would not us a containerised system
- Interfacing
  - Nanosats will be provided with power and TT&C connections to enable the Nanosats to remain in good health throughout the transfer
  - The containers will be thermally controlled



Market Generation

Agencies

Private Sector

Near Term (Lunar Based Market)

Science

- Manned Missions
- Sample return
- Geology
- Seismology
- Tenuous Atmosphere
- Volatiles extraction
- Magnetic Fields
- Etc.

Technology Demonstration:

For Mars

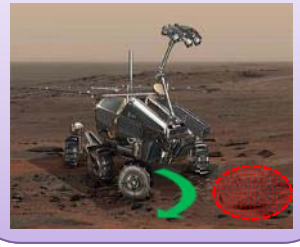
- Rapid iterations of rover technologies
- Near real time control of rovers could be demonstrated
- Coordinated exploration with multiple assets

Airless bodies

- Test sensor technologies for asteroid prospecting against known datasets
- Simpler orbital dynamics than asteroids and will provide longer mission durations and simplified CONOPS

Long Term (Lunar, Mars, NEO)

Autonomous Rover



Habitats Construction

Manned Missions

Resource Prospecting

Thank You!