SURREY

CHANGING THE ECONOMICS OF SPACE

HAPS role in future multi-layer EO systems

Liam Sills: Airborne Business line manager
Contact: l.sills@sstl.co.uk

SSTL and HAPS

- Why is SSTL interested in HAPS?
  - SSTL has a connection with the Zephyr programme through Qinetiq employees who developed the first systems.
  - SSTL provided core CFC design expertise and production for some airframe components.
  - SSTL, using its optical systems capability, has been developing imaging payloads for HAPS.
  - HAPS, Satellites and UAVs have complimentary CONOPS that allow EO systems to be more than the sum of their parts.
  - We are exploring new applications combining satellites HAPS and UAVs in a 3 layer EO system of systems

EO layers; general attributes

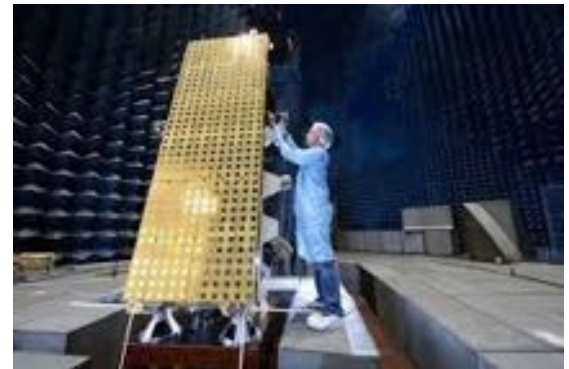
- Satellite
  - Global coverage possible, can optimize for the most populated latitudes.
  - Microsatellites enable rapid revisit constellations, imaging possible every 20-30 mins for the smallest constellations

48 sats 30 min revisit

300 sats 3-9 min revisit

484 sats 2 min revisit

  - Imaging ~50cm GSD, video possible for ~2 mins per access, SAR satellites in development.



EO layers; general attributes

- HAPS
  - Multiple platform types in development, aircraft and airships @20km alt
  - Persistence once on site from 2 weeks up to a year depending on type
  - Poor global coverage compared to satellites.
  - Imaging ~10cm GSD visible, 0.7m GSD MWIR, 25 – 100 sqkm area, Field of Regard ~20km radius
  - RF 'flying cell tower' operations possible.
- Enable high res long duration observations and comms



EO layers; general attributes

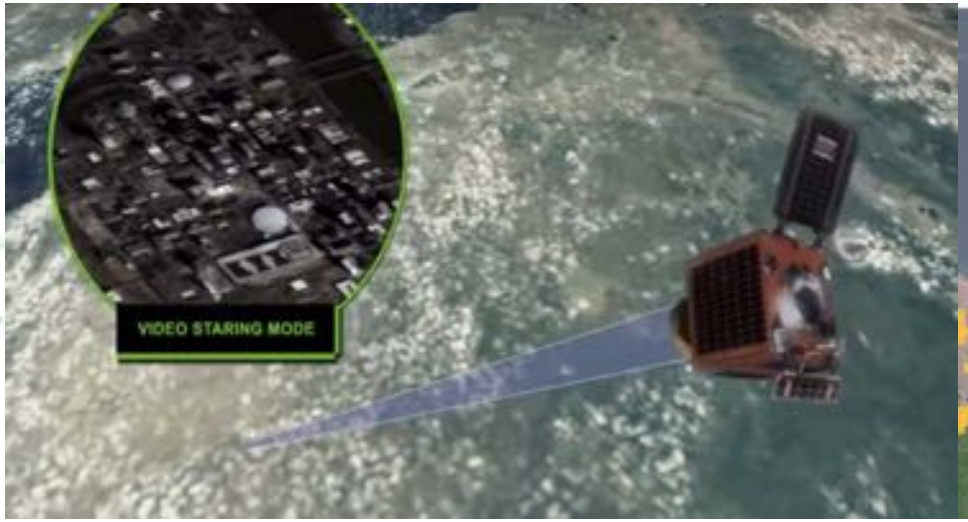
- UAVs <130m alt, legislation limited
  - Persistence ranges from ~20 mins (battery powered) up to many hours (petrol powered)
  - Imaging payloads can relay high def video in visible, SW/MW/LWIR, at cm/mm resolutions
  - Modular payload capacity of ~10-20kg (e.g. industrial UAVs) or 100 kg for larger petrol powered UAV's
  - Can perform limited deliveries and actions.

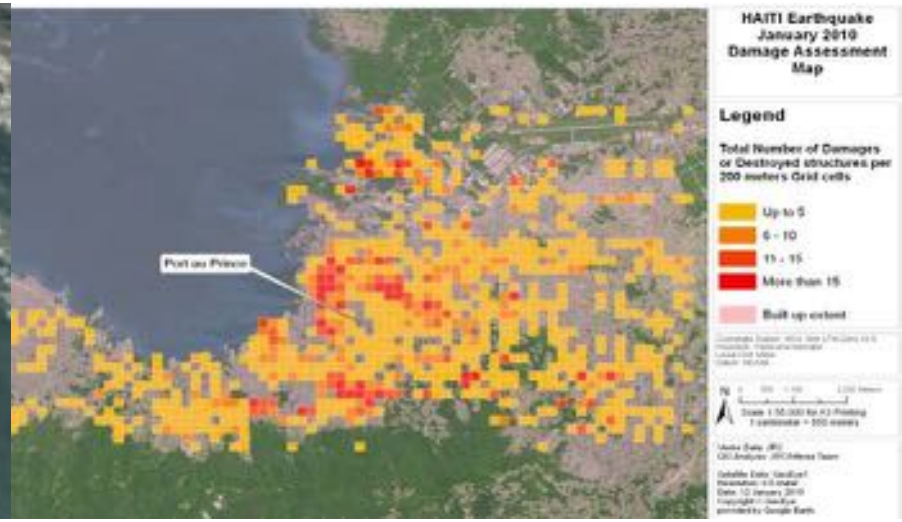
Layered system themes

- Information from higher layers cue the lower ones
  - Satellite imagery gives locations for HAPS deployment
  - HAPS information gives locations for UAV deployment and general C&C
- Higher layers give wider areas of influence.
  - Consequence of observing/communications geometry
- Data integration, Command & Control, must be centralized & made available to decision makers/service providers
  - Integrated C&C platforms must combine data from multiple sources to allow intelligent plans to be made.
- Lowest layer takes limited action if possible
  - UAV's use equipment specific to application, e.g; to drop supplies, start controlled burns, spray crops…

Disaster relief scenario

- Priority – Search and rescue teams provide first aid to victims within first 72 hrs
- Rapid revisit LEO constellation (48 sats) responds to image requests of disaster location
- Image/video captured, downlinked and backhauled to disaster relief agency < 4hrs SRT (System Response Time)
  - Imaging opportunities every 20-30 mins thereafter
  - Understand scale of affected area
  - Decide if further action is needed and if more detailed, persistent data is required
  - Redeploy most suitable HAPS assets to the region.





Disaster relief scenario

- HAPS deployed/re-directed to disaster location
  - Platform SRT's vary on type, worst case 'winged' range is **24-48 hrs** dependent on HAPS location on ground or in the air.
  - 'Back pack' deployable ground station transported to site to collect data from HAPS and feed into command centre (range ~100's km from site)
  - Alternative optical comms link to EDRS for BLOS comms allows global coordination of efforts
  - Possible bent pipe flying cell tower to re-establish local cellular comms
  - Live imagery and video communicated back to relief coordinators for situational awareness, cueing and planning of aid deployment

Disaster relief scenario

- Low level UAV's deployed with disaster relief teams
  - Teams usually arrive in the first 24 – 48 hrs
  - UAV fleet sized for affected area to cover, spare batteries, hydrogen for fuel cells, petrol for engines allow for quick turnaround times
  - AOI's identified by HAPS are surveyed at cm resolutions; informs aid deployment and better identifies hazards
  - A 10km radius area may have 100's or 1000's of victims needing help

Disaster relief scenario

- UAV capability on site
  - Single battery powered UAV can move at ~10m/s, 10kg load, for up to 20 mins before return to base, range ~10km
  - In **12 hours** A fleet of **50** can deliver **~20 tonnes** of aid material (first aid kits, water, food, blankets, tents) over a combined journey distance of ~4000km!
  - UAVs give unprecedented access in dangerous areas at speed.
  - Live video and voice links can instruct victims until more help arrives - especially emergency first aid.
- Conservative **SRT** from disaster to first aid provision is **32-56hrs.**
- HAPS are key to planning and situational awareness that improve response time and effectiveness with limited resources.

Conclusion

- Multi-layered EO systems can provide new and efficient solutions across a wide range of real-world applications
- HAPS are critical, they bridge the gap between global access from space and direct action on the ground for many applications
- Further work in system design with layered approach outlined will generate more detailed requirements for technology developments across the layers.

SURREY

CHANGING THE ECONOMICS OF SPACE

Thank You!

Liam Sills: Airborne Business line manager
Contact: l.sills@sstl.co.uk

Tycho House, 20 Stephenson Road, Surrey Research Park, Guildford, Surrey, GU2 7YE, United Kingdom
Tel: +44(0)1483803803 | **Fax**: +44(0)1483803804 | **Email**: info@sstl.co.uk | **Web**: www.sstl.co.uk