

## **Abstract**

Velocities approaching 5 miles per second-roughly 18,000 mph-which gives even the tiniest bits of junk enormous destructive energy. A one centimetre wide aluminium sphere in low-earth orbit packs the kinetic equivalent of a safe moving at 60 mph. If it hits your satellite, well, that could ruin the whole day. Aggregate too much debris in certain areas and low-earth orbit becomes an increasingly difficult and far costlier environment for commercial firms.

British astronaut Tim Peake sparked an orbital kerfuffle after he tweeted a picture showing a crack in the International Space Station's window. It was caused by space debris. What caused the crack, the European Space Agency said it was probably a fleck of paint that had been shed from an old satellite or booster, or possibly a small metal fragment around a few thousandths of a millimetre across. How is that possible?

Because they are travelling very, very fast, and impart that kinetic energy to whatever they hit. What's more worrying is that a larger piece of space junk, around one centimetre across could do more serious damage – possibly disabling a satellite or outside instrument on the ISS. Anything larger than 10 centimetres could "shatter a satellite or spacecraft into pieces," said the ESA.

What is the risk to a sub orbital space tourism passenger ship?

## ***GEO STATIONARY RING & SPACE GRAVEYARD: POINT NEMO***

The most congested place in space is the GEO stationary ring<sup>i</sup>. To "bury" something in the cemetery, space agencies have to time a crash over that spot. Smaller satellites don't generally end up at Point Nemo, as NASA explains, "the heat from the friction of the air burns up the satellite as it falls toward Earth at thousands of miles per hour." The problem is larger objects, like Tiangong-1: the first Chinese space station, which launched in September 2011 and weighs about 8.5 tons. Tiangong-1: expected ReEntry is 2018 with possibly only 3 hours' notice.

## ***KESSLER SYNDROME and Hyper Ledger***

Will the impact of space debris on sub orbital space tourism be accelerated by the ramp up of nano cluster launches? In just 3 months according to SPACE track there have been 100 new entries that's 33.3 a month<sup>ii</sup>. What are the benefits of emerging block chain technology: such as Hyper Ledger for cataloguing space assets? Could Distributed Ledger Technology assist with Global Cataloguing of Assets? Who would lead this initiative across the industry globally?

## ***Space Situational Analysis***

Debris in orbit occurs when parts (nosecone shrouds, lens or hatch covers) are separated from the payload, when rocket bodies or payloads disintegrate or explode, or when objects are placed into free space from manned orbiting spacecraft during operations. Debris is detected by its size and distance from the Earth.<sup>iii</sup>

## **Track protect detect assets**

- Launch

**Space Tourism Telecommunications 'Impact on Space Tourism & Debris Naomi McGill B.IT, MBA**

- Catalogue

### ***Ground Based Protection of Assets***

- LASERS
- PHOTONICS

### ***LEO Protection & Remediation of Assets***

- Japanese Magnetic Tethers
- Space Spiders,
- LASO'se
- Solar Sails<sup>iv</sup>
- EDDE
- SLINGSHOT

### ***Protected Regions***

- LEO<sup>v</sup>
- GEO<sup>vi</sup>

### ***Conclusions***

Future proofing travel to space hotels by space flights and eventual inter planet evolution travel requires forethought for decongesting the flight paths and launch paths now. This is achieved by

1. Inter-agency approaches by NASA, ESA and UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS.
2. The co-ordination and co-operation of all thought leaders across FAA, CAA, ICAO ITU and Sub Orbital Space Tourism Flight operators to accurately define Spectrum and Policy definitions that are future proof.
3. Increased awareness of industry organisations tracking interference such as IRG UK<sup>vii</sup>

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<sup>i</sup> According to Bill Ailor, an aerospace engineer and atmospheric re-entry specialist "It's a great playground you can put things down without hitting anything,"

<sup>ii</sup> <https://www.space-track.org/#/catalog>

<sup>iii</sup> Debris objects are the last objects after payload(s), platform, and rocket body(s) listed in the Satellite Situation Report, i.e., 1982 087D, 1982 087E, 1982 087F.

<sup>iv</sup> Self-Sabotage Solar Sails using Sun to disintegrate

<sup>v</sup> up to 2000km

<sup>vi</sup> Geostationary altitude plus or minus 200km Equatorial latitude plus or minus 15 deg

<sup>vii</sup> Presented this abstract at IRG Conference Brighton 25<sup>th</sup> October 2017