Kessler Syndrome

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What is Kessler Syndrome?

The Kessler syndrome, also called the Kessler effect, collisional cascading or ablation cascade, is a scenario in which the density of objects in Low Earth Orbit (LEO) is high enough that collisions between objects could cause a cascade where each collision generates space debris that increases the likelihood of further collisions.

Who proposed it?

- It is a theory proposed by NASA scientist Donald J. Kessler in 1978, used to describe a self-sustaining cascading collision of space debris in LEO.
- In an article published on June 1, 1978 in the American Journal of Geophysical Research, the authors Donald J. Kessler and Burton G. Cour-Palais, two NASA experts, identified the risk of an exponential increase in the number of space debris or orbital debris under the effect of mutual collisions.
- The two authors believed that a belt formed by these objects or fragments of objects around the Earth would soon form.
- Eventually threatening space activities, this phenomenon will be popularized a few years later under the name of *Kessler syndrome*

Implications

- One implication is that the distribution of debris in orbit could render space activities and the use of satellites in specific orbital ranges impractical for many generations.
- The Kessler syndrome is troublesome because of the domino effect and feedback runaway wherein impacts

between objects of sizable mass spall off debris from the force of the collision

- Every satellite, space probe, and manned mission has the potential to produce space debris.
- A cascading Kessler syndrome becomes more likely as satellites in orbit increase in number.
- The most commonly used orbits for both manned and unmanned space vehicles are LEO.
- The number of space debris that naturally falls back into the atmosphere is less than the number of those generated by the collision of existing space debris.
- According to the authors the debris population would continue to increase exponentially, leading to a situation in which some orbits would become impassable in the long run.

What is low earth orbit (LEO)?

- LEO is an Earth-centred orbit with an altitude of 2,000 km (□1,200 mi) or less or with at least 11.25 periods per day (an orbital period of 128 minutes or less) and an eccentricity less than 0.25.
- Most of the artificial objects in outer space are in LEO
- It is relatively close to Earth’s surface.

What is space debris?

Space debris (also known as space junk, space pollution, space waste, space trash, or space garbage) is a term for defunct human-made objects in space, principally in Earth orbit which no longer serve a useful function.