


Time to clean up low Earth orbit

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Although space debris has been a problem for decades, recent investment in active debris clearing shows a wider commitment to sustainable space development.

Space debris is a growing concern, as most recently demonstrated on 2 October 2022 when ESA's CryoSat had to actively dodge a 3 cm shard from an Agena-D rocket upper stage. Of the tens of thousands of such tracked space objects in orbit, only 4,000 or so are operational satellites. The rest is all space junk; besides rocket stages, there are defunct satellites, launch adapters, exploded fragments – deliberate or otherwise, solid rocket-motor firings plus objects of unknown (human) origin.

As described in an [Analysis](#), many of these objects are concentrated in shells above the Earth. In addition to being launch risks, satellites making active manoeuvres to avoid crashes use up extra fuel, thereby shortening their lifespan and hastening their membership to the space junk graveyard. Additional satellites are then needed to replace them, often sooner than originally planned. We all know how this kind of growth proceeds; Donald Kessler proposed a cascade effect, now named after him, for when the space pollution density is such that each collision produces new objects that lead to more collisions. Unfortunately, he concluded that the space environment was already unstable in 2009. But removing these derelict objects is costly and requires a concerted effort by more than one space agency or nation, just as [Earth's environment](#) is a global issue. Progress has lacked urgency and coordination, but the burgeoning private sector and the queue of tens (or even hundreds) of thousands of satellites in megaconstellations pose a significant threat to existing spacecraft, the communications infrastructure and future safe access to space. The congestion up high has now focused minds and, crucially, brought funding down on the ground.

The latest initiative is the Orbital Sustainability Act of 2022, introduced to the US Senate by four Democratic and Republican Senators on 12 September. The bipartisan bill



provides \$150 million over five years for NASA to “establish a demonstration programme for the active remediation of orbital debris” and it “require[s] the development of uniform orbital debris standard practices in order to support a safe and sustainable orbital environment”. This cash injection represents a step change in the 30 odd years of various US government policies regarding space debris and shows a commitment to leading by example.

On 23 June 2022, the UK government announced a similar Plan for Space Sustainability to reign in the new ‘Wild West’ in space, which has developed independently in the absence of binding regulations for all space-faring nations. The idea is for the UK government, in partnership with the UK Space Agency, to work with stakeholders in industry by incentivizing best practice, lowering insurance premiums and thereby attracting investment in a sustainable way. An extra £5 million for the Active Debris Removal programme will go towards consortia projects. This funding is in addition to the £5 million granted to the National Space Surveillance and Tracking Programme, which provides a ‘monitor your satellites’ collision assessment service for all UK-licensed operators of satellites.

The aforementioned consortia are led by ClearSpace UK and by Astroscale Ltd, respectively. Both consortia completed feasibility studies for actively removing at least two decommissioned UK-operated satellites from low Earth orbit (LEO). The picture shows an artistic impression of the ClearSpace concept, the Clearing the LEO Environment with Active

Removal (CLEAR) mission, capturing a derelict satellite. Having been awarded £2.25 million, the consortium will complete its design phase by October 2023.

Astroscale, meanwhile, was awarded £1.7 million to design a servicer that can remove multiple satellites in one mission. The Cleaning Outer Space Mission through Innovative Capture (COSMIC) programme will build on the End-of-Life Services by Astroscale-demonstration (ELSA-d). Last year ELSA-d successfully demonstrated its magnetic spacecraft capture system to dock, hold and release client spacecraft. In May 2022, ELSA-M was announced as a follow-up, full-scale servicer to capture and remove more than one derelict satellite. Its £14.8 million funding comes from OneWeb, Astroscale, UK and European Space Agencies, as part of the [Sunrise programme](#).

Another consortium, which includes Airbus and is co-funded by the 7th Framework Programme of the EU, is working on Remove-DEBRIS. The capture mechanism uses a net and harpoon, with a vision-based navigation system. The 100-kg satellite was released by the International Space Station (ISS) in 2018 and captured a cubesat. In principle, it can snatch up a target of up to 2 metres in diameter, and weighing up to 2 tonnes. Once captured, the combined object will de-orbit within months rather than years and burn up in our atmosphere.

While removing space debris is a welcome practice, it would be better to not create so much junk in the first place. Anti-satellite

(ASAT) missiles launched from Earth (in the name of defence) represent a particularly dangerous yet avoidable source of space debris. A Chinese ASAT test in 2007 increased the number of tracked space objects by 25%. Last November, a Russian ASAT missile destroyed one of their old satellites. The resulting

space debris threatened both the ISS and a Chinese science satellite. In response to this kind of unnecessary and high-risk activity, US Vice President Kamala Harris announced a self-imposed ban on “destructive, direct-ascent, anti-satellite missile testing” in April 2022. So far, Canada, New Zealand, Japan

and Germany have signed up, and in the hope that more countries will follow their example, the US will table a resolution at the United Nations General Assembly. We certainly hope more countries will join.

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