ESA heading toward removing space debris

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Simulations of orbital debris show that actively removing large items of debris, such as entire derelict satellites, should help to stabilise the population and prevent cascading collisions. ESA has performed a system study for an Active Debris Removal mission called e.Deorbit. Credit: ESA

ESA's goal of removing a derelict satellite from orbit is picking up pace, as a mission design is assembled to be put before European ministers next year for approval.

The e.Deorbit mission came through ESA's Clean Space initiative,

tasked with reducing the environmental impact of the space industry in both the terrestrial and orbital realms.

Space debris levels are increasing relentlessly, as colliding objects bequeath more debris and further collisions. Conserving the heavily trafficked and valuable low orbits calls for removing the large objects at a high risk of collision.

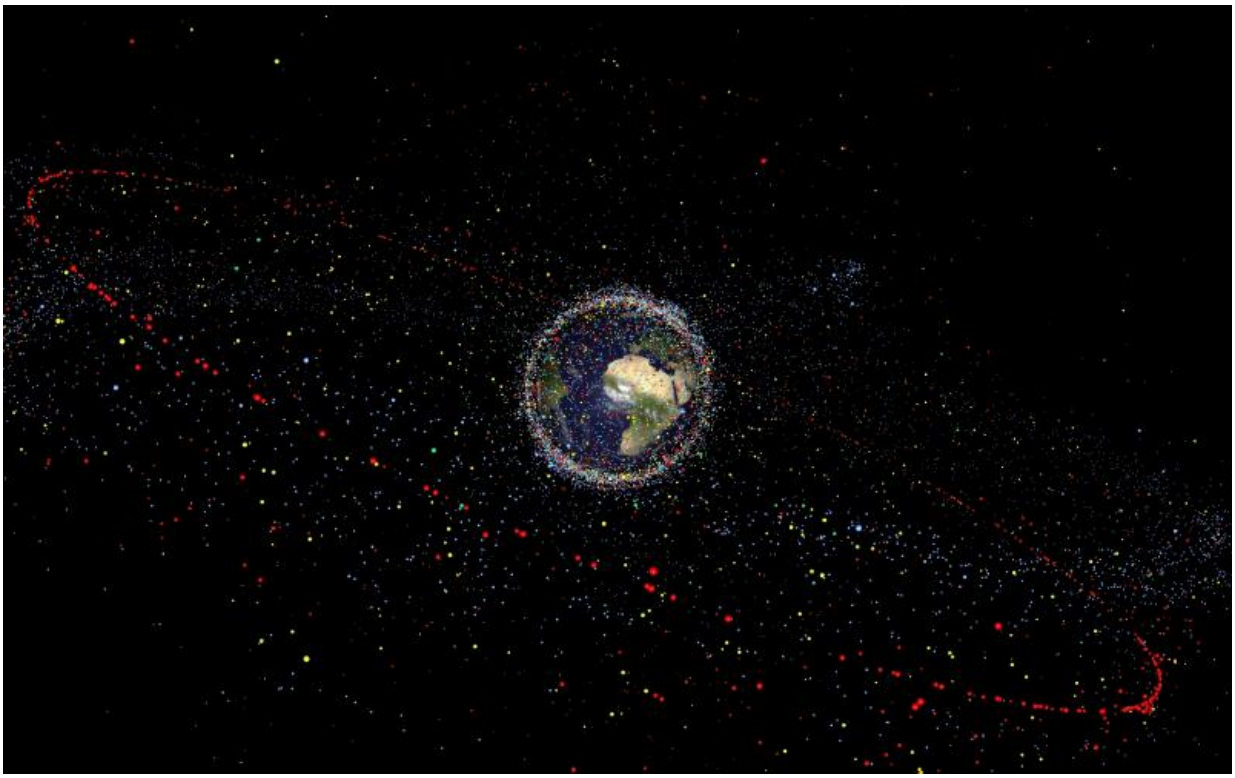
e.Deorbit would target an ESA derelict in this region, capture it, then safely burn up both the satellite and itself through a controlled atmospheric reentry.

Having proved this approach, multiple missions per year could be flown – and e.Deorbit is being designed with recurring flights in mind.

In space industry parlance, e.Deorbit has completed its 'Phase-A' preliminary analysis that began in January 2014. With many aspects already finalised, it is now moving on to 'Phase-B1'.

The aim now is to bring e.Deorbit to a point where it is essentially ready to build if ESA's Council of Ministers in December 2016 gives its assent for launch in 2021.

Several studies in ESA's Concurrent Design Facility have already defined aspects of the mission, which would adapt a Vega rocket upper stage as a platform for its capture system.



All human-made space objects result from the near-5000 launches since the start of the space age. About 65% of the catalogued objects, however, originate from break-ups in orbit – more than 240 explosions – as well as fewer than 10 known collisions. Scientists estimate the total number of space debris objects in orbit to be around 29 000 for sizes larger than 10 cm, 670 000 larger than 1 cm, and more than 170 million larger than 1 mm. Any of these objects can cause harm to an operational satellite. For example, a collision with a 10 cm object would entail a catastrophic fragmentation of a typical satellite, a 1 cm object will most likely disable a spacecraft and penetrate the International Space Station shields, and a 1 mm object could destroy subsystems. Scientists generally agree that, for typical satellites, a collision with an energy-to-mass ratio exceeding 40 J/g would be catastrophic. Credit: ESA

The proposal to harpoon its target has been dismissed as too difficult for the time being, in favour of alternative capture options such as robotic

arms or nets. The initial prospect of taking debris into higher, quieter orbits has also been ruled out in favour of downward deorbiting.

"I am very pleased with the progress we are making," said Robin Biesbroek, managing the effort. "In this phase we will really go into detail on the concept of operations, e.Deorbit's subsystems design, and especially the capture and deorbit phases.

"Extensive simulations will be done not only for standard cases, but also for off-nominal cases."

As ESA engineers work together to design a future space mission, it takes virtual shape before them in three dimensions. This 3D visualisation system is one of many state-of-the-art networking tools found in the Concurrent Design Facility (CDF) at ESA's ESTEC technical centre in Noordwijk, the Netherlands. The

CDF's network of computers, multimedia devices and software tools allow experts from different engineering disciplines to work in close coordination, in the same place at the same time, to complete the most complex designs imaginable – in a matter of a few weeks rather than several months. The CDF enables 'concurrent engineering' based on teamwork and focused on a common design model that evolves iteratively in real time as the different subsystem experts make their contributions. It has proved an influential approach over the CDF's 15 years of operations, helping to inspire new ways of working for Europe's hi-tech industries. Credit: ESA/Guus Schoonewille

The work to come will define the mission's technical specifications around various goals, the most important of which is to minimise the danger to people on the ground, down to less than one in 10 000.

e.Deorbit's next milestone will be its 'systems requirements review', due in May–June 2016.

Provided by European Space Agency