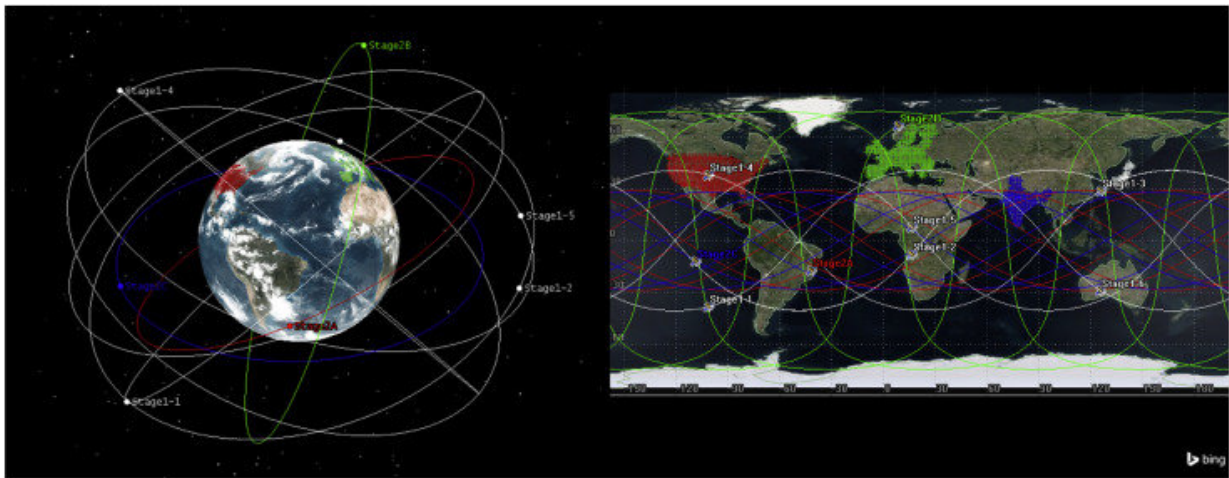


Study explores options that optimize profit in broadband satellite constellations

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3-D and ground track views of the optimized constellation (unique satellite design case). Credit: University of Illinois Department of Aerospace Engineering

Several large telecommunications companies have proposed plans to provide global broadband services by launching hundreds and even thousands of satellites into orbit. Although broadband for everyone sounds like a great idea, it also carries great financial risk, resulting in bankruptcy for some who've tried it. Recent research at the University of Illinois suggests a more cost-effective strategy using regional coverage and staged deployment.

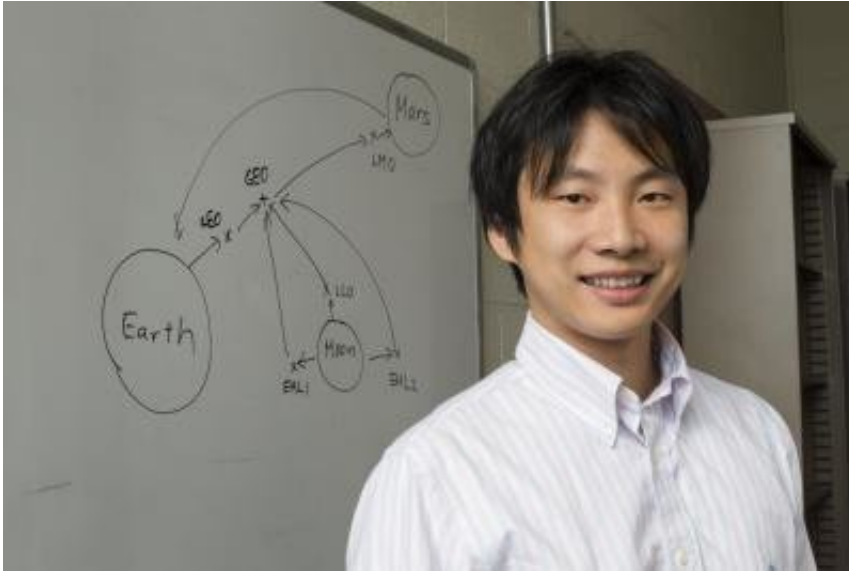
"It's actually very easy to determine how many satellites you need to get

global [coverage](#). You can do the math by hand," said Koki Ho, assistant professor in the Department of Aerospace Engineering at U of I. "But total global coverage isn't necessarily what a company wants or needs.

It might not be the best way for the company to maximize their profit. We looked at different ways to design a [satellite](#) constellation that first provides regional coverage and then can be expanded stage by stage, keeping areas with uncertain demand in consideration to maximize profit."

For the study, Ho and his graduate students, Hang Woon lee and Pauline Jakob, divided regions of the Earth into a grid, with each unit measuring 4 degrees latitude by 4 degrees longitude to calculate whether full coverage was being achieved.

"Satellites are continually moving in orbit so there isn't one satellite serving a specific unit," Ho explained. "One satellite might move out of the range and another one moves in. As the satellite remains in orbit, the orbit slowly decays and the satellite falls lower so we also calculated for the propulsion needed to return the satellite to its proper orbit and, when needed, to decommission it into outer space."



Koki Ho, assistant professor in the Department of Aerospace Engineering at the University of Illinois at Urbana-Champaign. Credit: University of Illinois Department of Aerospace Engineering

Ho said that broadband companies in the United States may be looking only at global coverage, but smaller countries, such as Japan, may want to start their business by serving only their own country and having success there before adding more countries or going global.

"There is a level of uncertainty in knowing what the next area of interest will be in the market, so we created a multi-staged plan," Ho said. "We started from zero, as if there were no satellites in space. The first stage, might just serve one country. The second stage could add Europe, India, or the 48 contiguous states in the U.S. However, the second stage will take advantage of the first stage and provide more coverage. All of the stages are optimized to minimize the launch and other costs and still provide full coverage to each area of interest."

The financial savings are substantial.

One example in the study compares two scenarios: an optimized two-stage deployment strategy with a global coverage constellation and one that deploys all of the satellites in one stage. The expected lifecycle cost for the optimal two-stage configuration is shown to be 28.9 percent and 19.5 percent less than the optimal global-coverage constellation for unique and same satellite design cases, respectively.

The paper, "Optimization of satellite constellation deployment strategy considering uncertain areas of interest," is authored by Hang Woon Lee, Pauline C. Jakob, Koki Ho from the University of Illinois, and by Seiichi Shimizu, and Shoji Yoshikawa from Mitsubishi Electric Corporation. It is published in *Acta Astronautica*.

More information: Hang Woon Lee et al, Optimization of satellite constellation deployment strategy considering uncertain areas of interest, *Acta Astronautica* (2018). [DOI: 10.1016/j.actaastro.2018.03.054](https://doi.org/10.1016/j.actaastro.2018.03.054)

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