

Background

Since the start of the decade, AI has become increasingly prominent. With this, the physical land its data centers occupy is under scrutiny by environmentalists and the general public. The land the companies behind this expansion want is becoming exceedingly unavailable to them. Thus, expansion into space is becoming highly considered by AI companies (OpenAI, xAi, etc.).

Purpose

The purpose of this poster is to inform an interested audience, regardless of their knowledge base, of the feasibility of space-based data centers from a quantitative perspective. This poster will present data, data analysis, supporting visuals, and plans for future research.

Methods

The sources used were retrieved from a mix of the FSU library and its accompanying databases, and normal Google searches. Opinion pieces or blogs were rejected. The selection of sources was based on whether they focused on AI's power usage, current satellite technology, or current rocket technology to launch said satellites. Only sources post 2020 were selected. After filtering, 7 sources were used

Findings

- Single Racks (individual computing unit) can consume upwards of 150kW (600kW promised by Nvidia in 2027)
 - Standard Satellites (GPS, etc) only consume, on average, 5kW
- The entire array of solar panels on the ISS produce 84-120kW
- The total power per data center ranges from 5-100 MW(5 to 100 million watts, 5000-100000kW)
- Each rack weighs 1.5 to 2 tons
 - Hyper scale data centers house 100s-1000s of these racks.
- Payload of current rockets to LEO is up to 150tons, but only 27 tons to GEO

Discussion

The data suggests that the bottleneck for AI data centers in space is power. Current solar panels are unable to provide the immense power that these data centers will need. Assuming that the average data center houses 150 racks (hyper-scale centers are rarer, or are still in construction), the weight from them alone (excluding cooling, generators, etc.) is well over the payload of the single most powerful rocket. This means that computing would either be split into smaller units, connected through some medium, or moderately more powerful, standalone units will be developed.

The information presented in this poster is limited by the absence of first party documentation of things such as amount of server racks, power per rack, etc. Additionally, most of the current, useful information came from popular sources as opposed to academic articles.

Conclusions

- The feasibility of space based AI data centers is severely limited by power.
- Companies are faced with a choice of moderately powerful standalone units, or a mesh of smaller scale units working as one.
- Further research into the connection between each satellite and then Earth is needed.

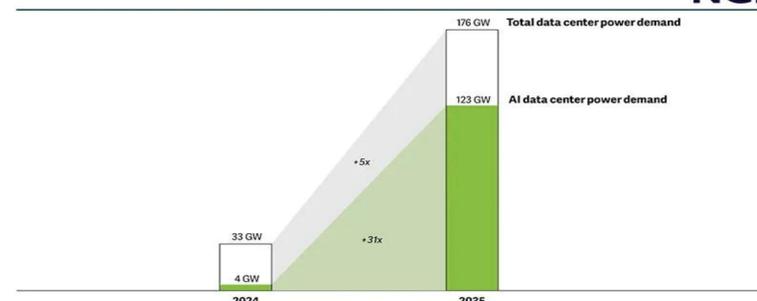
Acknowledgements

Special thanks to Mrs. Flammia and Dr. Manzak from FSU PC for assistance and guidance in creating this project.

References

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US Power Demand from AI Data Centers is Expected to Boom NGI



Source: Deloitte analysis of data from DC Byte, Wood Mackenzie, S&P Global, Lawrence Berkeley National Library, Center for Strategic and International Studies, and Wells Fargo

