

ITU Space Connect

Orbital Data Centres: Drivers, Opportunities, & Challenges

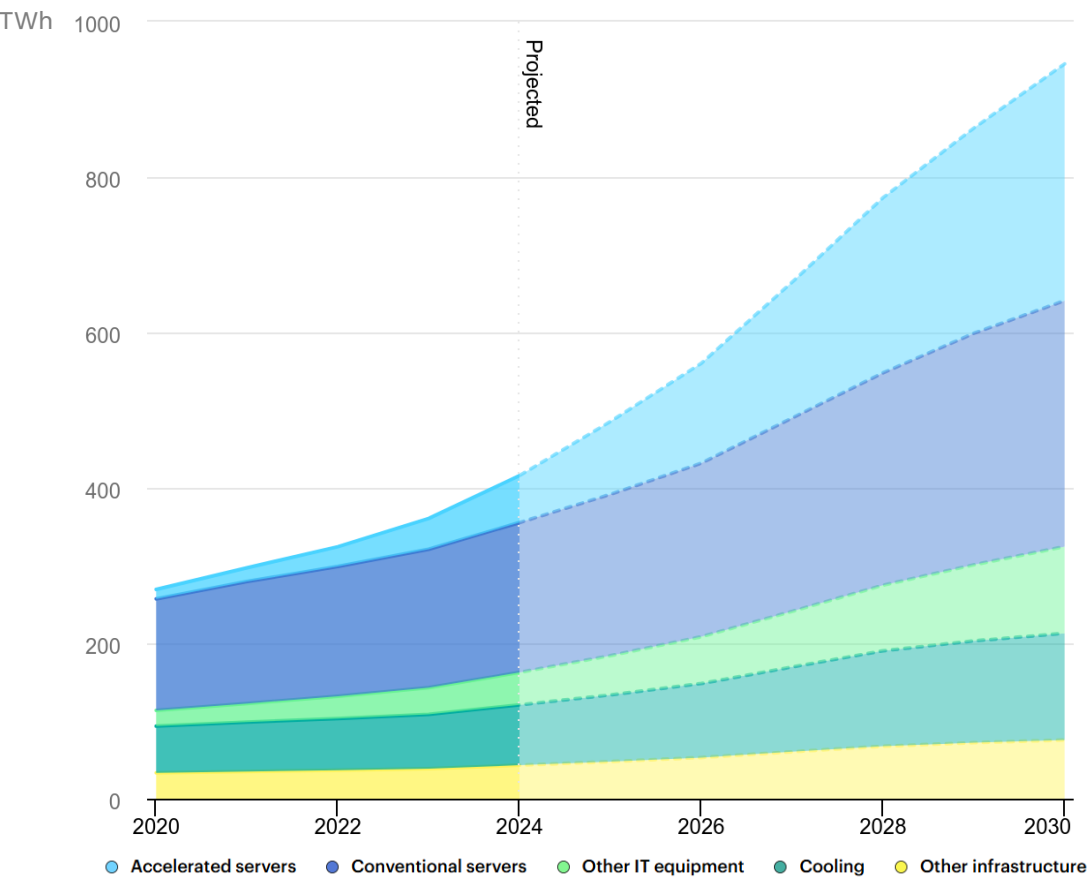
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WHY Orbital Data Centres?

“A facility whose primary function is data processing and/or storage, via IT equipment plus supporting subsystems.”¹

Global data centre electricity consumption, by equipment, Base Case, 2020-2030



Pressures on Earth

AI demand meets grid, siting, and cooling constraints:

Accelerated servers +30% electricity use annually.

Data-centre demand growth >4x faster than growth in electricity demand from other sectors.

Permitting restrictions and societal pushback (NIMBYs) on the rise.

Strategic drivers

Actor	Core motivation	Strategic objective
	Digital sovereignty & resilience.	Avoid dependence on foreign digital infrastructure and build sovereign capacity.
	Compute sovereignty & technological leadership.	Expand AI capacity and shape a new strategic industry.
	Commercial scaling & ecosystem dominance.	Extend cloud/AI leadership into orbital infrastructure.

¹ Hein et al

3 Emerging Opportunities

Not exhaustive

Speed of doing business

Global grid connection wait times for new data: 5-7 years in major markets like Northern Virginia;
7-13 years in congested European hubs.

Space may enable time-to-revenue acceleration.

Premium pricing

Time-to-power: deployment advantage in orbit.

Resilient: independence from terrestrial outages, disaster resilience, political backlash.

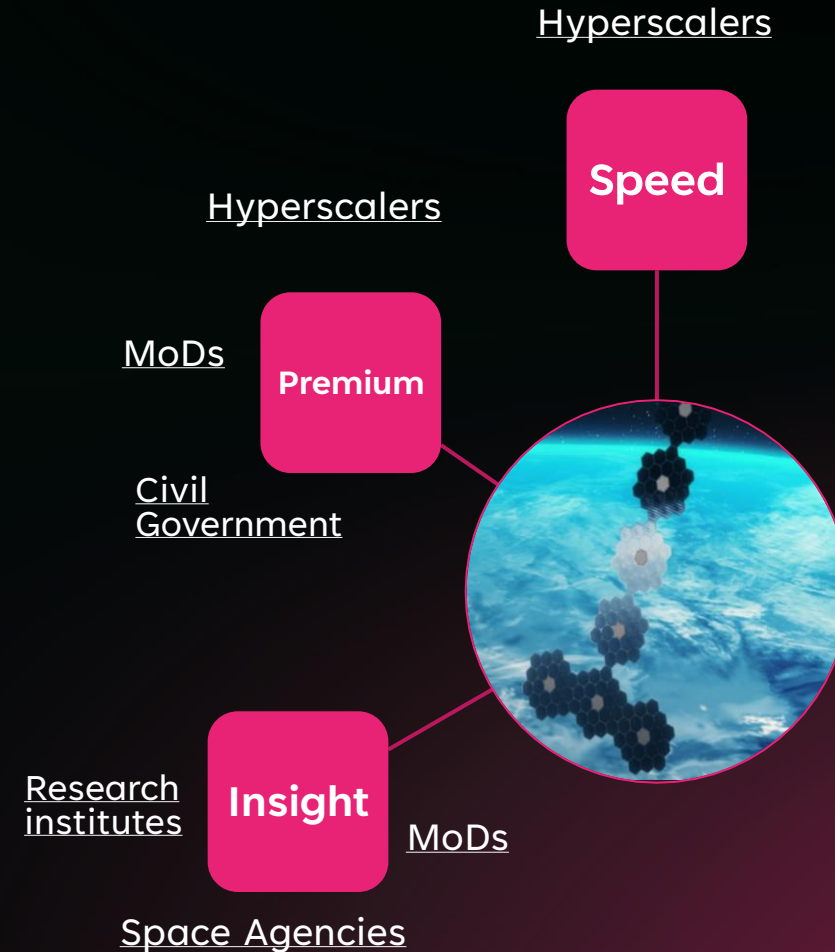
Sovereign: Paying for trusted, controlled compute jurisdiction.

Strategic insight

Edge processing for EO, signal intelligence, reduced latency.

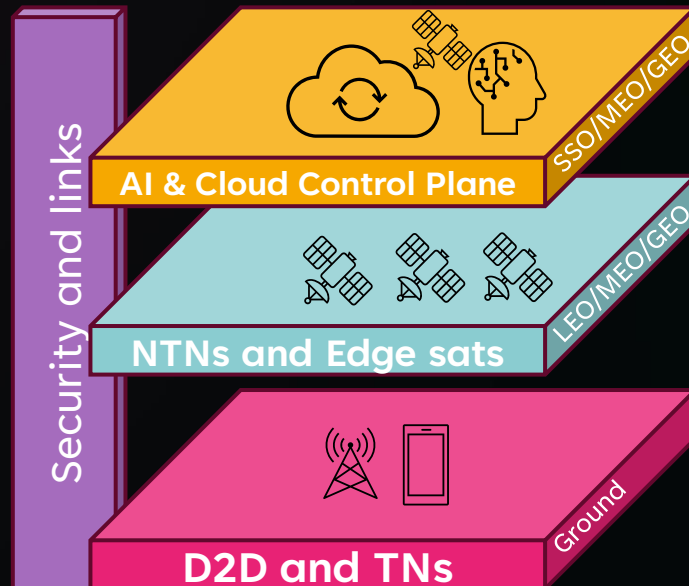
AI for space-native data processing and autonomous ops.

Data utilization improvements as space data generation accelerates.



Software-defined Satellites Are Coming

The orbital backbone of the second digital era



Data processing at Edge

Data is generated at the edge, carried across terrestrial and satellite networks, and unified by cloud and AI as a single horizontal operating layer.

Software defined infrastructure

Ground and space assets virtualise, operations shift to software-defined, cloud-native control models.

AI and Cloud native

Virtualisation and cloud orchestration enable faster service rollout, continuous change, and automation at scale.

AI-assisted operations improve utilisation, link budgets, and service agility.

Seamless integration with enterprise cloud platforms.

Economic and Technical Challenges

Developed with TUM

Modelled cost comparison for 1GW SSO-monolithic architecture

FY2025 USD	Terrestrial	Orbital
CAPEX \$m/MW	29.73	31.30
OPEX \$m/MW/year	9.00	12.75

Source: ESPI Report 98 (2025), Annex A, Table 2, p. 44.



Scan for full
report +
compendium

Key hurdles

Resilient & optimized compute

> 30 TOPS / Watt | 30-50 krad.

Power generation

> 30% cell efficiency | Optimized power distribution.

Thermal management

150 – 300 W/m² rejection | Optimized active cooling.

Optical networking

> 100 Gbps links | > 99% availability crosslinks.

Scalable launch economics

< €1000/kg launch target | Reusable heavy lift.

Robotic assembly and station keeping

Assembly and control of ultra large planar spacecraft | Orbital safety

Thank you!

