Table of Contents

Chapter Glossary

(COTS)	Commercial-off-the-Shelf
(EELV)	Evolved Expendable Launch Vehicle
(ESPA)	EELV Secondary Payload Adapter
(GEO)	Geostationary Equatorial Orbit
(I&T)	Integration and Test
(kg)	Kilogram
(LEO)	Low Earth Orbit
(MEO)	Medium Earth Orbit
(MTBF)	Mean Time Between Failures
(NASA)	National Aeronautics and Space Administration
(SHF)	Super High Frequency
(SPA)	Secondary Payload Adapter
(STMD)	Space Technology Mission Directorate
(TRL)	Technology Readiness Level
(UHF)	Ultra High Frequency
(UK)	United Kingdom
(Unk)	Unknown
(USA)	United States of America
(VLEO)	Very Low Earth Orbit
(VHF)	Very High Frequency
(W)	Watts
(xGEO)	Beyond Geostationary Equatorial Orbit

2.0 Complete Spacecraft Platforms

2.1 Introduction

Small spacecraft continue to enable a broad range of science missions, technology demonstrations, and operational services. Regardless of mission type, each spacecraft relies on a bus, which provides essential services to the payload. These services typically include power generation and storage, thermal control, attitude determination and control, navigation and timing, communications, propulsion, and command and data handling. While this report examines the state of the art for individual subsystems, this chapter focuses on complete, readily available spacecraft platforms that practitioners can procure or access as services.

To reflect how teams make acquisition decisions, the chapter is organized into two main categories: hosted orbital services and spacecraft bus procurement. Hosted orbital services offer end-to-end mission support by integrating customer payloads onto provider-managed spacecraft and conducting system-level integration, test, commissioning, and operations. Spacecraft bus procurement focuses on purchasing a flight-proven or development-stage bus and, depending on the provider, optionally leveraging their system-level integration and test support while the customer leads mission operations. The procurement section is further subdivided by platform class: PocketQube, CubeSat, and ESPA-class.

Procuring a complete platform—whether as a hosted service or as a bus—can reduce technical and programmatic risk by leveraging proven hardware and established processes. It does not eliminate the need for mission-level trades and responsibilities, which typically include payload-to-bus interface definition and verification, environmental qualification, regulatory and spectrum licensing, concept of operations development, commissioning, and on-orbit data handling. Hosted services can shift many of these responsibilities to the provider, allowing investigators to focus on payload development and data ground processing; purchasing a bus can provide greater control over mission tailoring and operations, at the cost of increased integration effort.

Inclusion in this chapter is non-exhaustive and intended as a snapshot of the market as of January 2026; offerings evolve rapidly, and readers should confirm details directly with providers.

To use this chapter, start by clarifying your mission needs and payload envelope (mass, volume, power). If you seek end-to-end support and faster access to space, review hosted orbital services first. If you plan to own and operate the spacecraft, proceed to the bus procurement section, selecting among PocketQube, CubeSat, and ESPA-class platforms based on size and capability. Each subsection includes summary tables to help compare offerings, and Section 2.4 outlines systems engineering considerations and links to relevant guidance documents for the development of small spacecraft.

2.2 State-of-the-Art – Spacecraft Platforms

2.2.1 Hosted Orbital Services

Hosted orbital services provide end-to-end mission support by integrating customer payloads onto provider-managed spacecraft and conducting system-level integration and test, launch accommodations, commissioning, and on-orbit operations with data return. Providers differ in vehicle type, business model, and the degree of transparency and control they offer to customers, but the common objective is to reduce barriers to flight and streamline the path from payload development to scientifically or operationally useful data. This section focuses on hosted orbital services using small spacecraft platforms; other space-based hosting opportunities—such as hosting on the International Space Station, on launch vehicle structures, or on returnable capsules—exist but are beyond the scope of this chapter. Hosted orbital services can be implemented in several ways. The choice among these models depends on payload needs, desired control and customization, as well as schedule, and budget.

- **Dedicated spacecraft**: a single customer's payload flies on its own spacecraft, with the full bus resources reserved for that mission.
- **Shared hosted capacity on provider missions**: unused mass, power, and data margins on the provider's internally funded mission are allocated to one or more customer payloads.
- **Multi-payload missions**: multiple customer payloads share a single spacecraft bus with partitioned resources and interfaces.
- **Virtual or software-only hosting**: payload functionality is implemented as software on an existing spacecraft, leveraging onboard processing and data links without dedicated hardware.

The benefits of hosted orbital services are centered on speed, cost, risk reduction, flexibility, and focus. Standardized interfaces and recurring flight campaigns can shorten the timeline from payload delivery to on-orbit operations, accelerating technology maturation and science return. Shared spacecraft resources and established processes reduce non-recurring engineering and programmatic overhead relative to building and launching a bespoke spacecraft. Providers typically leverage flight-proven buses, deployers, ground networks, and mission assurance practices, which can improve the probability of mission success. Services can be tailored to payload needs and scaled across flights or constellations, allowing adjustments to bandwidth, coverage, and mission duration as needed. Importantly, hosted services enable investigators to concentrate on instrument development and data ground processing while the provider handles spacecraft integration, commissioning, and routine operations.

Although offerings vary, hosted orbital services generally articulate clear payload acceptance envelopes and interface requirements. Customers should expect specifications for mass, volume, mounting constraints, keep-out zones, and center-of-gravity limits; power budgets, including average and peak draw, duty cycles, inrush limits, and electrical interfaces; thermal interfaces, allowable temperature ranges, and heat rejection capability; data interfaces, protocols, expected throughput, onboard storage, and downlink schedules; and attitude determination and control performance available to the payload, including pointing knowledge, control/accuracy, and stability/jitter. Providers typically define environmental qualification expectations (random vibration, shock, thermal vacuum, electromagnetic compatibility/interference), radiation environment assumptions and component-level tolerance, and software integration approaches, including flight software architectures, command/telemetry schemas, and on-orbit authority. Ground segment provisions—data formats, latency, delivery mechanisms, security measures, and archiving—are also defined as part of the interface.

Several considerations warrant careful attention during selection and contracting. Data rights and access should be explicitly defined, including ownership, latency, formats, and any restrictions on redistribution or publication. Operational authority and autonomy must be clear: who can command payload modes, update software, and respond to anomalies on orbit, and what safeguards or approval workflows apply. Regulatory and licensing responsibilities—such as spectrum coordination and remote sensing approvals—require planning; customers should confirm what support the provider offers and which tasks remain with the payload team. Cybersecurity posture across command and data links and ground systems should address authentication, encryption, monitoring, and incident response. In multi-payload missions, resource partitioning and contention management are central to predictable operations; customers should understand how power, data, pointing, and schedules are allocated and prioritized. Lead times and manifests must be realistic, and should include contingency plans for integration delays or launch slips. Mission assurance practices and flight heritage should be reviewed for relevance to the target orbit and environment, while end-of-life planning should ensure deorbit or passivation meets applicable guidelines. Finally, export controls may affect certain providers or payload components; early planning for compliance can help mitigate delays.

To compare hosted orbital services effectively, customers can frame their selection around mission outcomes and constraints. Begin with the target orbit, coverage, and revisit rates the provider can offer, and assess whether these meet science or operational objectives. Examine payload envelopes—mass, volume, power, and thermal—and verify interface compatibility against provider standards. Evaluate the attitude control performance available to the payload and the vibration/jitter environment relative to pointing or imaging requirements. Communications capacity, downlink latency, and ground network architecture should align with data volumes and cadence; confirm that onboard storage and scheduling flexibility support high-duty-cycle payloads. Propulsion capabilities, if relevant, should cover orbit changes, collision avoidance, and disposal. Flight heritage and reliability metrics provide insight into expected performance; preference may be given to providers with demonstrated performance in similar missions. Integration and test services, facilities, and verification approaches should be commensurate with payload complexity, and data services—including processing, storage, and delivery guarantees—should meet analysis workflows. Regulatory and licensing support, cybersecurity features, schedule and production cadence, and cost structure (including any per-bit or per-pass fees) round out the comparison. Terms governing data rights, on-orbit authority, and change control should be negotiated early and documented.

Procurement of hosted orbital services typically proceeds through commercial agreements that include a statement of work, interface control documents, verification and validation plans, acceptance test procedures, project lifecycle reviews, and service-level agreements for operations and data delivery. Clear definition of deliverables and decision gates—such as project lifecycle review entrance/exit criteria, payload acceptance review, environmental test reports, mission operations plan, commissioning report, and data handover specifications—helps reduce ambiguity. Roles and responsibilities for licensing, launch integration, anomaly response, and end-of-life disposition should be explicitly assigned. If you intend to use government procurement mechanisms or programs, confirm current eligibility, terms, and contracting pathways through official documentation and appropriate contracting office.

Not all hosted service providers sell their spacecraft buses. If owning the bus is required, refer to the Spacecraft Bus Procurement section of this chapter. Offerings evolve rapidly; treat provider lists and capabilities as a snapshot as of January 2026 and confirm details directly with providers.

Table 2-1: Hosted Orbital Service Providers

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the Hosted Orbital Services category)

Organization	Largest Platform	Peak Power (W)	3-σ Pointing Control/ Knowledge	Destination	US Office
2NDSpace Italy	CubeSat	>100	0.1°/0.02°	VLEO, LEO, MEO	No
AAC Clyde Space Sweden	CubeSat	400	<0.01°/<0.0075°	LEO	Yes
Aerospacelab Belgium	ESPA	300	<0.005°/ <0.005°	LEO, GEO	Yes
Alba Orbital UK	PocketQube	15	5°/2°	LEO	Yes
Alén Space Spain	CubeSat	180	0.2°/0.1°	LEO	No
Apex USA	ESPA	4,000	0.005°/ 0.0025°	LEO, MEO, GEO	Yes
Argotec Italy	ESPA	440	<0.01°/<0.008°	LEO, MEO, GEO, Deep Space	Yes
Artemis Space Technologies UK	ESPA	1,500	0.01°/0.01°	LEO, MEO, GEO, Lunar and Deep Space	No
Astranis Space Technologies Corp. USA	ESPA	300	<0.1°/ <0.09°	GEO	Yes
Astro Digital USA	ESPA	3,000	<0.03°/ <0.02°	LEO, GTO, GEO	Yes
Axelspace Japan	ESPA	1,800	<0.05°/ <0.04°	LEO	No
BAE Systems SMS USA	ESPA	2,500	<0.006°/<0.003°	LEO, MEO, GEO, Cislunar, Deep Space	Yes
Berlin Space Technologies Germany	ESPA	2,500	<0.017°/< 0.017°	LEO	Yes
Blue Canyon Technologies USA	ESPA	1,082	0.002°/0.002°	LEO, GEO, Deep Space	Yes
C3S Electronics Development Hungary	CubeSat	505	0.4°/ 0.6°	LEO, MEO	No
CesiumAstro USA	ESPA	4,500	<0.1°/<0.01°	LEO	Yes
CREOTECH Poland	ESPA	600	<0.02°/< 0.015°	LEO, MEO, GEO, Lunar, Deep Space	No
D-Orbit Italy	ESPA	300	0.1°/ 0.05°	LEO	No
D-Orbit USA	ESPA	2,000	0.1°/ 0.05°	LEO, GEO	Yes
EnduroSat Bulgaria	ESPA	6,800	0.1°/0.006°	LEO	Yes
Exobotics UK	ESPA	3,600	0.1°/ 0.008°	LEO, MEO, HEO, GEO, Lunar	No
FOSSA Systems Spain	CubeSat	60	<0.1°/<0.1°	LEO	No
German Orbital Systems Germany	CubeSat	150	<1°/< 1°	LEO	No
GomSpace Denmark	CubeSat	150	0.070°/ 0.056°	LEO, MEO, GEO, Lunar, Deep Space	Yes
Harpy Aerospace India	ESPA	2,100	0.35°/0.35°	LEO, GEO, Lunar, ISS	Yes
Hemeria France	ESPA	250	<0.03°/<0.01°	LEO, GTO, GEO	No
HEX20 India	CubeSat	150	0.008°/ 0.008°	LEO, MEO, Lunar	Yes
Hydra Space Systems Spain	CubeSat	30	<1°/< 1°	LEO	No
Innova Space Argentina	CubeSat	4	<15°/< 15°	LEO	Yes
Loft Orbital USA	ESPA	4,000	<0.01°/<0.007°	LEO	Yes
Magellan Aerospace Canada	ESPA	200	0.01°/0.01°	LEO	No
Malin Science Space Systems USA	ESPA	918	<0.015°/<0.015°	Mars	Yes
Momentus Space USA	ESPA	3,000	0.008°/ 0.008°	LEO, MEO, GEO, Lunar, Deep Space	Yes

Table 2-1: Hosted Orbital Service Providers

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the Hosted Orbital Services category)

Organization	Largest Platform	Peak Power (W)	3-σ Pointing Control/ Knowledge	Destination	US Office
Moog USA	ESPA	2,000	<0.050°/<0.033°	LEO, GEO	Yes
Muon Space USA	ESPA	4,000	0.01°/0.004°	LEO	Yes
NanoAvionics Lithuania	ESPA	378	0.15°/ 0.03°	LEO	Yes
Nara Space South Korea	CubeSat	120	0.05°/ 0.03°	LEO	No
NearSpace Launch USA	CubeSat	160	0.5°/ 0.2°	LEO	Yes
Northrop Grumman USA	ESPA	420	<4°/<1°	LEO	Yes
NovaWurks USA	ESPA	>5,000	0.002°/0.0004°	LEO, GEO, xGEO	Yes
NPC SPACEMIND Italy	CubeSat	100	<0.1°/<0.1°	LEO, MEO	Yes
OHB LuxSpace Luxembourg	ESPA	600	<0.022°/ 0.01°	LEO	No
OHB Sweden Sweden	ESPA	1,500	0.008°/ 0.008°	LEO, MEO	No
Orbital Astronautics UK	ESPA	5,000	<0.05°/<0.01°	LEO, MEO, GEO, Deep Space	No
Orion Space Solutions USA	CubeSat	400	<1°/<1°	VLEO, LEO, GEO, Lunar	Yes
Pumpkin Space USA	CubeSat	400	0.05°/<0.05°	LEO, Lunar	Yes
Quantum Space USA	ESPA	400	0.006°/0.006°	LEO, GEO, Cislunar, Lunar, Deep Space	Yes
Quub, Inc. USA	CubeSat	50	5°/2°	LEO, Lunar	Yes
Redwire Space USA	ESPA	500	0.005°/0.0017°	LEO, MEO, GEO and Deep Space	Yes
Reflex Aerospace Germany	ESPA	3,000	<0.01°/<0.005°	LEO	No
SatRev Poland	CubeSat	150	1°/1°	LEO	No
SFL Missions Inc. Canada	ESPA	1,500	0.009°/0.004°	LEO, GEO, Lunar	No
Sierra Space USA	ESPA	500	0.001°/ <0.001°	LEO, MEO, GEO	Yes
SITAEL Italy	ESPA	2,000	0.0017°/ 0.001°	LEO	No
Southwest Research Institute USA	ESPA	1,550	0.015°/0.002°	LEO, GEO	Yes
Space Dynamics Laboratory USA	ESPA	2,000	0.021°/0.021°	LEO, GEO, GTO, Cislunar, Deep Space	Yes
Space Inventor Denmark	ESPA	1,500	<0.008°/<0.008°	LEO, GEO, MEO, Lunar	No
Spacemanic Czech Republic	CubeSat	216	1°/ 0.5°	LEO, MEO, GEO, Lunar	No
Spire Global USA	CubeSat	300	0.1°/ 0.05°	LEO	Yes
Surrey Satellite Technology Ltd. UK	ESPA	2,000	<0.01°/ <0.01°	LEO, MEO, GEO, Lunar	No
Terran Orbital USA	ESPA	1,500	0.014°/0.002°	LEO, GEO, Lunar	Yes
U-Space France	ESPA	250	0.007°/0.005°	LEO	No
Varda Space Industries USA	ESPA	500	2.25°/ 0.40°	LEO with Re-entry Recovery	Yes
York Space Systems USA	ESPA	2,200	0.002°/ 0.0004°	LEO, GEO, Lunar	Yes

2.2.2 Spacecraft Bus Procurement

The SmallSat market includes providers of complete spacecraft bus solutions, encompassing system-level integration and test (I&T) and operations capabilities. Providers that deliver end-to-end services are addressed in Section 2.2.1. The providers profiled here offer bus procurement and possibly provide system-level I&T. Readers should use this document to narrow candidate options; refer to Table 2-9 for providers websites and contact information.

2.2.2.1 PocketQubes

PocketQubes are very small satellites built around a 5 cm cube unit, denoted "P." A 1P spacecraft occupies a single 5 cm cube, and larger configurations combine units (for example, 2P, 3P, and beyond where deployers permit). Figure 2.3 illustrates the standard dimensions of a 1P unit, providing a visual reference for the geometry used across PocketQube designs. Figure 2.5 shows an example of a PocketQube. The PocketQube ecosystem has matured in recent years, and multiple providers offer off-the-shelf buses that integrate power, command and data handling, communications, and basic attitude sensing within extremely constrained mass and volume envelopes. These platforms are well suited to tightly focused technology demonstrations and compact instruments that can tolerate limited power and modest attitude control.

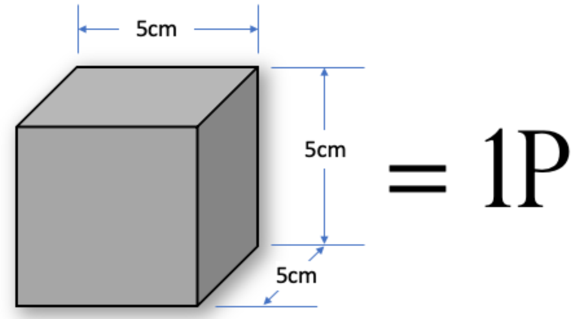

Figure 2.3: PocketQube Dimensions.

Figure 2.4: Alba Orbital Integration of PocketQubes into the Deployers. Credit: Alba Orbital.

Selecting a PocketQube bus centers on a clear understanding of payload constraints and mission requirements. Mechanical considerations include strict keep-out zones, mounting features compatible with the chosen deployer, and center-of-gravity placement to meet deployment requirements. Figure 2.4 shows PocketQubes and deployers for integration. Electrical power budgets are typically low, with tight limits on average and peak draw, duty cycles, and inrush currents; payload modes must align with available storage and generation. Communication subsystems generally offer lower data rates relative to larger classes, so data volume, latency, and downlink scheduling should be planned accordingly. Attitude determination and control capabilities vary, but pointing performance is often limited by scale; payloads that demand fine pointing or low jitter may require tailored solutions or selection of a larger platform class. Environmental qualification—random vibration, shock, thermal vacuum, and electromagnetic compatibility—should match the launch and orbit, and radiation tolerance assumptions should be confirmed with the provider.

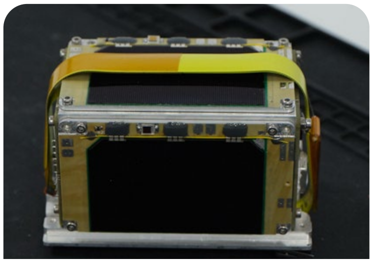

Figure 2.5: Hydra Space Systems PocketQube. Credit: Hydra Space Systems.

PocketQube deployers define the mechanical interface and envelope for flight. While a typical deployer accommodates up to 3P, larger systems may exist; specific dimensions, clamp features, and external volume allowances are determined by the deployer and launch integration configuration. As shown in Figure 2.4, understanding the deployer integration early helps ensure mechanical compatibility and proper verification of separation mechanisms. Prospective buyers should coordinate with their sponsoring organization or launch provider to identify the deployer that will be used and verify bus compatibility. The summary table in this subsection lists representative PocketQube buses, including power availability, communications options, and any optional integration services.

Table 2-2: PocketQubes Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the PocketQube category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
Alba Orbital $^{\text{UK}}$	15	5°/2°	UHF, S	LEO	Flown LEO	Yes
DIYSATELLITE $^{\text{Argentina}}$	9	<5°/<5°	VHF, UHF, SHF	LEO, GEO, Lunar	Flown LEO	No
FOSSA Systems $^{\text{Spain}}$	10	<5°/<5°	UHF, S	LEO	Flown LEO	No
Hydra Space Systems Spain	8	5°/5°	VHF, UHF	LEO	Flown LEO	No
Innova Space $^{\text{Argentina}}$	3.9	N/A -Magnetic Passive	UHF	LEO	Flown LEO	Yes
Quub, Inc. $^{\text{USA}}$	26	5°/2°	UHF, S	LEO, Lunar	Flown LEO	Yes

2.2.2.2 CubeSats

CubeSats are modular small satellites built from 10 cm cube units, denoted “U.” The standard—originally developed to facilitate access to space for educational missions and now widely adopted—supports a range of sizes from sub-unit form factors up to multi-unit configurations (e.g., from sub-1U form factors up to 27U-class configurations). The market offers a broad spectrum of CubeSat buses spanning basic platforms for rapid technology demonstrations to highly capable systems with precise pointing, increased power generation, redundant subsystems, and

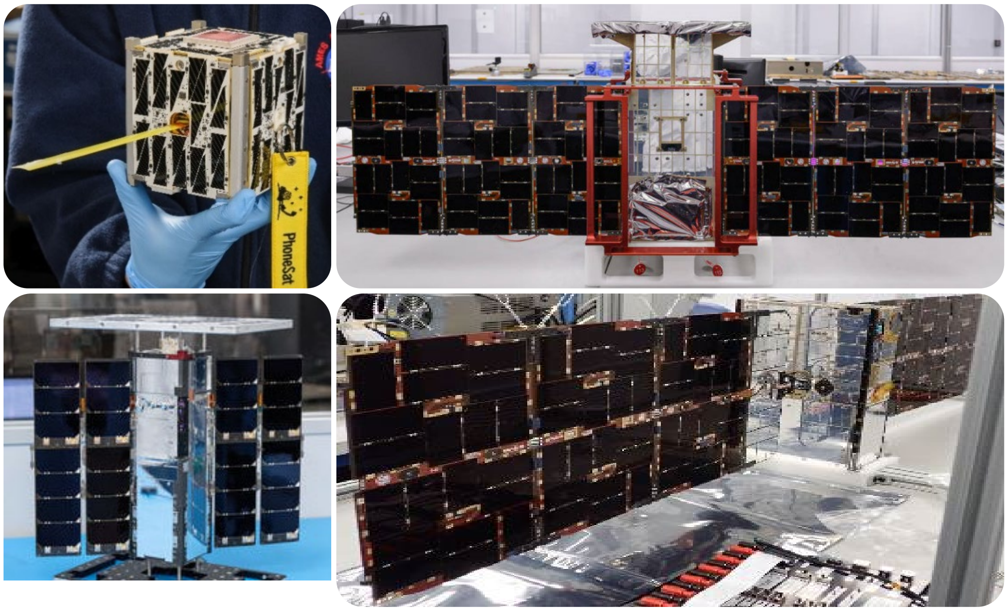

Figure 2.6: Examples of flown CubeSats. (Top left) 1U PhoneSat spacecraft, (top right) 12U CAPSTONE spacecraft, (lower left) 3U CLICK spacecraft, (lower right) 6U PTD-3 spacecraft. Credits: NASA and Terrain Orbital.

integrated propulsion. Examples of flown CubeSats at multiple sizes are shown in Figure 2.6, illustrating the diversity of implementations.

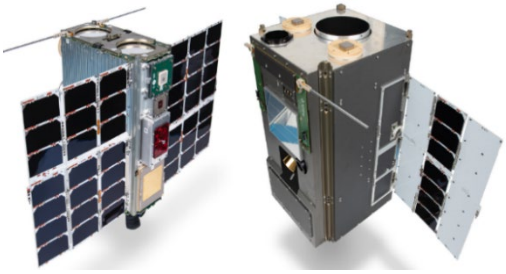

Figure 2.7: Examples of a 6U and 16U CubeSat. Credit: Spire Global.

Selecting a CubeSat bus typically begins by mapping mission requirements to size and capability. Smaller buses (e.g., 1U–3U) often suit low-power payloads and missions with relaxed pointing or data demands, while mid-size platforms (e.g., 6U) provide more power and volume, enabling more capable ADCS, communications, and propulsion subsystems. Larger configurations (e.g., 12U, 16U and above) support higher duty cycles, larger instruments, and more stringent pointing and stability requirements. Figure 2.7 provides visual examples of 6U and 16U CubeSat form factors. Across sizes, common trade factors include average and peak power availability, battery capacity and array configuration, ADCS performance (pointing accuracy, knowledge, stability, and jitter), communications bands and data rates, onboard storage, and optional propulsion (including propellant type and expected delta-V). Heritage in similar orbits and environments and the provider's test and quality practices are important indicators of reliability.

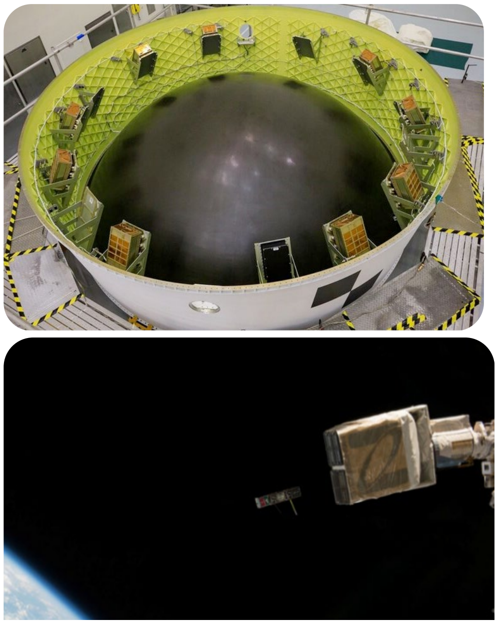

Figure 2.8: (top) Location of Artemis CubeSat deployers in between the Orion Crew Vehicle and the Interim Cryogenic Propulsion Stage (ICPS); (lower) NASA Nodes mission deployment from ISS. Credit: NASA.

Mechanical interface compliance is fundamental. CubeSat deployers enforce strict keep-out zones, surface features, and load paths. Two primary interface families are in use: classic corner rails and tab-based systems (clamped and unclamped variants). Most bus providers offer adaptations to support both, but buyers should verify the specific deployer used by their launch provider and ensure the bus meets the corresponding mechanical and environmental requirements. Differences in deployer location on the launch vehicle can affect shock, vibration, and thermal environments; qualification plans should account for these conditions. Figure 2.8 illustrates this variability, showing the location of Artemis CubeSat deployers between the Orion Crew Vehicle and the Interim Cryogenic Propulsion Stage (left), and the NASA Nodes mission deployment from the International Space Station (right). Payload teams should also confirm electrical interfaces and protocols, data handling and downlink scheduling, and any software integration requirements, including flight software hooks and command/telemetry schemas.

This report organizes CubeSat buses by size to streamline comparison. The summary tables for 0.25U–3U, 6U, 12U, and 16U+ list representative platforms. Offerings evolve quickly; readers should treat the tables as a starting point and engage providers to obtain current details.

Table 2-3: 0.25U-3U Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the 0.25U-3U category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
2NDSpace Italy	>100	0.1°/0.02°	VHF, UHF, S, X	VLEO, LEO, MEO	Flown LEO	No
AAC Clyde Space Sweden	90	<0.1°/<0.01°	VHF, UHF, S, X	LEO	Flown LEO	Yes
Blue Canyon Technologies USA	27	0.003°/0.003°	L, S, X	LEO, GEO, Deep Space	Flown LEO Qualified GEO and Deep Space	Yes
Deimos Space Spain	35	0.2°/0.2°	UHF, X	LEO	Flown LEO	No
EnduroSat Bulgaria	84	<1°/<0.6°	UHF, S, X	LEO	Flown LEO	Yes
Exobotics UK	75	0.1°/ 0.05°	VHF, UHF, S, X	LEO	Under Development	No
FOSSA Systems Spain	30	1°/1°	UHF, S	LEO	Flown LEO	No
German Orbital Systems Germany	35	<1°/<1°	UHF, VHF, S, X	LEO	Flown LEO	No
GomSpace Denmark	35	0.139°/0.056°	S, X	LEO	Flown LEO	Yes
Gran Systems Taiwan	50	2°/ 2°	VHF, UHF, S	LEO	Flown LEO	Yes
GUMUSH AeroSpace Turkey	80	<1°/ <0.1°	VHF, UHF, S, X	LEO	Flown LEO	No
Harpy Aerospace India	72	<0.1°/<0.01°	VHF, UHF, S, X	LEO, GEO, Lunar	Qualified LEO and Lunar	Yes
HEX20 India	30	0.003°/ 0.003°	VHF, UHF, S	LEO	Flown LEO	Yes
Hydra Space Systems Spain	30	<1°/ <1°	VHF, UHF, Ka	LEO	Under Development	No
Innova Space Argentina	7.5	<15°/<15°	UHF	LEO	Flown LEO	Yes
ISISPACE The Netherlands	50	<15°/<15°	VHF, UHF, S	LEO	Flown LEO	No
NanoAvionics Lithuania	175	13.20°/12.93°	UHF, S, X	LEO	Flown LEO	Yes
NearSpace Launch USA	100	0.5°/0.2°	L, UHF, S, X	VLEO, LEO	Flown LEO	Yes
NPC SPACEMIND Italy	51.6	<0.1°/<0.1°	UHF, S, X, Ka	LEO, MEO, GEO, Lunar	Flown LEO and MEO	Yes
Orbital Astronautics UK	400	0.1°/ 0.01°	S, X, K, Ka, Optical	LEO, MEO	Flown LEO Qualified MEO and GEO	No
Orion Space Solutions USA	8	1°/1°	L, S, X	LEO	Qualified LEO	Yes
Pumpkin Space Systems USA	200	0.05°/<0.05°	UHF, S, X, Ka	LEO	Flown LEO	Yes
Quub, Inc. USA	44	5°/2°	UHF, S	LEO, Lunar	Flown LEO	Yes
SatRev Poland	150	0.01°/0.01°	UHF, S, X	LEO	Flown LEO	No
SFL Missions Inc. Canada	100	0.009°/0.004°	UHF, S, X, Ka	LEO, GEO, Lunar	Flown LEO Qualified GEO and Lunar	No
Space Inventor Denmark	100	0.01° / 0.01°	VHF, UHF, S, X, L	LEO	Flown LEO	No
Spacemanic Czech Republic	48	1°/0.5°	VHF, UHF, S	LEO, GEO, Lunar	Flown LEO	No
U-Space France	35	10°/10°	S, X	LEO	Flown LEO	No

Table 2-4: 6U Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the 6U category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
2NDSpace Italy	>100	0.1°/0.02°	VHF, UHF, S, X	VLEO, LEO, MEO	Flown LEO	No
AAC Clyde Space Sweden	150	<0.1°/<0.01°	VHF, UHF, S, X	LEO	Flown LEO	Yes
Argotec Italy	80	<0.02°/<0.01°	UHF, S, X	Deep Space	Flown Deep Space	Yes
Astro Digital USA	240	<0.1°/<0.05°	UHF, S, X, Ka	LEO	Flown LEO	Yes
Blue Canyon Technologies USA	108	0.003°/0.003°	L, S, X	LEO, GEO, Deep Space	Flown LEO and Lunar Qualified GEO and Deep Space	Yes
Deimos Space Spain	40	0.05°/0.05°	UHF, S, X	LEO	Under Development	No
EnduroSat Bulgaria	172	0.08°/0.04°	UHF, S, X	LEO	Flown LEO	Yes
Exobotics UK	400	0.1°/ 0.008°	VHF, UHF, S, X, Optical	LEO	Flown LEO	No
FOSSA Systems Spain	60	<0.1°/<0.1°	UHF, S	LEO	Under Development	No
German Orbital Systems Germany	70	<1°/<1°	UHF, VHF, S, X	LEO	Flown LEO	No
GomSpace Denmark	103	0.070°/0.056°	S, X	LEO, Deep Space	Flown LEO and Deep Space	Yes
GUMUSH AeroSpace Turkey	160	<0.1°/<0.05°	VHF, UHF, S, X	LEO	Under Development	No
Harpy Aerospace India	160	<0.1°/<0.01°	VHF, UHF, S, X	LEO	Qualified LEO	Yes
HEX20 India	100	0.003°/0.003°	UHF, S, X	LEO, MEO, Lunar	Under Development	Yes
ISISPACE The Netherlands	100	<0.3°/<0.3°	UHF, S, X	LEO, Lunar	Flown LEO Qualified for Lunar	No
NanoAvionics Lithuania	175	0.18°/0.12°	UHF, S, X	LEO	Flown LEO	Yes
Nara Space South Korea	120	0.05°/0.03°	VHF, UHF, S	LEO	Flown LEO	No
NearSpace Launch USA	160	0.5°/0.2°	L, UHF, S, X	LEO	Flown LEO	Yes
NPC SPACEMIND Italy	85.2	<0.1°/<0.1°	UHF, S, X, Ka	LEO, MEO, GEO, Lunar	Flown LEO	Yes
Orbital Astronautics UK	1,000	0.1°/0.01°	S, X, K, Ka, Optical	LEO, MEO	Flown LEO Qualified MEO and GEO	No
Orion Space Solutions USA	15	1°/1°	L, S, X	LEO	Flown LEO	Yes
Pumpkin Space USA	200	0.05°/<0.05°	UHF, S, X, Ka	LEO, Lunar	Flown LEO Qualified Lunar	Yes
Quub, Inc. USA	50	5°/2°	UHF, S, Ku	LEO, Lunar	Under Development	Yes
SatRev Poland	150	0.01°/0.01°	UHF, S, X	LEO	Flown LEO	No

Table 2-4: 6U Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the 6U category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
Space Dynamics Laboratory USA	400	0.021°/0.021°	UHF, S, X, Ka	LEO, GEO, GTO, Cislunar, Deep Space	Flown LEO Qualified GEO, GTO, Lunar and Deep Space	Yes
SFL Missions Inc. Canada	240	0.009°/0.004°	UHF, S, X, Ka	LEO, GEO, Lunar	Flown LEO Qualified GEO and Lunar	No
Space Inventor Denmark	200	<0.008°/<0.008°	VHF, UHF, S, X	LEO	Flown LEO	No
Spacemanic Czech Republic	432	1°/0.5°	VHF, UHF, S, X	LEO, GEO, Lunar	Qualified LEO	No
Terran Orbital USA	180	0.021°/0.007°	UHF, S, X	LEO, GEO, Lunar	Flown LEO and Lunar	Yes

Table 2-5: 12U Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the 12U category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
2NDSpace Italy	>100	0.1°/0.02°	VHF, UHF, S, X	VLEO, LEO, MEO	Flown LEO	No
AAC Clyde Space Sweden	400	<0.01°/<0.0075°	VHF, UHF, S, X, K, Ka, Ku, Optical	LEO	Qualified LEO	Yes
Argotec Italy	100	<0.02°/<0.01°	UHF, S, X	LEO	Under Development	Yes
Blue Canyon Technologies USA	108	0.002°/0.002°	L, S, X	LEO, GEO, Deep Space	Flown LEO and GEO Qualified Deep Space	Yes
EnduroSat Bulgaria	346	0.08°/0.04°	UHF, S, X, K/Ka	LEO	Flown LEO	Yes
Exobotics UK	400	0.1°/ 0.008°	VHF, UHF, S, X, Optical	LEO, HEO, Lunar	Flown LEO and HEO	No
German Orbital Systems Germany	144	<0.1°/<0.1°	UHF, VHF, S, X	LEO	Qualified LEO	No
GomSpace Denmark	108	0.070°/0.056°	S, X	LEO	Flown LEO	Yes
GUMUSH AeroSpace Turkey	240	<0.05°/<0.05°	VHF, UHF, S, X	LEO	Under Development	No
Harpy Aerospace India	420	<0.1°/<0.01°	VHF, UHF, S, X, K, Ka, Ku, Optical	LEO	Qualified LEO	Yes
HEX20 India	125	0.008°/0.008°	UHF, S, X, Optical	LEO, MEO, Lunar	Under Development	Yes
ISISPACE The Netherlands	190	<0.03°/<0.03°	UHF, S, X, Ka	LEO	Under Development	No
NanoAvionics Lithuania	175	0.18°/0.09°	UHF, S, X	LEO	Flown LEO	Yes
Nara Space South Korea	120	0.05°/0.03°	S, X	LEO	Qualified LEO	No
NearSpace Launch USA	500	0.5°/0.2°	L, UHF, S, X	LEO, MEO	Under Development	Yes
NPC SPACEMIND Italy	96	<0.1°/<0.1°	UHF, S, X, Ka	LEO, MEO, GEO, Lunar	Flown LEO	Yes
Orbital Astronautics UK	2,000	0.05°/0.01°	S, X, K, Ka, Optical	LEO, MEO, GEO	Flown LEO Qualified MEO and GEO	No
Orion Space Solutions USA	40	<1°/<1°	L, S, X, Ka	LEO, GEO	Flown LEO	Yes
Pumpkin Space USA	400	0.05°/<0.05°	UHF, S, X, Ka	LEO, Lunar	Qualified LEO	Yes
Space Dynamics Laboratory USA	400	0.021°/0.021°	UHF, S, X, Ka	LEO, GEO, GTO, Cislunar, Deep Space	Flown LEO Qualified GEO, GTO, Lunar and Deep Space	Yes
SFL Missions Inc. Canada	322	0.009°/0.004°	UHF, S, X, Ka	LEO, GEO, Lunar	Flown LEO Qualified GEO and Lunar	No
Space Inventor Denmark	200	<0.008°/<0.008°	VHF, UHF, S, X	LEO	Flown LEO	No
Spacemanic Czech Republic	432	1°/0.5°	VHF, UHF, S, X	LEO, GEO, Lunar	Under Development	No
Terran Orbital USA	100	0.021°/0.007°	UHF, S, X	LEO, GEO, Lunar	Flown LEO and Lunar	Yes
U-Space France	150	0.009°/0.008°	S, X	LEO	Flown LEO	No

Table 2-6: 16U+ Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the 16U+ category)

Organization	Format	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
2NDSpace Italy	16U	>100	0.1°/0.02°	VHF, UHF, S, X	VLEO, LEO, MEO	Qualified LEO	No
AAC Clyde Space Sweden	16U	400	<0.01°/<0.0075°	VHF, UHF, S, X, K, Ka, Ku, Optical	LEO	Qualified LEO	Yes
Argotec Italy	16U+	220	<0.02°/<0.01°	UHF, S, X, K, Ka	GEO, Deep Space	Under Development	Yes
Astro Digital USA	16U+	500	<0.05°/<0.01°	UHF, S, X, Ku, Ka, V, W, Optical	LEO	Flown LEO	Yes
Blue Canyon Technologies USA	16U	108	0.002°/0.002°	L, S, X	LEO, GEO, Deep Space	Qualified LEO, GEO and Deep Space	Yes
Deimos Space Spain	16U+	100	0.025°/0.025°	UHF, S, X	LEO, Lunar, Deep Space	Under Development	No
EnduroSat Bulgaria	16U	346	0.08°/0.04°	UHF, S, X, K/Ka	LEO	Flown LEO	Yes
Exobotics UK	16U	400	0.1°/ 0.008°	VHF, UHF, S, X, Optical	LEO	Under Development	No
German Orbital Systems Germany	16U+	164	<1°/<1°	UHF, VHF, S, X	LEO	Qualified LEO	No
GomSpace Denmark	16U	116	0.070°/0.056°	S, X	LEO	Flown LEO	Yes
GUMUSH AeroSpace Turkey	16U	240	<0.05°/<0.05°	VHF, UHF, S, X	LEO	Under Development	No
Harpy Aerospace India	16U, 27U	420	<0.1°/<0.01°	VHF, UHF, S, X, K, Ka, Ku, Optical	LEO	Qualified LEO	Yes
HEX20 India	16U, 27U+	200	0.008°/0.008°	UHF, S, X, Optical	LEO, MEO, Lunar	Under Development	Yes
ISISPACE The Netherlands	16U	190	<0.03°/<0.03°	UHF, S, X, Ka	LEO	Under Development	No
NanoAvionics Lithuania	16U	175	0.18°/0.09°	UHF, S, X	LEO	Flown LEO	Yes
Nara Space South Korea	16U	120	0.05°/0.03°	S, X	LEO	Flown LEO	No
NPC SPACEMIND Italy	16U	120	<0.1°/<0.1°	UHF, S, X, Ka	LEO, MEO, GEO, Lunar	Under Development	Yes
Orbital Astronautics UK	16U, 27U	2,000	0.05°/0.01°	S, X, K, Ka, Optical	LEO, GEO, Lunar	Qualified LEO and GEO	No
Orion Space Solutions USA	16U+	400	<1°/<1°	L, S, X, Ka	VLEO, LEO, GEO	Qualified VLEO, LEO	Yes
Pumpkin Space USA	16U, 27U	400	0.05°/<0.05°	UHF, S, X, Ka	LEO, Lunar	Qualified LEO	Yes

SatRev Poland	16U	150	0.01°/<0.01°	UHF, S, X	LEO	Under Development	No
Space Dynamics Laboratory USA	16U+	1,600	0.021°/0.021°	UHF, S, X, Ka, Optical	LEO, GEO, GTO, Cislunar, Deep Space	Flown LEO Qualified GEO, GTO, Lunar and Deep Space	Yes
SFL Missions Inc. Canada	16U+	500	0.009°/0.004°	UHF, S, X, Ka	LEO, GEO, Lunar	Flown LEO Qualified GEO and Lunar	No
Space Inventor Denmark	16U	200	<0.008°/<0.008°	VHF, UHF, S, X, L, Ka, Ku, QV	LEO, GEO, MEO	Flown LEO and GEO	No
Spacemanic Czech Republic	16U	432	1°/0.5°	VHF, UHF, S, X	LEO, GEO, Lunar	Under Development	No
Terran Orbital USA	16U	100	0.021°/0.007°	UHF, S, X	LEO, GEO, Lunar	Flown LEO and Lunar	Yes
U-Space France	16U	150	0.009°/0.008°	S, X	LEO	Under Development	No

2.2.2.3 ESPA-Class

Figure 2.9: LandSat-9 ESPA Ring populated with payloads and mass ballasts. Credit: NASA/Randy Beaudoin.

ESPA-class spacecraft are designed to fly as secondary payloads on launch vehicles using the Evolved Expendable Launch Vehicle Secondary Payload Adapter (ESPA) or similar structures. The ESPA ring separates the primary payload from the upper stage and provides multiple mounting locations for secondary spacecraft. Rings can be stacked to accommodate additional payloads. Figure 2.9 illustrates a populated ESPA ring on the Landsat-9 mission, showing a practical arrangement of payloads and mass ballasts and providing context for available mounting configurations. For the purposes of this chapter, ESPA-class refers to platforms with mass typically under 500 kg that can be adapted to rideshare opportunities on ESPA or analogous interfaces. While some ESPA-class missions exceed this mass, the focus here aligns with SmallSat taxonomy and common rideshare constraints.

Procuring an ESPA-class bus introduces considerations distinct from PocketQubes and CubeSats. For example, requirements for safety compliance will be more stringent as an ESPA spacecraft is not encased by a deployer. Mechanical compatibility with the ring or equivalent adapter must be confirmed, including the choice of separation system, envelope constraints, and interface loads. Shock and vibration environments at the ring can differ from other locations in the stack, and qualification plans should reflect these specifics. Rideshare accommodations can also be implemented via plate-based adapters rather than direct ring ports, as depicted in Figure 2.10.

Larger buses typically offer significantly higher power generation and storage, enhanced attitude determination and control with precision pointing and jitter control, multiple communications bands and high data rates, robust thermal control, and propulsion systems capable of meaningful orbit changes and end-of-life disposal. These capabilities support a wider range of mission types, including more demanding remote sensing, communications, and technology demonstrations, potentially beyond low Earth orbit depending on the bus design and heritage.

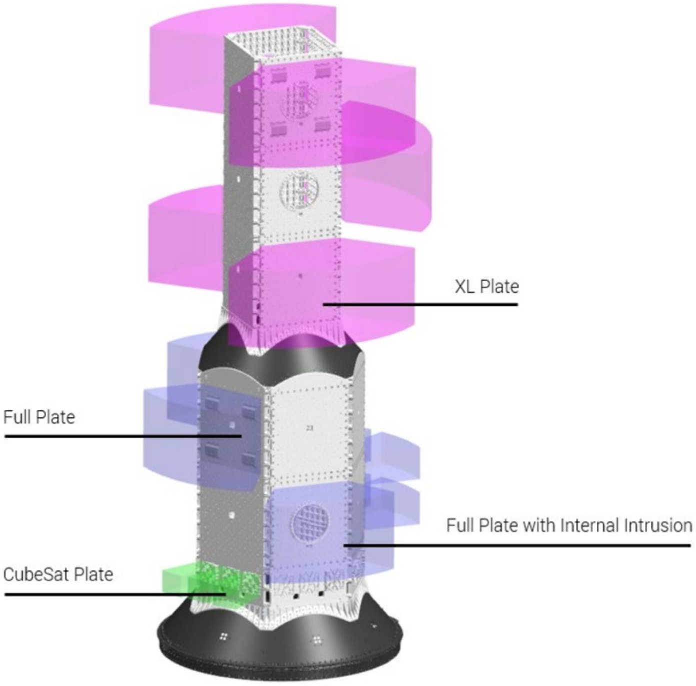

Figure 2.10: Example Payload Plate and Volume Configurations using Rideshare Plates. Credit: SpaceX.

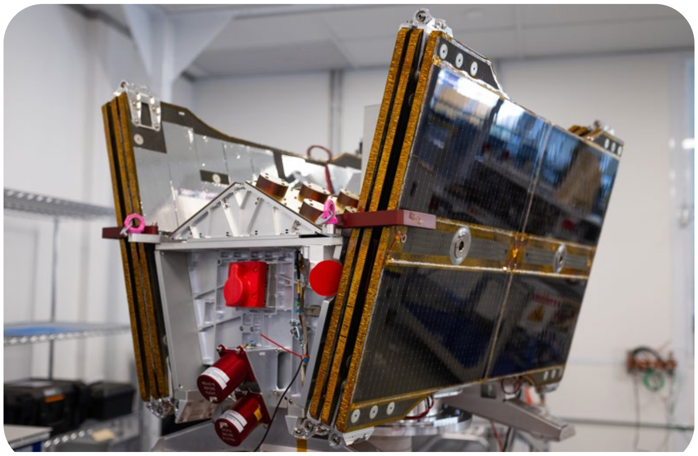

Figure 2.11: ESPA-Class satellite bus from Muon Space launched on SpaceX Transporter-14 rideshare mission in June 2025. Credit: Muon Space.

Selection should balance capability with integration complexity and schedule. Understanding the provider's flight heritage in the target orbit and environment, mission assurance practices, and production cadence helps assess programmatic and technical risk. Payload envelope and interfaces—mechanical, electrical, thermal, data, and software—must be specified in detail, and ground segment accommodations for data delivery, latency, and security must be confirmed. Regulatory and licensing responsibilities, including spectrum and remote sensing approvals where applicable, should be planned early. End-of-life and disposal must meet applicable guidelines, and passivation requirements should be incorporated into bus design and operations. Figure 2.11 depicts an ESPA-class satellite bus from Muon Space during integration at a SpaceX facility for the Transporter-14 rideshare mission.

The ESPA-class summary table in this subsection presents representative commercially available platforms. As with other classes, readers should verify current specifications and lead times with providers and ensure compatibility with the specific rideshare opportunity and adapter that will be used.

Table 2-7: ESPA-Class Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the ESPA-Class category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
Aerospacelab Belgium	1,000	<0.003°/<0.003°	S, X, Ka, Optical	LEO, GEO	Flown LEO Under Development GEO	Yes
Airbus US Space & Defense USA	2,200	<0.006°/<0.006°	S, X, Ka, Optical	LEO	Flown LEO	Yes
Apex USA	4,000	0.005°/0.0025°	UHF, S, X, Ka	LEO, MEO, GEO	Flown LEO Under Development GEO	Yes
Argotec Italy	440	<0.01°/<0.008°	UHF, S, X, K, Ka	LEO	Qualified LEO Under Development MEO, GEO, Deep Space	Yes
Astro Digital USA	3,000	<0.03°/<0.02°	UHF, S, X, Ku, Ka, V, W, Optical	LEO, GTO, GEO	Flown LEO	Yes
Astroscale USA	3,530	0.05°/0.025°	S, X, C	LEO, GEO	Under Development	Yes
Axelspace Japan	1,800	<0.05°/<0.04°	S, X, Ka	LEO	Under Development	No
BAE Systems SMS USA	2,500	<0.006°/<0.003°	L, S, X, Ka	LEO, MEO, GEO, Cislunar, Deep Space	Flown LEO and Deep Space	Yes
Berlin Space Technologies Germany	2,500	<0.017°/<0.017°	S, X	LEO	Flown LEO	Yes
BlackSky USA	2,000	0.013°/0.009°	UHF, S, X	LEO	Flown LEO	Yes
Blue Canyon Technologies USA	1,082	0.002°/0.002°	L, S, X	LEO, GEO, Deep Space	Flown LEO and GEO Qualified Deep Space	Yes
CREOTECH Poland	600	<0.02°/<0.015°	S, X, Optical	LEO, Lunar	Flown LEO	No
Deimos Space Spain	300	<0.005°/<0.005°	S, X, iDRS	LEO	Under Development	No
EnduroSat Bulgaria	3,500/ 7,000	0.1°/0.006°	S, X, K/Ka, L, Optical	LEO	Qualified LEO (3,500W) Under Development (7,000W)	Yes
Exobotics UK	3600	0.08°/ 0.008°	VHF, UHF, S, X, Optical	LEO	Under Development	No
Harpy Aerospace India	2,100	0.35°/0.35°	S, Ka, Optical	LEO	Qualified LEO	Yes
Hemeria France	>1,000	<0.03°/<0.01°	S, X	LEO, GEO, GTO	Flown LEO Qualified GEO and GTO	No
Lockheed Martin USA	500+	<0.1°/<0.1°	S, X, Ka	LEO, GEO, Lunar, Deep Space	Flown LEO Qualified GEO, Lunar and Deep Space	Yes
Magellan Aerospace Canada	200	0.01°/0.01°	S, X	LEO	Flown LEO	No
Malin Science Space Systems USA	918	<0.015°/<0.015°	UHF, X, Ka	Mars	Under Development	Yes
Moog USA	2,000	<0.050°/<0.033°	S, X, Ka, Optical	LEO, GEO	Flown LEO Under development GEO	Yes
Momentus Space USA	3,000	0.008°/0.008°	S, X, Ka, Optical	LEO, MEO, GEO, Lunar, Deep Space	Flown LEO	Yes

Table 2-7: ESPA-Class Market Solutions

(The fields indicate maximum capability; organizations may offer multiple options including smaller capabilities within the ESPA-Class category)

Organization	Peak Power (W)	3-σ Pointing Control/ Knowledge	Comm Options	Intended Destination	Maturity	US Office
Muon Space USA	4,000	0.01°/0.004°	S, X, Optical	LEO	Flown LEO	Yes
NanoAvionics Lithuania	660	0.24°/0.09°	UHF, S, X	LEO	Flown LEO	Yes
Northrop Grumman USA	400	<0.01°/<0.008°	S, X, Ka	LEO, GEO, HEO	Flown LEO, GEO, and HEO	Yes
NovaWurks USA	>5,000	0.002°/0.0004°	UHF, S, L, X, Ka, Ku and Optical	LEO, MEO, GEO, GTO, HEO, Lunar and Deep Space	Flown LEO and GTO	Yes
OHB LuxSpace Luxembourg	834	<0.022°/ 0.01°	S, X	LEO	Qualified LEO	No
OHB Sweden Sweden	1,500	0.008°/0.008°	S, X, L	LEO, MEO	Flown LEO	No
Orbital Astronautics UK	5,000	0.05°/0.01°	S, X, K, Ka, Optical	VLEO, LEO, MEO, GEO, Deep Space	Qualified LEO	No
Quantum Space USA	1,000	0.006°/0.006°	S, X, Ka	LEO, GEO, Cislunar, Lunar, Deep Space	Under Qualified Development	Yes
Reflex Aerospace Germany	3,000	<0.01°/<0.005°	S, X, Ka, Ku, Optical	LEO	Flown LEO	No
Redwire Space USA	600	0.005°/0.0017°	UHF, S, X	VLEO, LEO, GEO	Flown LEO Under Development VLEO and GEO	Yes
SFL Missions Inc. Canada	1,500	0.009°/0.004°	UHF, S, X, Ka	LEO, GEO, Lunar	Flown LEO Qualified GEO and Lunar	No
Sierra Space USA	500	0.001°/ <0.001°	UHF, S, X	LEO, MEO, GEO	Flown LEO	Yes
SITAEL Italy	2,000	0.0017°/0.001°	S, X	LEO	Qualified LEO	No
Southwest Research Institute USA	1,550	0.015°/0.002°	S, X, Ka	LEO, GEO	Flown LEO Under Development GEO	Yes
Space Dynamics Laboratory USA	2,000	0.021°/0.021°	UHF, S, X, Ka, Optical	LEO, GEO, GTO, Cislunar, Deep Space	Flown LEO	Yes
Space Inventor Denmark	1,500	<0.008°/<0.008°	VHF, UHF, S, X, Ka, Ku, Q	LEO, GEO, MEO, Lunar	Flown LEO	No
Surrey Satellite Technology Ltd. UK	2,000	<0.01°/<0.01°	S, X, Ka, Ku, ISL	LEO, Lunar	Flown LEO Under Development Lunar	No
Terran Orbital USA	1,500	0.014°/0.002°	UHF, S, X	LEO, GEO, Lunar	Flown LEO	Yes

2.3 Other Complete Spacecraft Platforms Providers

The Small Spacecraft State of the Art team attempts to reach out to companies and organizations to obtain information directly, but the team is not always successful in receiving responses. To keep the information as updated as possible, Section 2.6 indicates if the team received a response for this edition, the previous edition or other. For companies in previous editions with older data, they have been removed from the main tables and are summarized in this section as potential providers since we have been unable to confirm their input for 2 years or more. This table also includes newly added companies from which the team has not received responses but which appear to offer spacecraft buses and/or hosted orbital services.

Table 2-8: List of other companies that may offer spacecraft buses and/or Hosted Orbital Services

Organization	PocketQubes	CubeSats	ESPA-Class
Berlin Nanospacecraft Alliance		X	
General Atomics EMS		X	X
IMT		X	
In-Space Missions		X	X
Open Cosmos		X	X
Quantum Galactics		X	
Rocket Lab			X
Satellogic			X
Space Information Laboratories		X	
XDLINX Space Lab		X	X

2.4 Programmatic and Systems Engineering Considerations

When determining the optimal mission design approach, small satellite mission developers should carefully evaluate the programmatic and systems engineering considerations that align most with their specific objectives and constraints. This assessment is crucial for making informed decisions that best serve the mission's goals and requirements. Examples of these considerations include:

- Environments the system will endure during development and in flight
- Concept of operations, including desired orbit and mission duration
- Functional and performance requirements
- Key performance parameters with appropriate margins (e.g., mass, volume, power, data link, data budget, pointing)
- Software considerations such as development environment and re-use
- Technology development considerations such as flight heritage, Technology Readiness Level (TRL), and reliability
- Risk posture for development and performance
- Trades between performance, cost, and schedule
- Procurement considerations such as production/lead time and contractual mechanisms
- Licensing requirements, as-applicable (e.g., RF licensing, remote sensing, export control, re-entry)

In addition to the considerations listed above, hosted orbital service missions should also consider:

- Payload priority/mission lifetime for multi-customer/multi-manifest missions
- Balance costs vs payload usage of platform resources (e.g., mass, volume, power, data link, data budget, pointing)

Before finalizing any mission design decisions, it is essential to thoroughly analyze and consider these factors for each potential option within the trade space. Given mission system performance requirements for key performance parameters like mass, volume, power, data link, data budget, and pointing, a functional importance rating and risk-based trade study should be used to screen the many options available. In addition to functional performance, relevant flight heritage or TRL, production lead time, and any available reliability data should be included in the trades. These, as well as cost, could drive the design to be done via COTS or commercial support.

Mission developers may want to consider the following guides to help them in their selection and design process:

- NASA CubeSat 101 Book
  https://www.nasa.gov/content/cubesat-launch-initiative-resources
- NASA CubeSat 201 Small spacecraft process, lessons learned, and reference database
  https://s3vi.ndc.nasa.gov/cubesat201/
- NASA Systems Engineering Handbook
  https://www.nasa.gov/connect/ebooks/nasa-systems-engineering-handbook
- NASA Small Spacecraft Technology Program Guidebook for Technology Development Projects
  https://www.nasa.gov/sites/default/files/atoms/files/smallsattechdevguidebook_rev-508d1.pdf

2.5 Summary

Several vendors have pre-designed fully integrated small spacecraft buses that are space-rated and available for purchase. The market ranges from companies that are willing to heavily modify their systems to fit the customer's needs to companies that standardize their systems with minimal customization to achieve lower cost. This chapter consolidated a long list of providers with key characteristics to facilitate the research and down-selection process for SmallSat practitioners.

For feedback about this chapter, email: arc-sst-soa@mail.nasa.gov. Please include a business email in case of follow up questions.

2.6 References

The references in this section are provided to facilitate the process in which practitioners can obtain information from the providers. The source indicates how the information provided in this chapter was obtained.

Source definition:

Current = organization provided the information through direct communication with the State-of-the-Art team for the **current edition** of the document.

Previous = organization provided the information through direct communication with the State-of-the-Art team on the **previous edition** of the document, and the team was unable to communicate with the organization to update the current edition of the document.

New = the inclusion of the organization is **new** for the document, but the SOA team was unable to communicate with the organization to obtain information. Organizations are encouraged to contact the SOA team to include information on corresponding tables or be removed from the chapter completely.

Obsolete = the information obtained by the State-of-the-Art team is **obsolete** since the team has been unable to communicate with the organization for more than 2 editions in a row. Organizations are encouraged to contact the SOA team to restore their place at the corresponding tables or to be removed from the chapter completely.

Table 2-9: List of Contact Information for Organizations in this Chapter

Organization	Source	Contact Email	Website
2NDSpace	Current	giulio@2ndspace.eu	2ndspace.eu
AAC Clyde Space	Current	enquiries@aac-clydespace.com	aac-clyde.space
Aerospacelab	Previous	gerry.jansson@aerospacelab.com	aerospacelab.com
Airbus US Space & Defense	Current	deborah.horn@airbusus.com	airbusus.com
Alba Orbital	Current	contact@albaorbital.com	albaorbital.com
Alén Space	Current	sales@alen.space	alen.space
Apex	Current	General Inquiries Page	apexspace.com
Argotec	Current	info@argotecgroup.com	argotecgroup.com
Artemis Space Technologies	Current	info@spaceartemis.com	spaceartemis.com
Astranis Space Technologies Corp.	Current	scott@astranis.com	astranis.com
Astro Digital	Current	brian@astrodigital.com	astrodigital.com
Astroscale	Previous	k.shahady@astroscale-us.com	astroscale-us.com
Axelspace	Current	Contact Page	axelspace.com
BAE Systems, Inc. SMS	Current	Contact Form	baesystems.com
Berlin Nanospacecraft Alliance	New	info@bna-space.de	bna-space.de
Berlin Space Technologies	Previous	info@berlin-space-tech.com	berlin-space-tech.com
BlackSky	Previous	Contact Form	blacksky.com
Blue Canyon Technologies	Current	info@bluecanyontech.com	bluecanyontech.com
C3S Electronics Development	Current	info@c3s.hu	c3s.hu
CesiumAstro	Current	info@cesiumastro.com	cesiumastro.com
CREOTECH	Current	space@creotech.pl	creotech.pl/space
D-Orbit- Italy	Current	eleonora.luraschi@dorbit.space	dorbit.space
D-Orbit- USA	Current	mike.kaplan@dorbit.com	dorbit.com
Deimos Space	Previous	cmentrena@deimos-space.com	elecnor-deimos.com
DIYSATELLITE	Previous	gus@diysatellite.com	diysatellite.com
EnduroSat	Current	Contact Page	endurosat.com
Exobotics	New	Contact Page	exobotics.space
FOSSA Systems	Current	contact@fossa.systems	fossa.systems
General Atomics EMS	Obsolete	Chris.white@ga.com	ga.com/EMS
German Orbital Systems	Current	info@orbitalsystems.de	orbitalsystems.de

Table 2-9: List of Contact Information for Organizations in this Chapter			
Organization	**Source**	**Contact Email**	**Website**
GomSpace	Current	info@gomspace.com	gomspace.com
Gran Systems	Current	info@gransystems.com	gransystems.com
GUMUSH AeroSpace	Previous	gumush@gumush.com.tr	gumush.com.tr
Harpy Aerospace	Current	jayakumar@harpyaerospace.in	harpyaerospace.in
Hemeria	Previous	Contact Form	hemeria-group.com/en
HEX20	Current	info@hex20.space	Hex20.space
Hydra Space Systems	Current	contacto@hydra-space.com	hydra-space.com
IMT	Obsolete	giovanni.cucinella@imtsrl.it	imtsrl.it
In-Space Missions	Obsolete	info@inspace.co.uk	in-space.co.uk
Innova Space	Previous	info@innova-space.com	innova-space.com/en
ISISPACE	Previous	sales@isispace.nl	isispace.nl
Lockheed Martin	Previous	timothy.m.linn@lmco.com	-
Loft Orbital	Current	justin.tilman@loftorbital.com	loftorbital.com
Magellan Aerospace	Current	rushi.ghadawala@magellan.aero	magellan.aero
Malin Space Science Systems	Current	yee@msss.com	msss.com
Momentus Space	Current	sales@momentus.space	momentus.space
Moog	Current	ddusza@moog.com	moog.com/markets/space
Muon Space	Current	info@muonspace.com	muonspace.com
NanoAvionics	Previous	info@nanoavionics.com	nanoavionics.com
Nara Space	Current	sales@naraspace.com	naraspace.com
NearSpace Launch	Previous	nsl@nearspacelaunch.com	nearspacelaunch.com
Northrop Grumman	Previous	John.Dyster@ngc.com	-
NovaWurks	Current	info@NovaWurks.com	novawurks.com
NPC SPACEMIND	Current	info@npcspacemind.com	npcspacemind.com
OHB LuxSpace	Previous	info@luxspace.lu	luxspace.lu
OHB Sweden	Current	spacesales@ohb-sweden.se	ohb-sweden.se
Open Cosmos	Obsolete	partnerships@open-cosmos.com	open-cosmos.com
Orbital Astronautics	Current	hello@orbastro.com	orbastro.com
Orion Space Solutions	Current	orioncontact@arcfield.com	orionspace.com
Pumpkin Space Systems	Current	sales@pumpkininc.com	pumpkinspace.com
Quantum Galactics	New	info@quantumgalactics.com	quantumgalactics.com
Quantum Space	Previous	sales@quantumspace.us	quantumspace.us
Quub, Inc.	Current	info@quub.space	quub.space
Redwire Space	Current	sales@rdw.com	rdw.com
Reflex Aerospace	Current	sales@reflexaerospace.com	reflexaerospace.com
Rocket Lab	New	enquiries@rocketlabusa.com	rocketlabusa.com
Satellogic	New	info@satellogic.com	satellogic.com
SatRev	Current	contact@satrev.space	satrev.space

Table 2-9: List of Contact Information for Organizations in this Chapter

Organization	Source	Contact Email	Website
SFL Missions Inc.	Current	info@sflmissions.com	sflmissions.com
Sierra Space	Previous	spaceapps@sierraspace.com	sierraspace.com
SITAEL	Previous	sales.space@sitael.com	sitael.com
Southwest Research Institute	Current	spacecraft-info@swri.org	-
Space Dynamics Laboratory	Current	info@sdl.usu.edu	sdl.usu.edu
Space Information Laboratories	Obsolete	sales@spaceinformationlabs.com	spaceinformationlabs.com
Space Inventor	Current	sales@space-inventor.com	space-inventor.com
Spacemanic	Current	sales@spacemanic.com	spacemanic.com
Spire Global	Current	sales@spire.com	spire.com
Surrey Satellite Technology Ltd.	Previous	info@sstl.co.uk	sstl.co.uk
Terran Orbital	Current	info@terranorbital.com	terranorbital.com
U-Space	Current	contact@u-space.fr	u-space.fr
Varda Space Industries	Current	john.boyer@varda.com	varda.com
XDLINX Space Lab	New	info@xdlinx.space	xdlinx.space
York Space Systems	Current	BD@yorkspacesystems.com	yorkspacesystems.com