# Public Mission Definition Summary

*Node 1 kW (SI-N1), proposed orbital power and compute reference mission*

**Compute where space data begins.**

> Public mission definition for Node 1 kW (SI-N1), a proposed reference mission for a free-flying orbital computing node in 500-600 km LEO. The concept combines 10 kW BOL solar generation with 1 kW continuous useful compute and defines the evidence gates required before later systems reviews.

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## Node 1 kW (SI-N1)

**Program:** Satellite Inference, a program of RFID INC **Category:** Orbital Computing Infrastructure **Review level:** Public MDR summary, pre-SRR **Configuration date:** 2026-09-01 **Release status:** Public working summary

All mission names in this document identify proposed reference missions. They do not represent contracted launches, approved flight programs, licensed operations, or fixed schedules.

## 1. Mission decision summary

Node 1 kW (SI-N1) is the proposed first company-controlled free-flying reference mission in the Satellite Inference program. Its public baseline is:

- 10 kW of beginning-of-life solar-array generation under a reference illumination and pointing condition to be defined at SRR;
- 1 kW of continuous useful compute payload power during nominal operations, including operation through the design eclipse;
- stored energy sized for the design eclipse, expected degradation, conversion losses, operating limits, and reserve;
- a near-circular LEO planning range of 500-600 km;
- processing of data that already originates in space, including Earth-observation, hyperspectral, SAR, and civil RF/spectrum analytics workloads;
- controlled end-of-mission disposal and passivation as part of the reference architecture.

The proposed reference missions are deliberately separated so that each stage closes a distinct set of risks.

| Proposed reference mission | Public purpose | Continuous compute | BOL solar generation |
|---|---|---|---|
| Hosted Pathfinder (SI-HP) | Characterize compute and recovery behavior on a third-party spacecraft platform | 0.2-1.0 kW in allocated windows | Provided by host |
| Node 1 kW (SI-N1) | Demonstrate the first company-controlled power, thermal, bus, and compute node | 1 kW | 10 kW |
| Node 10 kW (SI-N10) | Extend the architecture to sustained 10 kW compute | 10 kW | Approximately 30 kW in Rev A |
| Node 100 kW (SI-N100) | Explore a modular industrial-scale node | 100 kW | Approximately 288 kW in Rev A |
| Grid 1 MW (SI-G1MW) | Explore an aggregate cluster of standardized nodes | 1 MW aggregate | Approximately 2.88 MW aggregate in Rev A |

SI-HP does not demonstrate the SI-N1 solar array, battery continuity, company-controlled spacecraft bus, or end-to-end disposal concept. SI-N10 is not an operating mode of SI-N1. Its continuous compute level requires a larger power, storage, and thermal architecture.

The planning launch category for SI-HP and SI-N1 is a U.S. rideshare service. No specific launch provider, launch date, price, or integration arrangement is selected in this public summary.

## 2. Mission purpose

The purpose of the proposed SI-N1 reference mission is to reduce four coupled uncertainties that shape orbital computing viability:

1. deployment and operation of a scalable solar-power system;
2. continuous useful compute through orbital sunlight and eclipse;
3. rejection of compute heat in the orbital environment;
4. delivery of a measurable result while transmitting materially less data than a raw-data workflow.

SI-N1 is not defined as a generic cloud region in orbit. It is a proposed engineering demonstration that space-originated data can be processed reliably and autonomously near its source.

## 3. Scope

### 3.1 Included in the public mission definition

- top-level spacecraft, compute payload, power, thermal, communications, software, and ground-operations functions;
- deployment, commissioning, nominal operation, anomaly response, and disposal phases;
- representative space-originated workloads for Earth observation, hyperspectral sensing, SAR, and civil RF/spectrum analytics;
- radiation-aware runtime behavior, checkpointing, telemetry, and power-thermal scheduling at a functional level;
- mission objectives, candidate success criteria, review assumptions, and evidence gates;
- the relationship among SI-HP, SI-N1, SI-N10, SI-N100, and SI-G1MW.

### 3.2 Excluded from this public summary

- manufacturing data, detailed design data, and implementation drawings;
- named providers, detailed external interfaces, procurement choices, or binding prices;
- site-specific and internal operations planning;
- detailed command, update, identity, or mission-protection mechanisms;
- controlled technical data or restricted technical exchanges;
- final spectrum, remote-sensing, launch, debris, or reentry determinations;
- constellation deployment and generic terrestrial cloud inference;
- Lagrange-point operations as a baseline mission;
- commitment to a specific processor, accelerator, or component count.

## 4. Definitions and accounting boundaries

| Term | Public definition |
|---|---|
| 10 kW BOL solar | Nameplate DC electrical power at the array output at beginning of life under a defined reference condition. It is not orbital-average usable power. |
| 1 kW continuous compute | 1 kW delivered continuously to the compute payload during nominal operations. Spacecraft support loads are accounted separately. |
| Eclipse continuity | Compute remains at or above the committed 1 kW payload electrical level throughout the design eclipse without violating energy, thermal, or pointing constraints. |
| Useful compute | A representative workload that produces a verifiable output, rather than a resistive load or an unvalidated synthetic benchmark alone. |
| BOL / EOL | Beginning-of-life / end-of-life capability, with degradation assumptions tied to orbit, radiation environment, temperature cycles, and design life. |
| Hosted payload | A compute module carried by another operator's spacecraft, using a defined set of host services. |
| Free-flyer | An independently operated spacecraft for which the program controls mission operations and the top-level subsystem architecture. |
| Rev A | A transparent parametric planning model used to compare proposed stages. It is not a detailed design result or external quotation. |

The 10 kW solar nameplate and 1 kW continuous compute values are intentionally different. SI-N1 uses the difference to support spacecraft loads, battery recharge, losses, reserve, and bounded experiments. The reference architecture never assumes that the full 10 kW nameplate value is continuously available to compute.

## 5. Mission objectives

| ID | Objective | Public evidence concept |
|---|---|---|
| MO-01 | Deploy and operate a 10 kW BOL-class solar-generation system in LEO | Deployment-state evidence and normalized power time series |

| ID | Objective | Public evidence concept |
|---|---|---|
| MO-02 | Sustain 1 kW of continuous useful compute through sunlight and eclipse | Calibrated payload power, workload, energy-state, and temperature records |
| MO-03 | Demonstrate a repeatable space-originated data workflow | Dataset manifest, processing record, and independently assessable output metric |
| MO-04 | Reduce transmitted raw data while preserving defined user utility | Input/output volume, quality, latency, and error metrics |
| MO-05 | Demonstrate fault containment and autonomous recovery | Fault records, checkpoint or rollback evidence, and recovery timing |
| MO-06 | Characterize coupled power and thermal scheduling on orbit | Predicted-versus-observed energy and temperature envelopes |
| MO-07 | Preserve and execute a credible disposal and passivation path | Orbit, maneuver, and final-state records appropriate to the approved mission plan |

These are proposed objectives. Acceptance thresholds remain subject to controlled requirements development and later review.

## 6. Candidate mission success criteria

### 6.1 Minimum success

- establish two-way command and telemetry after separation;
- reach a power-positive, thermally safe operating state;
- deploy the minimum array configuration required for safe operations;
- execute at least one useful compute workload and recover its result;
- maintain controlled operations for at least 30 days;
- preserve a credible disposal path.

### 6.2 Full success

- characterize 10 kW BOL-equivalent array capability against the defined reference condition;
- sustain 1 kW of continuous compute for at least seven consecutive days, including all eclipses, without an energy or thermal limit violation;
- complete at least 1,000 cumulative payload compute hours;
- demonstrate at least 10x raw-data reduction on an agreed representative workload while meeting its quality threshold;
- demonstrate autonomous recovery from at least three representative fault classes;
- reconcile power and thermal models to on-orbit observations within agreed uncertainty bands;
- operate for at least six months and retain the ability to execute the approved end-of-mission plan.

### 6.3 Stretch success

- twelve months of useful operations;
- controlled sunlit compute bursts above 1 kW without compromising eclipse reserve;
- a higher-rate data-return experiment;
- enough on-orbit evidence to refine the proposed SI-N10 reference architecture.

These criteria are planning targets, not guarantees of mission outcome or service availability.

## 7. High-level concept of operations

### Phase A, readiness

The mission completes the planned verification, integration, review, and rehearsal activities. Rehearsals cover initial acquisition, safe-state entry, staged deployment decisions, compute isolation, and end-of-mission commanding.

### Phase B, launch and separation

The spacecraft remains inhibited through launch. After separation, it establishes time, coarse attitude, energy state, and communications. Large deployables remain restrained until the required attitude and keep-out conditions are met.

### Phase C, detumble and power-positive state

The spacecraft reduces angular rates, acquires a safe attitude, establishes commandability, and maintains a survival power balance before full deployment. Compute remains below the nominal 1 kW level during this phase.

### Phase D, staged deployment

Power, thermal, and communications deployables are released in a sequence designed to preserve commandability and safe-state options. Each stage produces independent state evidence. The concept includes partial-deployment and delayed-deployment operating cases.

### Phase E, commissioning and characterization

The mission characterizes orbit, pointing, solar generation, stored energy, thermal response, communications, and payload health. Compute power increases in steps toward 1 kW continuous only after the energy and thermal envelopes are confirmed.

### Phase F, nominal workload operations

Space-originated data enters through a local sensor, partner instrument, or defined data service. The compute system selects an approved workload, checks energy and thermal headroom, performs inference or preprocessing, records evidence, and schedules result downlink. Data retention follows the applicable experiment and civil-use policy.

During eclipse, stored energy supplies the spacecraft and the committed compute load. During sunlight, solar generation supports current loads, restores eclipse energy with margin, and may support bounded experiments. Workloads may be deferred when energy, thermal, conjunction, or communications constraints require it.

### Phase G, extended experiments

After full success, the proposed mission may evaluate bounded compute bursts, additional recovery methods, alternate civil workloads, and higher-rate data return. Extended experiments must preserve the approved energy and disposal reserves.

### Phase H, end of mission

The spacecraft ends workload operations, preserves command and tracking, executes the approved disposal sequence, passivates stored energy, and records its final state. The planning target is disposal within five years after mission completion, subject to the final orbit, authorization, and then-current rules.

## 8. Orbit and lifetime assumptions

| Parameter | Public MDR assumption | Caveat |
|---|---|---|
| Regime | Near-circular LEO | Reference architecture only |
| Altitude | 500-600 km | Exact insertion altitude is not selected |
| Inclination | Workload and access dependent | SSO and mid-inclination cases remain under study |
| Orbital period | Approximately 95 minutes | Recalculate for the selected orbit |
| Preliminary maximum eclipse case | 36 minutes | Replace with seasonal and beta-angle mission analysis |
| Nominal design life | Up to 3 years | Subject to the selected architecture and approved mission plan |
| Full-success operating threshold | At least 6 months | Candidate success criterion |
| Disposal target | Within 5 years after mission completion | Confirm against the final authorization and then-current rules |

At 550 km directly overhead, one-way propagation time is approximately 1.8 ms. Practical latency is higher because of slant range, routing, ground-contact scheduling, protocol, and processing. Intermittent contact, rather than light-travel time, is the principal reason the proposed SI-N1 reference mission begins with space-originated data processing instead of an interactive generic cloud service.

Lagrange points are excluded from the baseline. Sun-Earth L1 and L2 are approximately 1.5 million km from Earth, adding approximately 5 seconds of one-way light time before routing and processing. A future customer-specific reference study may revisit those regions, but they do not improve the SI-N1 evidence plan.

## 9. Public reference architecture

### 9.1 Power and stored energy

The proposed architecture includes deployable solar generation, power conversion and distribution, protected stored energy, telemetry, and a controlled response to unused generation. Rev A uses 10 kW BOL solar generation, approximately 60 minutes of sunlight in the reference orbit, and a 36-minute preliminary eclipse case. A 4-8 kWh nameplate stored-energy range is retained for early screening and must be replaced by a time-domain model.

### 9.2 Compute and software resilience

The proposed payload combines compute, memory, storage, health monitoring, and independent recovery functions within a 1 kW continuous electrical envelope. The processor implementation remains open. Selection depends on representative workload performance per watt, thermal behavior, lifecycle considerations, and radiation-environment evidence.

The primary performance measure is not nominal TOPS or FLOPS. It is independently assessable output per unit of spacecraft energy, thermal capacity, data return, and mission time.

### 9.3 Thermal control

Nearly all compute electrical power becomes heat. The proposed architecture therefore includes dedicated radiating area, a controlled thermal path, temperature sensing, and workload scheduling. Rev A carries 5-10 $m^2$ as an early radiator-area screening range. This is not a design value and must be replaced by a coupled orbital thermal model.

### 9.4 Spacecraft control and communications

The proposed spacecraft provides three-axis control sufficient for power generation, thermal rejection, communications, and the selected civil workload. A robust low-rate command and telemetry function is separated from the higher-rate mission-data function. The spacecraft is expected to continue bounded autonomous work between ground contacts.

### 9.5 Orbit control and disposal

The reference architecture includes controlled orbit-change capability or a demonstrated equivalent for conjunction response and end-of-mission disposal. The selected concept must protect the disposal reserve from optional experiments and support the approved response timelines.

## 10. Public-safe requirements categories

The controlled program requirements will be more detailed than this public summary. At public level, the proposed SI-N1 reference mission must address the following categories:

| Category | Public requirement intent | Evidence class |
|---|---|---|
| Mission and orbit | Operate within the authorized orbit and approved concept of operations | Analysis and mission records |

| Category | Public requirement intent | Evidence class |
|---|---|---|
| Power | Characterize 10 kW BOL-equivalent solar generation and support 1 kW continuous compute through the design eclipse | Analysis, ground evidence, and on-orbit observations |
| Energy reserve | Preserve protected energy for safe-state operation, commandability, and disposal | Analysis and system evidence |
| Useful compute | Execute a representative civil workload and produce a verifiable result | Demonstration and result record |
| Fault containment | Prevent a payload fault from removing essential spacecraft functions | Analysis and fault-response evidence |
| Thermal | Maintain the approved operating envelope across relevant hot, cold, eclipse, and compute cases | Analysis, ground evidence, and on-orbit observations |
| Deployment | Provide positive state evidence and safe responses to incomplete deployment | Test evidence and mission telemetry |
| Communications | Maintain command and telemetry sufficient for safe operation and recovery | Link analysis and end-to-end evidence |
| Software resilience | Enter a power-positive safe state after defined faults or loss of contact | Fault-response evidence |
| Radiation environment | Detect, log, characterize, and recover from defined radiation-induced faults | Ground characterization and on-orbit evidence |
| End of mission | Retain and execute a credible disposal and passivation plan consistent with authorization | Analysis and mission records |

Each controlled requirement needs an owner, rationale, parent objective, acceptance threshold, and verification method before SRR exit. This public table does not expose detailed interfaces or implementation methods.

## 11. Hosted Pathfinder role

Hosted Pathfinder (SI-HP) is a proposed risk-reduction reference mission, not a reduced SI-N1 spacecraft. A third-party platform provides defined spacecraft services, while Satellite Inference supplies a compute module, software, and experiment plan.

The proposed SI-HP evidence plan includes:

- on-orbit characterization of boot, update, watchdog, and recovery behavior;

- observed error behavior for memory, storage, and accelerator execution;
- checkpoint and rollback effectiveness;
- useful workload performance per watt;
- observed thermal response;
- integrity and reproducibility of workload results and telemetry.

SI-HP does not establish 10 kW solar deployment, SI-N1 stored-energy continuity, company-controlled bus behavior, autonomous conjunction response, or disposal capability. The proposed hosted mission may inform SI-N1 payload decisions, but it remains a separate reference mission with separate claims.

## 12. Principal risks and retirement gates

| Risk area | Public concern | Evidence gate |
|---|---|---|
| Deployment | Large deployables may fail to reach or retain their intended state | Staged-deployment evidence and safe partial-state behavior |
| Orbital energy | Available orbit-average energy may be below the planning model | Time-domain model, representative ground evidence, and commissioning observations |
| Stored energy | Eclipse performance or degradation may reduce compute continuity | Cycle and temperature evidence, conservative limits, and on-orbit characterization |
| Thermal rejection | Radiator performance may be insufficient in a limiting geometry | Coupled orbital model, representative thermal evidence, and workload controls |
| Radiation effects | Compute faults may be frequent or damaging | Radiation-environment characterization, fault containment, and recovery evidence |
| Fault propagation | A payload fault may affect essential spacecraft functions | Functional isolation and fault-response evidence |
| Communications and authorization | Data return or required approvals may not be available on the required schedule | Early regulatory planning and alternative operations cases |
| Mass and deployed envelope | The design may exceed its launch category assumptions | Controlled budgets with margin and interface-compatible configuration evidence |
| Disposal | End-of-mission capability may be degraded or reserves consumed | Protected reserve, reliability analysis, and backup-case assessment |
| Representative workload | A civil workload may lack a usable data interface or acceptance metric | Defined dataset, ground replay, and agreed evaluation method before PDR |

| Risk area | Public concern | Evidence gate |
| --- | --- | --- |
| Conjunction and debris | The orbit or operations concept may require revision | Early debris assessment, tracking concept, and maneuver authority |

Risk probability, impact, owners, and quantified retirement tests are controlled at later reviews. This public summary presents only the top-level logic.

## 13. Open decisions and review gates

### 13.1 Open decisions

- representative civil workload and acceptance metric;
- exact orbit, altitude, and inclination;
- design life, reliability assumptions, and redundancy approach;
- deployable power architecture and BOL/EOL model;
- stored-energy capacity and operating limits;
- compute implementation and module topology;
- thermal transport and radiator geometry;
- orbit-control and disposal method;
- command, telemetry, and mission-data communications concept;
- launch category and final integration constraints.

### 13.2 Review gates

1. **MDR exit:** approve the mission purpose, separation of proposed reference missions, objective hierarchy, baseline orbit, accounting definitions, and open decisions.
2. **SRR exit:** approve controlled requirements, the representative civil workload, preliminary authorization path, model assumptions, and verification approach.
3. **PDR exit:** show that the selected architecture closes mass, power, thermal, communications, reliability, radiation, and disposal budgets with margin.
4. **CDR exit:** complete controlled design and software baselines, interface definitions, the verification matrix, and the operations concept.
5. **TRR/FRR:** accept readiness evidence, applicable waivers, integration status, authorizations, mission rehearsals, and anomaly responses.

No later review is considered passed solely because an earlier planning value appears in this public summary.

## 14. Review assumptions and evidence status

- All missions are proposed reference missions and remain subject to technical, regulatory, programmatic, and operational review.
- Rev A values are transparent screening calculations used to compare stages. They are not external quotations or detailed design outputs.
- Mass, area, power, energy, schedule, and lifetime figures are planning ranges until controlled budgets and analyses replace them.
- Exact orbit, communications service, launch service, and external integration arrangements remain open.

- On-orbit characterization can provide flight evidence, but this document makes no component certification claim.
- Civil RF/spectrum analytics is the only RF-related workload category included in this public summary.
- Rules, authorizations, and disposal obligations must be reconfirmed against then-current requirements before each applicable review.
- No claim in this document overrides a contract, authorization, controlled requirement, or accepted verification record.

## 15. MDR recommendation

Proceed to SRR planning for the proposed Node 1 kW (SI-N1) reference mission, subject to five conditions:

1. retain Hosted Pathfinder (SI-HP) as a separate proposed payload-risk reference mission;
2. preserve the distinction between 10 kW BOL solar generation and 1 kW continuous compute;
3. define a representative civil workload and acceptance metric before freezing the payload requirements;
4. replace point estimates with version-controlled time-domain power and coupled thermal models;
5. obtain sufficient external interface evidence before approving detailed design baselines.

## 16. Public context references

- FCC, five-year post-mission disposal rule: <https://www.fcc.gov/document/fcc-adopts-new-5-year-rule-deorbiting-satellites-0>
- FCC, orbital debris FAQ: <https://www.fcc.gov/space/faq-orbital-debris>
- NASA Small Spacecraft Systems Virtual Institute, power subsystems: <https://www.nasa.gov/smallsat-institute/sst-soa/power-subsystems/>
- NASA Small Spacecraft Systems Virtual Institute, thermal control: <https://www.nasa.gov/smallsat-institute/sst-soa/thermal-control/>
- NASA, Lagrange point overview: <https://science.nasa.gov/resource/what-is-a-lagrange-point/>

These sources provide public context only. Technical requirements and compliance positions must be confirmed against then-current, mission-specific evidence and applicable authorizations.