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Artistic impression of ClearSpace-1 mission in Orbit © ClearSpace.

KICKSTARTING IN-ORBIT REPAIR

HOW FINANCE AND INSURANCE COMPANIES CAN HELP LIFT AN EMERGING INDUSTRY OFF THE GROUND.

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INTRODUCTION

In-orbit anomalies are operational events that can reduce a satellite's ability to deliver its intended service. Their outcomes span a spectrum from minor, recoverable degradations to reduced capacity or shortened lifetime and, in some cases, total mission loss. Even when a satellite remains partially functional, the economic impact can be severe due to lost revenue, impaired customer service, and multi-year replacement timelines.

Many of these anomalies are potentially repairable, for example helping an antenna deploy or repositioning a misaligned antenna reflector. The technology to inspect and diagnose spacecraft faults and then carry out repairs is developing at a rapid pace, but is not yet operationally proven, and adoption is hindered by satellite designs that were never intended to be serviced and uncertain financing. Detailed, spacecraft-specific repair case studies are also scarce at this stage, since a full assessment of technical feasibility requires failure-mode and design data that is not publicly available. Nevertheless, the financial case, subject to a technical feasibility assessment of any particular satellite, is compelling.

Although repair missions are costly and risky, in-orbit repair can transform a total-loss scenario into a recovered asset, reducing claim severity, shortening service downtime, and improving sustainability by avoiding unnecessary replacement launches.

Indeed, the level of the reward is high enough to sustain new models, such as third-party risk financing for the repair missions, pre-arranged servicing clauses, or other risk-sharing structures. These approaches can be put in place under existing frameworks; service-ready spacecraft design and clearer regulatory environments would help the model scale over time and unlock a more sustainable, resilient, and economically efficient future for satellite operations.

Inspection and repair are not only tools to fix satellites. They also represent a strategic opportunity to reduce risk, enhance insurability, and support the long-term sustainability of space.

THE ANOMALY RESOLUTION PROBLEM

Scale and cost of in-orbit anomalies

The economic stakes of anomaly resolution can reach hundreds of millions of dollars for an individual spacecraft.

Quantifying the true frequency and cost of anomalies across the global fleet of satellites is difficult because reporting is inconsistent. Insurance claims provide one of the clearest datasets on high-severity events because they are financially quantified and systematically recorded, albeit the data set is incomplete as many satellites are uninsured. Over the last 10 years, insurers have paid on average around $500 million annually in losses (Slingshot Aerospace, 2026), typically in respect of fewer than 10 spacecraft per year.

While aggregate claims data illustrates the scale of the problem, individual anomaly events highlight its operational severity. A single failure can remove a high-value asset from service, trigger a very large insured loss, and force operators into extended mitigation and replacement planning under tight commercial and customer constraints.

This is compounded by the fact that most satellite failures occur during launch and commissioning or early operations (Todd, Feast, Goddard, & Hart, 2024). Indeed, according to data held on Slingshot Aerospace's Seradata platform, nine of the ten largest in-orbit insured losses from 2004 to 2023 occurred prior to the spacecraft being fully deployed, and cost insurers nearly $2.5bn. Operators are likely to have suffered significantly larger uninsured losses. Not all satellites are insured to their full value, but more importantly the insurance generally only covers replacement cost and does not take into account the consequential losses arising from lost revenues, delay, and breached contracts, let alone the intangible costs of a damaged reputation.

Recent cases illustrate the diversity of on-orbit anomalies and the magnitude of insured losses. The Large Deployable Antenna on Viasat-3 F1 did not deploy, leading to a $400 million insurance claim (Rainbow, 2024). Intelsat-28's West C-band antenna reflector failed to deploy, resulting in a $146 million insurance claim and a significant loss of capability (Cavaciuti, Heying, & Davis, 2022). Société Européenne des Satellites (SES) experienced a launch anomaly affecting SES-14's trajectory, resulting in the need to deplete propellant reserves intended for standard orbital operations (Cavaciuti, Heying, & Davis, 2022). Sirius XM's SXM7 experienced a technical failure during on-orbit checkout fewer than two months after launch, resulting in the loss of the $220 million spacecraft (Cavaciuti, Heying, & Davis, 2022).

Limits of remote diagnostics and actions

As things stand, the operational response to an anomaly is typically decided with incomplete information about what actually happened to the spacecraft.

Satellite anomalies are notoriously difficult to diagnose and resolve because operators must rely almost entirely on telemetry, which provides only limited insight into the physical state of a spacecraft. When a failure occurs, telemetry often reveals symptoms rather than root causes, leaving significant uncertainty as to what happened and what corrective actions might be possible.

Consequences for operational decision-making and insurance

The limits of remote diagnostics translate directly into constrained decision-making. Operators must often choose between continued operations, conservative workarounds, or early write-offs based on incomplete information about the satellite's true condition. Recovery opportunities may be missed, while replacement planning and customer mitigation measures are initiated before the severity of the anomaly is fully understood.

For insurers, the same information gap reinforces outcome-based coverage structures. Insurance provides cover for spacecraft on an all-risks basis. Simply put, with a small number of exceptions, such as war or cyberattack, insurers will pay if the spacecraft fails such that it cannot complete its 'intended mission'. As a consequence, neither insurers nor their insureds are able to manage their exposures or the cost of insurance by purchasing cover for some parts of the risk (e.g. losses caused by space weather, or failure of particular components) but not others.

Cover is also on an agreed value basis, so the amount paid is fixed by the policy without the need for the insured to prove the actual value of the loss. The question of repair versus replacement does not arise, and the spacecraft has no scrap value.

Limited visibility into root causes restricts loss analysis, inhibits subrogation[1], and prevents meaningful differentiation between recoverable and unrecoverable failures. As a result, many anomalies are treated as binary events, success or failure, driving reliance on total-loss paradigms and contributing to high premiums and limited market capacity. The market consequence is visible in the numbers: around half (250 of 600) of active GEO satellites carry insurance on an ongoing basis after deployment, and for low-Earth orbit (LEO), even setting Starlink aside, the consensus in the insurance markets is that the figure is around 1%.

WHAT IN-ORBIT INSPECTION AND REPAIR CHANGE

Inspection as uncertainty reduction

In most large-scale infrastructure sectors such as aviation, energy, or civil engineering, visual inspection is a fundamental risk-management tool. It allows operators to monitor

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[1]Subrogation is the insurer's normal route to recover losses from a responsible third party (typically a contractor, supplier, or other liable counterparty) after a claim has been paid. Across the insurance industry it contributes 5–20% of payouts, depending on the line of business. In space it is largely foreclosed for two reasons: identifying fault requires diagnosing a loss that often defied diagnosis in the first place, and supply-chain contracts in space generally contain cross-waivers of liability that extinguish the insured's rights against suppliers. The spacecraft itself, with no scrap value and no practical recovery path, contributes nothing further.

degradation, understand where failures may occur, assess their likelihood, and identify root causes when incidents arise.

In-orbit inspection promises to extend these benefits to satellite operations. The ability to approach a spacecraft and visually observe its condition provides direct evidence of wear, damage, and degradation that cannot be inferred from telemetry alone. It can distinguish between internal technical failures such as structural defects, deployment issues, or component malfunctions, and external events such as debris or micrometeoroid impacts. In some cases, inspection may reveal the nature and severity of such impacts, providing information unattainable through telemetry.

The insights directly inform corrective actions and decisions on repair. In some cases, the inspection may provide sufficient information to resolve the anomaly from the ground. In others, it helps determine whether a dedicated repair mission is technically feasible and economically justified, or whether the anomaly is beyond repair.

Inspection thus reduces the operational risks associated with repair missions. By providing detailed information on spacecraft attitude, structural condition, and the specific anomaly to be addressed, along with identifying any potential hazard, it enables service providers to reduce the likelihood that the repair is unfeasible and design safer and more efficient missions. This enables service providers to identify the required tools and repair procedures in advance, reducing uncertainty in mission planning, and lowering the likelihood of unanticipated complications during servicing.

Finally, inspection data lowers uncertainty surrounding both the asset condition and the likely success of a repair mission. These two parameters directly influence the potential and price of financing the mission. Used as a tool to inform prognostics, inspection provides higher-quality information, enabling more accurate modeling of risk and supporting more precise premium-setting.

Repair as loss mitigation

Repairing satellites in orbit can preserve high-value space assets, reduce mission risk, and avoid the financial and environmental costs associated with replacing failed satellites. The potential benefits include cost efficiency, service continuity, risk reduction, and environmental impact mitigation.

For operators, repair avoids the need for a replacement spacecraft. Replacement would require procurement, manufacturing, and testing of the spacecraft as well as securing a suitable launch vehicle. While the industry is seeing compressed timelines for replacing serialized spacecraft for LEO constellations, for the repair target segment (large, early-life GEO losses) this process typically takes 3–5 years for a complex, high-performing spacecraft. During this time, operators may face substantial revenue loss and service disruptions for customers. Even where an early, first-of-a-kind mission takes as long as building a replacement, repair still delivers value: it recovers a working asset rather than a total loss and avoids the sunk cost of a new spacecraft and launch vehicle.

A servicing mission may restore service quicker, even more so if an ecosystem of standby repair capability becomes available in orbit, limiting downtime and maintaining continuity in critical sectors.

For designers and manufacturers, the prospect of post-launch corrective action reduces mission risk and thus opens the door to new approaches: accepting more innovative or higher-performance designs, streamlining certain aspects of assembly, integration, and testing (AIT), or reducing redundancy levels. This shifts the economics of satellite development and can improve performance-to-cost ratios across fleets.

From an environmental standpoint, a single servicing spacecraft can repair multiple satellites, reducing the total number of replacement satellites that must be built and launched. This directly cuts the mass placed into orbit and the number of launches required. Over time, this reduces launch-related emissions, slows the growth of on-orbit mass, and supports more responsible use of the space environment. By keeping satellites functional rather than discarding them, in-orbit repair aligns with a shift toward more sustainable and circular space activities. The true proportion of anomalies that are technically repairable cannot yet be quantified with confidence, as this would require more granular failure-mode and design data across the fleet than is currently publicly available.

Technical and economic boundaries

NASA's analysis (NASA Goddard Space Flight Center, 2010) highlights that many satellites fail due to common, serviceable issues, including propulsion subsystem failures, mechanical deployment errors, and avionics problems, many of which could be corrected through robotic servicing or modular replacement rather than total mission loss.

Some of these anomalies can be repaired without any prior design-for-servicing features. However, repairability varies widely between satellites; parts are often bespoke, and existing spacecraft were rarely designed with compatibility or standardization in mind.

Furthermore, servicing missions require timely deployment, appropriate tooling, and potentially mission-specific replacement units. For many anomalies, assembling the right capabilities and reaching the affected spacecraft within commercially acceptable timescales remains challenging.

In GEO, the economics of servicing improve significantly because a single servicer spacecraft can reposition efficiently between orbital slots and support multiple client satellites over its operational lifetime. Unlike LEO, where orbital mechanics make plane changes propellant-intensive, GEO's relative stability allows a servicer to conduct sequential missions with comparatively low propellant expenditure.

This multi-client utilization dramatically reduces per-repair mission cost, enables faster response times, and allows operators to benefit from a standing in-orbit capability rather than waiting years for a replacement spacecraft. As a result, the business case for commercial repair is materially stronger in GEO, with higher asset values, longer mission durations, and the ability to amortize servicer costs across several interventions.

Nevertheless, in-orbit repair remains complex and expensive to execute, and current satellite architectures were not developed with servicing in mind. As a result, some anomalies are not practically recoverable today, limiting the volume of viable early missions needed to mature the market.

FINANCING INSPECTION AND REPAIR MISSIONS

Despite the strong technical and economic rationale for in-orbit inspection and repair, several barriers continue to limit widespread adoption. The most immediate challenge is that in-orbit repair is expensive (tens of millions of dollars for a single repair mission) and there is no guarantee of success. At present no party has both the risk appetite and the obvious incentive to fund it.

Operators and their insurers

At first glance, the most obvious candidate to pay for in-orbit repair would be the operator, their insurers, or a combination thereof. The operator stands to recover a valuable capital asset, and to staunch the flow of revenue and other consequential losses, while insurers stand to recover some or all of the substantial payout they may have made.

However, at least for now, this is not happening. Insurance, despite being built around the management of risk, prefers to look to the past as a predictor of future performance. The absence of repeated, commercially successful repair missions in GEO or LEO makes operators and their insurers unwilling to risk tens of millions of dollars on a repair perceived as uncertain in circumstances where they have already suffered a very large loss.

Parallels with marine salvage and litigation funding

There are plenty of industries, from litigation funding through to purchasing distressed debts, where funders with deep pockets are prepared to invest substantial amounts of capital up front on high-risk ventures in the hope of a high reward. The economics are typically defined before the loss or claim crystallizes, and the funder is paid only on success. The two with the most direct relevance to satellite repair are marine salvage and litigation funding.

Marine salvage is the older of the two and the more iconic. It works as an industry because there is enough money to go around for everyone involved to benefit. The salvage service providers need to be paid enough to cover their costs and earn a reasonable return on capital; ship owners and operators (directly, or through their insurers) save on the costs of replacing their vessels and the disruption of having one out of action for an extended period; cargo owners receive their goods with a lesser delay.

Marine salvage dates back several millennia, as far as the ancient Phoenicians, Greeks, and Romans (National Space Society, 2019), and current estimates put the gross revenue for International Salvage Union members at $406 million in 2024 (International Salvage Union, 2025). Most of these services are provided privately, showing the willingness of businesses to invest in the recovery and repair of high-value assets when the legal, regulatory and contractual frameworks are right. The applicable legal and regulatory frameworks are well established. They are governed mainly by international treaties, most notably the International Convention on Salvage, 1989 (International Convention on Salvage, 1989), which superseded and built upon the earlier Convention for the Unification of Certain Rules of Law relating to Assistance and Salvage at Sea, 1910 (International Conventions for the Unification of Certain Rules of Law Respecting Collisions between Vessels and Assistance and Salvage at Sea, 1910).

These frameworks recognize two principal forms of salvage. 'Pure' salvage arises where a vessel is in immediate peril and time is of the essence. It is frequently conducted under well-established standard-form agreements, such as the Lloyd's Open Form (LOF), which provides a mechanism for securing payment. The LOF operates on a 'no cure, no pay' basis, meaning that where the salvage is not successful, the salvors are not entitled to remuneration. A defining feature of this regime is that salvors may intervene without prior agreement with the vessel owner, with remuneration determined ex post through arbitration. Such an approach is not readily compatible with the international legal framework governing outer space activities, which requires prior authorization and operator consent for intervention. The absence of any right to unilaterally "salvage" a space object is a fundamental constraint for this approach to be widely adopted[2].

In contrast, 'contract' salvage involves a pre-agreed contractual arrangement between the vessel operator and the salvor, typically establishing remuneration and risk allocation in advance of the salvage operation. Salvage operators increasingly prefer contract salvage, as the economic risks associated with the 'no cure, no pay' model of the LOF are deemed too uncertain. Given the longer timescales for intervention in space operations and the legal requirement for consent and authorization, contractual approaches are more relevant in the context of space activities.

Environmental protection is a central feature of the modern salvage regime. Under the International Convention on Salvage, 1989, a salvor may be entitled to up to 30% additional compensation toward its expenses, where those efforts have reduced or prevented environmental damage.

Litigation funding is the closer financial analogue. Specialist funders front the costs of complex commercial claims in return for an agreed share of any recovery, paid only on

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[2]A detailed examination of this model is outside the scope of this paper. See, for example, Garretson et al. (Garretson, Anzaldúa, & Davidson, 2019), Steele (Steele, 2020), or Listner (Listner, 2017) on this topic.

success. They do not seek diversification across thousands of small cases; they underwrite individual high-value claims on their own merits, narrow the risk as the case develops, and accept a binary outcome. The market is mature, the contracts are familiar, and the assignment of claims and proceeds is well established in most relevant jurisdictions. The economic shape of a litigation-funded claim (capital fronted on a no-cure-no-pay basis, narrowed over time, repaid out of recovery) maps almost directly onto a satellite recovery, with one practical advantage: a relatively cheap inspection step gives every party in the deal high-quality information before the larger repair commitment is made.

Contract salvage works through bilateral agreements between operator, salvor and insurer, sitting on top of a treaty framework but not requiring it; litigation funding operates entirely under existing private contract law. Neither model needed specific law to get started, and the same is true for in-orbit repair.

A worked example

A crude calculation suggests that there is sufficient margin at stake around satellite repair to make this kind of third-party funding viable, in particular for large geostationary satellites that fail in their early years.

Take, for example, a satellite that cost $600 million to build and launch, has an anticipated lifespan of 12 years, and fails during the deployment phase. $400 million is insured and $200 million is not. A typical fly-by inspection mission in GEO, followed by a repair mission, might cost in the region of $50 million and take around two years to plan and complete. If the mission succeeds, and the satellite functions again, it may be worth, say, $500 million, allowing for a potentially shorter lifespan.

If insurers and the operator funded the recovery proportionally to their share of the recovery, insurers would make a net recovery of $300 million and the operator $150 million on the asset alone, plus whatever additional revenue gains they would have from being operational again within two years, rather than the three to five it would take for a new satellite.[3]

If third-party funds were used to fund the $50 million on a no-cure-no-reward basis, the funders would expect a significant return. There are parallels with the litigation funding industry here; the sums involved are a similar order of magnitude, and the risks are high, but can be narrowed over time, as the case progresses with litigation funding, and following in-orbit inspection here.

If, following inspection, there is, say, a 65% chance of a repair being successful, a 200% return over a two-year period would not be unreasonable. On success, the operator keeps the working satellite and the funders' and insurers' shares are settled in cash against its $500 million restored value. The funders are paid first, taking $150 million on their $50

[3]A clear benefit in timeline between repair and replacement might require servicing vehicles to be stationed on orbit.

million commitment. The insurers recover $250 million of their $400 million payout, reducing their net cost from $400 million to $150 million. The operator absorbs the residual, leaving them $100 million down rather than the $200 million of uninsured loss they would otherwise have suffered.

If the mission fails, the funders forfeit their $50 million; the insurer is no worse off than under the current regime, having already paid the claim, and the operator is no worse off either; the asset was already a total loss. The picture remains workable on tougher assumptions: a lower conditional success rate would push the funder's required multiple up and narrow the operator's surplus, but it would not eliminate the case for negotiating the deal in the first place.

Immediate application to space

In the context of space, the absence of an international regulatory framework is no barrier to the adoption of this type of approach. The logistics would be down to a private contractual agreement between the financiers, the operator and its insurers, and the in-orbit servicer.

In practice, the deal can be assembled from four contractual building blocks, each with a mature equivalent in adjacent industries:

— A pre-launch servicing option in the insurance policy. An endorsement that preserves the operator's and insurer's right to attempt repair following an anomaly, defines who controls that decision, and clarifies that pursuing repair does not prejudice the loss claim. Drafted up front, it removes the negotiation friction that would otherwise delay action at the moment a loss occurs.

— A post-loss assignment of subrogation rights to the funder. Once the insurer has paid the claim, it acquires whatever rights of recovery exist against the asset. Those rights can be assigned, in whole or in part, to a third-party funder in return for funding the mission. The mechanics are no different from the assignment of legal claims in commercial litigation finance.

— A staged, no-cure-no-reward agreement with the servicer. Stage one is inspection, at a fixed price against a defined data deliverable. Stage two is repair, priced as a success fee against a pre-agreed schedule of restored capacity, payable from the recovery pool, so the funder's return is realized only if the mission succeeds. Some of that repair-stage risk can also be shared with the servicer — for example through a partial success-fee element — particularly where the servicer holds better information than the funder about technical feasibility at the point of contracting. Staging in this way bounds the funder's downside to the inspection cost if the asset turns out not to be recoverable and lets all parties make the repair decision against real information rather than telemetry alone.

— A litigation-funding-style recovery waterfall. A simple matrix that translates restored capacity into payouts to each party at defined thresholds, for example 25%, 50%, 75% and full restoration. This functions in the same way as LOF arbitration: it removes post-event negotiation, anchors expectations, and makes the deal underwriteable.

As with marine applications, a pre-contracted salvage agreement signed prior to launch would be the more efficient long-run option for high-value satellites, and removing or amending clauses restricting salvage in insurance contracts up front is likely to make the process easier. However, it is not a prerequisite for action, as all necessary agreements can equally be put in place after the loss has occurred.

The true constraint on this financing model is not a legal one. It is the absence of demonstrated in-orbit servicing capability and a track record of successful repairs. The earliest adopters will take the biggest risks for the biggest returns, but the financing wrapper proposed here is something the industry can build now, so that when the technical capability arrives, the commercial machinery is ready to use it.

SCALING BEYOND BESPOKE DEALS

The financing mechanism and contractual machinery set out above can be assembled today for a one-off, high-value recovery. However, moving from one-off deals to a recurring market will be aided by clearer demand signals, standard design practices that make satellites easier to inspect and repair, more efficient infrastructure, and the financial templates that turn each individual deal into a precedent for the next.

At the system level, the commercialization of in-orbit repair is hindered by the lack of governmental push, sustained funding, or regulatory leadership. While government programs and technological demonstrations (such as those sponsored by DARPA) show promise, these efforts have not yet translated into a mature, market-ready servicing ecosystem. The problem is chicken-and-egg. In-orbit service providers struggle to raise capital to build standby capability without a clear demand signal that the missions will materialize, and operators have little reason to commission service-ready designs without an in-orbit capability to use. Regulation offers few incentives to break the loop on either side, and the up-front cost of designing for serviceability adds further friction.

Financial models

A central opportunity lies in developing integrated models in which insurers, operators, and servicing providers collaborate to reduce the financial impact of spacecraft failures. In higher-value missions, insurers may be able to support repair-first approaches through structured mechanisms that reward successful anomaly resolution and share the benefits of avoided total-loss payouts.

These frameworks could include risk-sharing agreements, contingent repair awards, or 'litigation-fund-style' funding models in which third-party capital finances repair missions in return for a portion of any recovered claim value. Such structures allow insurers to reduce volatility, give operators faster restoration paths, and create predictable demand for servicing providers.

Future insurance policies could embed servicing-related provisions directly into coverage terms. Pre-agreed repair clauses, salvage-style awards, and modular compensation schedules offer ways to streamline decision-making the instant an anomaly occurs. By establishing the economic rules in advance, similar to how Lloyd's Open Form functions in maritime salvage, operators and insurers can reduce uncertainty, accelerate servicing decisions, and lower overall mission risk. Over time, these contractual innovations could evolve into standard industry templates once early missions build confidence and operational norms.

Regulatory incentives and industry standards

Current space-sector regulations offer little incentive for life extension or repairability. Engagement with national space agencies, licensing authorities, and international bodies will be required to create rules that balance safety, sustainability, and commercial viability. Clear regulation also strengthens investor confidence, enabling capital formation for servicing infrastructure.

Regulatory bodies could support servicing through incentives for life extension, standardized interfaces, and certification pathways for repair-capable satellites. Inspection and repair directly support long-term space sustainability by reducing debris creation, deferring replacement launches, and slowing GEO graveyard growth. Policymakers and regulators could integrate servicing into broader sustainability strategies, such as debris-mitigation requirements, end-of-life management protocols, or incentives for life extension. Positioning servicing as part of a circular-economy model for space operations may also attract public and governmental support.

To scale the repair market beyond a small set of bespoke missions, the industry will also need common design practices enabling safer and more efficient servicing. These may include modular components, robotic-compatible interfaces, standard grappling fixtures, and accessible power and data ports.

Early progress is likely to come through voluntary adoption by high-value commercial operators and through government procurement requirements. Establishing incremental and interoperable design standards will gradually expand the proportion of anomalies that are technically repairable, improving both insurability and economic feasibility.

The building blocks set out in Section 4.4 are sufficient to put the first deal in place, but there is no established space law framework for in-orbit servicing or repair. Operators and servicers therefore remain reliant on bespoke contractual arrangements for liability, access, and compensation. The bespoke model works for the first few deals, but it does not scale: each transaction reopens questions about how costs, responsibilities, and potential secondary damage should be allocated, and that drag is felt by every party in the deal. Standard templates, comparable precedent, and a more developed body of accepted practice would all reduce the friction. None of this changes the conclusion that a first deal can be done today using the building blocks already described. It will, however, make the tenth, hundredth, and thousandth deal materially cheaper than the first.

In-orbit infrastructure

Commercial viability improves substantially with multi-mission servicing assets in orbit, particularly in GEO. Future models may include pre-positioned servicers, refueling depots, and shared tooling or modular parts depots. These capabilities reduce deployment timelines, amortize costs across multiple missions, and provide the responsiveness required for economically attractive repair operations. Insurers and operators may consider co-funding such infrastructure where it demonstrably reduces loss exposure and enhances fleet resilience.

CONCLUSION

Satellite inspection and repair represent not just an engineering capability, but a structural shift in how risk is managed, financed, and mitigated in orbit. Today's insurance model is shaped by limited diagnostics, high uncertainty, and an assumption of irreparability that drives high premiums, restricts market capacity, and leaves satellite operators exposed to long replacement timelines and significant revenue loss. Introducing reliable in-orbit inspection and viable repair pathways directly addresses these constraints, reducing uncertainty, improving recoverability, and enabling insurers to move from simply paying for losses to actively avoiding them.

As the case studies illustrate, the financial stakes are substantial and the operational impacts profound. Even partial restoration of a high-value asset can transform a total-loss event into a recoverable mission, benefiting operators, insurers, and the wider orbital environment. By integrating inspection and repair into spacecraft design, regulatory frameworks, and insurance contracts, the sector can unlock a more resilient and economically efficient approach to managing satellites in GEO and beyond.

Real progress will require collaboration: insurers shaping new contract structures and incentives, operators adopting service-ready design principles, service providers building the capabilities needed for reliable on-orbit intervention, and governments supporting early demonstration missions and the standards work that follows. With coordinated action, the industry can move toward a repair-enabled future, one that reduces loss volatility, supports sustainable use of orbital infrastructure, and strengthens the long-term viability of space operations.

In short, satellite repair is not simply a technological possibility; it is a strategic opportunity. The first deal does not require new laws or new treaties: it requires an operator and its insurers facing a large, early-life geostationary Earth orbit (GEO) loss, a servicer with credible inspection and repair capability, and a third-party funder willing to back a staged, no-cure-no-reward mission against a litigation-funding-style recovery waterfall. Each party comes away with something current arrangements cannot give them: the operator a recovered asset and a faster return to service, insurers a recovery against an otherwise total claim, the servicer a commercially proven mission, and the funder a risk-priced return on capital. Building that first deal now is how the industry prepares for the technical capability that is coming.

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