



On-orbit Servicing and Assurance Engineering

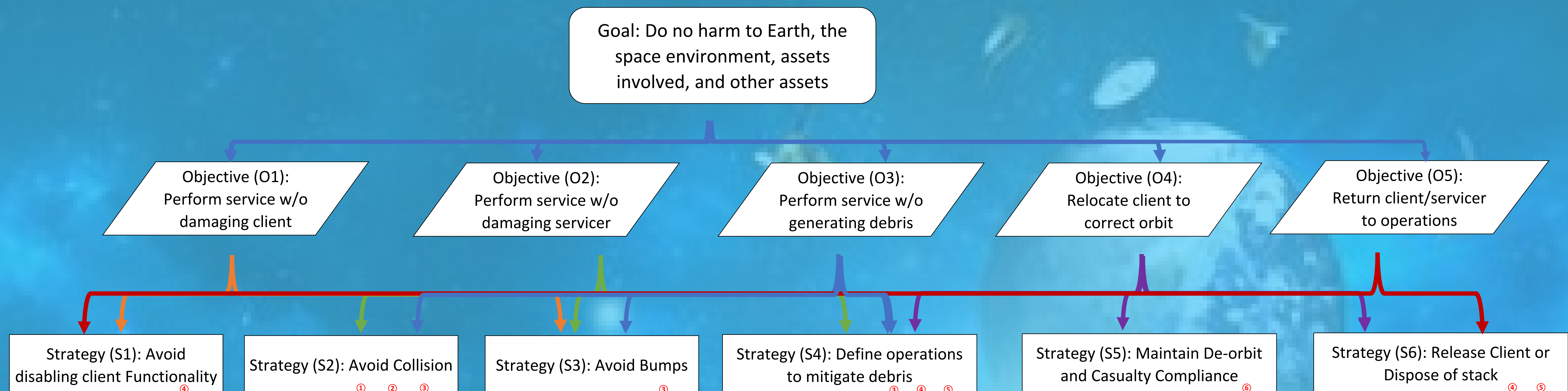
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“Spacekeeping” encompasses actions to maintain and sustain an operational orbital environment, such as on-orbit spacecraft refurbishment (servicing), Space Debris Monitoring, Space Debris/Asset Removal, Fragment/Collision Prevention, and Space Asset Management (Recordkeeping/Care/Servicing/Refurbishment), and space asset/material recycling.

Current Spacekeeping Strategies: Code of Conduct (Policies/Requirements), Design for Servicing/ADR, Servicing, Active Debris Removal (ADR)

How can Assurance Engineering support On-Orbit Servicing/ADR?



For Strategy S1: NASA/ESA/JAXA have or plan to:

- Perform Do No Harm FMECA/FT of Servicing/ADR operations
- Inspect Client/Debris from Ground, Telemetry, or On-orbit to determine current state (Attitude, damaged/dangling equipment)
- Conduct Aging (systems/material) analysis of Client/Debris
- Conduct Maintainability Analysis
- Develop Operations and Capture plans

With knowledge of:

- Grapple capture methods/limitations
- Debris/Client's design (serviceability) and current state
- Operations critical events and fault tolerance
- Doing Nothing Cost/Risks and insurance limitations
- Servicer capabilities including fail-safes/overrides
- System/part failure rates and expirations
- Existing serviceability technology of client/debris

For Strategies S2 and S3: NASA/ESA/JAXA have or plan to:

- Perform Operations Process FMECA/FT or STPA Hazard Analysis of Servicing/ADR operations
- Perform Probabilistic Risk Assessments (PRA) of all or critical events (rendezvous-capture)
- Inspect Client/Debris from Ground, Telemetry, or On-orbit to determine current state (Attitude, damaged/dangling equipment)
- Develop Operations and Capture plans
- Estimate via testing/modeling debris/break-up results from bumps/ collision and perform Causality Analyses

With knowledge of:

- Grapple capture methods/limitations
- Debris/Client's design (serviceability) and current state
- Operations critical events and fault tolerance
- Doing Nothing Cost/Risks and insurance limitations
- Servicer capabilities including fail-safes/overrides
- System/part failure rates and expirations
- Client/Debris material aging

For Strategies S4: NASA/ESA/JAXA have or plan to:

- Perform Operations Process FMECA/FT or STPA Hazard Analysis of Servicing/ADR operations
- Inspect Client/Debris from Ground, Telemetry, or On-orbit to determine current state (Attitude, damaged/dangling equipment)
- Conduct Aging (systems/material) analysis of Client/Debris
- Conduct Maintainability Analysis
- Develop Operations and Capture plans
- Estimate via testing/modeling debris generation results from operations

With knowledge of:

- Grapple capture methods/limitations
- Debris/Client's design (serviceability) and current state
- Operations critical events and fault tolerance
- Doing Nothing Cost/Risks and insurance limitations
- Servicer capabilities including fail-safes/overrides
- System/part failure rates and expirations
- Existing serviceability technology of client/debris

For Strategies S5 and S6: NASA/ESA/JAXA have or plan to:

- Assess De-orbit Probability, Duration, and Survivability
- Perform orbit analyses of stacked and unstacked configurations (orbit parameters and impact location)
- Inspect Client/Debris from Ground, Telemetry, or On-orbit to determine current state (Attitude, damaged/dangling equipment)
- Develop Operations/Disposal plans (maneuvers/release)
- Perform Causality Analyses

With knowledge of:

- Stacked and unstacked mass and maneuverability
- Debris/Client's design (serviceability) and current state
- Operations critical events and fault tolerance
- Doing Nothing Cost/Risks and insurance limitations
- Servicer release capabilities including fail-safes/overrides
- System/part failure rates and expirations
- Client/Debris material aging