

Rideshare Mission Assurance on Multi-Payload Missions



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Introduction

- Given the decreasing cost and increasing capabilities of small (<250Kg) spacecraft, the traditional One Satellite, One Launch mission is no longer a guarantee
 - *There are an increasing number of missions that are including rideshare partners, including launches in the NSS realm*
- An established method of assessing mission risks across programs with differing levels of risk tolerance is becoming essential
- Rideshare Mission Assurance allows multiple programs with vastly different risk tolerances to share a single launch
 - *Especially useful when the organization responsible for certifying the entire mission does not have a Mission Assurance role for all of the spacecraft on the mission*

Rideshare Mission Assurance/Do-No-Harm

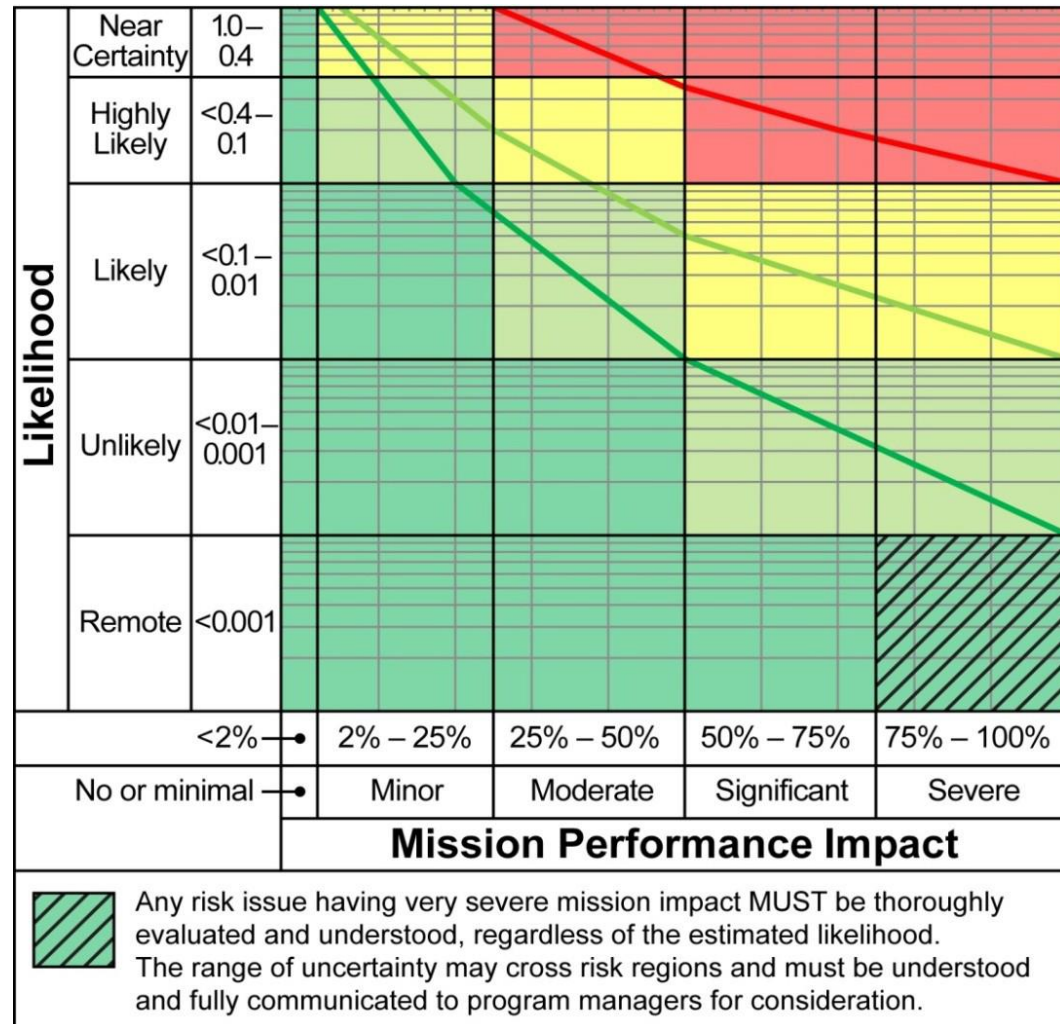
Where did it come from?

- The AFSPC-4 mission included an SMC primary payload (GSSAP) and an AFRL provided APL (ANGELS)
- This created a clash of cultures between a traditionally risk averse primary payload and a much more risk tolerant APL
 - *This forced the development of a hybrid mission assurance system that would allow all mission partners to accept mission risks independently*
- Rideshare Mission Assurance/Do-No-Harm (RMA/DNH) is a process by which risk acceptance can be downwardly delegated to the lowest possible authority for a given rideshare partner
 - *Allows mission partners to accept all self induced/programmatic risks without having to evaluate any circumstances beyond their direct control*

Rideshare Mission Assurance/Do-No-Harm

What Is It?

- A process that focuses on insuring that no payload on a rideshare mission will negatively affect the on-orbit functionality of any other payload.
- The Aerospace risk identification and capture process is unchanged
 - *Guides which of the identified risks require further effort/mitigation*



RMA/DNH does NOT take into account the on-orbit functionality of the payload being assessed

Rideshare Mission Assurance/Do-No-Harm

Cradle to Grave process

Design

- Design Loads
- Electrical inhibits

Build

- Implementation of design criteria and military standards

Test

- Qualification regimen
- Appropriate margin

Launch Integration

- De-confliction of joint operations

Launch

- Deployment sequence

Operations/ End of Life

- Safing
- Disposal
- Deorbit

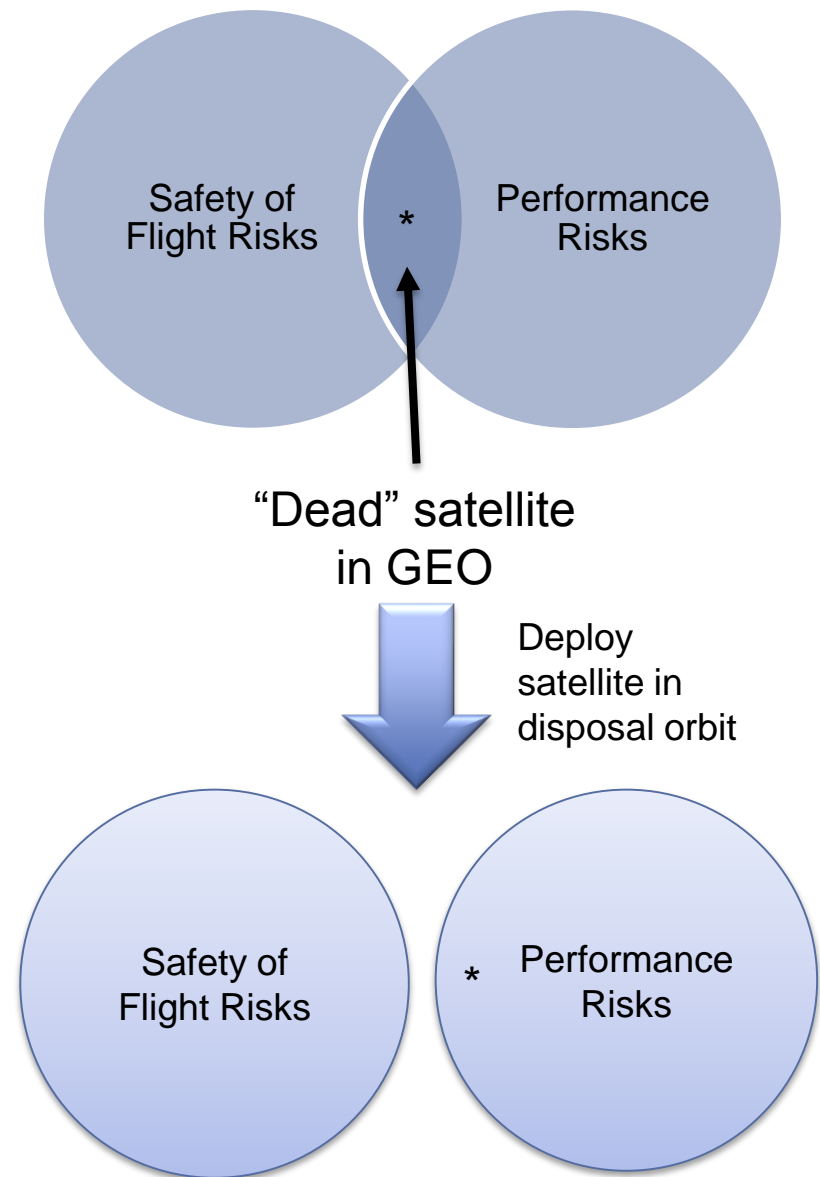
Mission Unique Risks

- RMA/DNH allows Mission Managers to break all payload related mission risks into two categories
 - *Payload Mission Success*
 - *Safety of Flight*
- Payload Mission success risks are accepted by each individual payload's Risk Acceptance Authority
 - *These risks only affect the functionality of an individual payload*
 - *Risks that are generally considered “mission assurance”*
- Safety of Flight risks are accepted by the mission team as a whole
 - *Only risks that pose a threat to the mission from the start of launch processing until SV separation*
 - *Risks that are generally considered “space safety”*

Mission Unique Risks

Overlapping and separating risks

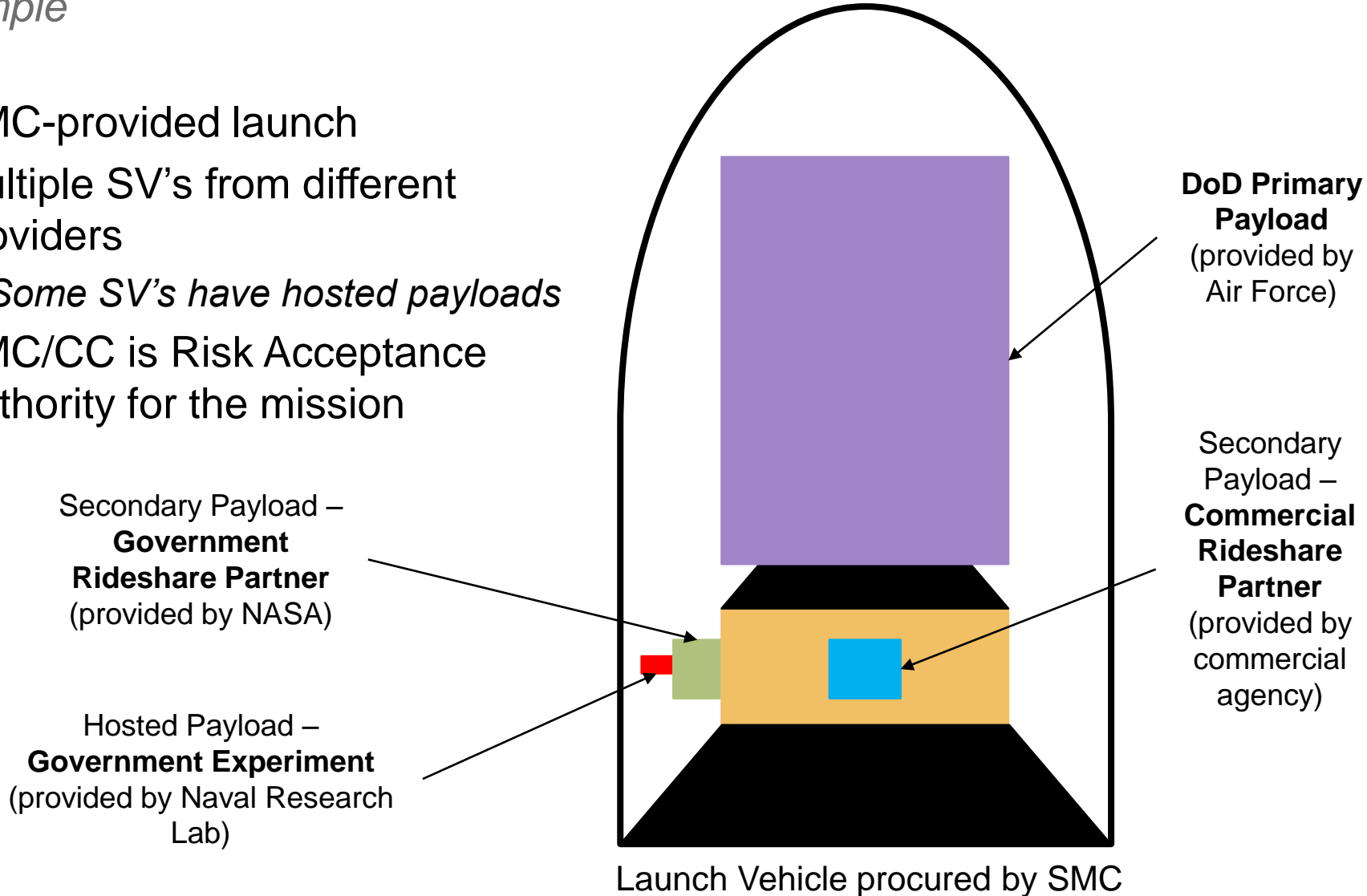
- Some risks are clearly “safety of flight risks”
 - *Underqualified bus structure*
 - *Weak inhibit strategy, etc.*
- Some risks are clearly “performance” risks
 - *Solar Array not power-positive*
- Some risks overlap
 - *Unable to control a SV in active GEO orbit*
- Good engineering can help separate risks
 - *Separating risk-tolerant SV into GEO disposal orbit*
 - *Once SV checkout is complete, SV moves to GEO orbit*



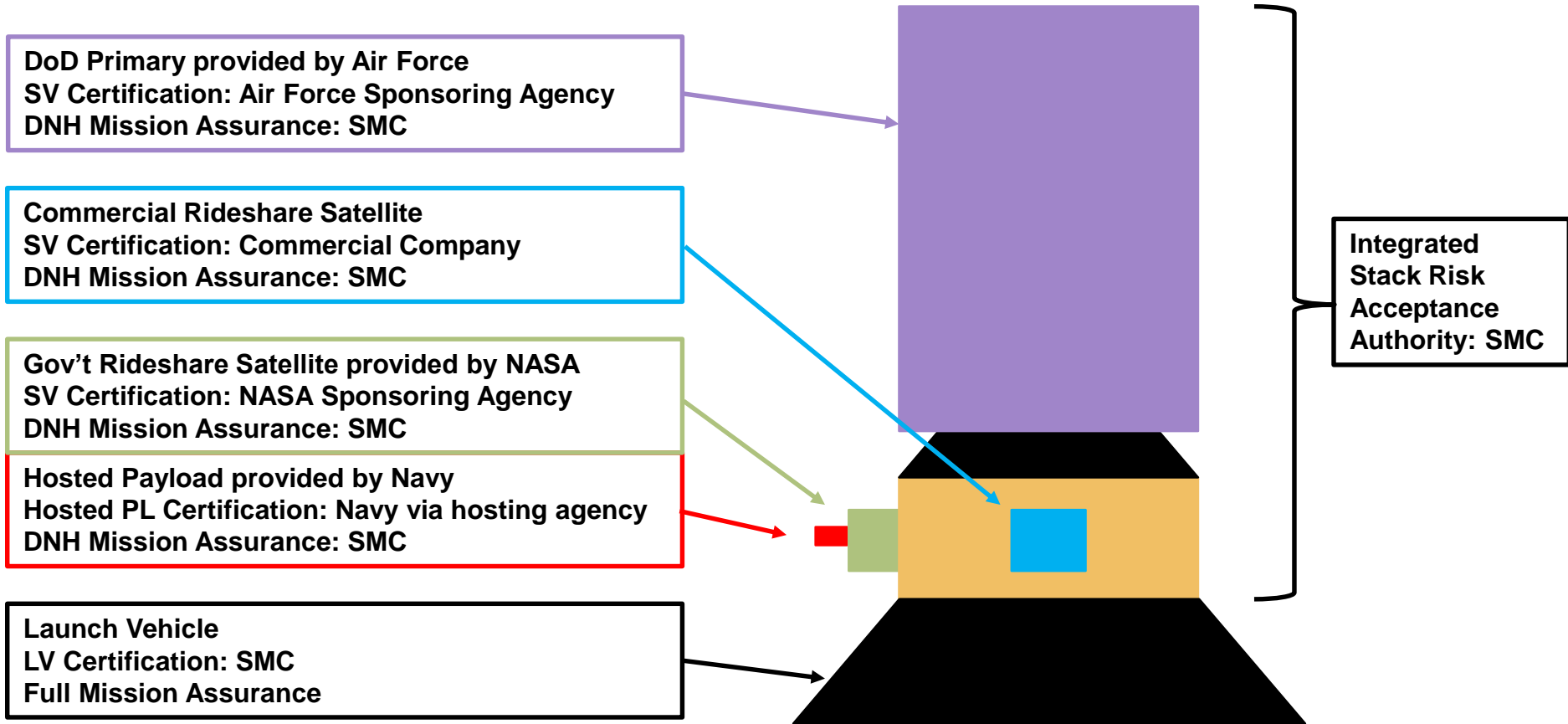
Rideshare Mission Assurance/Do-No-Harm

Example

- SMC-provided launch
- Multiple SV's from different providers
 - *Some SV's have hosted payloads*
- SMC/CC is Risk Acceptance Authority for the mission



Rideshare Mission Assurance/Do-No-Harm Certification



Rideshare Mission Assurance/Do-No-Harm

Summary

- Each agency provides its own Mission Assurance and certification letter for their own spacecraft
 - *Verification artifacts are provided with the certification letter to provide inputs to the DNH analysis*
- SMC with Aerospace support provides the Do No Harm mission assurance assessment for the payload stack
- SMC/CC will provide certification for the mission as a whole

Rideshare Mission Assurance/Do-No-Harm

Expanded System Example: STP-2

- The STP-2 Mission
 - 2 *Co-prime Missions*
 - DSX – Provided by AFRL
 - Formosat-7/COSMIC-2 – Provided by NSPO (Taiwan) with US Air Force instruments
 - 6 *Auxiliary Payloads*
 - NASA
 - Surrey Satellite Technologies US
 - Georgia Tech
 - Michigan Tech
 - US Air Force Academy
 - Naval Postgraduate School
 - 24*U of Cubesats*

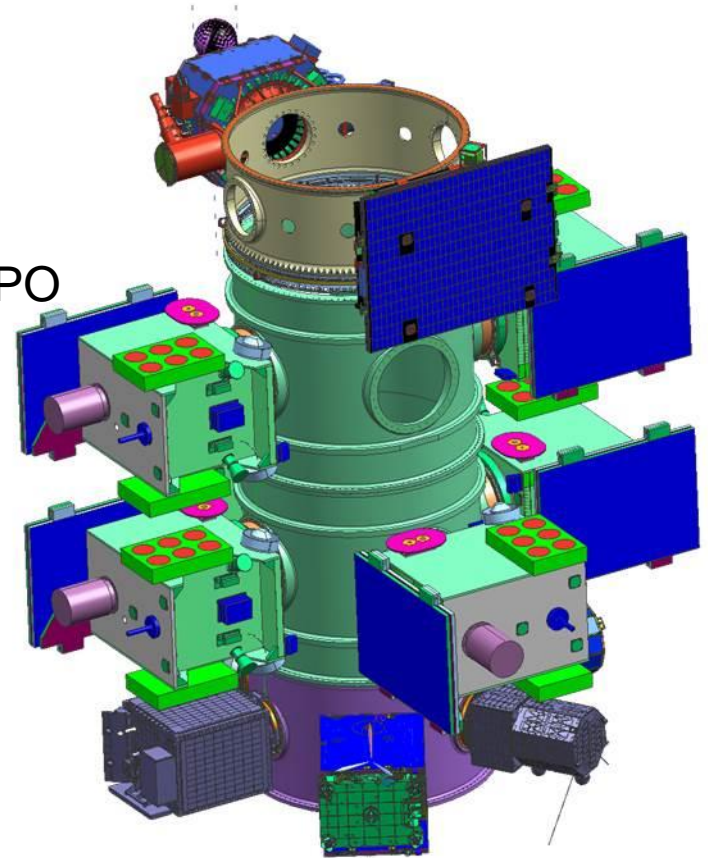


Photo courtesy of SpaceX

DNH Relevant Testing

- Random Vibration
 - *Generally tested to proto-qual (MPE +3dB)*
- Acoustic
 - *Also tested to proto-qual*
 - *Can be waived if SV does not have acoustically driven components*
- Shock
 - *Measured against industry standard 50in/sec line*
- Outgassing & Contamination
 - *Primary concern is to protect optics*
- EMI/EMC
 - *Focused on ground operations in co-processing facilities*
- Inhibits
 - *Three required for all critical functions*

Lessons Learned

- RMA / DNH process must be agreed to early in the program
 - *I&T methods must be detailed to the program office to ensure that sound designs are not compromised by inadequate processes*
 - *All post test changes to the SV (Component Remove & Replace, new/differing payloads etc) must be vetted by the Rideshare Mission Assurance authority PRIOR to implementation*
- Adequate “do no harm” test levels not always clear cut
 - *For STP-2, the Falcon Heavy has not yet launched, so environments are uncertain*
 - *Many secondary / rideshare spacecraft are designed and sometimes built before a launch vehicle is identified*
 - Assumptions must be made about launch loads / environments
 - Conservative assumptions drive cost; relaxed environments drive risk

Conclusion

- Rideshare Mission Assurance/Do-No-Harm allows mission partners to accept all internal risks at the program level while elevating only the safety risks to the mission level
- The RMA process as developed by Aerospace is currently being implemented and refined on both STP-2 and an upcoming Air Force Space Command mission

Questions?

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