

ALSET – Air Launch System Enabling Technology R&D Program



Mr. Takashi Arime, Mr. Seiji Matsuda, Mr. Masanori Sugimine, Mr. Jun Yokote
IHI AEROSPACE CO., LTD. | t-arime@iac.ihl.co.jp | Tomioka-shi, Gunma, Japan

Mr. Takayoshi Fuji, Mr. Kenji Sasaki
Institute for Unmanned Space Experiment Free Flyer (USEF) | fuji@usef.or.jp | Tokyo, Japan

Mr. Dominic DePasquale
SpaceWorks Commercial | dominic.depasquale@sei.aero | Washington, D.C., U.S.A.

Mr. Hideki Kanayama, Mr. Mitsuteru Kaneoka
CSP Japan, Inc. | kanayama@csp.co.jp | Tokyo, Japan

Contents

- Introduction
- Objectives
- Technology Roadmap
- Overall Concept
- Air Launch Method Selection
- Trade Study Result
- Test Range Selection
- Aircraft Selection
- Conclusion

Introduction

Background

Small satellite is increasingly becoming popular in world wide in late years. With the expectation of rapid growth of small satellite market in the future, METI* initiated new launch system R&D project called ALSET, Air Launch System Enabling Technology in April 2009.

* Ministry of Economy, Trade and Industry

Air Launch System Enabling Technology (ALSET)

ALSET project is carried out by USEF, IHI Aerospace, CSP Japan, Kawasaki Heavy Industries and Fujitsu. This project aims to build air launch concept to provide higher flexibility and responsiveness to meet the launch needs from emerging small satellite market, and also, to demonstrate key technologies of the new launch system to validate its feasibility for future commercialization.

Objectives

ALSET Objectives

The research and development thoroughly covers issues for new launch system and it consists of six sections.

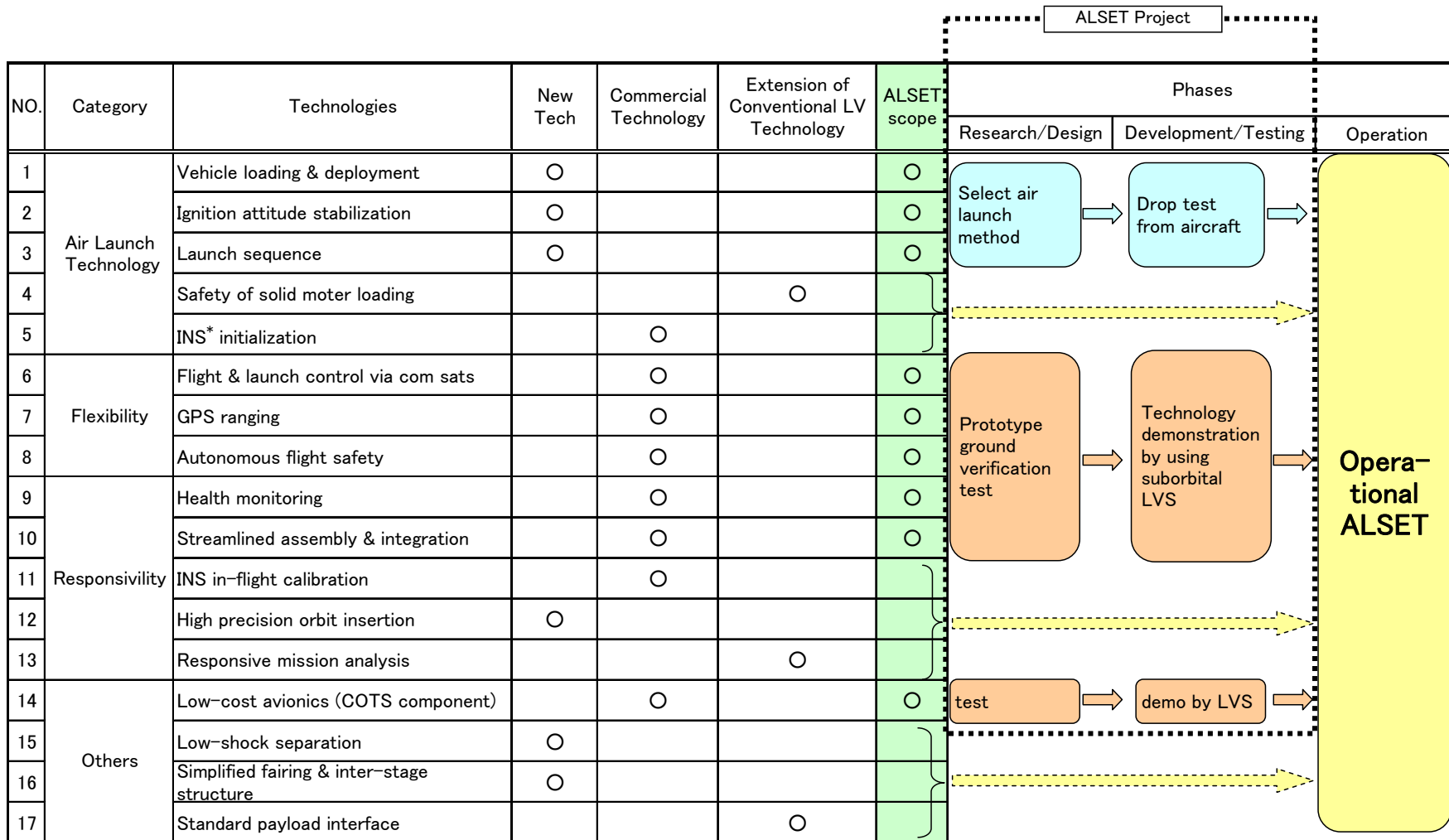
- (1) Air launch system overall concept study
- (2) Air launch method selection and technology research
- (3) Air launch system operation study
- (4) GPS ranging and satellite-based TT&C* study and feasibility validation
- (5) Low cost and light-weight avionics
- (6) Legal, regulatory and safety standards necessary for a new launch system

* TT&C : Telemetry, Tracking and Command

Areas (1), (2), and their progress in JFY2010 are illustrated in the paper.

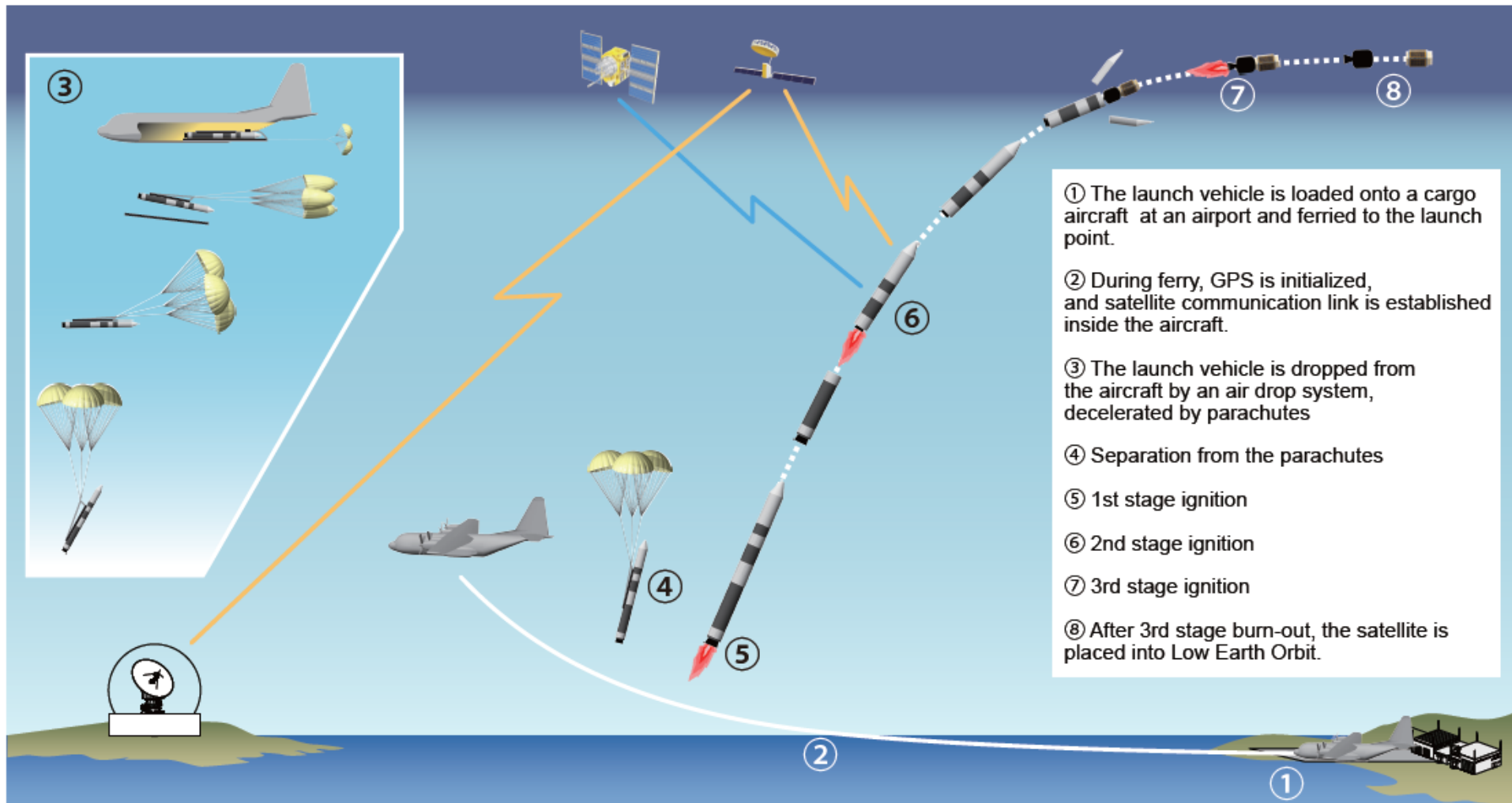


Technology Roadmap

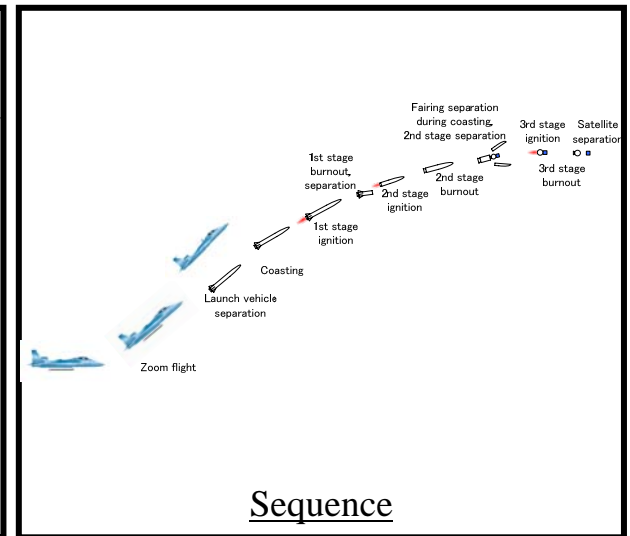
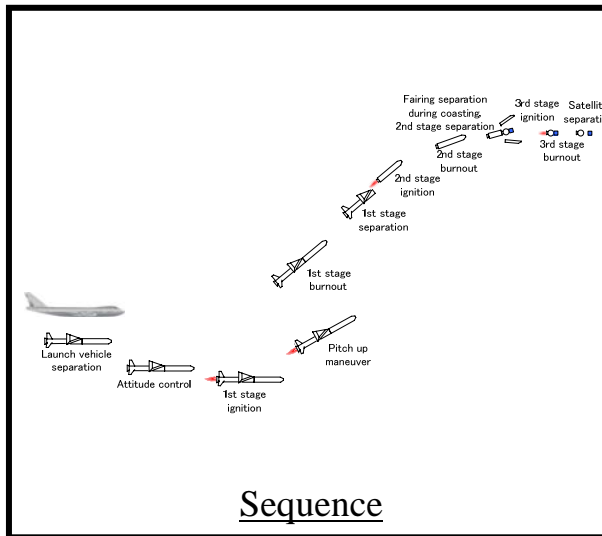
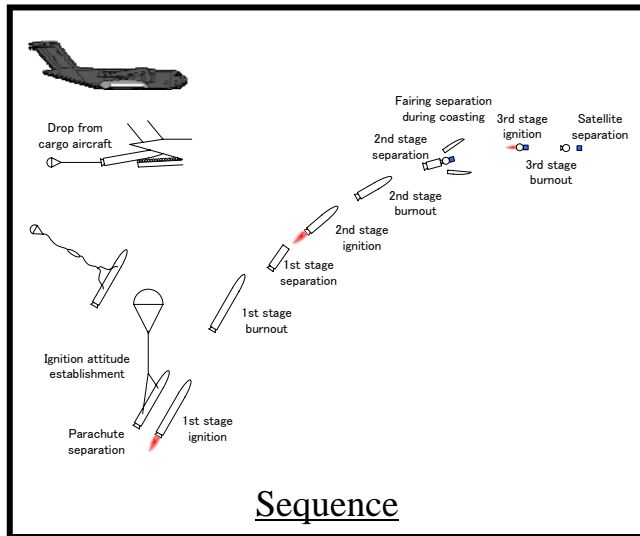


*Inertial Navigation System

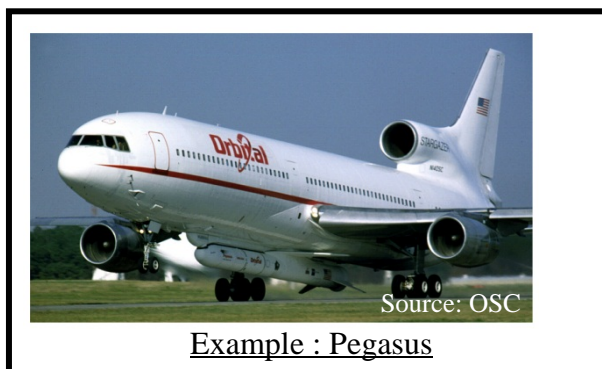
Overall Concept



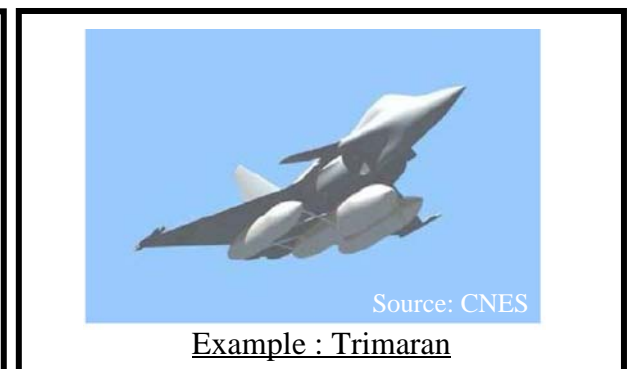
Air Launch Method Selection



Air drop



Subsonic horizontal



Supersonic zoom

Trade Study Result

Air Launch Method	Air Drop	Subsonic Horizontal Air Launch	Supersonic Zoom Launch
Development Risk	○Low development risk <ul style="list-style-type: none"> •Using aircraft with cargo and air drop capability, modification to the aircraft is unnecessary, especially using Type-V platform 	△High development risk <ul style="list-style-type: none"> •Need to develop new mechanical interface to carry the launch vehicle externally 	△ <ul style="list-style-type: none"> •Same as on the left
Schedule	○Low schedule risk <ul style="list-style-type: none"> •Due to low development risk 	△High schedule risk <ul style="list-style-type: none"> •Due to high development risk 	△ <ul style="list-style-type: none"> •Same as on the left
Cost	○Low cost risk <ul style="list-style-type: none"> •Due to low development risk 	△High cost risk <ul style="list-style-type: none"> •Need to design/manufacture/verify aircraft modification 	△ <ul style="list-style-type: none"> •Same as on the left
Aircraft Availability	○Many candidates <ul style="list-style-type: none"> •Can select many types of aircraft which equips platform delivery system 	△Specific aircraft <ul style="list-style-type: none"> •Need to design/manufacture/verify aircraft modification for each aircraft due to aerodynamic interference 	△ <ul style="list-style-type: none"> •Same as on the left
Other	<ul style="list-style-type: none"> △Range restriction by disposal (parachute, platform, etc) △Possible to occur attitude error before 1st stage ignition △Altitude limitation for crew environment 	<ul style="list-style-type: none"> ○No or few disposal ○Few attitude error possibility before 1st stage ignition △Need to consider weather condition because of external carry 	<ul style="list-style-type: none"> •Same as on the left
Launch Vehicle Size (separation condition)	Total weight : 15ton class (altitude 7km, velocity 0m/s)	Total weight : 12ton class (altitude 12km, velocity mach0.8)	Total weight : 9ton class (altitude 15km, velocity mach1.5)

Test Range Selection

Range	Range Test Organization	U.S. Location	Favorable for ALSET	Summary
Yuma Proving Ground	Yuma Test Center (YTC)	AZ	○	Good candidate test site experienced with ALSET type of drop test.
Edwards Air Force Base	Air Force Flight Test Center (AFFTC)	CA	○	Good candidate test site experienced with ALSET type of drop test.
Eglin Air Force Base	Air Force Operational Test and Evaluation Center	FL	×	Drop over land likely not possible.
China Lake and Point Mugu	Naval Air Warfare Center	CA & Pacific	△	Have capability but not as well suited as YPG or EAFB for ALSET drop.
Ronald Reagan Test Site	Kwajalein Range Services, LLC	Pacific	×	Inconvenient for aircraft and complications of ocean drop



The drop test will be conducted in the US in CY 2013.

Aircraft Selection

Aircraft	Provider(s)	Payload (Metric Tons)*	Favorable for ALSET?	Summary
C-130A	Commercial Provider (USA)	15.9	○	Good candidate aircraft, though older model. Available commercially.
C-130E/H/J	US Air Force (USA)	19.1	○	Good candidate aircraft
C-17A	US Air Force (USA)	77.5	○	Good candidate aircraft. Likely more difficult to obtain than C-130
L-100 (L-382)	Commercial Provider (USA)	21.8	×	The commercial provider cannot support ALSET drop test
C-5A	US Air Force (USA)	122.5	×	Decertified for air drops by the USAF
IL-76	Commercial Provider (UAE)	46	×	Unfavorable complexity of overseas provider and non-US aircraft
AN-124	Commercial Provider (UAE)	120	×	Unfavorable complexity of overseas provider and non-US aircraft



Conclusion

- ✓ ALSET objective and concept are introduced.
- ✓ The air drop method using PDS was selected for the ALSET drop test.
- ✓ Yuma Proving Ground and Edwards AFB were selected as the most suitable U.S. test ranges.
- ✓ The C-130 and C-17 were selected as the most promising carrier aircraft.