

Providing Low Cost Access to Space

SUSTAIN Conference briefing February 2009

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2009	PORT DATE 2. REPORT TYPE N/A		3. DATES COVERED		
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER	
XCOR AeroSpace Providing Low Cost Access to Space				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) XCOR Aerospace				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFIC	17. LIMITATION OF	18. NUMBER	19a. NAME OF		
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	– ABSTRACT UU	OF PAGES 14	KESPONSIBLE PERSON

Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39-18



Company Status (XCOR in 60 sec)

- Founded in 1999
- Located at Mojave Air & Spaceport
- Ten different rocket engine designs with over 3,500 firings
- Two generations of rocket powered vehicles built and flown
- Now designing Sub-Orbital Lynx & Lynx II space craft
- Funded by angel investors and revenues (\$2-3MM/yr)
- Customers : NASA, U.S. Air Force, SpaceX, Private Clients, ATK (NYSE: ATK) , Aurora Flight Systems, NRO, DARPA





Small Satellite Launch



Operating Advantages Lynx and Lynx II

- Engine Technology
- Low cost / low weight
- High reliability
- Highly re-usable
- Environmentally friendly fuels
- <u>Operational Advantages</u>
- Extremely low cost (\$95K/flight RETAIL)
- Capable of 4 flights/day
- Available < four hours notice
- Multiple mission capability
 - -- passenger, scientific, recon, payload launch





OTHER MISSIONS





Other missions relevant to DoD

Surveillance Mission

- Pop-up Reconaissance
 - Easy to transport anywhere in world and fly (6-8000 ft of runway needed)
 - Fly unpredictable times, multiple times per day, cheaply!

Small Satellite Launch

- Mark 2 with upper stage
 - Re-usable launcher, with small expendable upper stage (priced ~\$500,000 / launch)
 - Lead time (standard payload interface) <3 days
 - 10kg payloads

Technology Demonstration

- Use of Lynx to augment other programs
 - Improve TRL of subsystems before inserting in to "bigsat" programs
 - Avoiding ONE failure or substantial program slip pays for the whole Lynx program many-fold



UPDATE - Progress In Last 30 Days

•Further test firings of 2800 lbf LOX/Kerosene Lynx engine

•First successful "all-up" test of cryogenic multicylinder piston pump

•Engineering test article of Lynx cockpit being fabricated in shop now









SUSTAIN & Similar Missions

- XCOR may have a role to play in elements of such a system (lauchers and related subsystems such as propulsion)
- In XCOR's view, neither we, or anyone else, will be building the One True Vehicle that fulfills this mission
 - If thought of as a VEHICLE, SUSTAIN is like trying to incorporate a MAU (troops, ship, assault craft, helicopters...) in one set of requirements
 - But viewed as a SYSTEM, no other military transport need from CONUS to target is done by single vehicle either!
- Therefore, a few thoughts on possible architecture



How to get there?

Disaggregate Requirements

- The less you require any one piece of the system to do, the easier that piece is to build. You can always explore "combined" functions later, AFTER you have the end-to-end system working
- Whenever you don't have the TRL or \$\$ to do the big thing, do a smaller thing – repeat until done
 - People are indivisible; squads are not
 - Minimum unit in WW2 bombing was 8-20 aircraft to get the job done; but we never built the 32-80 engine B-117 "flying battlestar"
 - Minimum "quantum" of insertion probably 2 people "buddy system"
 - Start shorter range (theater) and work up from there



Notional architectures for full SUSTAIN

- NOT how it WILL or SHOULD be done but to show some ways it CAN be done
- 3 Pieces: Launch, Ingress, Egress
- Launch pick your favorite. Expend/reuse, VT/HT, VL/HL. But whatever it is, however far it throws it, it throws a payload (probably at least 2000lb), to the target



Ingress

Space Paratroopers

- "parachute" paradigm; troops released from delivery system
- TPS built in to suits or MOOSE-like solo system
- Aero deceleration high in atmosphere, GPS-guided chutes
- Formation flight automatically keeps troops on-target and in formation unlike WW2 drops

Capsule Troopers

- Disposable capsule for 2+ people and equipment carries troops and equipment to target
- Doors permit rapid egress on landing
- As above, steerable chute/parafoil brings troops to target
- Capsules can carry many things besides troops
- Some capsules might include fixed weapons for securing LZ



Extraction

- Once you have rapid transport, USE it to minimize combat load (keep sending resupply), and to deliver the egress means "on demand" instead of keeping it with you.
- "Yank me up, Scotty"
 - Launch a number of UAV's to target that exceeds troop count
 - UAV might be fast, stealthy, or both (ramjet?)
 - Uses skyhook-style system to pull troops out; once aboard, get out, 1500+ km away
 - Pressure suits act as protection from air loads until crew aboard
- "Retrieval boat"
 - Minimal craft, launched as a payload to target area
 - Lands vertically under steerable chute + retro rocket like Soyuz
 - Takes off vertically under rocket power to clear denied airspace, then airbreathing cruise to recovery zone







The point

- If you break up the pieces, you DO NOT have to decide the one best way – each piece can proceed by itself and you can pick what you like.
- Perhaps, as with gliders and parachutes, or amphibious and helicopter operations, multiple modes will coexist, each suited for different purposes
- If you scale this down to small payload delivery (even 10kg??) you can start RIGHT NOW on demos for low \$\$
 - Nothing sells like success, even at small scale....