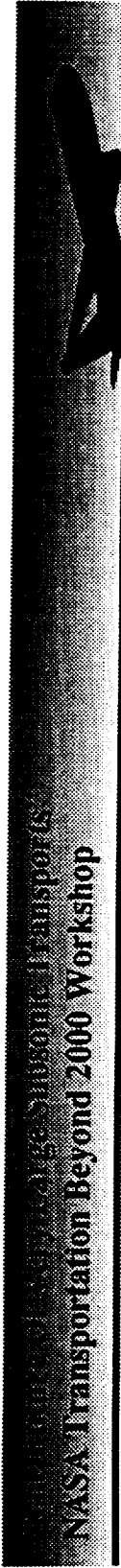


THE FUTURE OF VERY LARGE SUBSONIC TRANSPORTS

**R. Steven Justice,
Anthony P. Hays, & Ed L. Parrott**

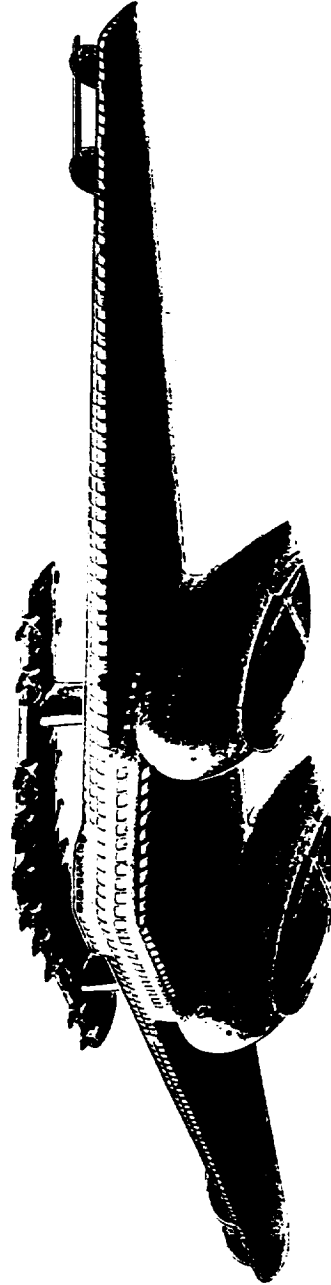
Advanced Design
Lockheed Martin Aeronautical Systems





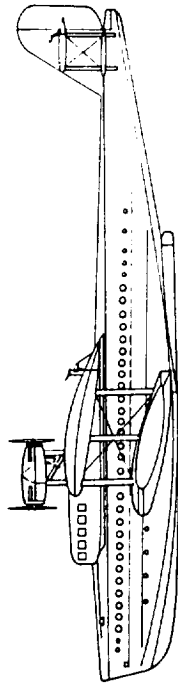
The Vision

Bel Geddes Air Liner Number 4 (1929)

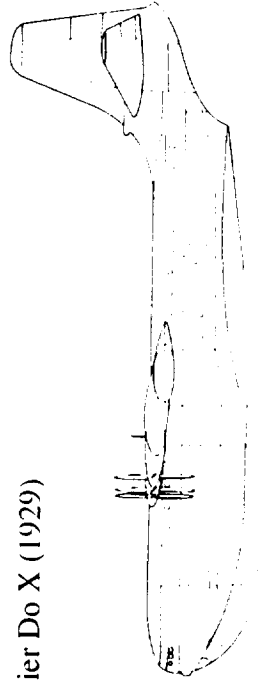




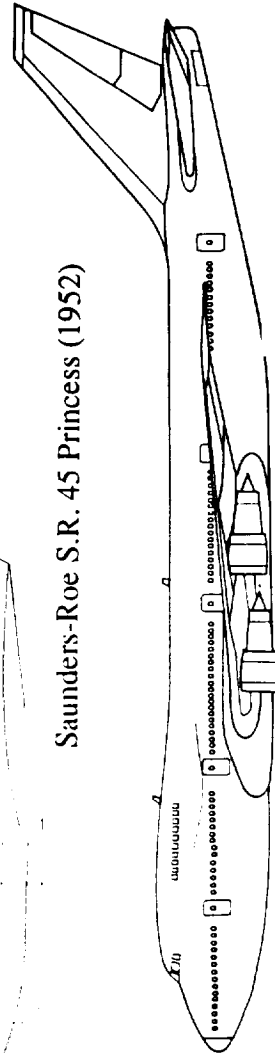
VLST - Past & Present



Dornier Do X (1929)



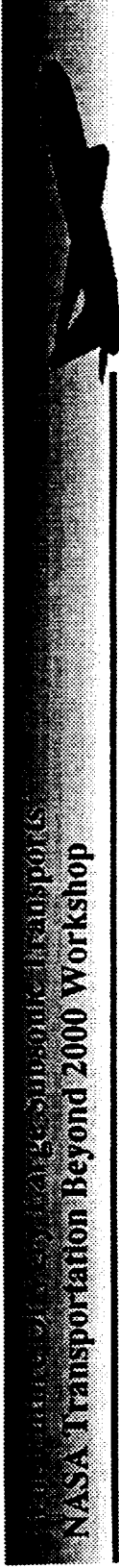
Saunders-Roe S.R. 45 Princess (1952)



Boeing 747 (1969)



Lockheed Martin



Today's Situation

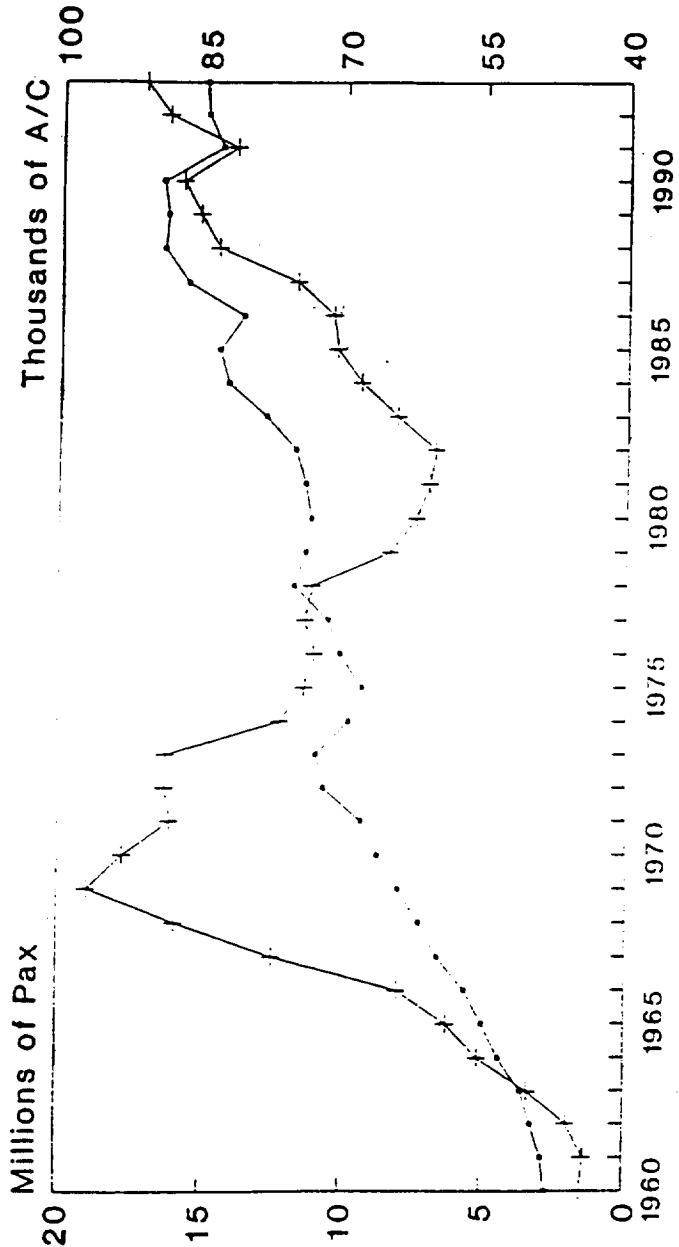
- ◆ Slot Limits At Existing Airports
- ◆ Traffic Growth Outpacing New Airport Development
- ◆ Bigger Aircraft Required To Increase System Capacity & Productivity
- ◆ Heavy Airlift Military Aircraft To Be Replaced In Early 21st Century



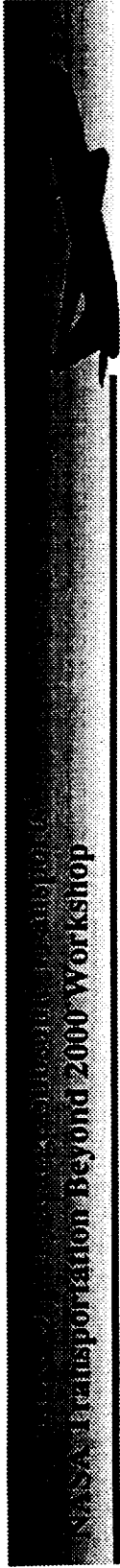
Airport Congestion

Kennedy International Airport

International Passengers Vs Aircraft Movements

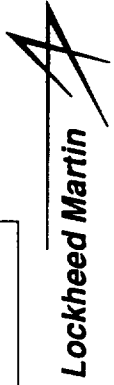
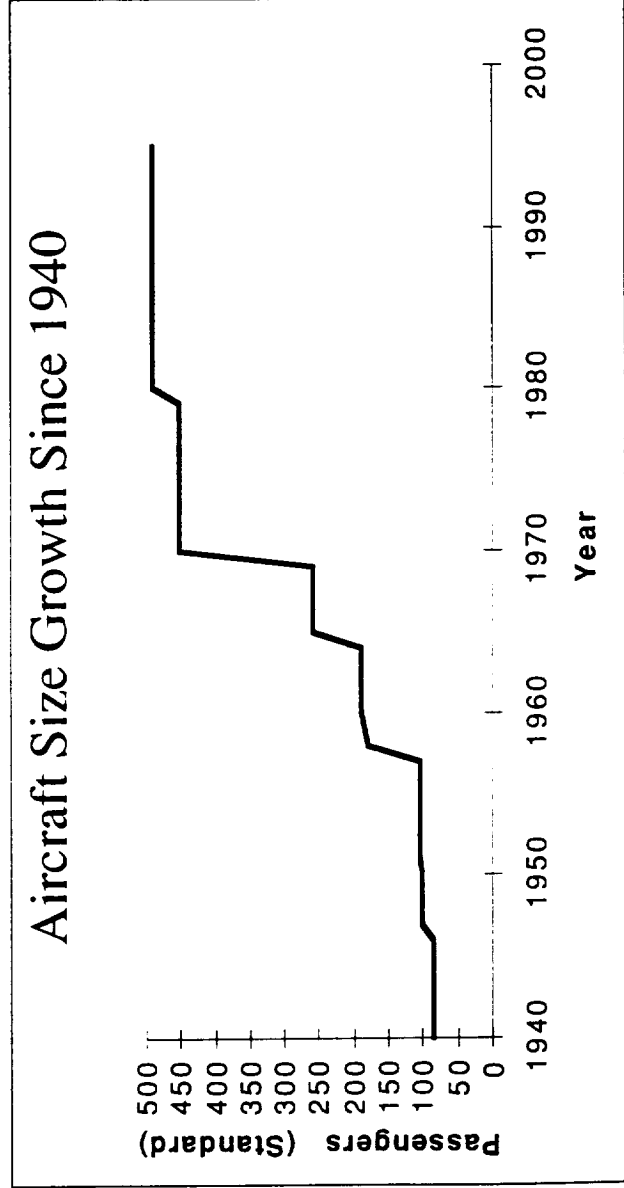


Lockheed Martin



How Did We Get Here?

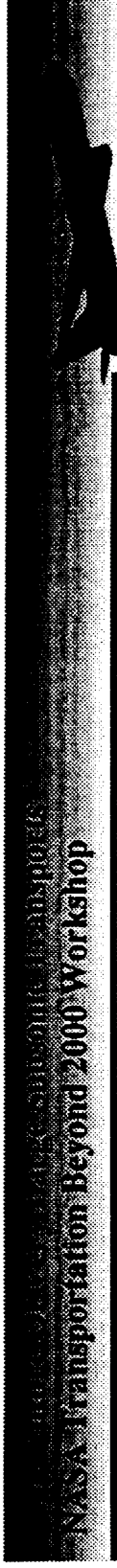
- ◆ No Significant Increases In Aircraft Capacity Since Early 1970's





VLST Missions

- ◆ Passenger Transport
 - 600 to 800 Passengers Over Global Distances
- ◆ Commercial Freighter
 - 6.5% Annual Cargo Growth
 - Increased Use Of ISO & Intermodal Containers
- ◆ Military Airlift
 - Payload Of C-5 Over Global Distances

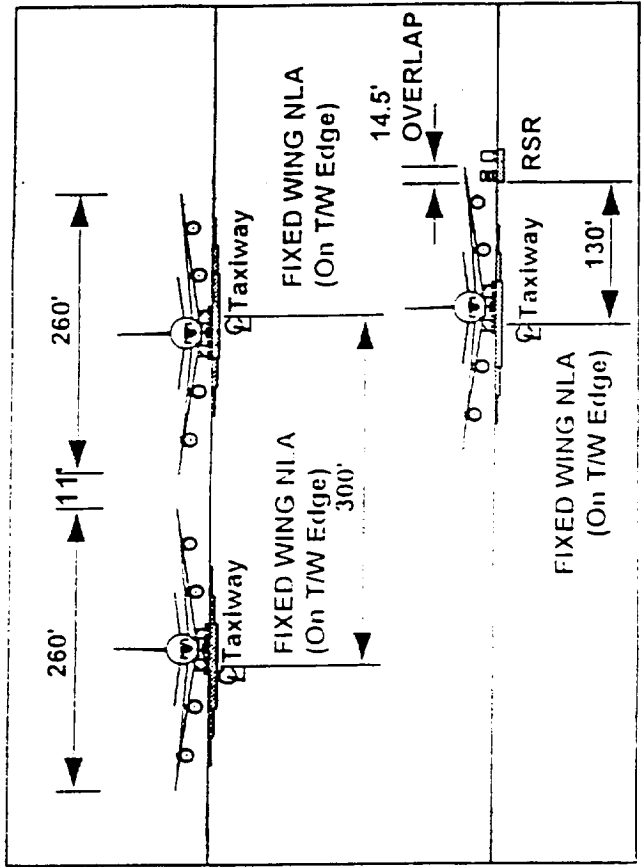


Key Design Challenges

- ◆ **Size Issues & Constraints**
 - Clearances At Gates, Taxiways, & Runways
 - Ground Loading & Flootation
- ◆ **Increased Aircraft Separation Requirements**
 - Increased Power In Wing Vortex
 - Increased Separation Will Reduce Aircraft Throughput At Airport

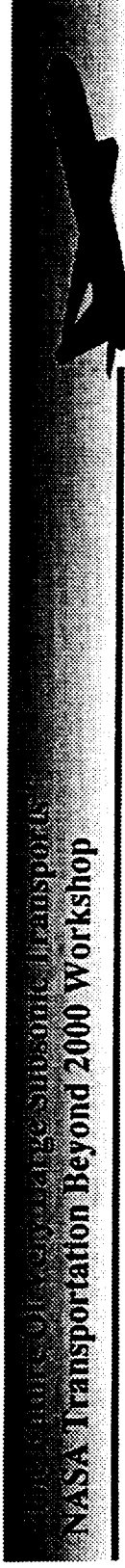
Key Design Challenges

◆ Taxiway Clearance



PANY&NJ Aviation Department





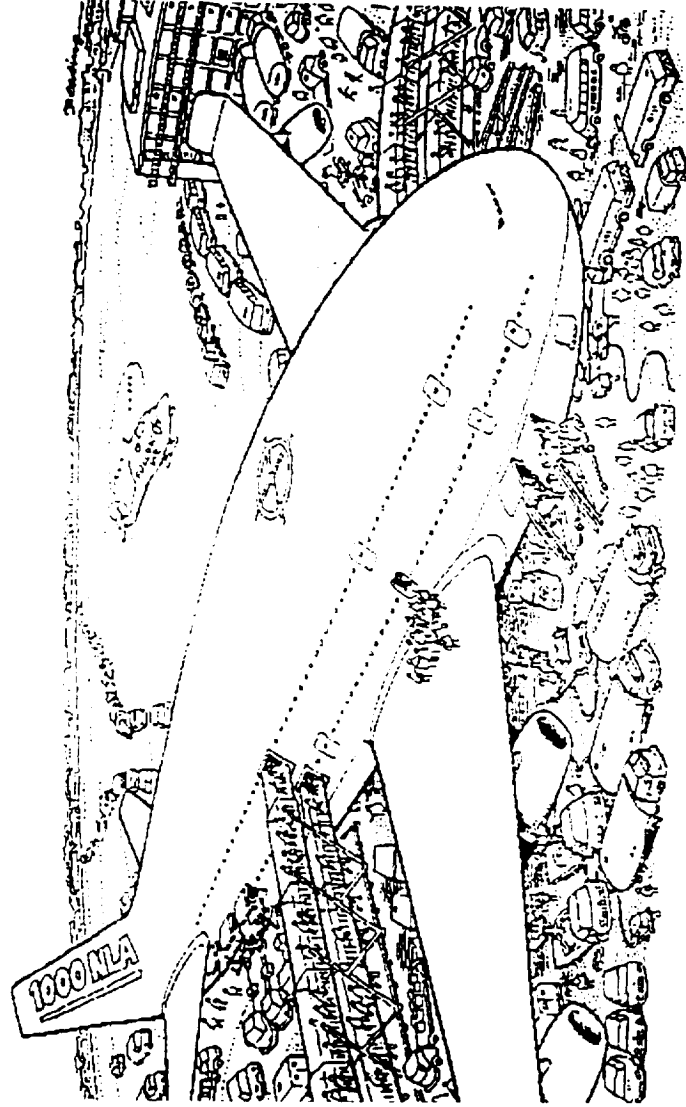
Key Design Challenges

- ◆ Loading & Servicing
 - Compatibility With Current Gates
 - Servicing Vehicle Congestion
 - Longer Time Required For Loading & Servicing



Key Design Challenges

◆ Ground Support



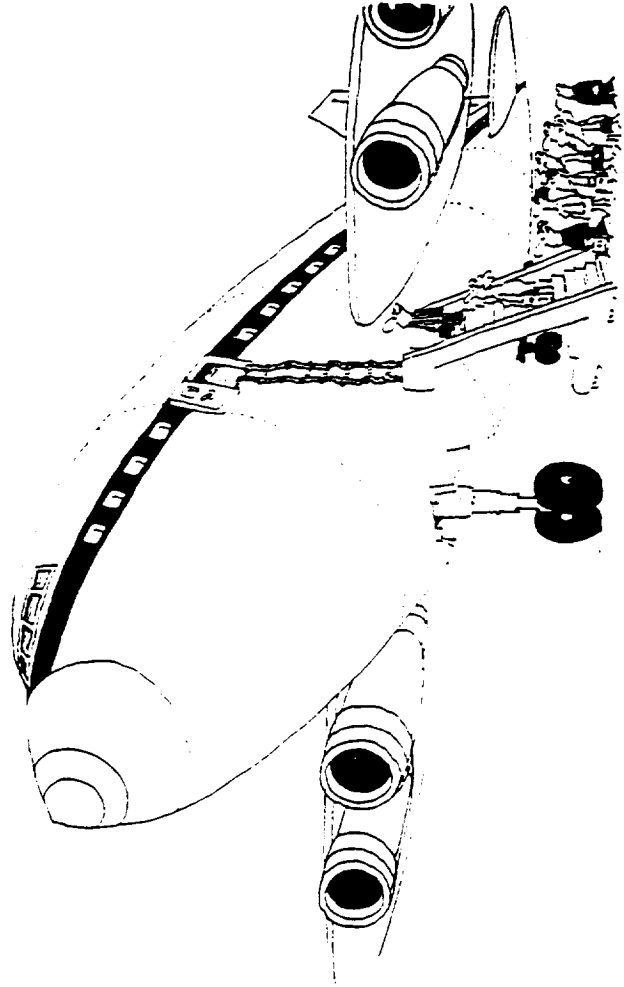
"Airport Support", December 1994





Key Design Challenges

- ◆ Gate Compatibility

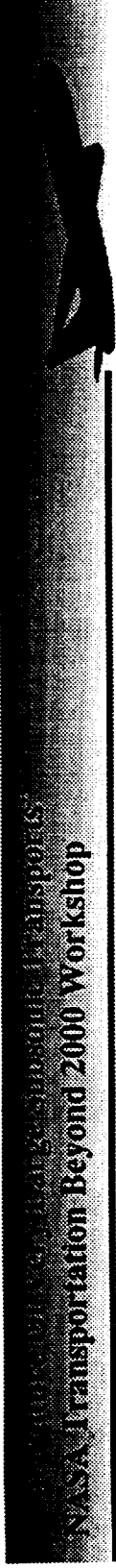


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Key Design Challenges

- ◆ Emergency Systems
 - Emergency Exit/Slide Height
 - Passenger Escape From Emergency Site
 - Emergency Systems Must Handle Up To 1,600
Victim Event (2 Aircraft)



Key Design Challenges

- ◆ Aircraft Noise Requirements
- ◆ Fabrication Of Large Composite Structures
- ◆ Control Of A Large Flexible Structure



Enabling Technologies

- ◆ Fly-By-Light/Power-By-Wire
- ◆ Active Control Systems
- ◆ Simple, Effective High Lift Systems
- ◆ Laminar Flow (Hybrid & Natural)
- ◆ Flight Deck Systems
- ◆ Modular Design

NASA Transportation Beyond 2000 Workshop

Options For VLST

BOEING 747-400F
 WINGSPAN: 211 FT.
 LENGTH: 251 FT.
 MAXIMUM PAYLOAD: 400,000 LB

LOCKHEED VERY LARGE AIRPLANE
 WINGSPAN: 281 FT.
 LENGTH: 271 FT.
 MAXIMUM PAYLOAD: 410,000 LB

MCDONNELL DOUGLAS BLENDED WING-BODY
 WINGSPAN: 297 FT.
 LENGTH: 271 FT.
 MAXIMUM PAYLOAD: 380,000 LB

LOCKHEED SPANLOADER
 WINGSPAN: 311 FT.
 LENGTH: 258 FT.
 MAXIMUM PAYLOAD: 400,000 LB

AIRBUS SUPER TRANSPORTER A300-600ST
 WINGSPAN: 142 FT.
 LENGTH: 188 FT.
 MAXIMUM PAYLOAD: 100,000 LB

MOLNIYA 1000 HERCULES
 WINGSPAN: 247 FT.
 LENGTH: 247 FT.
 MAXIMUM PAYLOAD: 912,000 LB

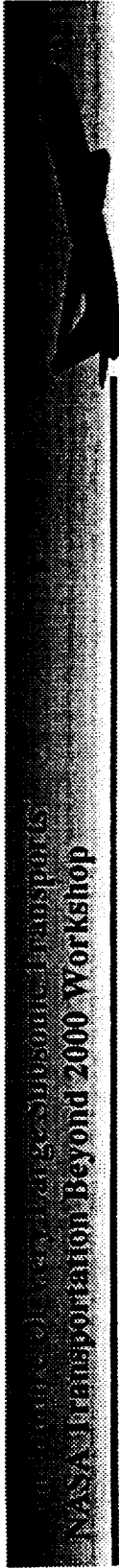


Lockheed Martin



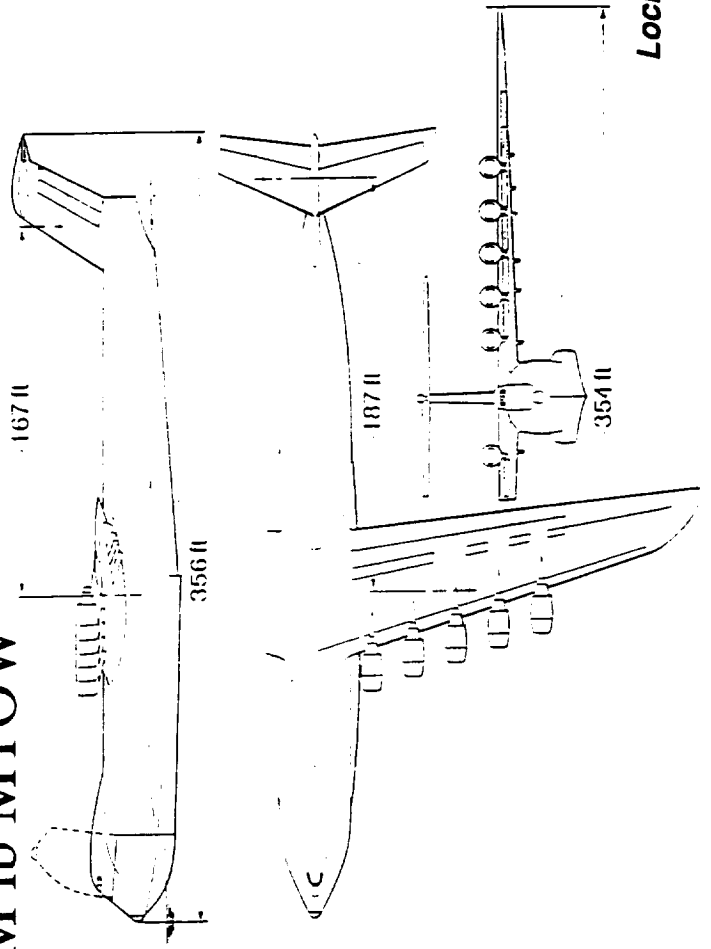
Options For VLST

- ◆ Sea Based Vehicles
 - Conventional Seaplane
 - Wing In Ground-Effect (WIG)
- ◆ No Runway Construction
- ◆ Use Existing Cargo Port/Terminals
- ◆ Increased Emergency/Alternate Landing Sites



Options For VLST

- ◆ Lockheed/Dornier Sea-Based VLST
 - 3,500 Nm Range With 882k lb Payload
 - 2.2M lb MTOW

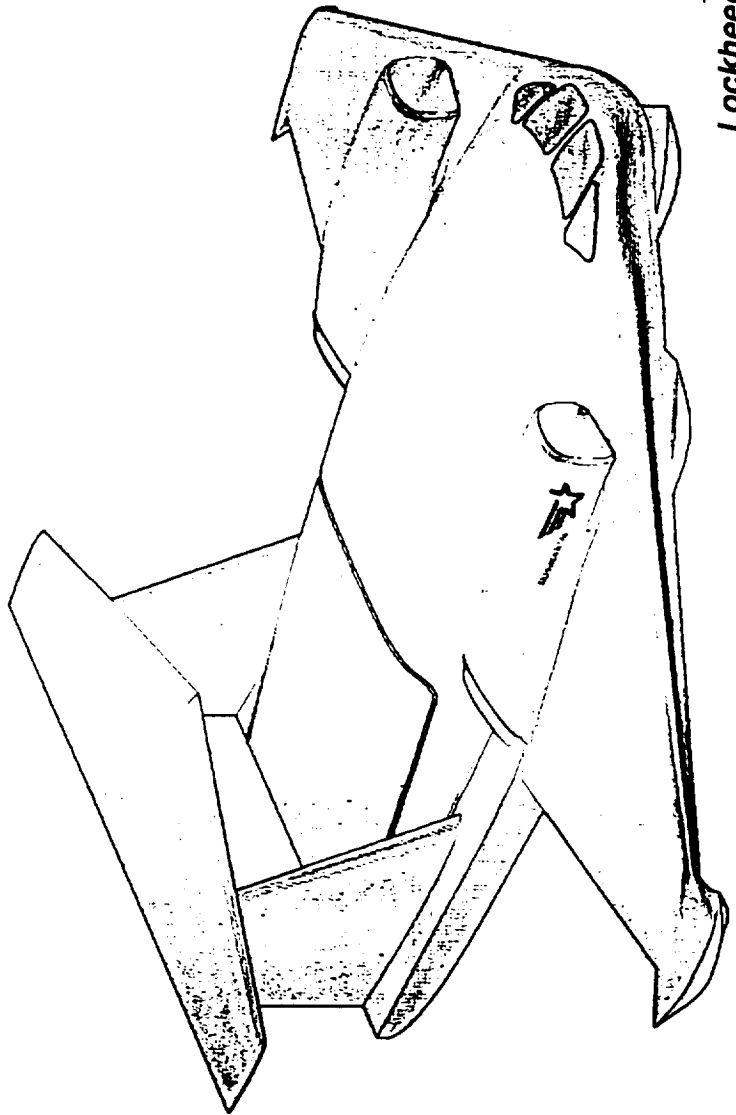


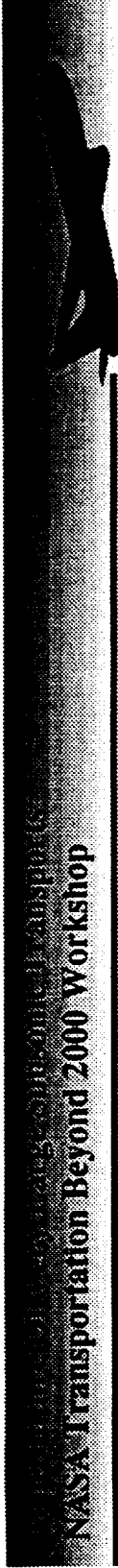
Lockheed Martin



Options For VLST

- ◆ Lockheed Martin Sea-Based WIG





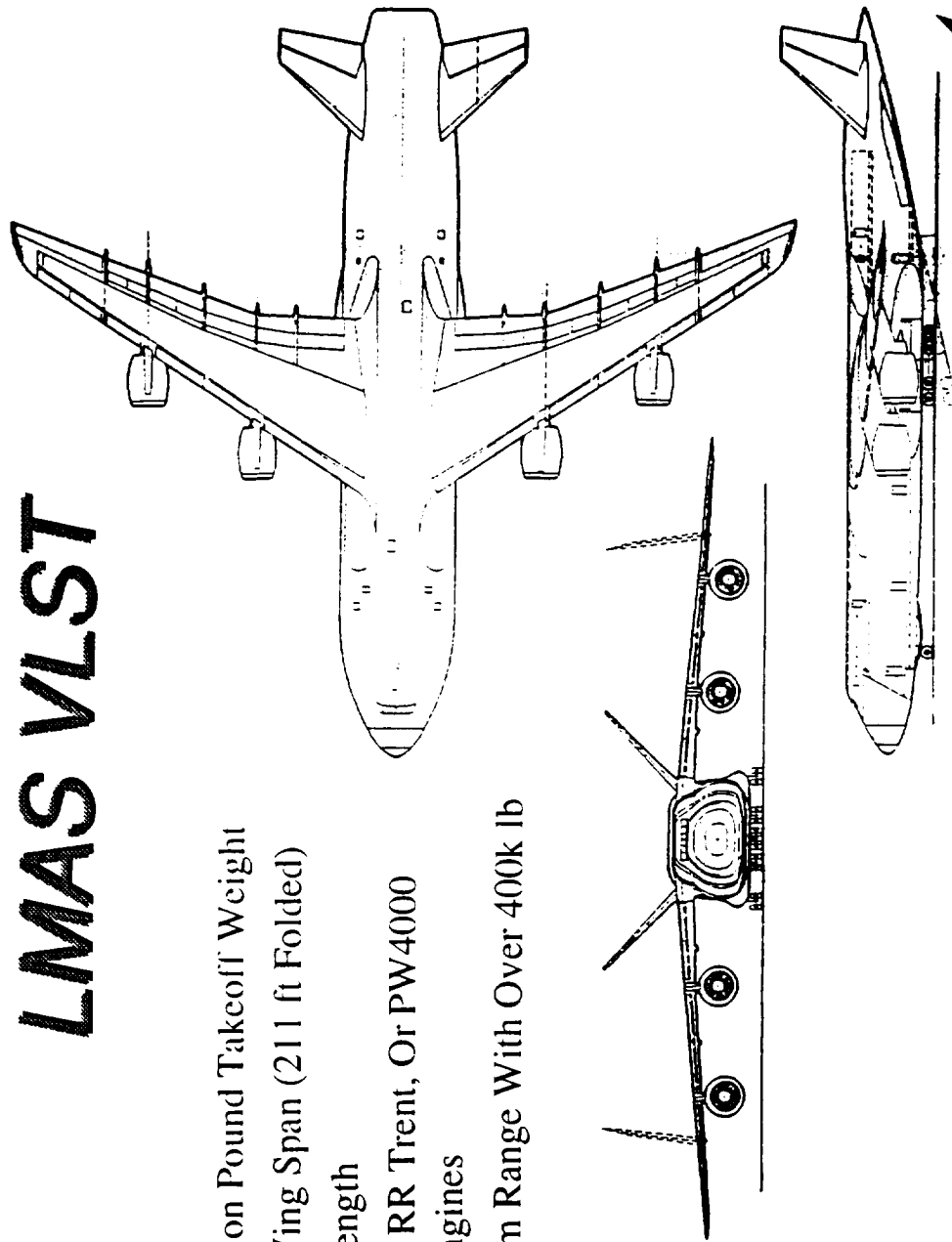
Who Will Build The VLST?

- ◆ McDonnell Douglas
- ◆ Boeing
- ◆ AIRBUS
- ◆ Lockheed Martin

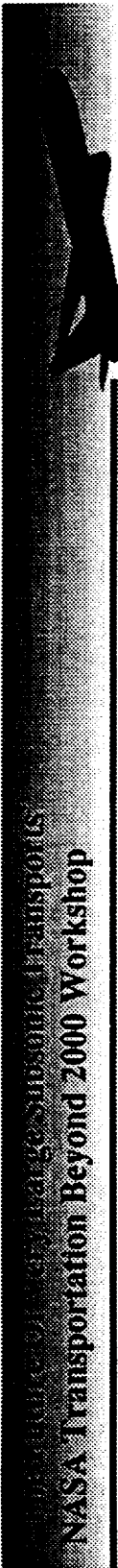


LMAV VLST

- ◆ 1.4 Million Pound Takeoff Weight
- ◆ 282 ft Wing Span (211 ft Folded)
- ◆ 262 ft Length
- ◆ 4 GE90, RR Trent, Or PW4000 Class Engines
- ◆ 3,200 Nm Range With Over 400k lb Payload

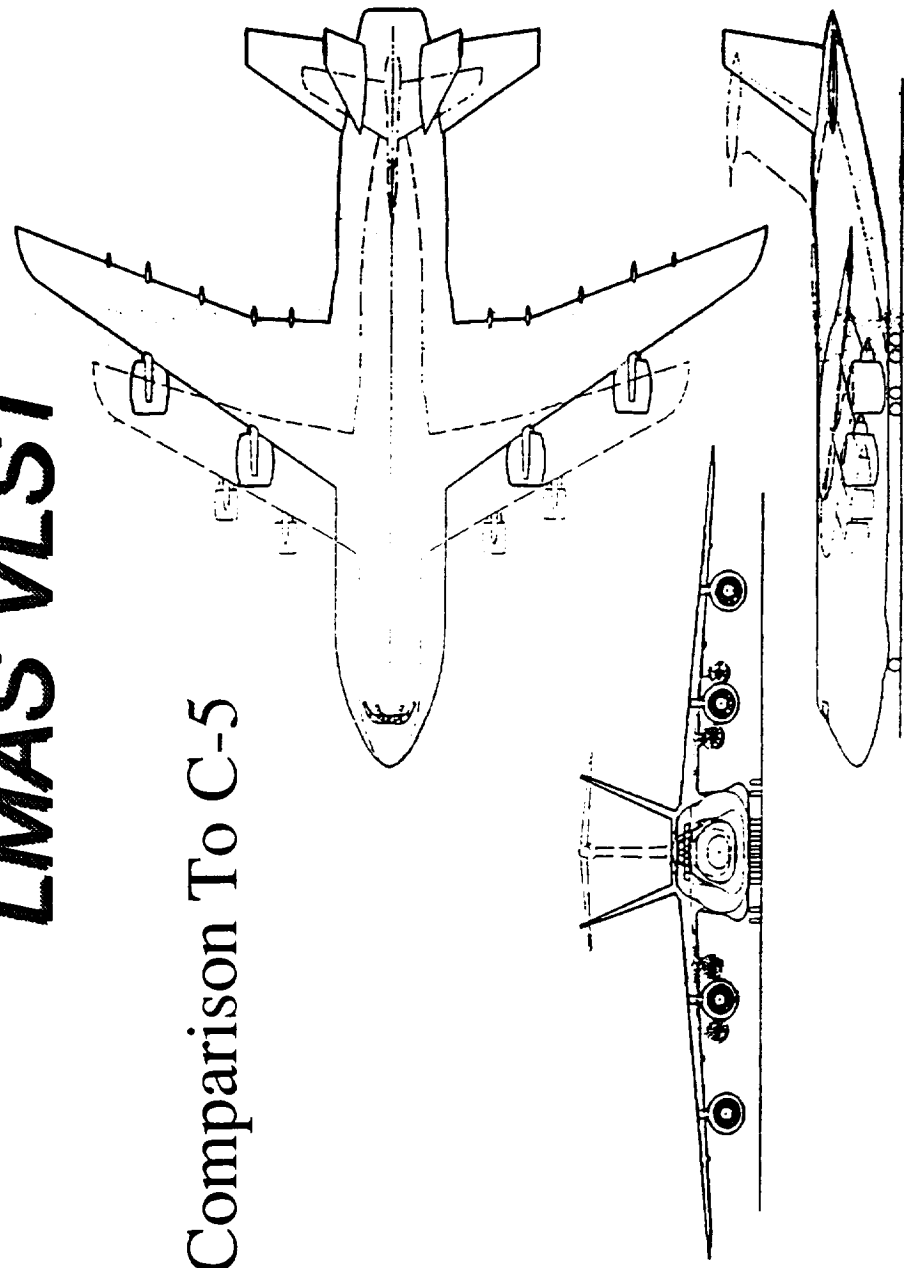


Lockheed Martin



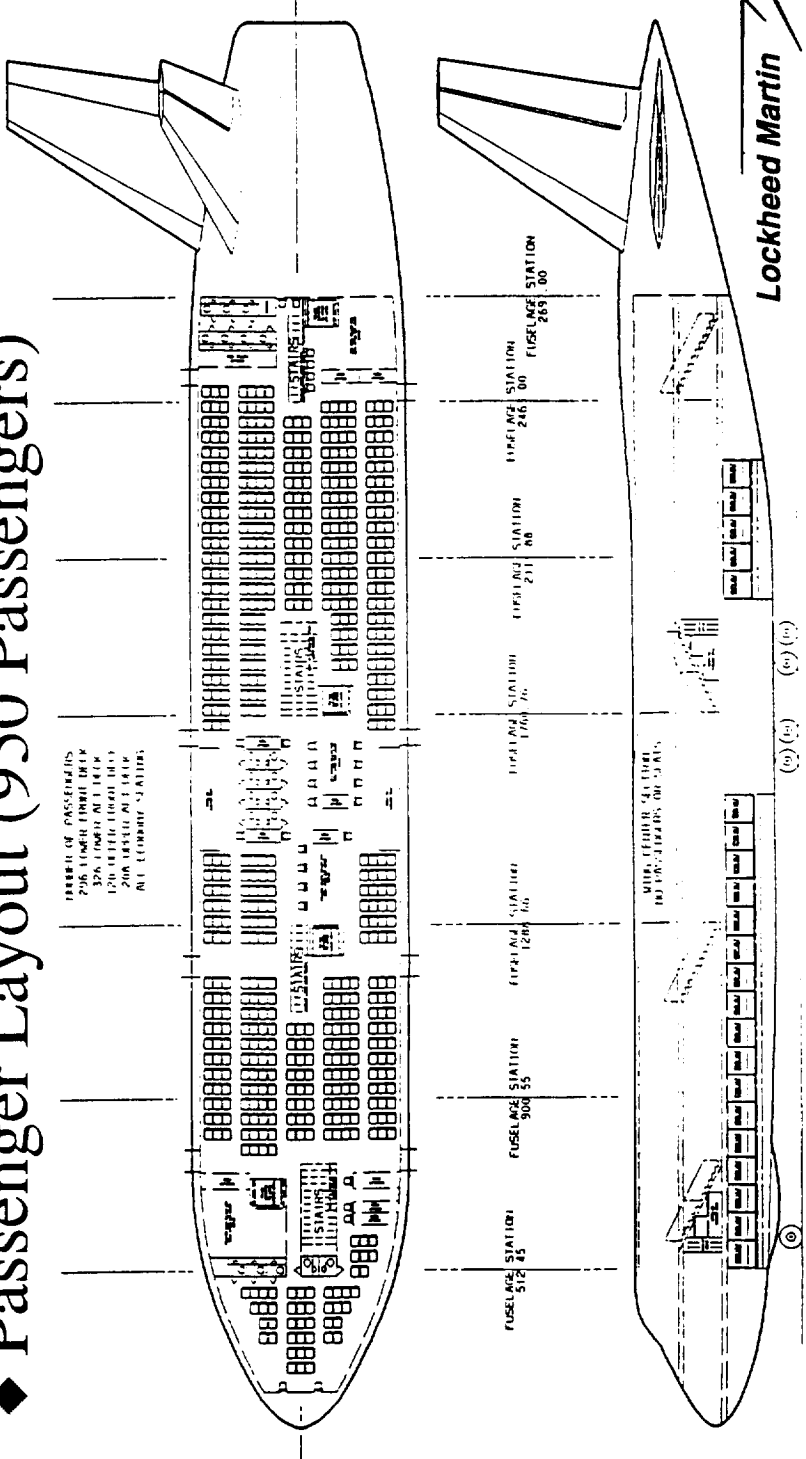
LMAS VLST

◆ Comparison To C-5



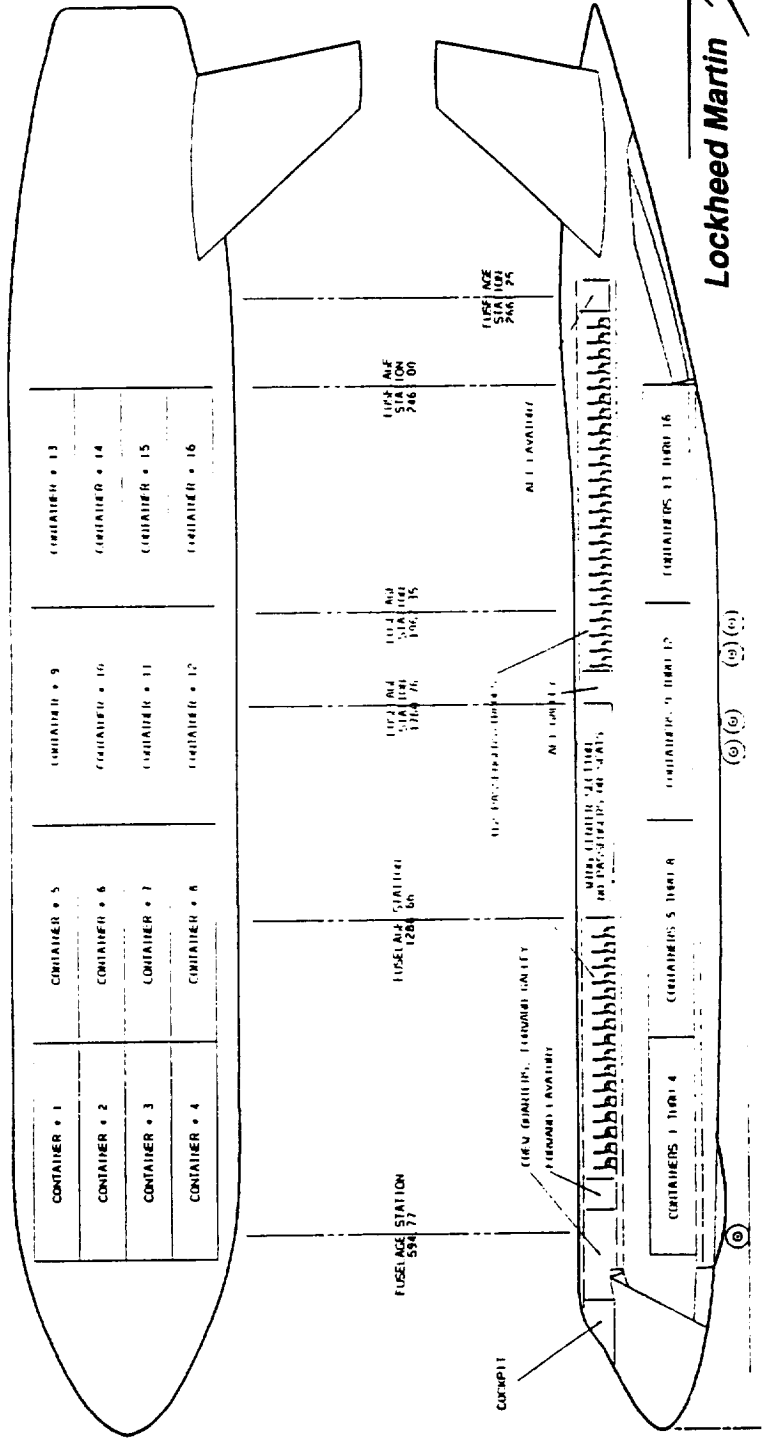
LMAS VLST

◆ Passenger Layout (950 Passengers)



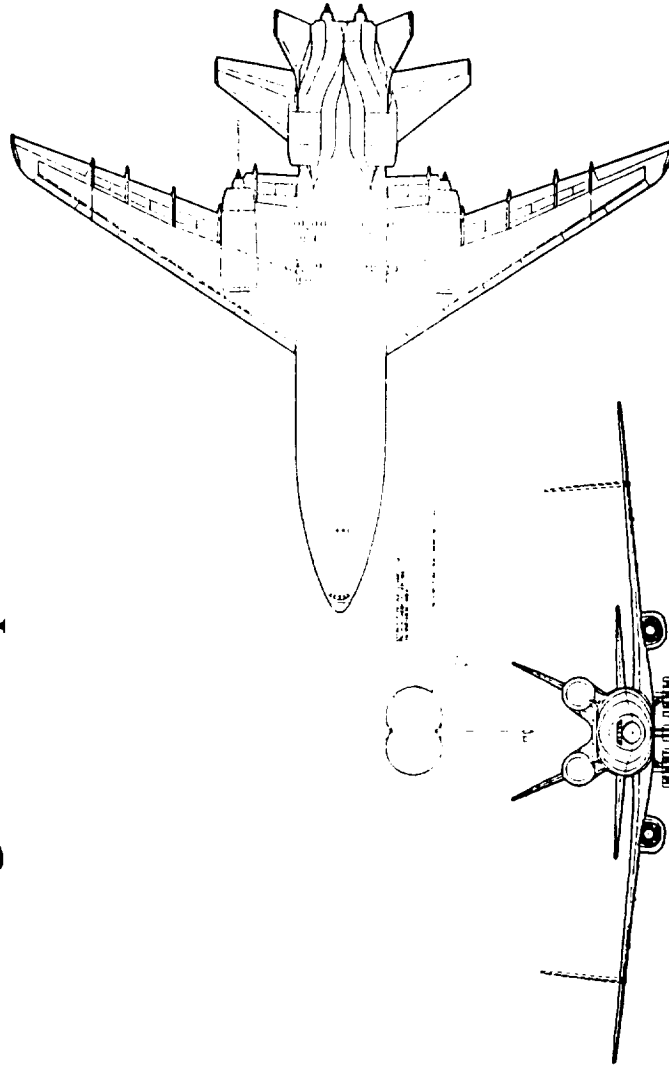
LMAS VLST

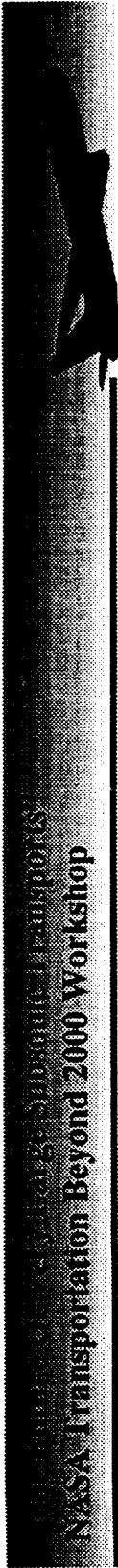
◆ Cargo Layout (16 ISO 40 ft Containers)



LMAS VLST

- ◆ Low Wing Concept





LMAS VLST

- ◆ Blended Wing/Body Concept



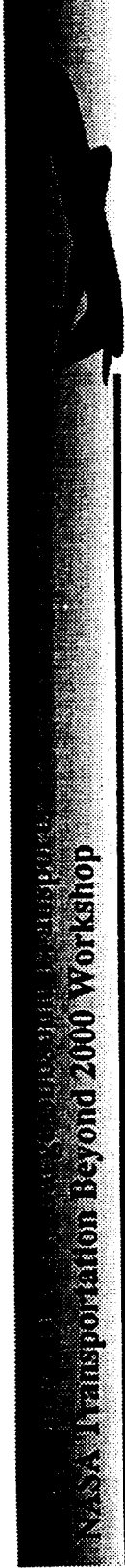


Routes That Could Use A VLST Today



- London - Tokyo
- London - Hong Kong
- London - Singapore
- New York - London
- New York - Paris
- New York - Frankfurt
- Tokyo - San Francisco
- Tokyo - Los Angeles
- Tokyo - Honolulu
- Hong Kong - San Francisco





VLST Market

(By 2010)

◆ Big Enough For More Than One Aircraft?

Asia/Pacific	160-200
USA	70-100
Europe	50-70
<u>Total</u>	<u>280-370</u>

(British Airways Forecast)



How Much Money?

- ◆ \$8-15 Billion Development Cost
 - More Than One Company Can Handle
- ◆ \$200-300 Million Unit Cost
 - Larger Than Annual Profits For Many Airlines
 - Unlikely To Be Internally Financed By Airline & Leasing Companies
 - Resulting High Capital Cost For Operator

Summary

- ◆ VLST Is Technically Possible Now
- ◆ Airline Interest Has Decreased Recently
Due To Financial Difficulties
- ◆ Major Aircraft Manufacturers Are Poised
To Act Once Economics Improve



VLST - Argosies Of The Sky!

“For I dipt into the future, far as the human eye could see,
Saw the Vision of the world, and the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales.”

Lord Tennyson



