NASA Office of
Aero-Space Technology

NASA General Aviation Research

National General Aviation Roadmap

Small Aircraft Transportation System

Presented to
Friends of Meigs Field
Chicago, Illinois
January 28, 2000

Bruce J. Holmes
NASA General Aviation Program Office

Figure 1

Outline

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The Golden Rule of the information age is
"Time is the Scarce Commodity."

Early in the 21st century,
the demand for personal transportation will soar beyond supply.

The Millennial Opportunity:
SATS creates more time for more people.

SATS Concept

Community Opportunities

National Strategies

The Administration's 2001 Budget

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"Among other programs, Langley will see new funds directed to the "Small Aircraft Transportation" Program, which will fundamentally change our future air transportation system for both business and personal air travel. The small aircraft transportation program will enable travel for the public at their convenience--any time, any where to over 4,000 airports--not the 400 airports used today with our over crowded hub and spoke system--and we'll do it with the same level of safety of today's commercial jet transport aircraft."

Senator Charles Robb (VA)
at NASA Langley Research Center
January 7, 2000

Solving 21st Century Transportation Challenges

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The Small Aircraft Transportation System is a safe travel alternative, freeing people and products from transportation delays, by creating access to more communities in less time.

Known Transit Demand Will Soon Exceed Supply

...not even considering pent-up travel demand...

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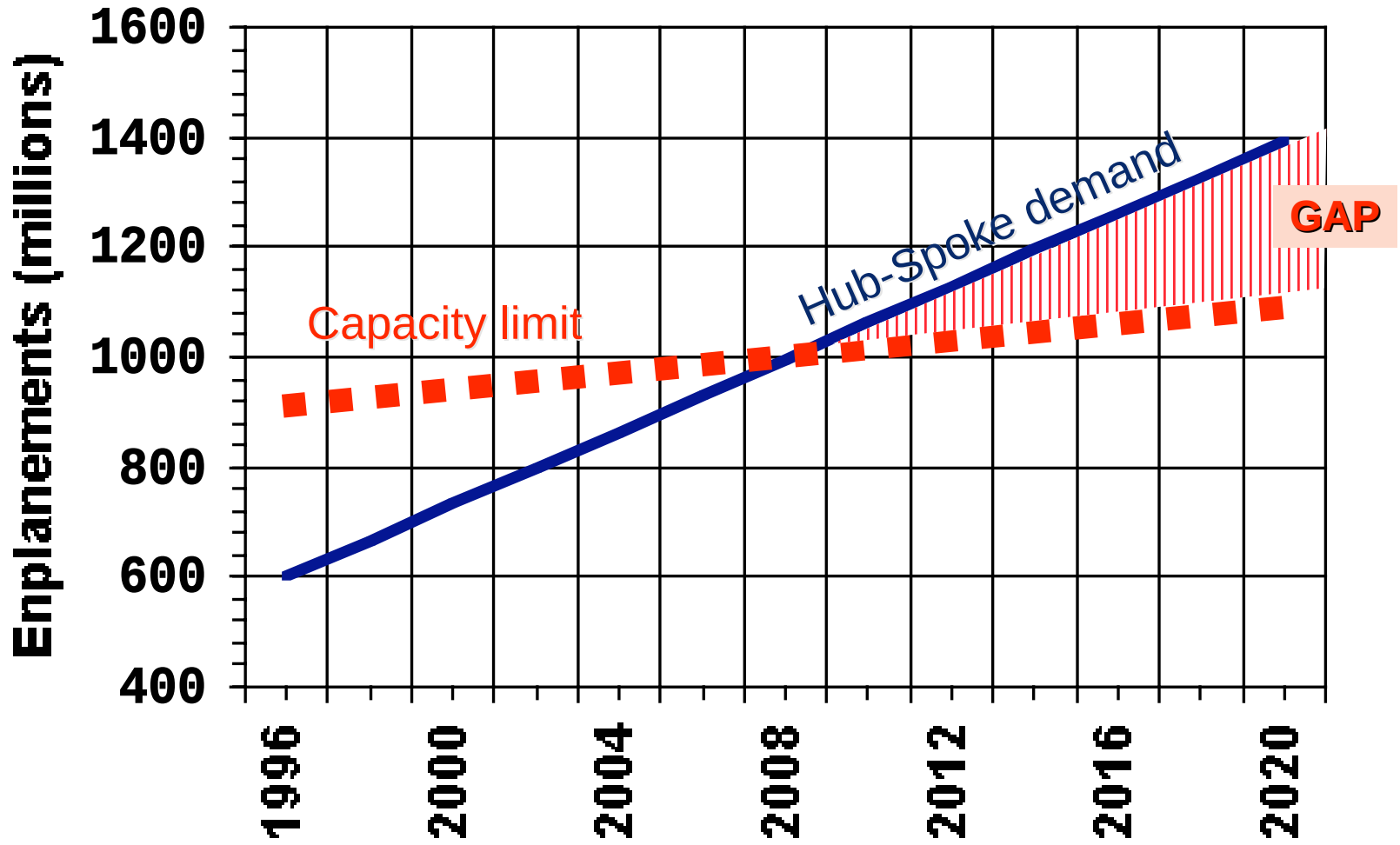

Innovation and Cost Life Cycles

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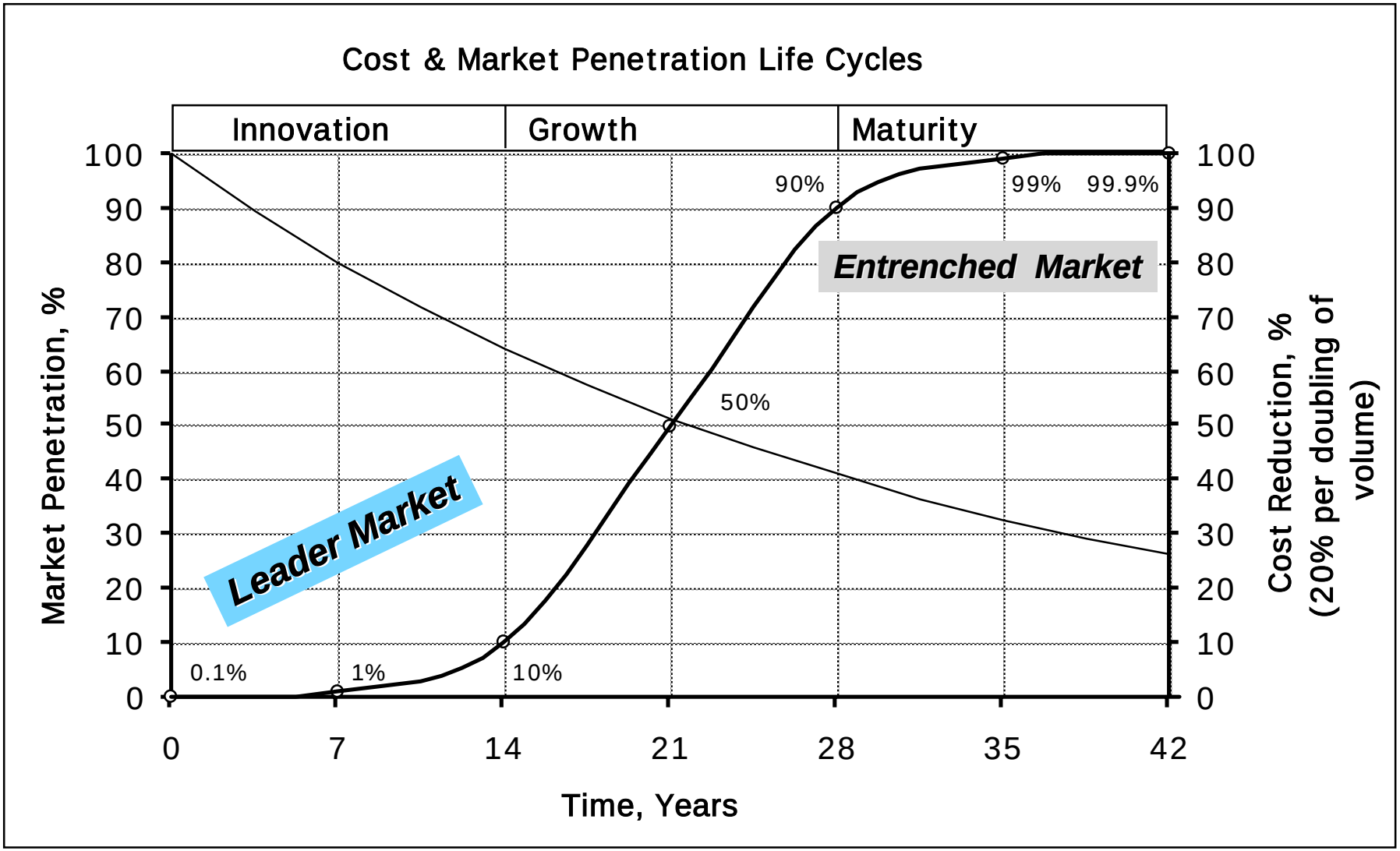

Life Cycle of the Piston Aircraft Market

...or is it really?...

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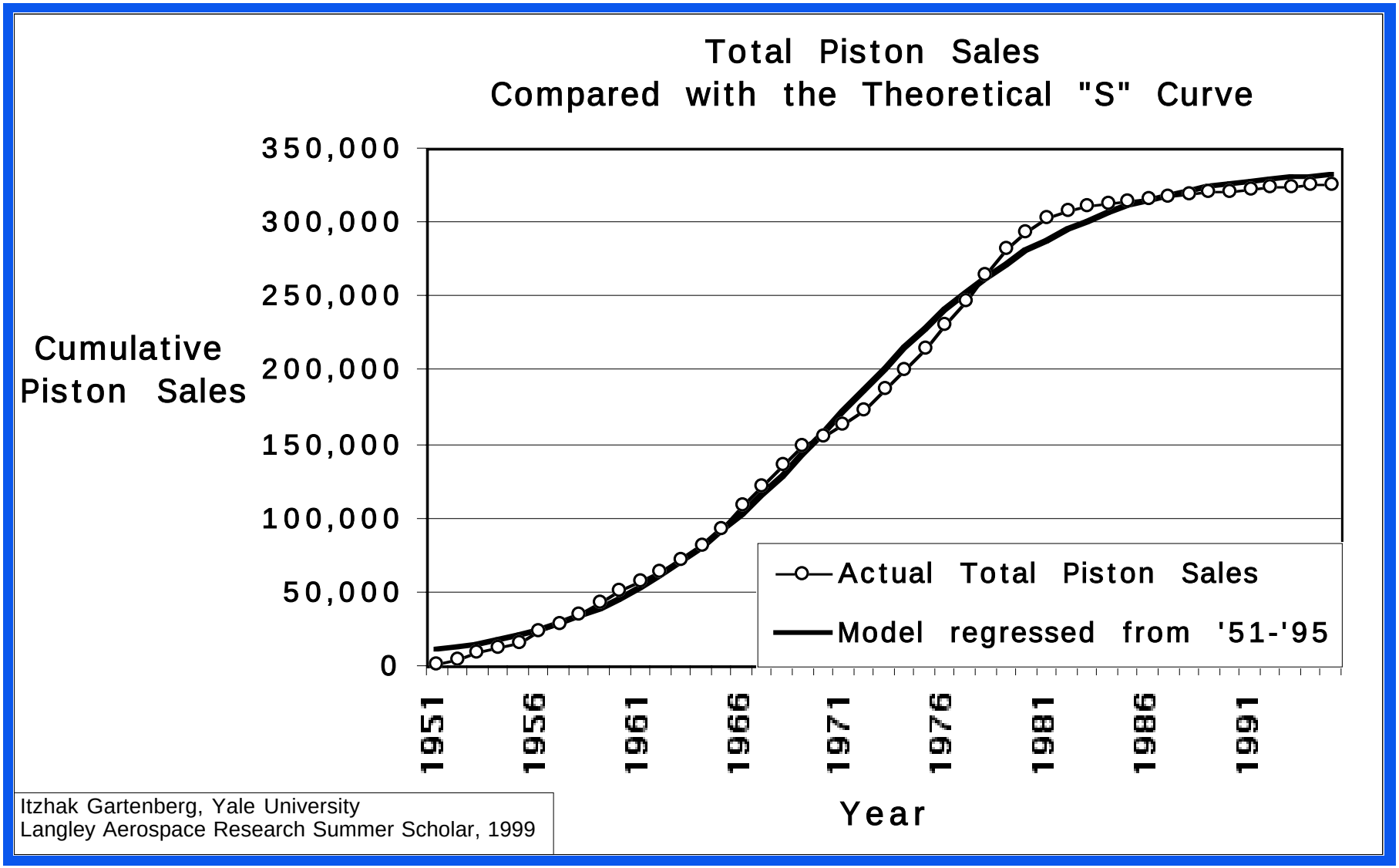

Itzhak Gartenberg, Yale University
Langley Aerospace Research Summer Scholar, 1999

(R)evolutions in Higher Speed Travel

What is Next? More Speed to More Destinations

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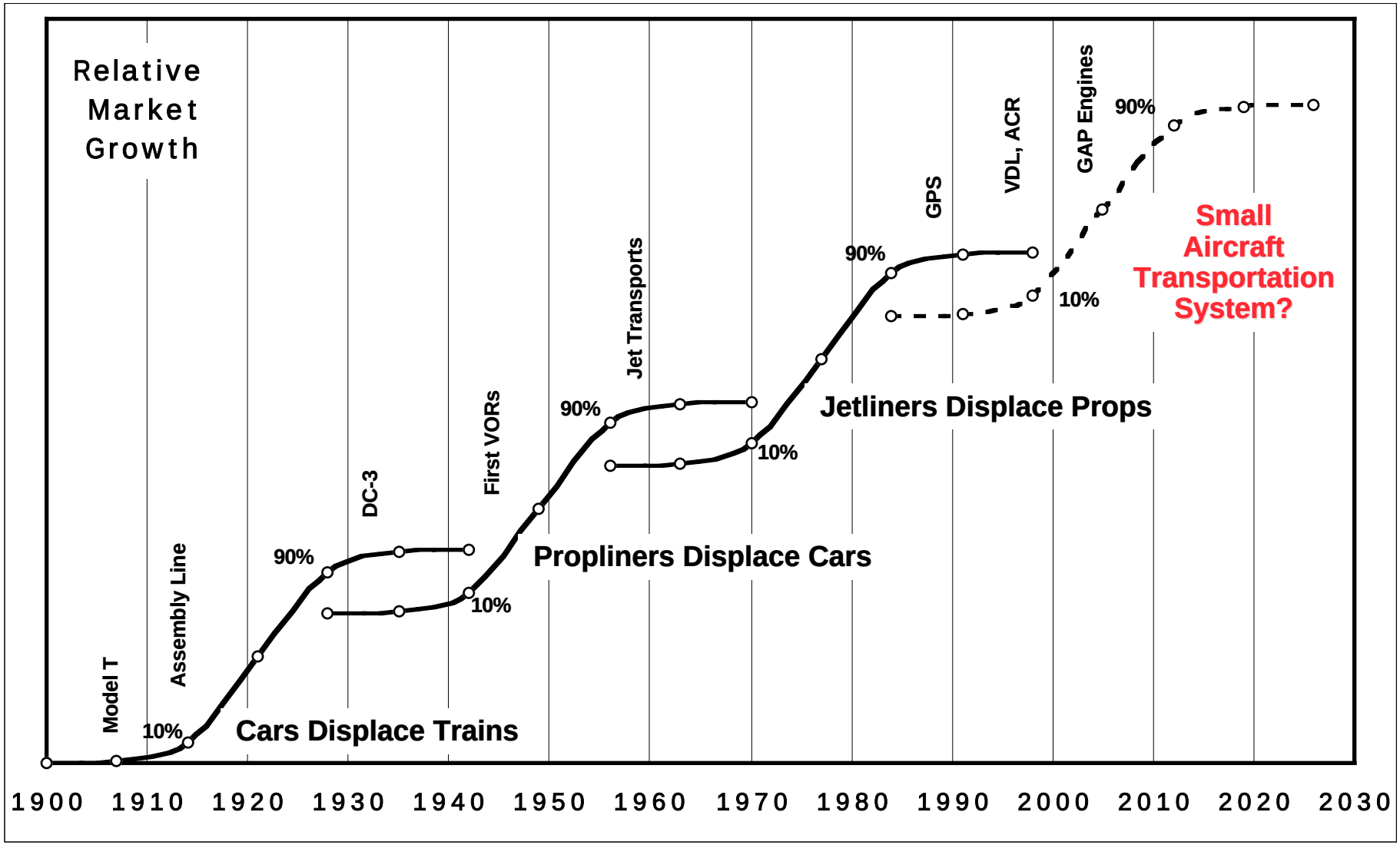
The "Atomic Structure" of Business Innovation Cycles



Small Aircraft Transportation System Mobility

"...doorstep-to-destination at four times the speed of highways..."

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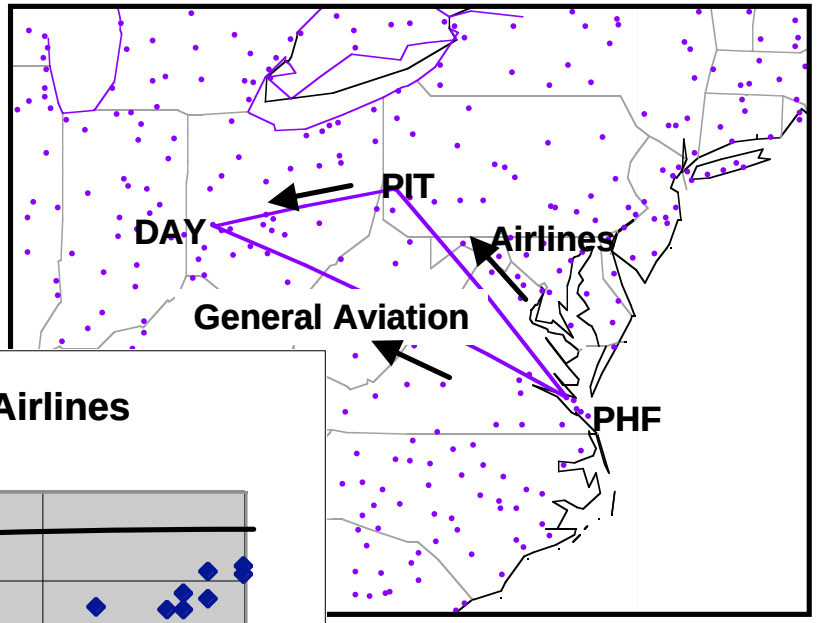
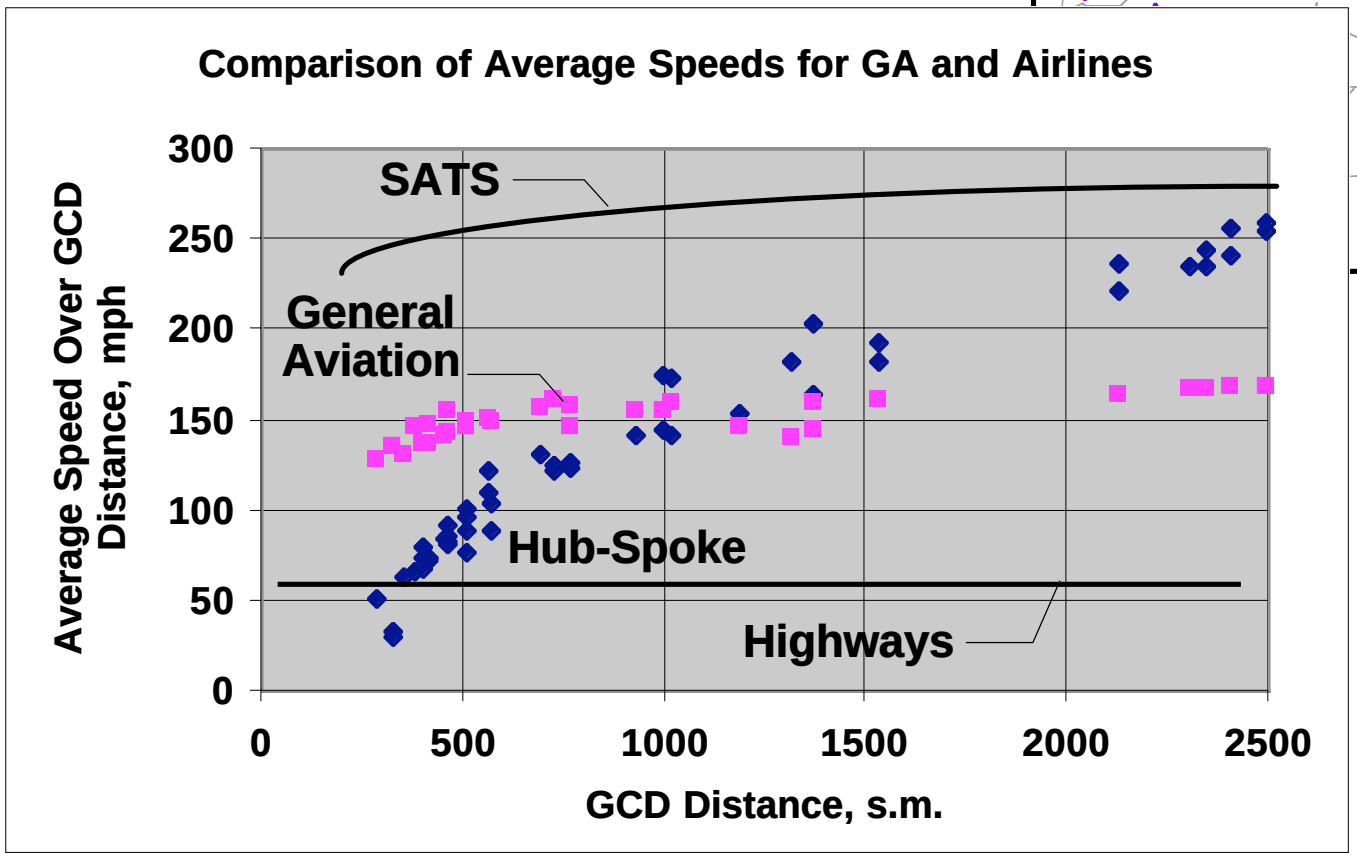
SATS reduces travel times, while highways and Hub-and-spoke travel times will continue to increase.





- Hub-Spoke: OAG times for 28 destinations
- General Aviation: time-optimized flight plans
- Including intermodal penalties (:45 +:45 for airline & :30+:30 for GA departure & arrivals)
- No GA destination benefit (for proximity of airports)
- SATS with new GAP engines: costs equal current General Aviation at 2 times the speed.

SATS Increases Accessibility and Mobility

(". . .creating access to more communities in less time. . .")

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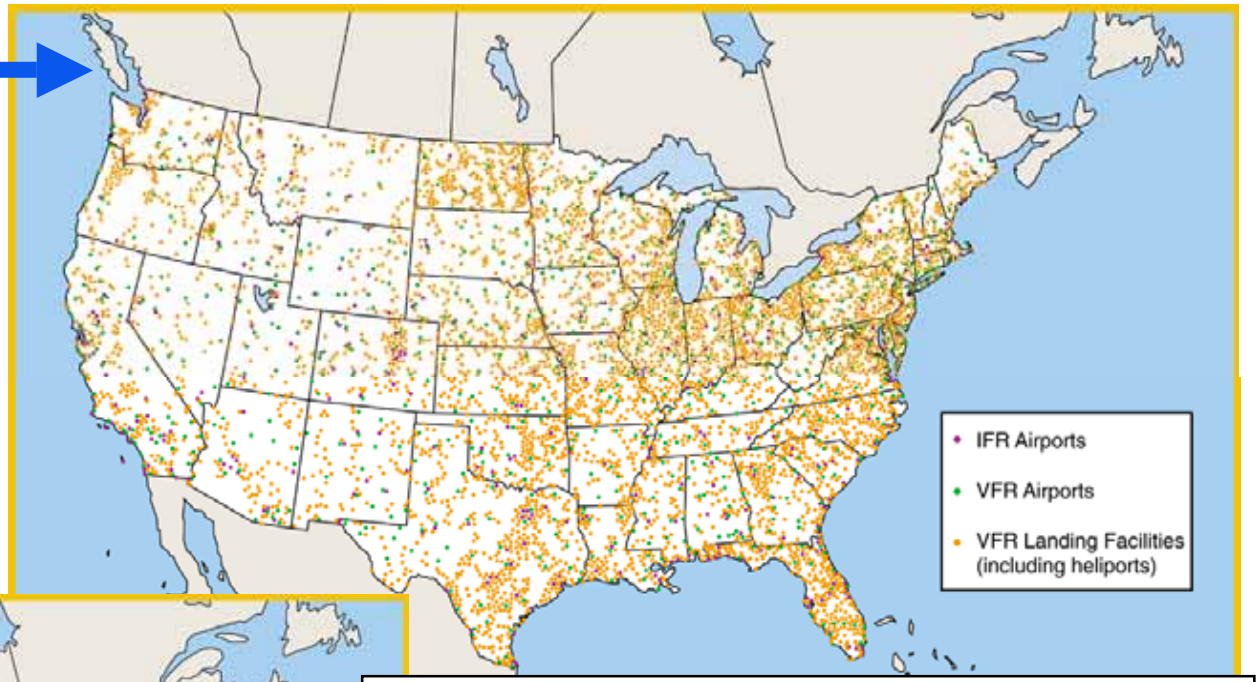
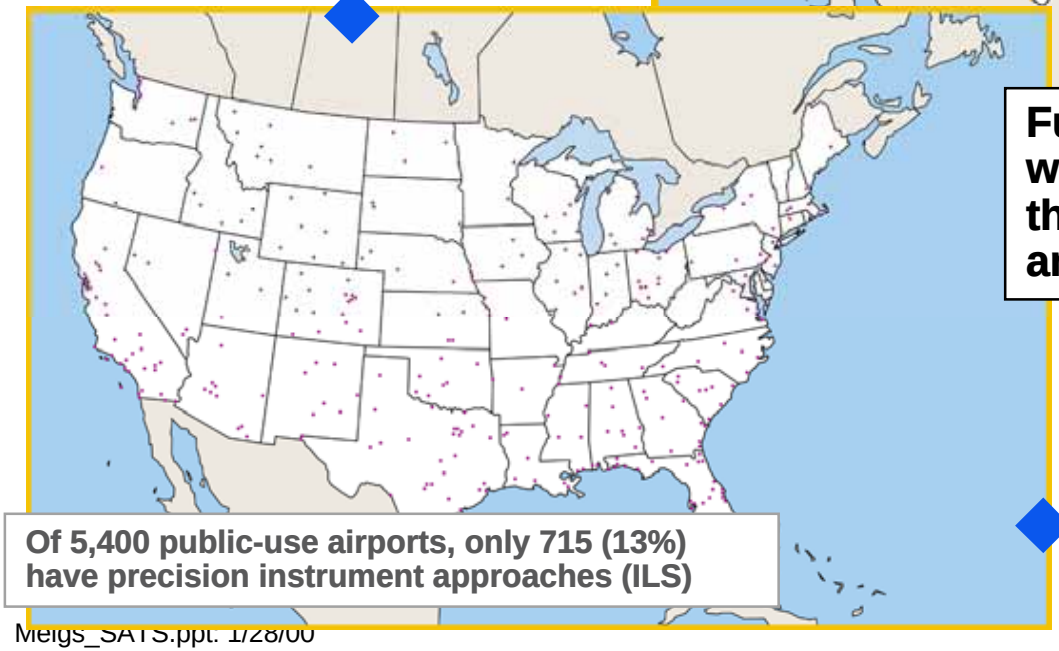
Expanded <u>Accessibility</u> to several times more destinations





Fully utilized 5,400 public-use near-all-weather landing facilities can increase theoretical NAS Throughput by more than an order of magnitude

Improved <u>Mobility</u> saving more travelers more time

Of 5,400 public-use airports, only 715 (13%) have precision instrument approaches (ILS)

Figure 10

The Next Generation Cockpits and Aircraft

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Lancair Columbia 300

Cirrus SR-20

Williams V-Jet

and Others….

Coming Soon
to an airport near you!

Precision Guidance to Every Runway End in America

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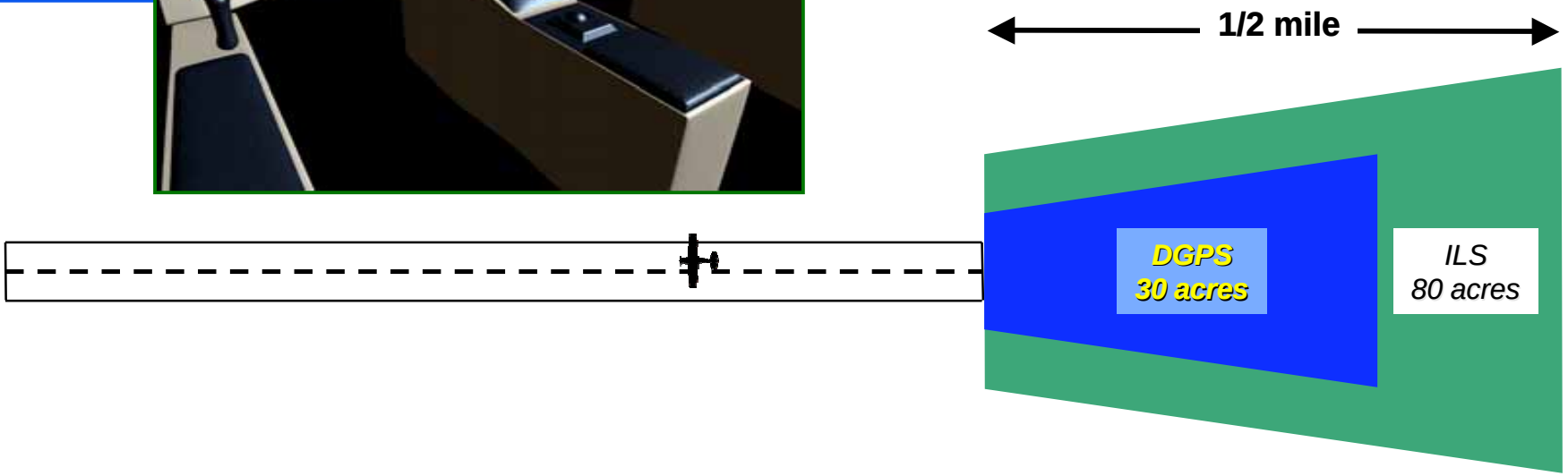
Highway in the Sky / Synthetic Vision with "Virtual" Approach Procedures:

- **Saves land**
- **Limits noise**
- **Increases safety**

Runway Protection Zone (RPZ)



Virginia SATSLab

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Functions:

- **Airborne Internet : Client (Aircraft) -- Server (Landing Facility) Architecture**
- **High speed digital Datalink for Flight, Traffic, and Commercial Information Services**
- **Controller - Pilot Datalink Communications (CPDLC)**
- **Differential GPS precision guidance to all runway ends and helipads**
- **Towerless, Radarless near-all-weather operations**

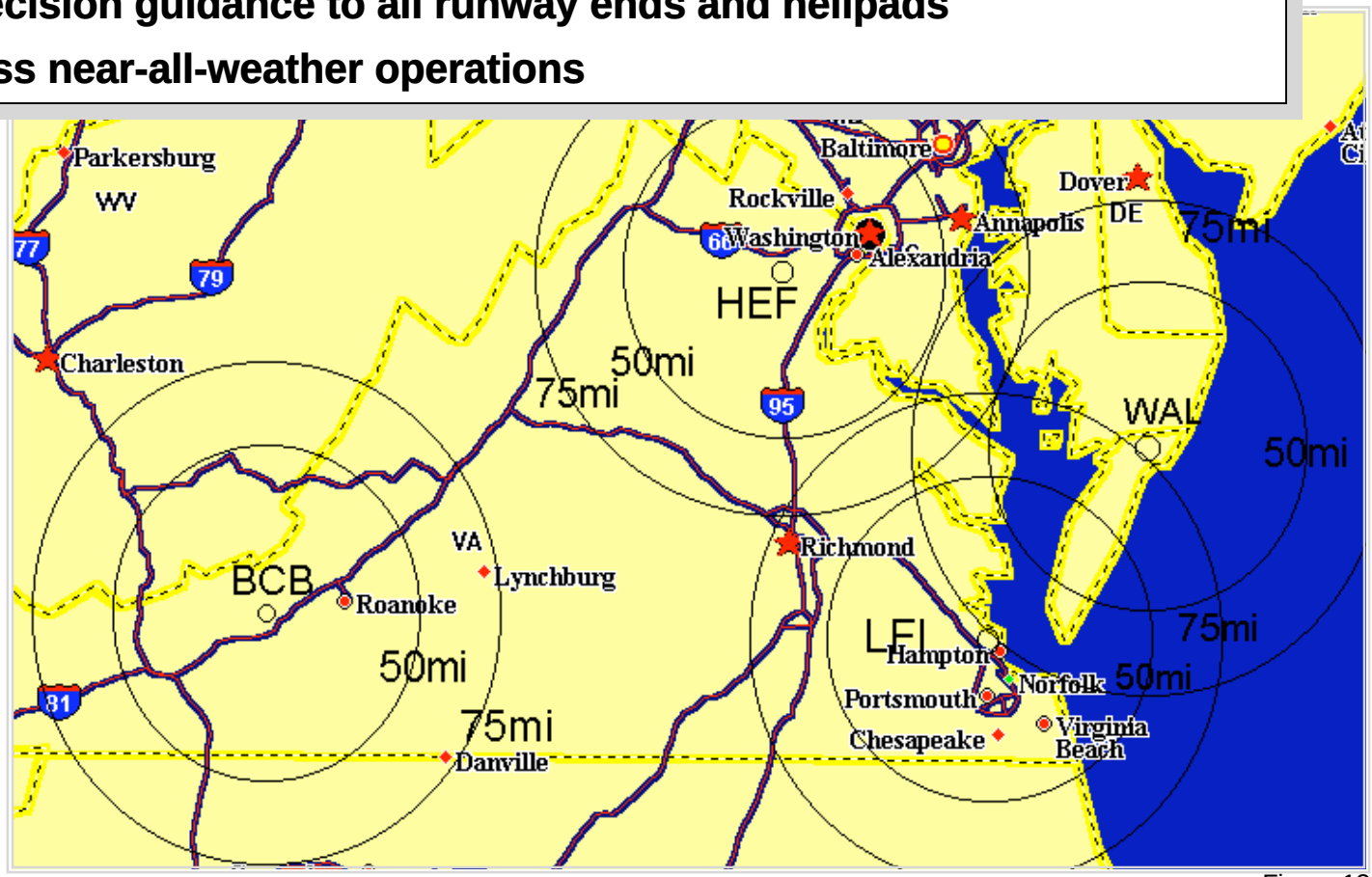

Figure 13


The Small Aircraft Transportation System is a safe travel alternative
freeing people and products from transportation delays,
by creating access to more communities in less time.
"Reduce public travel times by half in 10 years and two-thirds in 25 years"
http://sats.nasa.gov

SATS Features and Capabilities

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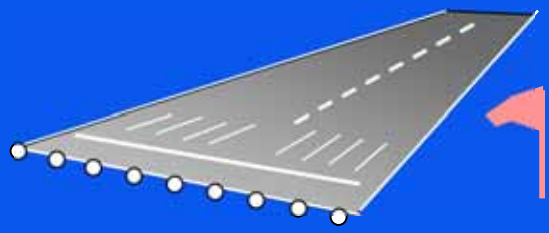
SATS Features (Strawman)

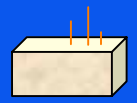
- **"Smart" Airports (Highway in the Sky Approaches; Airport databus; "Virtual" Terminal Procedures (TerPs); Synthetic tower/towerless-radarless operations)**
- **Ultra- Propulsion (non-hydrocarbon and heat engine options; low-noise/emissions)**
- **AutoFlight (Integrated Vehicle and Air Traffic Services automation; Control de-coupling; Ride Smoothing)**
- **Airborne Internet (Satellite-based communications-navigation-surveillance for Ground-to-Sky Air Traffic Management functions in all airspace)**
- **Simultaneous Non-Interfering (SNI) Approaches at Class B airports for Runway-Independent Aircraft**
- **Affordable Manufacturing (Thermoplastics, aluminum, composites automation for integrated airframe systems design & manufacturing)**
- **Wireless Cockpit (open standards for on-board systems and architecture; databus; through-the-window displays)**
- **Cyber-tutor and InterNet-based training systems (embedded and on-board training and expert systems)**
- **Extremely Slow Takeoff & Landing (Configuration Aerodynamics for slow & vertical flight; roadability)**

Typical GA Landing Facilities

GPS

VOR





FBO

2000

18,000 Landing Facilities

5,400 Public Use

SATS Landing Facilities - 2007

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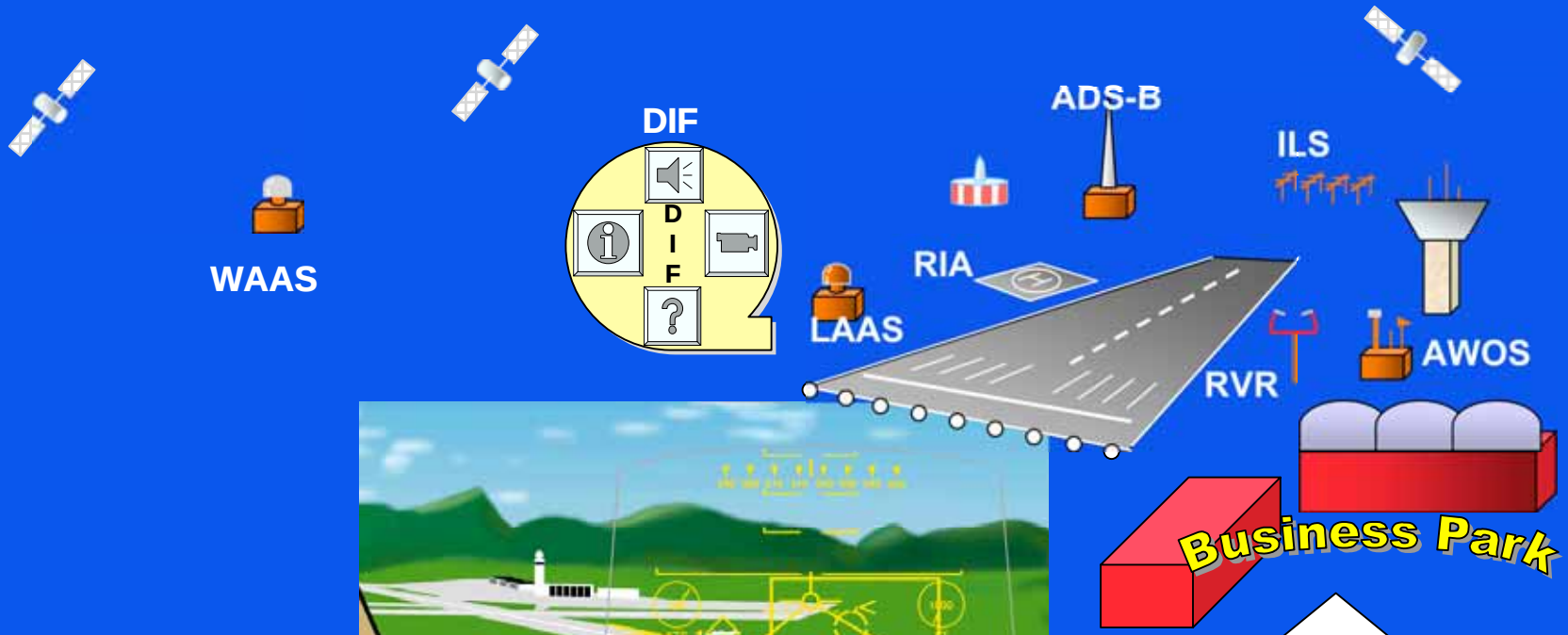

SATS Avionics

Digital Terrain Map
Synthetic Vision
Situational Awareness Display
Some **Use of Virtual TERPS**

2007

25% of Public Use Landing Facilities

SATS Landing Facilities - 2022

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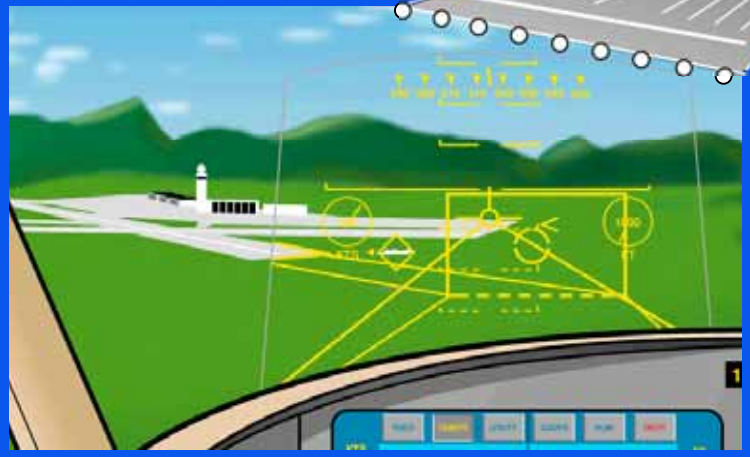

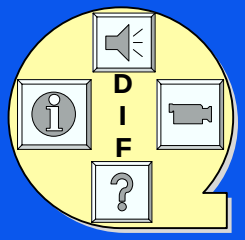

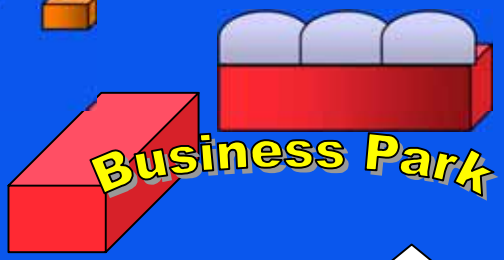

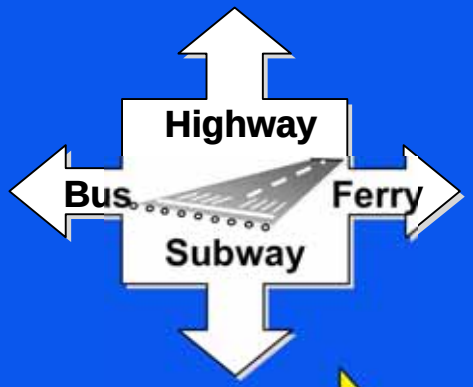

SATS Avionics

Digital Terrain Map
Synthetic Vision
Situational Awareness Display
***Full* Use of Virtual TERPS**

90% of Public Use Landing Facilities

2022