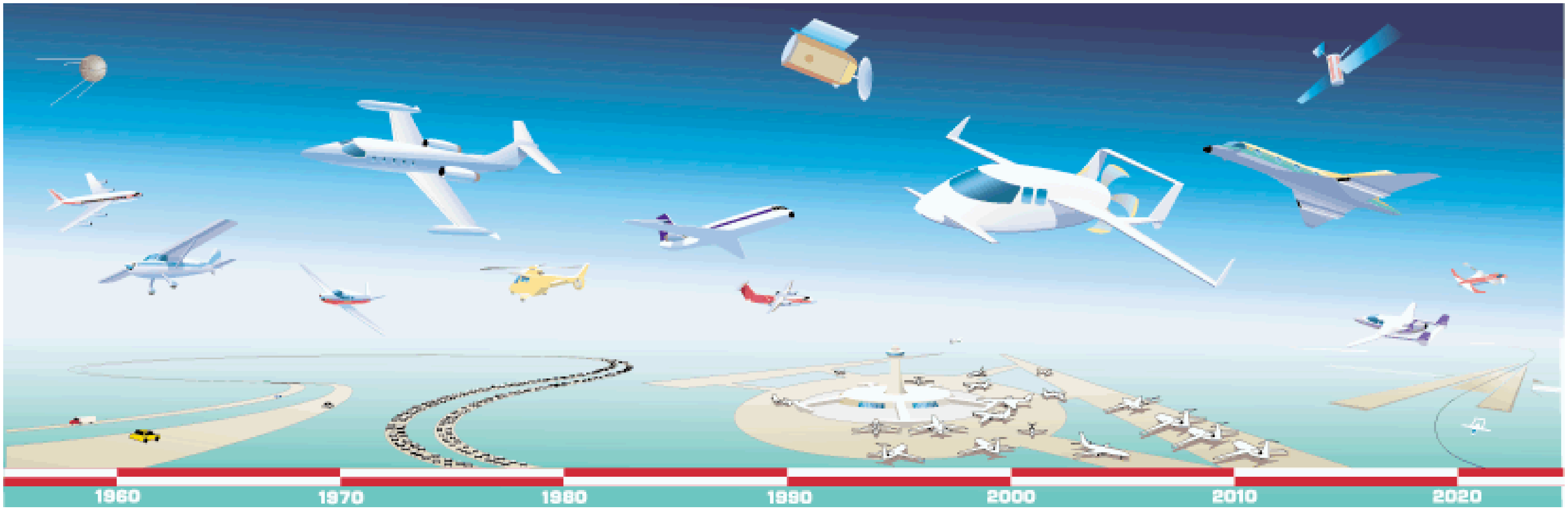


NASA Aero-Space Technology Enterprise

Small Aircraft Transport System

Presented to

AGATE All Members Plenary

Kissimmee FL
April 17, 2000

Outline

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 Theoretical and Hypothetical Framework

SATSLab Program Mandate

Partnership Challenges and Opportunities

Program Strategies

- **Position SATS as a "down-market" (*vs.* up-market)latent transportation consumer innovation**
- **Govern SATSLab Alliance research program to stimulate latent transportation services market**
- **Structure the alliance for relevance to organizational charters:**
  - ➢ **NASA-industry partners define technologies for TRL $\leq$6**
  - ➢ **States-industry-FAA partners define technologies for 7$\leq$TRL$\leq$9**
  - ➢ **All partners collaborate to produce the Demonstration**
- **Organize to :**
  - ➢ **Deliver SATS technology "proofs"**
  - ➢ **Influence NAS Architecture**
  - ➢ **Affect State Aviation & Regional Transportation System Planning**

Program Implementation Strategy

SATS is a "Disruptive Innovation"

SATS is a disruptive innovation comprised of a cluster of technologies targeted toward stimulation of latent markets for transportation of people, goods, and services.

Some SATS technologies will be of interest to current markets.

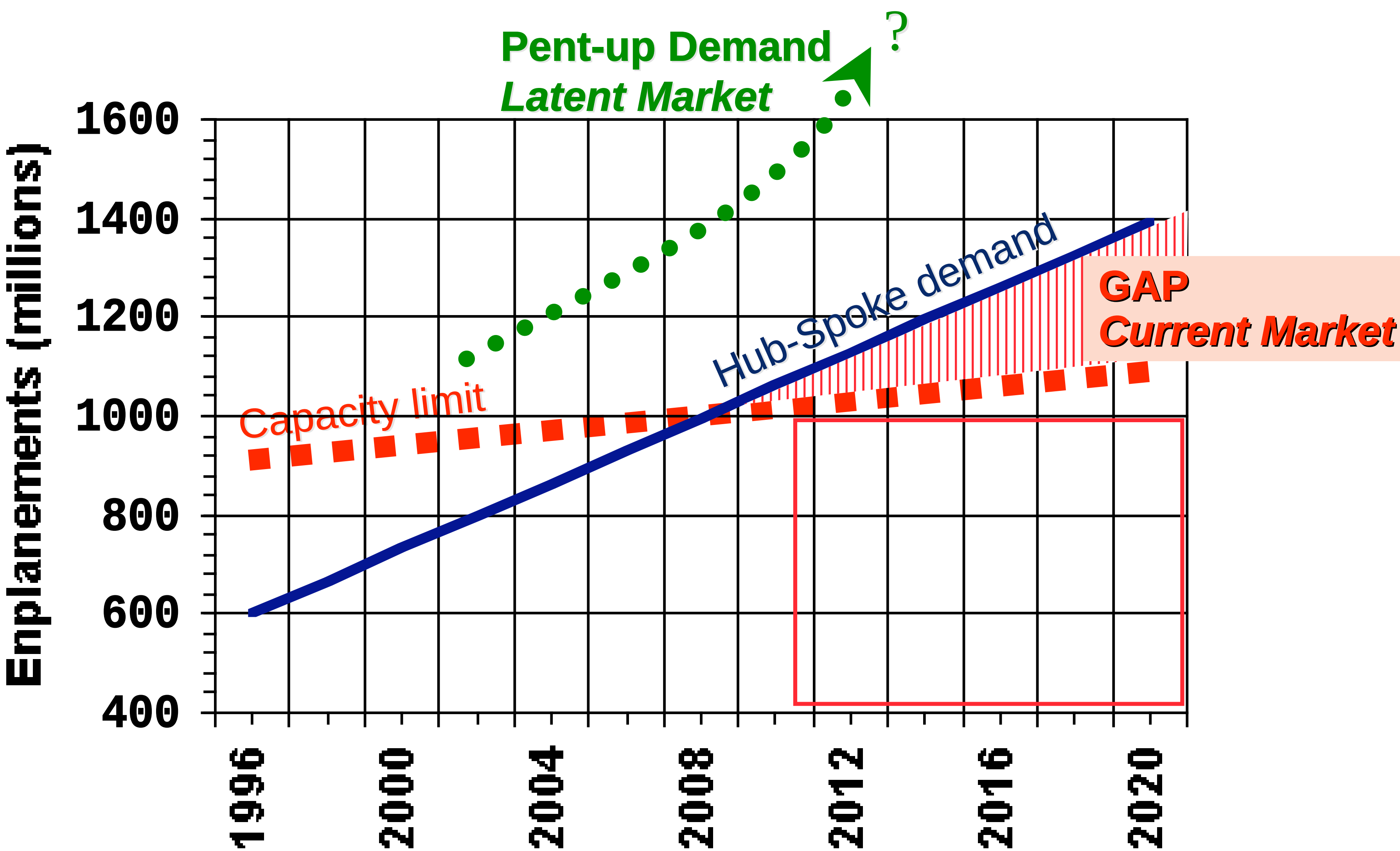
However, NASA is investing in SATS to stimulate the creation of the latent markets, not to satisfy current markets.

Latent SATS markets are defined as:

- **Trips not taken (due to time, cost, inaccessibility, or inconvenience)**
- **Trips not imagined (for goods, services, or people)**
- **Trips not possible in current infrastructure (vehicles and airspace)**

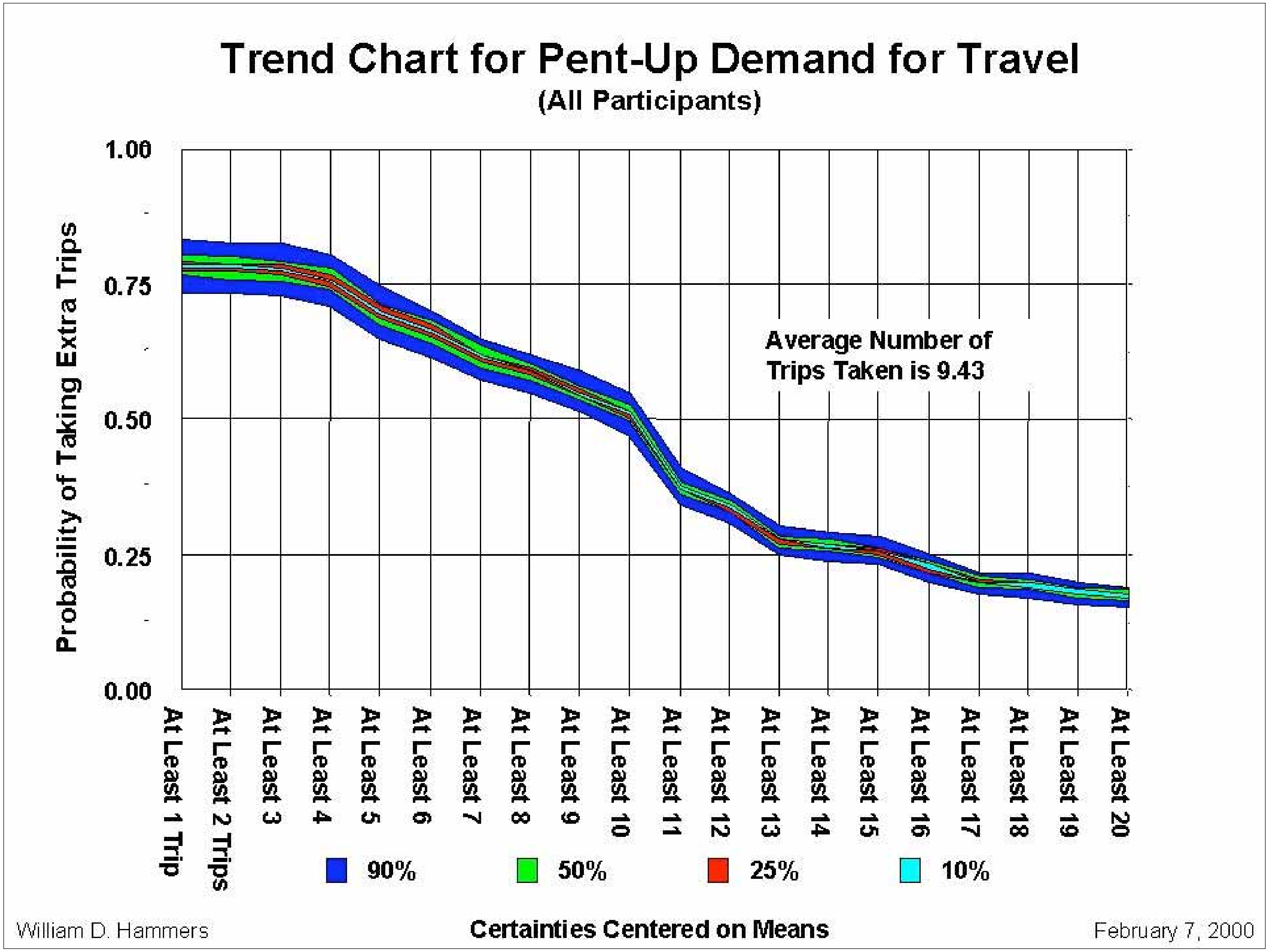
Demand Will Soon Exceed Supply

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

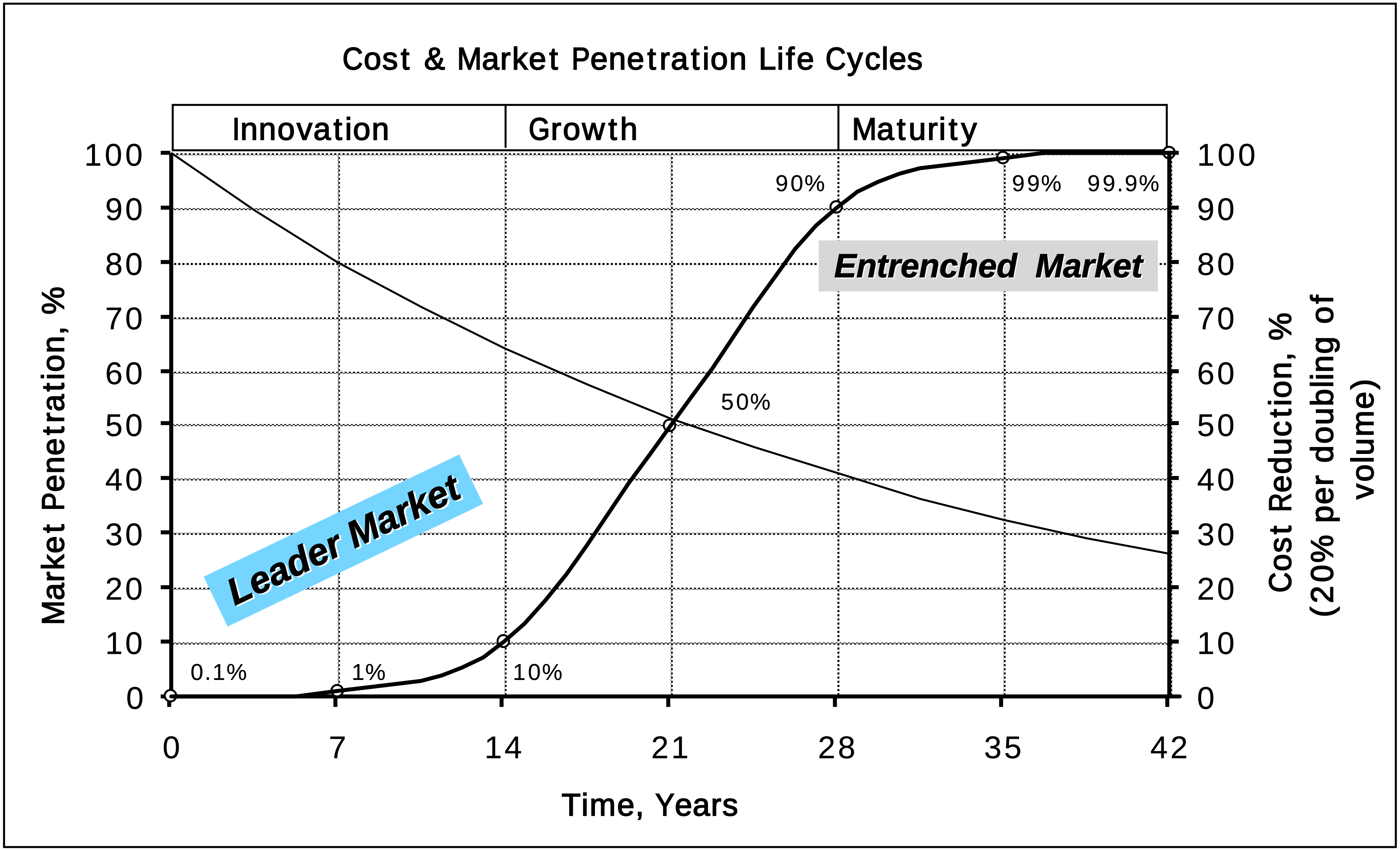


Pent-up Demand (http://apats.org)

"How many more trips would you take annually if you could save time?"

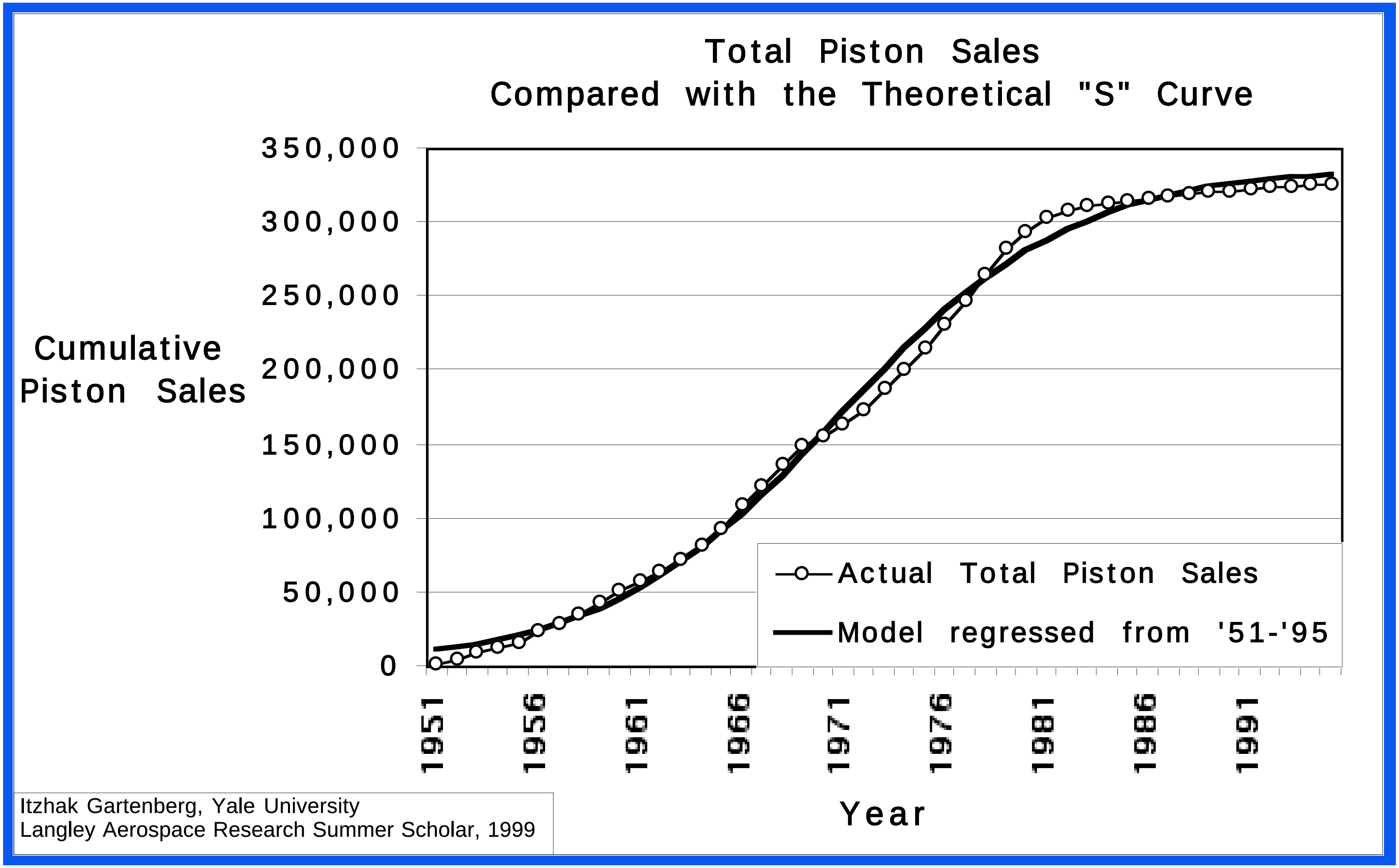


Innovation and Cost Life Cycles

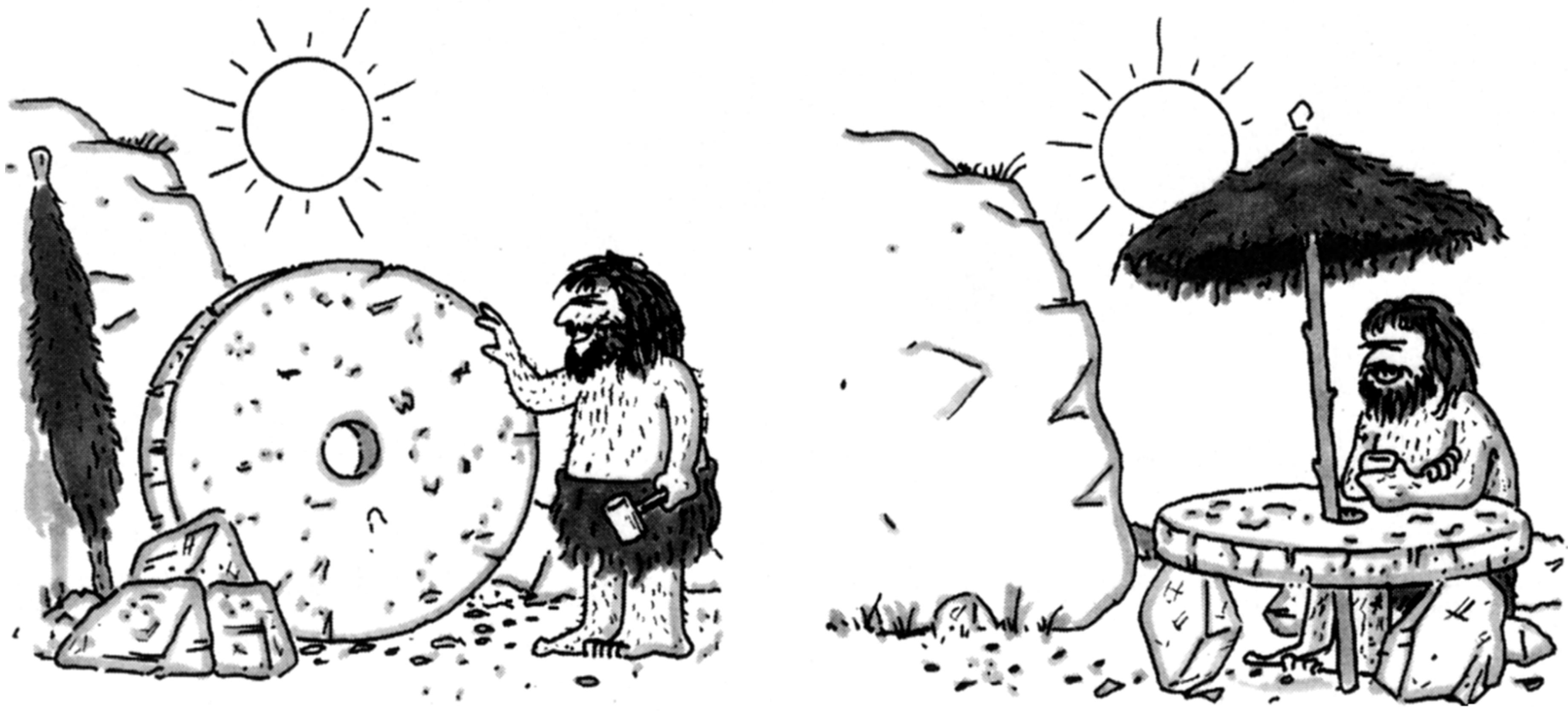


Life Cycle of the Piston Aircraft Market

...or is it really?...

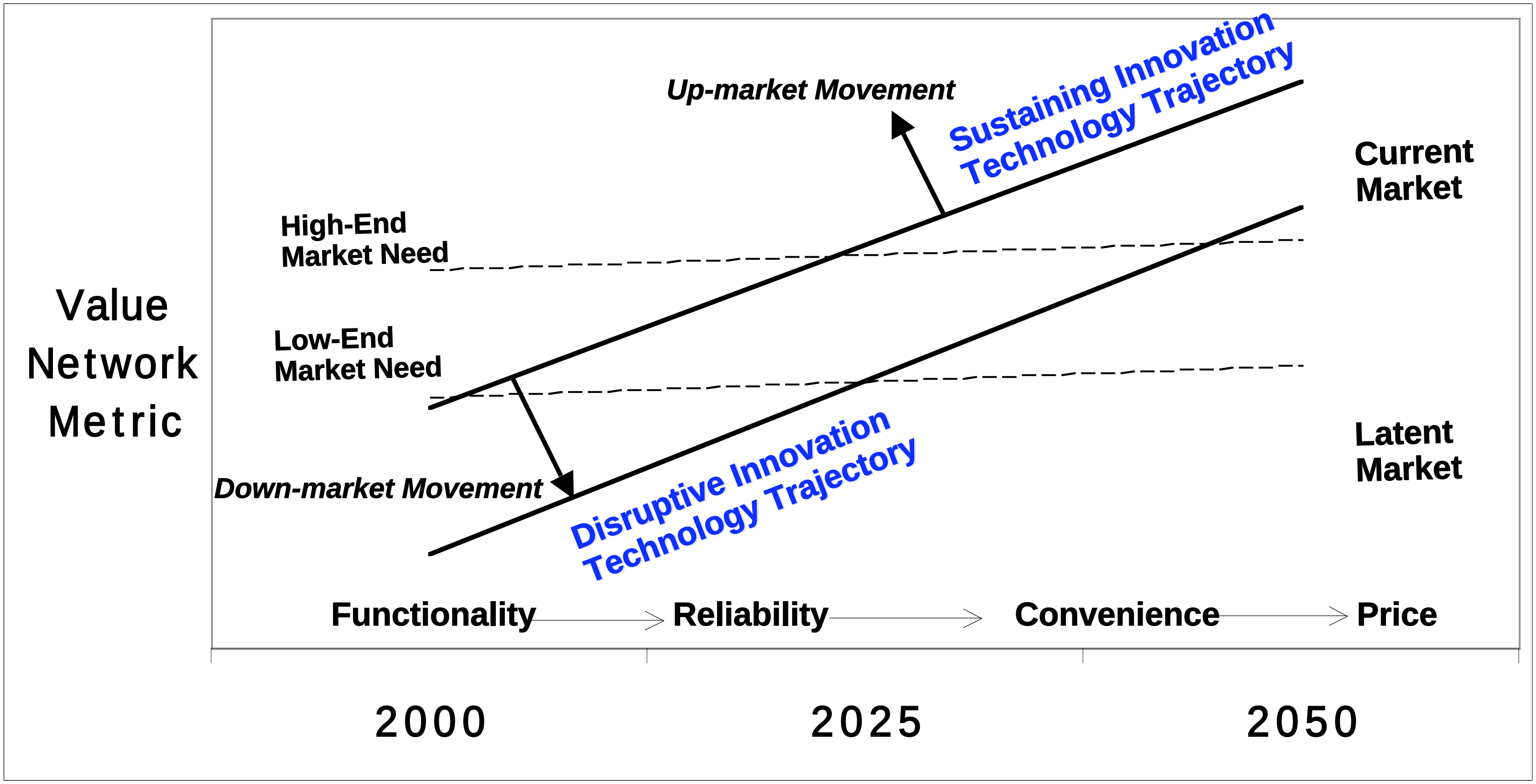


What Is a Disruptive Innovation?



Innovation Categories

Clayton Christensen: <u>The Innovators Dilemma</u>, Harvard Business School Press, 1997

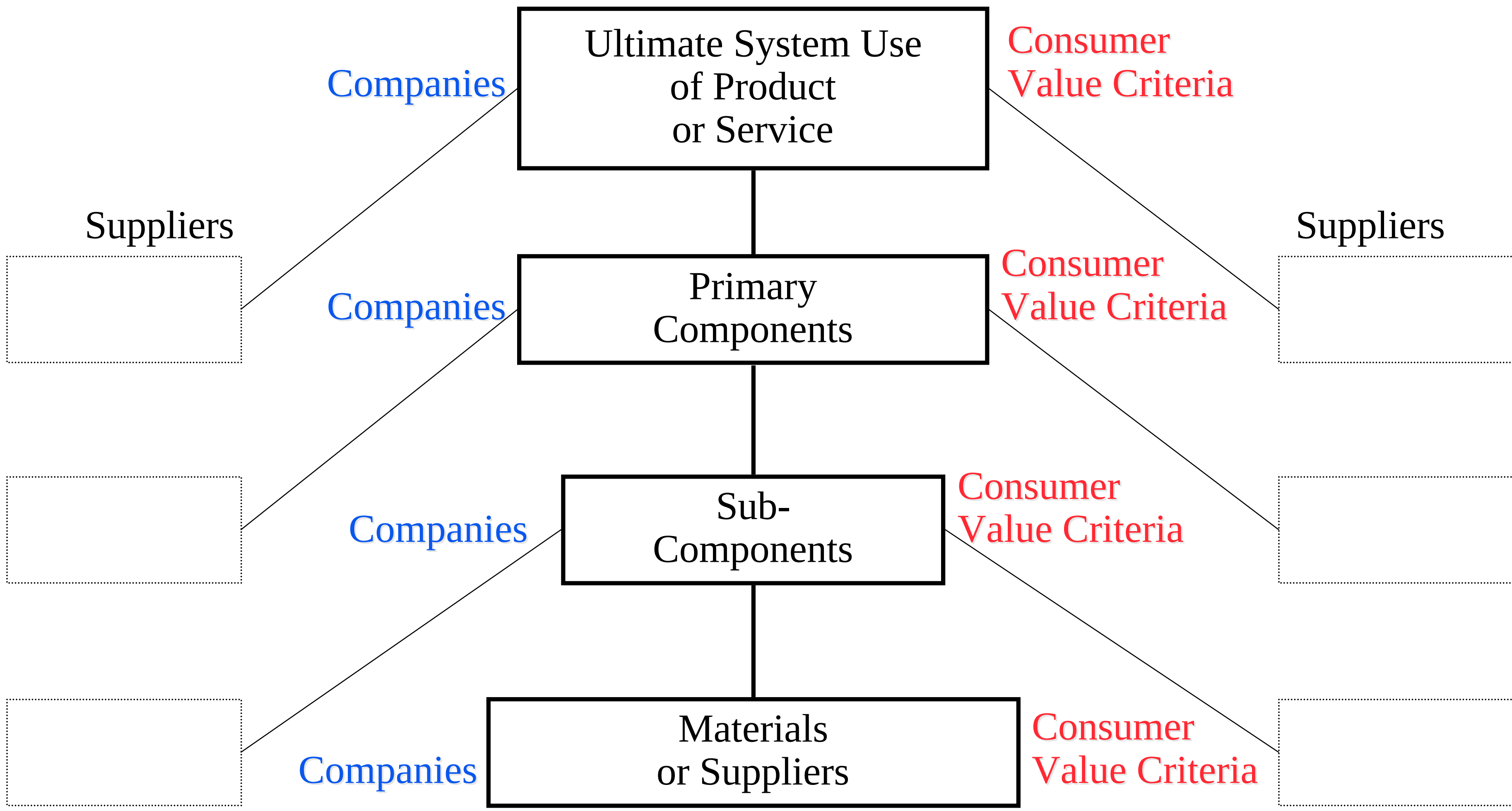


The <u>innovators dilemma</u> is that excellent management in established organizations drives resource allocations away from latent market enabling, paradigm-shifting innovations toward continued satisfaction of current market consumer and investor expectations.

Value Networks

(Clayton Christensen, The Innovators Dilemma, Harvard Business School Press, 1997)

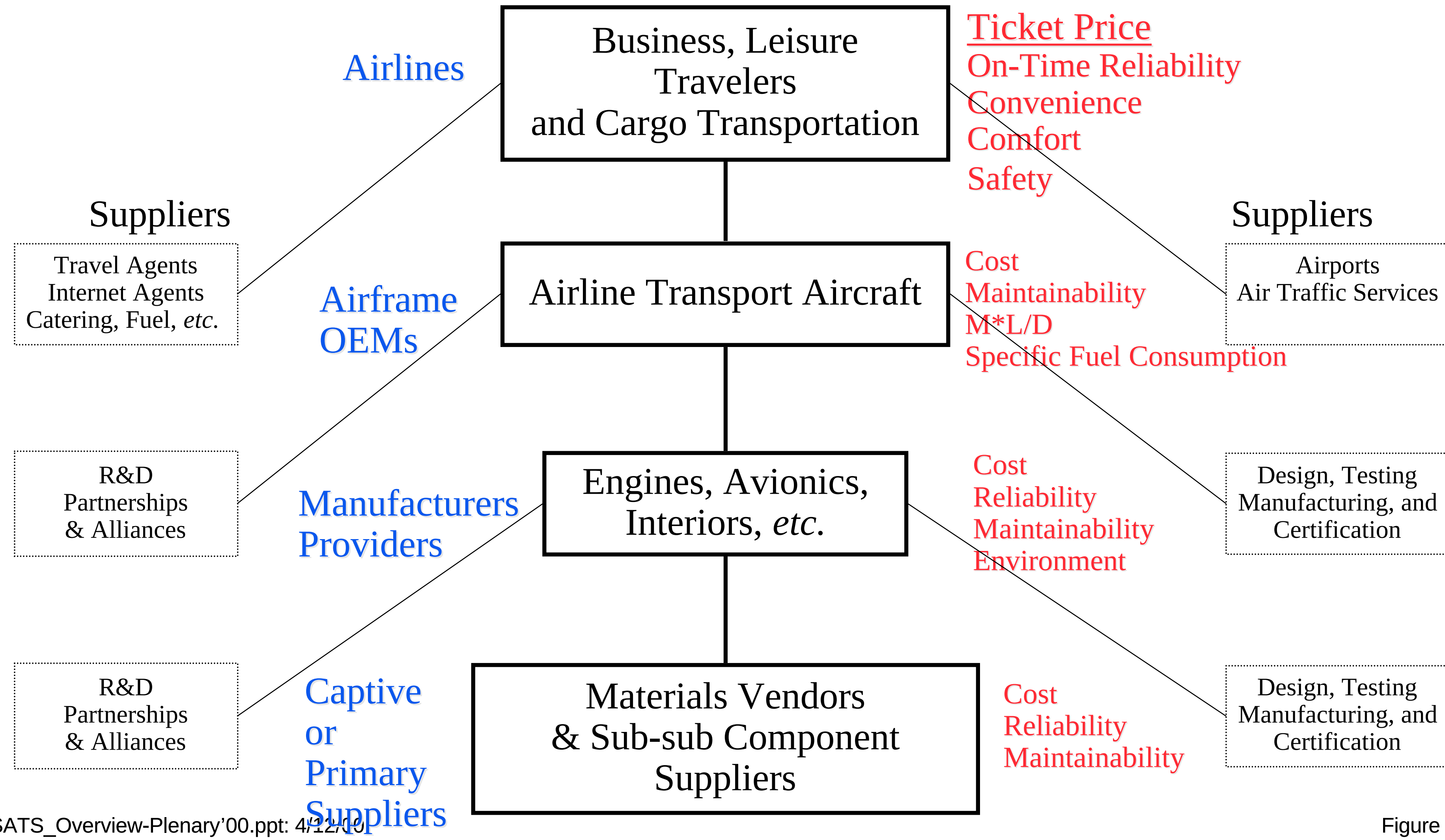
Value Networks create a nested system of expected rewards
for an incumbent or entrant enterprise
serving an existing or latent consumer base



Hub-and-Spoke Value Network

Consumer Value Criteria

Expected rewards from existing consumers for an incumbent enterprise (including investors) drive resource allocations toward innovations for growth of the current market.



SATS Program Planning Structure

- **Vision:** ***"SATS is a safe travel alternative, freeing people, goods, and services from transportation delays, by creating access to more communities in less time."***
- **Goal:** ***"Reduce public travel times by half in 10 years and by two-thirds in 25 years."***
- **Program Objective:** ***"Prove SATS Works" Hypotheses***
- **Approach:** ***2003 Experiments leading to the 2005 Showcase Demonstration***
- **Demonstration Objective:** ***The SATSLab Demonstration will prove the technology potential and limits for a new transportation innovation based on the following capabilities:***
  1. ***Near zero visibility access to all runways with reduced land use, noise, and equipment requirements.***
  2. ***About 100 times current traffic density with reduced ground infrastructure costs and requirements.***
  3. ***Aircraft as affordable and easy to use as automobiles for the general public.***
- **SATS Demonstration Hypotheses:**
  – ***SATS Approach and Landing***
  – ***High-Density 4D Operations***
  – ***Automotive Synergies***

Meeting 21st Century Transportation Challenges

The Small Aircraft Transportation System is a safe travel alternative that frees people and products from today's system delays creating access to more communities in less time.

Proposed SATS Value Network

Consumer Value Criteria

Expected rewards from latent consumers for entrant enterprises drive resource allocations toward paradigm shifting innovations.

Fractional
Taxi/Limo Jet
Charter
Lease/Rental
Owned

Business, Leisure Travelers and Cargo Transportation

Time (Door-to-Door Speed)
Accessibility (5,400 Airports)
Cost (3X speed at less cost)
Safety (10X Improvement)

Suppliers

Internet Agents
Dispatch,
Catering, Fuel, *etc.*

Airframe OEMs

SATS Aircraft

Jet Performance at Prop Costs
Reliability
Maintainability
Specific Fuel Consumption

Suppliers

Airports
Air Traffic Services
Intermodal Services

R&D Partnerships & Alliances

Manufacturers Providers

Engines, Avionics, Interiors, *etc.*

SATS Features
Cost
Reliability
Maintainability
Environment

Design, Testing Manufacturing, and Certification

R&D Partnerships & Alliances

Captive or Primary Suppliers

Materials Vendors & Sub-sub Component Suppliers

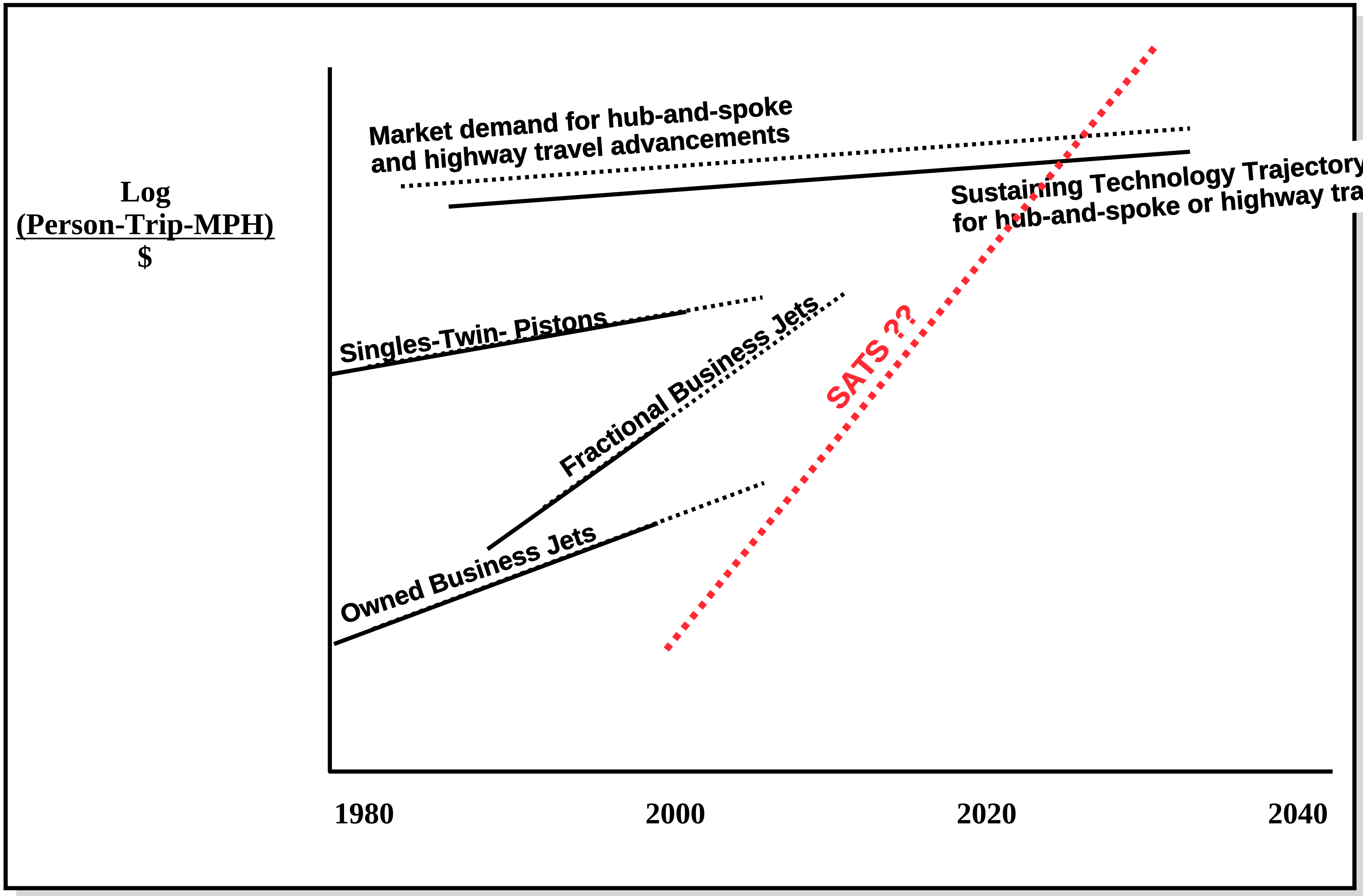
Cost
Reliability
Maintainability

Design, Testing Manufacturing, and Certification

SATS Value Network Metrics

Notional

SATS triggers a new disruptive innovation path



The New Generation Cockpits, Propulsion, and Aircraft

Lancair Columbia 300

Eclipse 500

Cirrus SR-20

Safire S26

And others….

SATS Accessibility = Economic Development

Michigan General Aviation Today

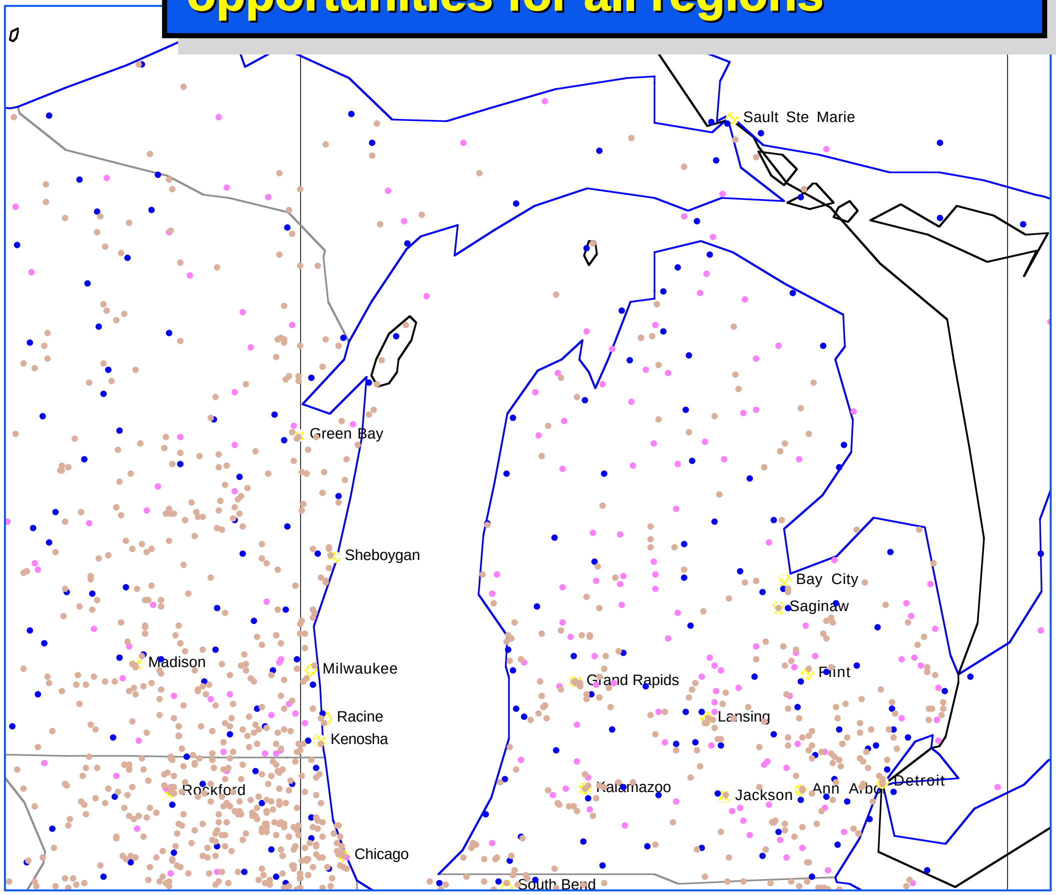
- **$ 475 Million in Economic Impact**
- **389 Public-Use and Private Airports**
- **20 Precision Approach Airports**
- **18,510 Active Pilots**
- **6,570 Aircraft**

~~INSTRUMENT LANDING FACILITIES~~

~~VISUAL ONLY~~

Highway in the Sky SATS Facilities

SATS will enable ~75% more accessibility by air for all Michigan's communities, expanding economic opportunities for all regions

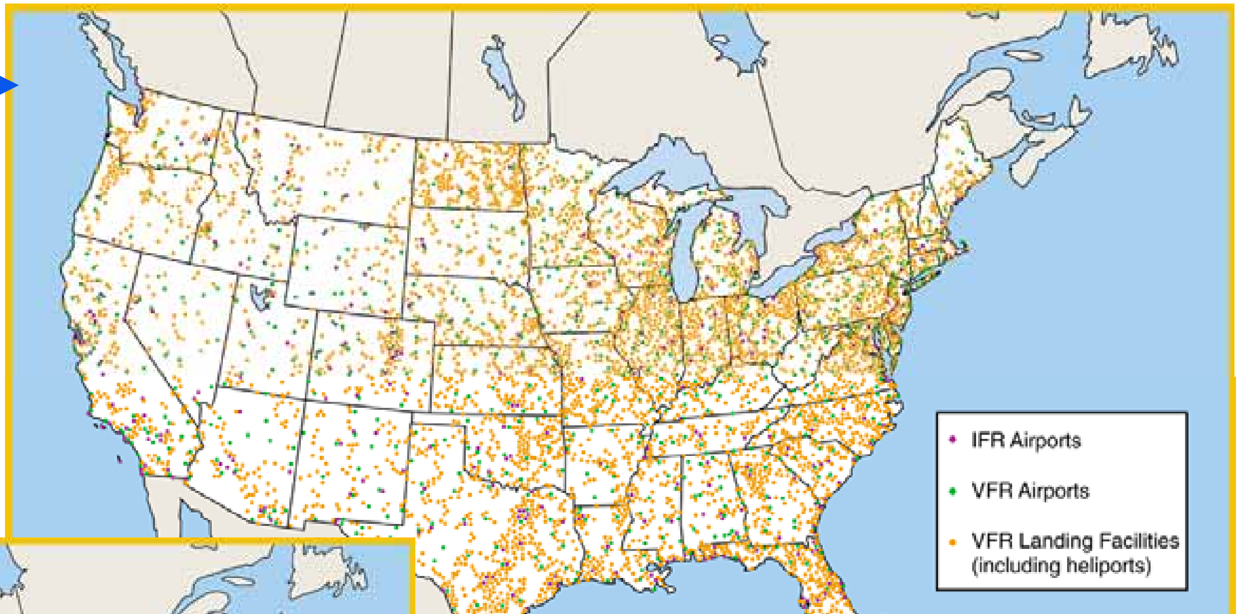


SATS Increases Accessibility and Mobility

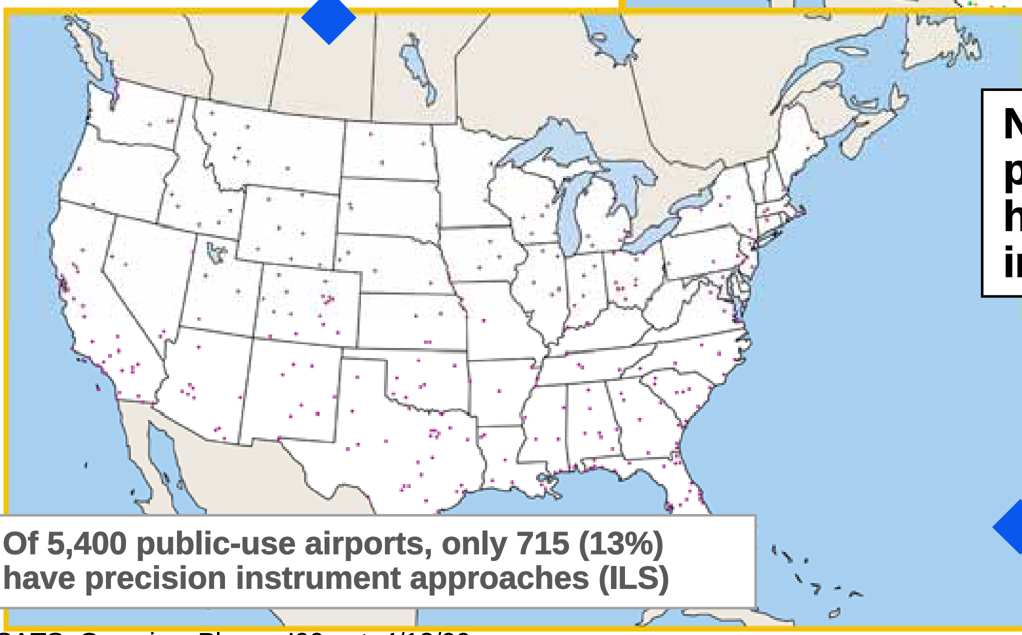
(". . .creating access to more communities in less time. . .")

A very short theoretical break even time for SATS infrastructure can be estimated.

Expanded Accessibility to several times more destinations



Near-all-weather accessibility to 5,400 public-use landing facilities can be a highly affordable national infrastructure investment.

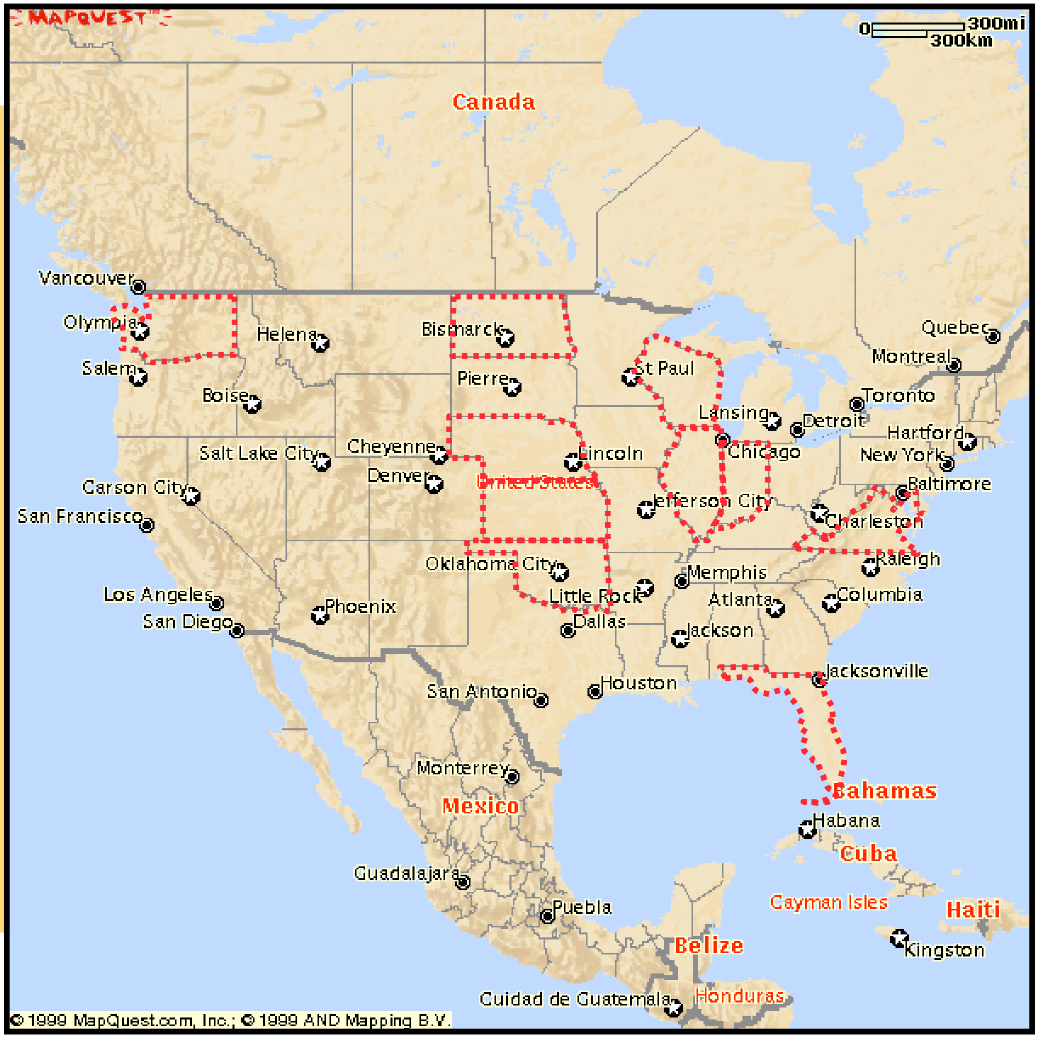


Of 5,400 public-use airports, only 715 (13%) have precision instrument approaches (ILS)

Improved Mobility saving more travelers more time

States Roles in SATS Planning

- **Aerospace States Association SATS Resolution, July, 1999 (~40 states)**
- **SATS "Leader" States Committed to Support Program Planning (~10 states)**
- **State SATSLab Partnerships (2 states to date)**
- **Showcase Demonstrations planned in 2003, 2005**



Technology Readiness Levels

9 Actual system "flight proven" on operational flight

8 Actual system completed and "flight qualified" through test and demonstration

7 System prototype demonstrated in flight

→ **Product Refinement**

Typical End of NASA Involvement

6 System/subsystem model or prototype demonstrated in a relevant environment

5 Component (or breadboard) validation in a relevant environment

4 Component and/or breadboard validation in a laboratory environment

→ **Focused Program**

Limit of R&T Base Activities

3 Analytical & experimental critical function and/or characteristic proof-of-concept

2 Technology concept and/or application formulated

1 Basic principles observed and reported

→ **Base R&T**

Candidate Federal-States SATS Partnership Roles

US Innovation Partnership

Universities
SATS Policy, Impact Analyses
NASA Space Grant
Collaboration
SATS R&D

TRL ≤ 6 (NASA SATSLab Projects)

States
Aviation System/Airport Master Plans
SATS Airport Equipage
SBIR, EPSCoR Collaboration

NASA
Vehicle & Infrastructure Technologies R&T
Organize & Coordinate Partnerships
Integrate Requirements

DOT
One-DOT Initiative
ITS Synergies

FAA
Certification & Regulation
Airports
Air Traffic Services
Flight Standards
R&D

DOC
U.S. Innovation
Partnership Facilitation
EPSCoT Collaboration

TRL = 7-9 (SATS “Institute” States SATSLabs)

Industry
Competitive Subsystem Technologies
Industry Standards
Transportation Service Business Infrastructure
Non-Profit for Partnership Administration

SATS Draft Program Structure

SATS Governance
- Transportation Strategy
- Policy Strategy
- Technology Strategy

SATS Alliance Operations (AGATE-Like Non-Profit)

NASA HQ Code R

NASA Langley

NASA SATS Office
SATSLab Program
AGATE Program

FAA Technical Integration

SATS Focused Program
NASA Technology Validation (TRL ≤ 6)
State/Industry Demonstration (TRL >6)

uSATS Base R&T
- Configurations
- Propulsion
- AutoFlight

NASA SATSLab Projects
- App./Landing
- High Density
- Automotive Synergies

2005 Demonstration
- SATS Procedures
- Architecture
- Concept Vehicle

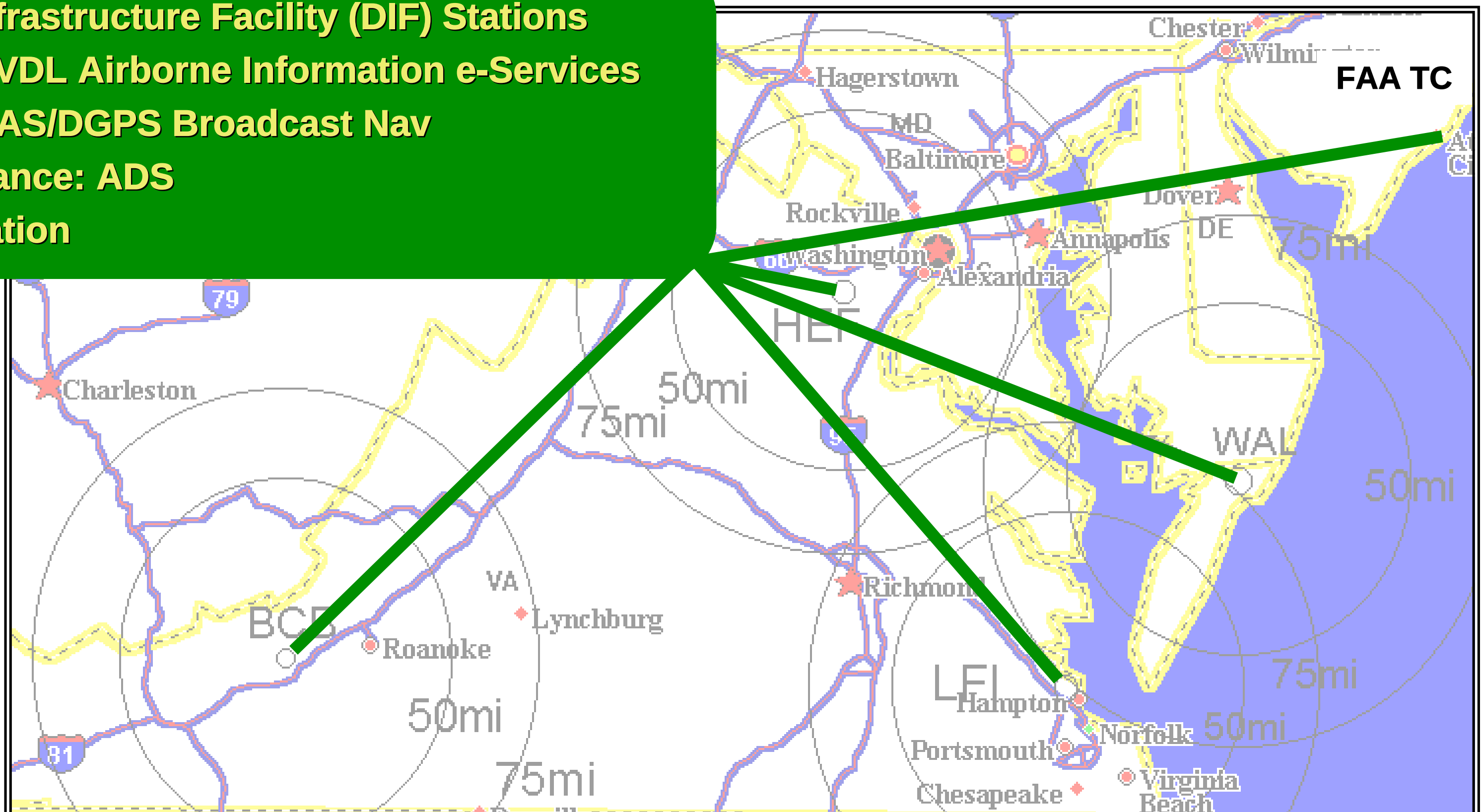
State SATSLab Projects
- VA SATSLab
- FL SATSLab
- NB SATSLab
- OK SATSLab
- KS SATSLab
- TN SATSLab, *et. al.*

Technology
Market Research
Policy Analysis
Certification
Regulation
Education
Security

SATS will operate under a Joint Sponsored Research Agreement
- **Cost Shared**
- **Collaboration for pre-competitive outcomes**
- **Competition for competitive technologies**

Virginia SATSLab

Datalink Infrastructure Facility (DIF) Stations
- Comm: VDL Airborne Information e-Services
- Nav: LAAS/DGPS Broadcast Nav
- Surveillance: ADS
- ATM Station



- Highway in the Sky (HITS) Precision Guidance to All Runway Ends
- Airborne Internet, Client-Server architecture
- VFR 20:1 Approach Zones in IMC using “Virtual” TerPs
- Towerless, Radarless Operations with self-sequencing & separation

SATS Hypotheses
"Prove SATS Works"

1. The public can safely operate a SATS vehicle in 4-D, in near all-weather, including abnormal operations

2. The public can afford to travel by SATS

3. SATS infrastructure is an affordable option for national transportation system investments

4. SATS benefits all suburban, rural, and remote communities in terms of accessibility, mobility, economic opportunity, environment and quality of life

SATSLab "Discovery" Objectives

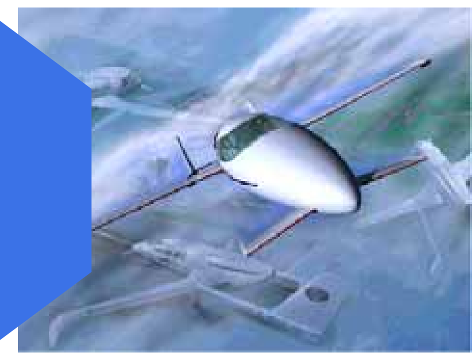
"Prove SATS Works"

'Virtual VMC' for Routine IMC Operations

Prove that cockpit displays, automated systems, and "virtual" terminal procedures can enable non-commercial aircraft operators to conduct VMC-like approaches, departures, and missed approaches in IMC. Establish the limitations for application to virtually all runways and helipads in the nation without requiring expansion of airport protection zones.

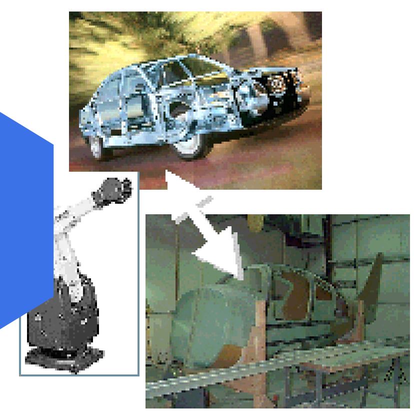
High-Density Operations

Prove that SATS automation-aided air-based technologies have the potential to enable user preferred trajectories with sequencing and separation including applications in non-towered, non-radar airspace in near-all-weather conditions. Establish the upper limits of aircraft density for both enroute and terminal operations. Establish the potential for seamless, non-interfering interoperability at facilities in Class B airspace.



Automotive Synergies

Prove that automotive design and manufacturing technologies have the potential for application to easy-to-use SATS vehicles while satisfying the public need for safety, energy efficiency, and environmental acceptability. Establish the lower boundaries for vehicle cost based on automotive synergies, including all certification processes.

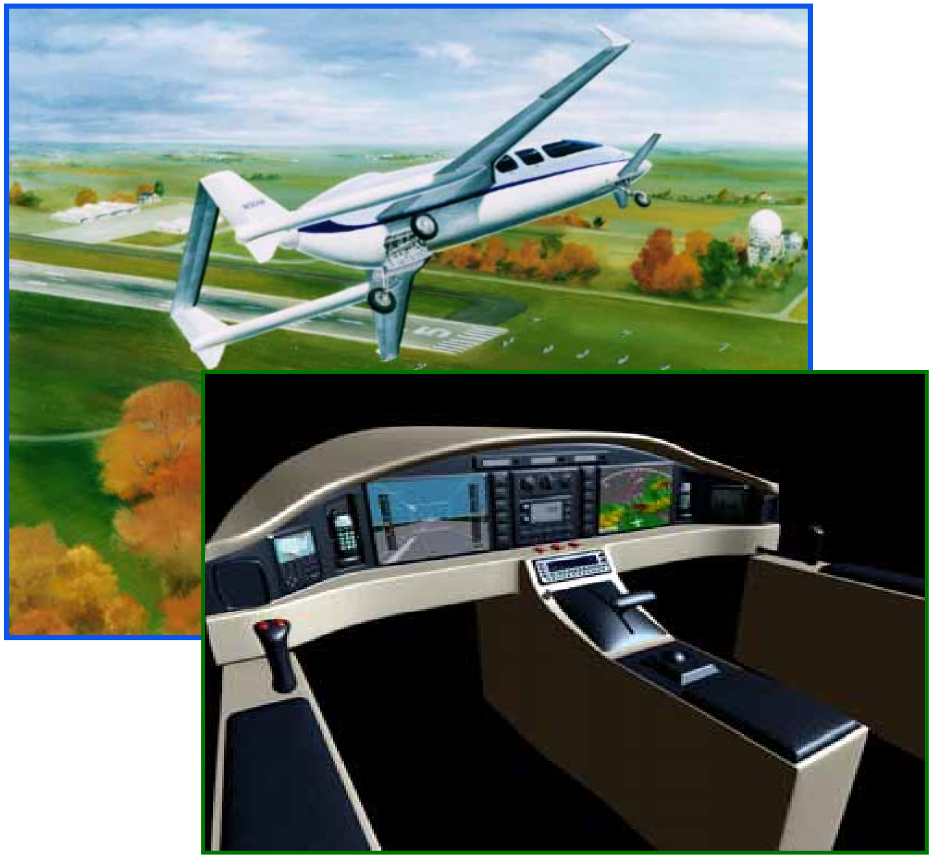


Demonstration Hypotheses

'Virtual VMC' for Routine IMC Operations

- Use of synthetic vision with Highway in the Sky operations enables near zero visibility landing minima.
- Appropriate automation can enable safe operations by single-crew non-commercial operators.
- Terminal Procedures (TerPs) can be "virtual" (*I.e.,* computed on-board in real-time) and dynamic under all conditions including weather, traffic, geographic, and environmental constraints (noise, etc.).
- Traditional approach lighting will not be required.
- IMC terminal operations can be conducted without requiring expansion of airport protection zones for virtually all runway ends and helipads.

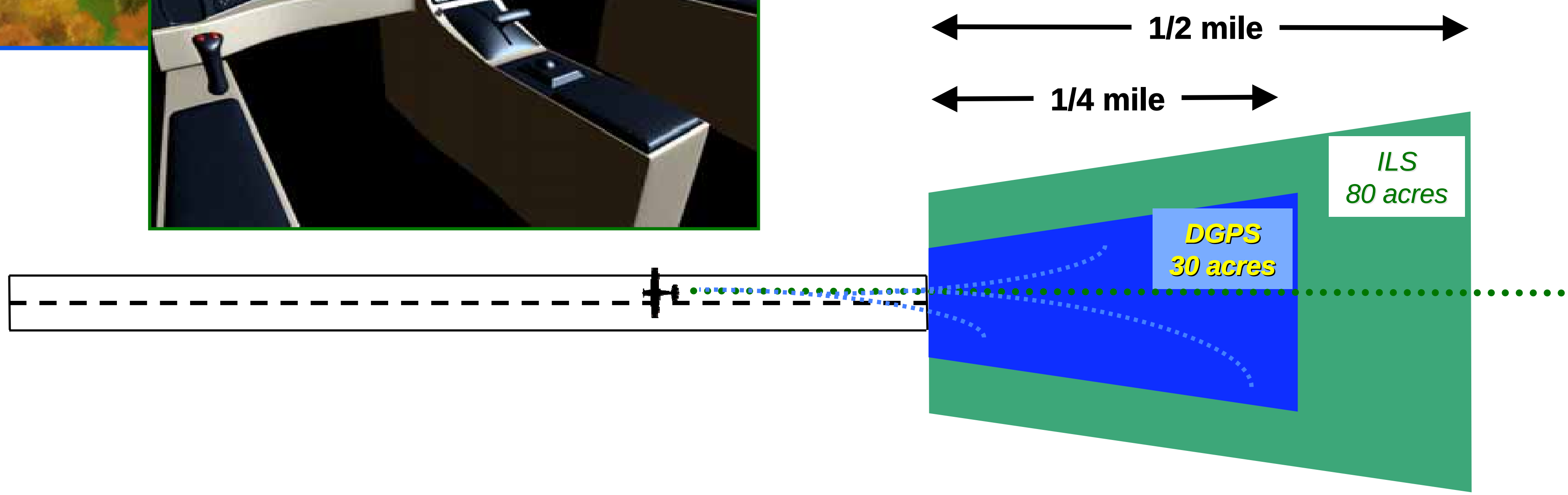
Precision Guidance to __Every__ Runway End in America



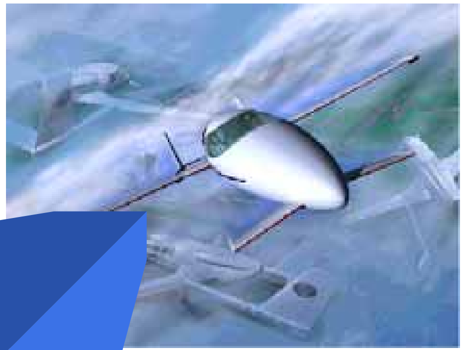
Highway in the Sky / Synthetic Vision with "Virtual" Approach Procedures:

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

Runway Protection Zone (RPZ)



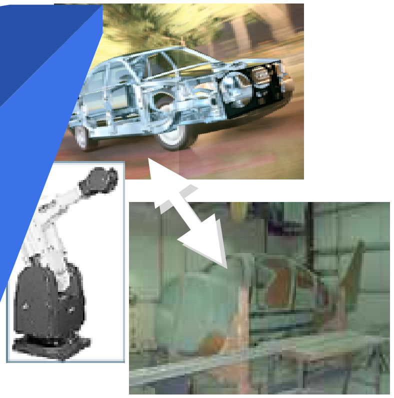
Demonstration Hypotheses



High-Density Operations

- The SATS-enhanced NAS is capable of accommodating significantly increased aircraft densities.
- The SATS Client technologies enable airborne autonomous separation & sequencing decisions.
- Routing and altitude segments can be operator-controlled (user-preferred) including non-radar-airspace operations in IMC and VMC.
- SATS flight operations can be conducted without voice communication.
- SATS equipped aircraft can operate seamlessly with non-SATS equipped aircraft at facilities in Class B airspace.

Demonstration Hypotheses



Automotive Synergies

- **Aircraft can be designed and manufactured at unit costs comparable to automobiles.**
- **Ease-of-use technologies can be common between automobiles and SATS aircraft.**
- **Cockpit architectures can share common elements between automobiles and SATS aircraft.**

NASA Roles

- **Establish the role for automation technologies in proving the SATS operator hypotheses.**
- **Establish the architecture technologies for the cockpit, the comm/nav/surveillance systems, and the airspace that prove the SATS infrastructure hypotheses.**
- **Create the collaborative environment that establishes technology options that prove the SATS vehicle hypotheses.**

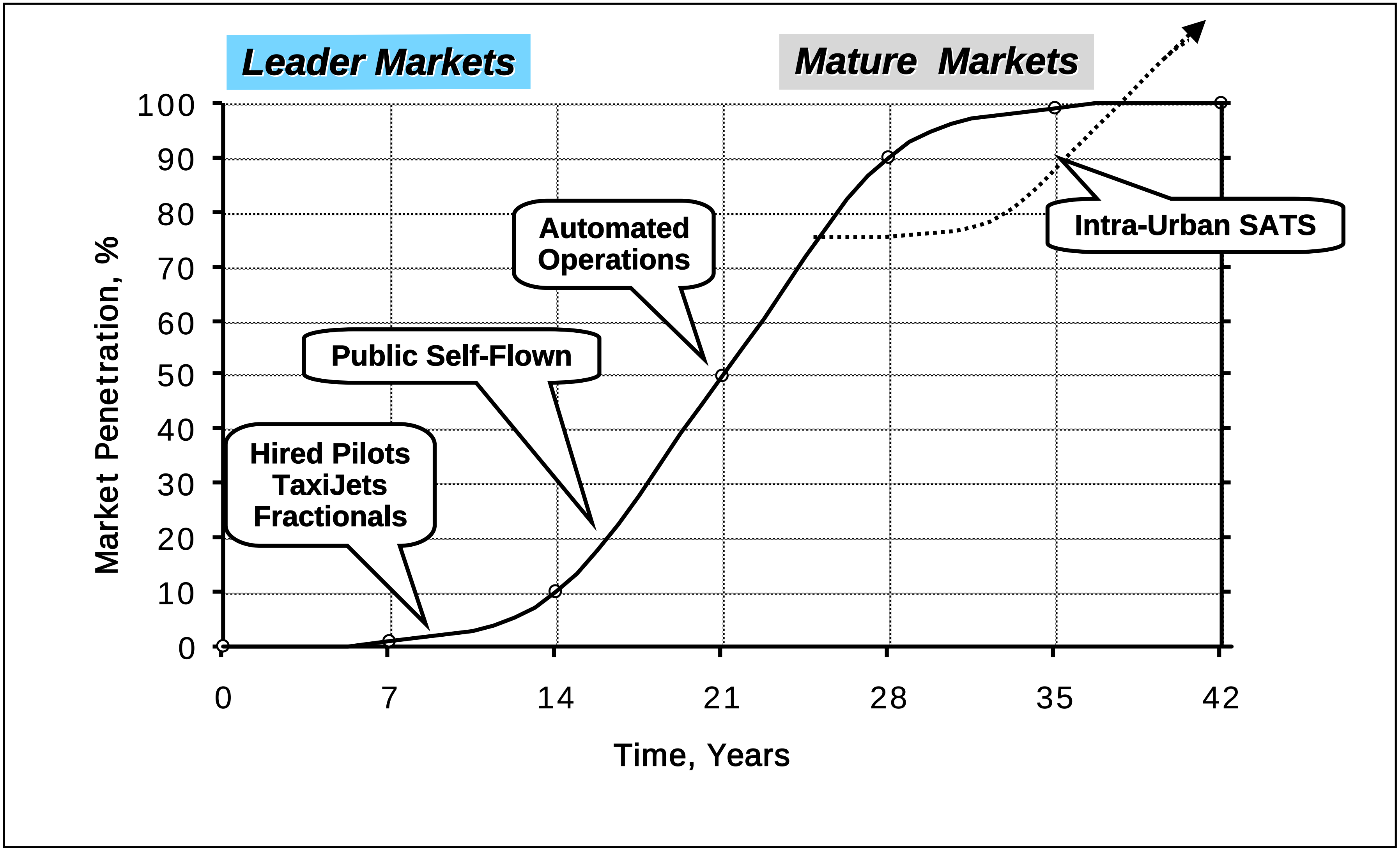
1. **The public can safely operate a SATS vehicle in 4-D, in near all-weather, including abnormal operations**
2. **The public can afford to travel by SATS**
3. **SATS infrastructure is an affordable option for national transportation system investments**
4. **SATS benefits all suburban, rural, and remote communities in terms of accessibility, mobility, economic opportunity, environment and quality of life**

Potential FAA Roles

Agree to metric requirements for acceptance of SATS "proofs"

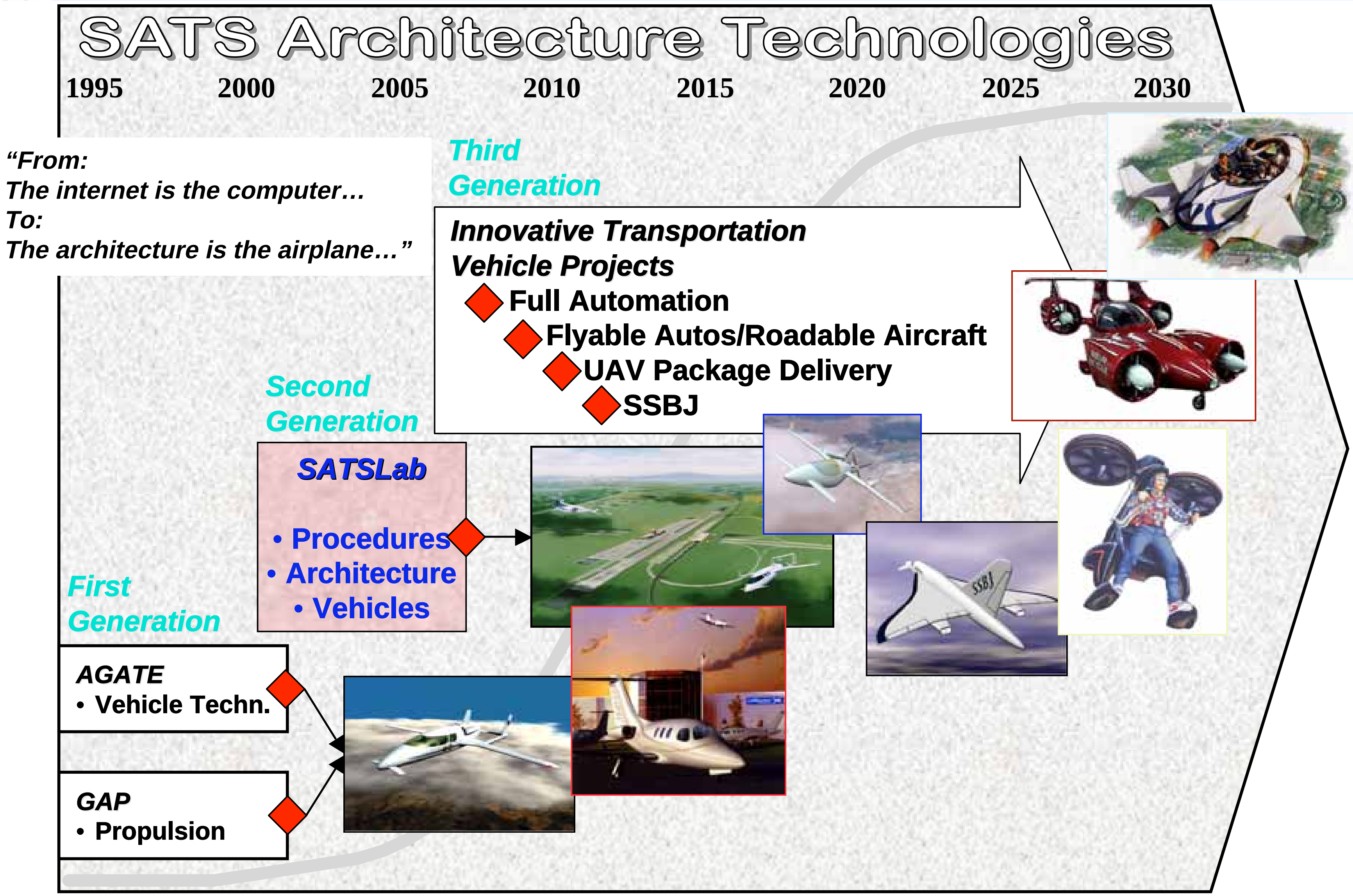
- **Operations approvals for experiments and demonstration (AFS)**
- **Airport issues for HITS approach design, commercial activities, *etc.* (ARP)**
  - **FAR 77**
  - **AC 150-series**
- **Air Traffic Services issues for non-managed and managed airspace (ATS)**
  - **Procedures**
  - **Airspace**
  - **Regulatory**
- **Certification reform and streamlining (AIR, AFS, ATS)**
  - **Aircraft**
  - **Equipment**
  - **Airmen**
- **SATS transition and deployment plans (ARA, ATS, AFS)**
  - **Handling mixed equipage**
  - **Infrastructure transition**
- **Further FAA roles to be determined (AOA)**

A Potential SATS Innovation Life Cycle



Transportation System Innovations

Vehicle-Centric Architecture-Based Revolutions



SATS NRC Study

Purpose: Provide an independent assessment of the validity of SATS hypotheses

Status:

- **Committee to consist of 12-15 members**
- **18-24 month study**
- **Currently assembling list of candidates**
- **First committee meeting in May or June**

Issues:

- **Committee chairman still not identified**
- **Late start pushes completion of study well into FY02**

Desired Committee Expertise

Technology and Infrastructure

- **Avionics/Flight Deck Systems**
- **Alternative Technologies**
- **Product Manufacturing and Integration:**
- **Propulsion**
- **Air Space/Air Traffic Control and Management**
- **Airports/Landing Facilities**
- **Automation Systems/Com-Nav Capabilities**

Market Demand and Use

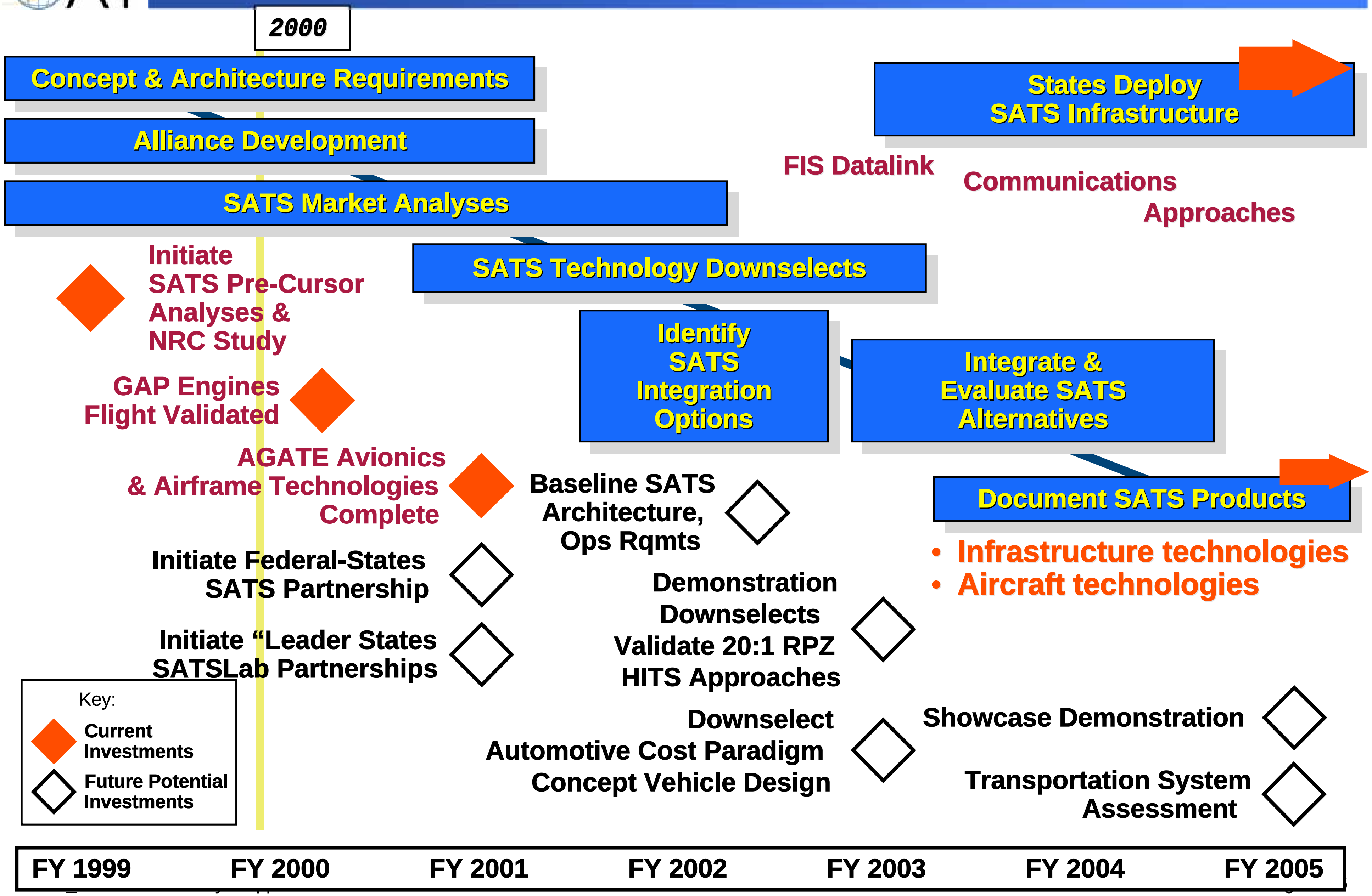
- **Human Factors Integration**
- **Aviation Safety**
- **User Training**
- **Aircraft Certification**
- **Future Travel Demand**
- **Transportation Economics**
- **Airport and Airway Capacity/Logistics**
- **Private Finance**

Airline markets/Aviation Operations

Public Sector Role and Policy Issues

- **Public Policy**
- **Environment**
- **Technology Policy/History**
- **Innovation Process/Role of Government**
- **Local Economic Development**
- **Public Finance**

SATS Milestones



SATS Funding

Administration FY 2001 Budget Submittal to Congress*

	FY 01	02	03	04	05
SATS Focused Program*	$9M	$15M	$20M	$20M	$5M
SATS Base Program	$3M	$5M	$8M	$8M	$8M
SATS-Focused SBIR/STTR**	$5M	$5M	$5M	$5M	$5M
TOTAL (Focused+Base+SBIR)**	$17M	$25M	$33M	$33M	$18M

* In Administration's FY 2001 Budget
** Estimated values

FAA/NASA Executive Committee

SATS Agreement

SATS Program Description:

"The Small Aircraft Transportation System concept is a safe travel alternative that frees people and products from transportation system delays, creating access to more communities in less time."

Joint NASA-FAA supporting statements are:

- FAA and NASA are working together to define a SATS operational concept as it relates to the transportation infrastructure of the U.S. and will begin a NASA funded research initiative to explore the feasibility and viability of implementing that concept.
- Under the charter of the NASA/FAA Executive Committee, the agencies agree to form a working group to define the FAA-NASA engagement in SATS program development and implementation planning.

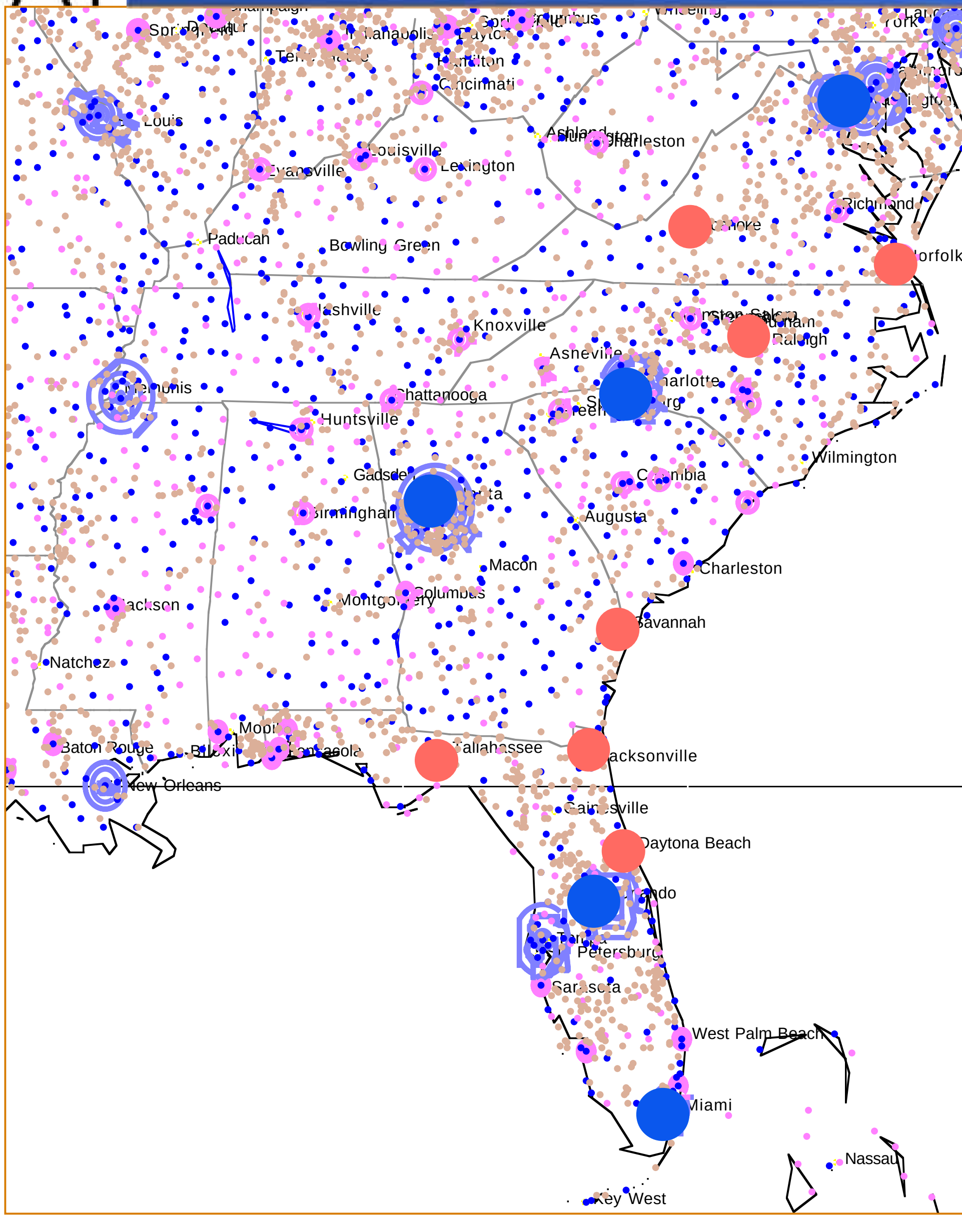
Summary

- SATS builds on AGATE and GAP investments in vehicles technologies, by expanding the focus to target infrastructure technologies.
- The partners in SATS need to position the investment and organization as a "disruptive innovation"
  (*I.e., apart from "mainstream" customer- and resource allocation-driven processes*)
- SATS has sufficient potential value to the nation, and consistency with Free Flight and NAS 4.0, for FAA to participate in SATSLab Program establish the role of SATS in NAS enhancement.


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
http://agate.larc.nasa.gov

Backup Charts

SATS Creates Third Tier Market Access



- **Facilities that serve the Third Tier market are non hub-and-spoke**
- **Current Regional Jet service is driven by up-market forces, toward larger aircraft serving existing spoke network**
- **Pent-up demand measurements portray latent market opportunity for SATS**
- ***SATS creates air carrier access to Third Tier markets***

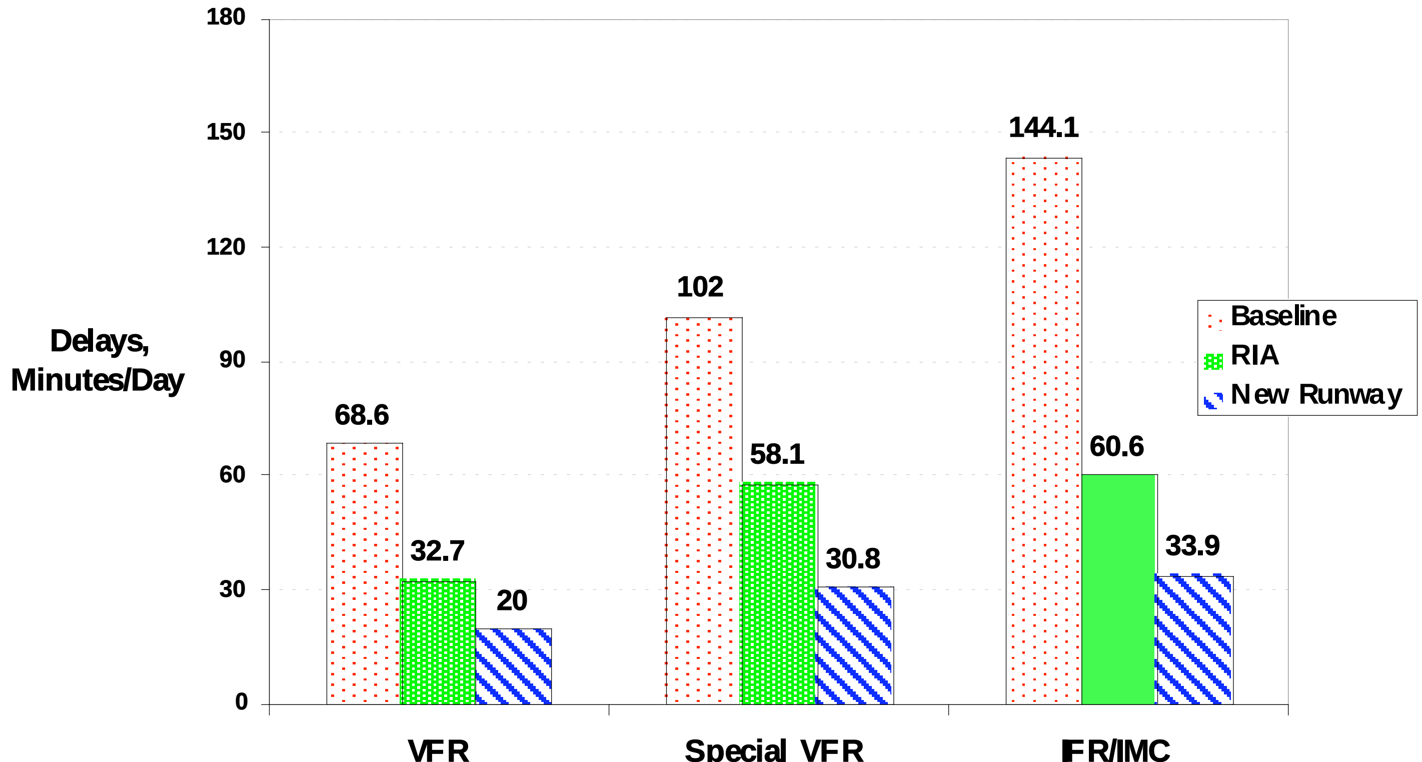
SATS Accelerates Free Flight

- **Accelerated fleet equipage is vital to NAS modernization and free flight**
- **SATS accelerates pace of small aircraft fleet equipage for free flight capabilities**
- **SATS will accelerate migration of free flight technologies and procedures into air carrier applications**
- ***SATS accelerates air carrier access to free flight***

SATS Reduces Delays

- **Runway Independent Aircraft (RIA) using Simultaneous Non-Interfering (SNI) approaches can reduce delays associated with the growing air transportation demand by more than 50% for a hub airport.**
- **The economic and environmental efficiencies of the RIA/SNI alternative provide orders of magnitude savings over building new runways.**
- ***SATS reduces delays at Class B facilities*.**

Runway Independent Aircraft (RIA) Reduce Airport Delays



Results of 1999 FAA Newark Airport Task Force Study

Showcase Demonstrations

"Showcase Demonstrations", implemented with State and Local Government partners, integrate SATS Features and validate key technologies. Experiment in FY 03 and Demonstrations in FY 05 are planned for a constrained spectrum of variables (vehicle, terrain, meteorological, geographic, demographic, and airspace). Demonstrations serve as basis for (1) technology application strategies by industry (regulation and certification) and (2) influence of public policy decisions on deploying SATS infrastructure based on consumer and community response to technologies. Demonstrations to be limited to 2 states at most.

•FY03- Validate subset of SATS Operational Capabilities in Terminal Airspace

- Validate 20:1 runway protection zone for near all weather operations using Highway-In-The-Sky (HITS) operating system
- Basic Datalink system philosophy (only demonstrate essential communication link with Flight Information (FIS) and Traffic Information (TIS) Services)
- Intuitive vehicle controls (integration of AGATE Features, e.g., decoupled controls, single power lever)
- Training systems concepts for reducing cost and time for all-weather operations (extension of AGATE activities)

•FY05- Airport-to-airport validation of integrated technologies for safe, near all-weather accessibility including:

- Automation-enabled separation and self-sequencing in non-towered, non-radar airspace (multiple aircraft demonstration)
- Simultaneous non-interfering operations (limited demonstration)
- Datalink system, including full suite of information services (Flight Information Services, Commercial Information Services, Traffic Information Services)
- Integrated avionics standards and systems

SATS Features and Capabilities

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)

SATS Distinctions

- **The SATS concept establishes a new priority ranking for intercity transportation consumer value-criteria, minimizing <u>door-to-door time.</u>**
- **SATS fills a vacuum not currently populated by transportation services (vacuum left by up-market movements of the rest of the industry).**
- **SATS serves a latent market that cannot be quantified *a priori*; a business case cannot be based on *a priori* known behavior of this latent market.**
- **SATS also serves a current market for enthusiast, romance and elitist aviation products and services that can be quantified.**
- **Upmarket forces in the established G A industry may make it easier for entrant firms to introduce SATS vehicles, or for organizations embedded in established firms with insulation from mainstream resource constraints.**
- **Upmarket forces at well-developed General Aviation and Regional landing facilities may make it easier for SATS infrastructure to be introduced by entrant communities.**
- **NAS Architecture, regulation and certification for SATS will require innovation (SATS serves a personal *versus* a mass transportation need).**

States’ SATSLab Products

Products

- **Community, economic & environmental education & advocacy**
- **Airport management & patrons education & advocacy**
- **Design of SATSLab experimental infrastructure, patron services, training & FAA coordination**
- **Analysis of *current* & *latent* SATS consumer markets**
- **Deployment of Virginia SATSLab Demonstration**
- **Design of other local experiments**
- **Implementation of other local experiments?**
- **Implementation of other SATS Demonstrations?**

Funded*

Unfunded

- **Implementation of other local experiments?**
- **Implementation of other SATS Demonstrations?**

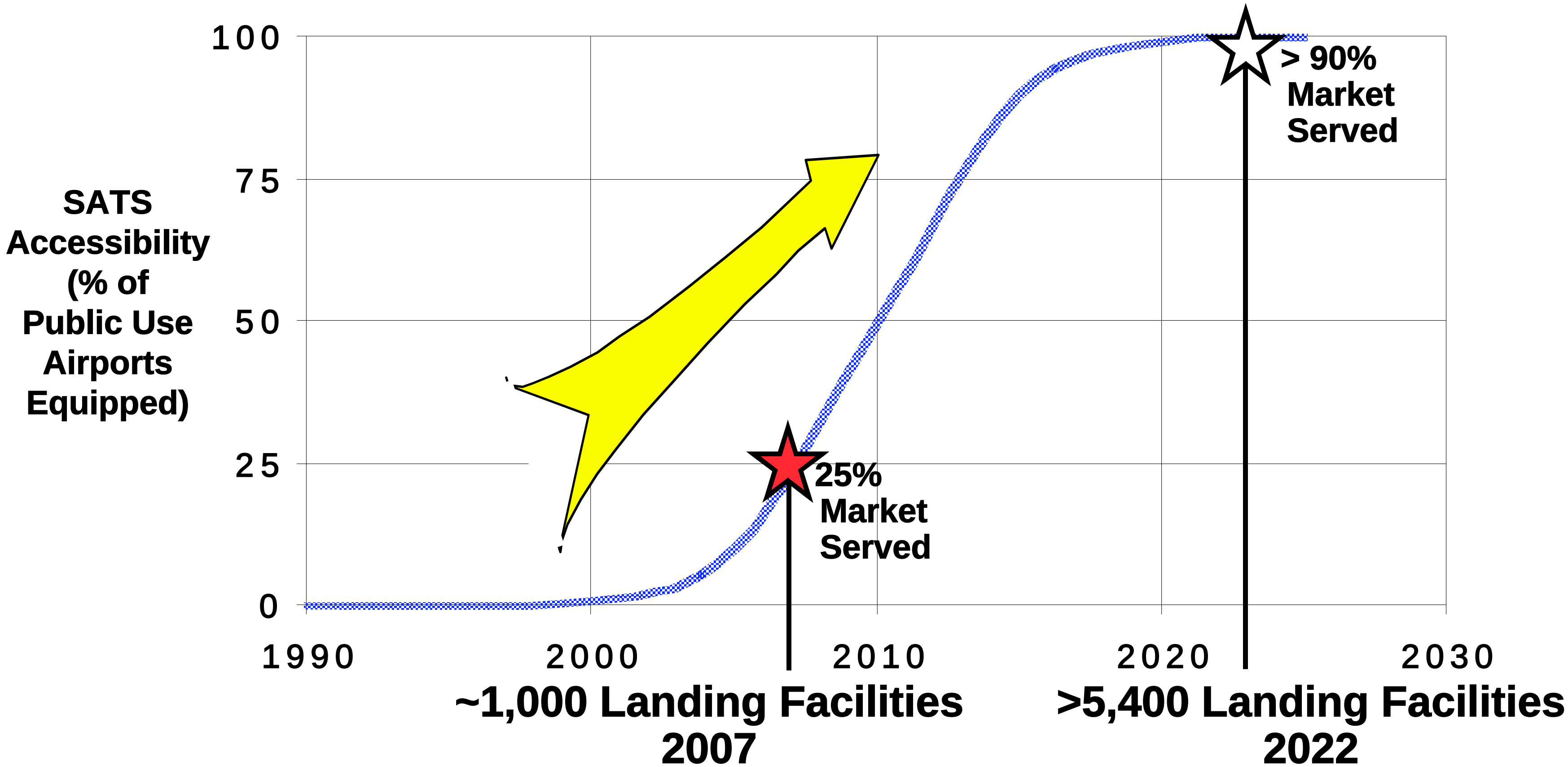
*** In Administration’s FY 2001 Budget**

National General Aviation Roadmap Goal

(Revised December 1999)

" Reduce public travel times by half in ten years and two-thirds in 25 years,"

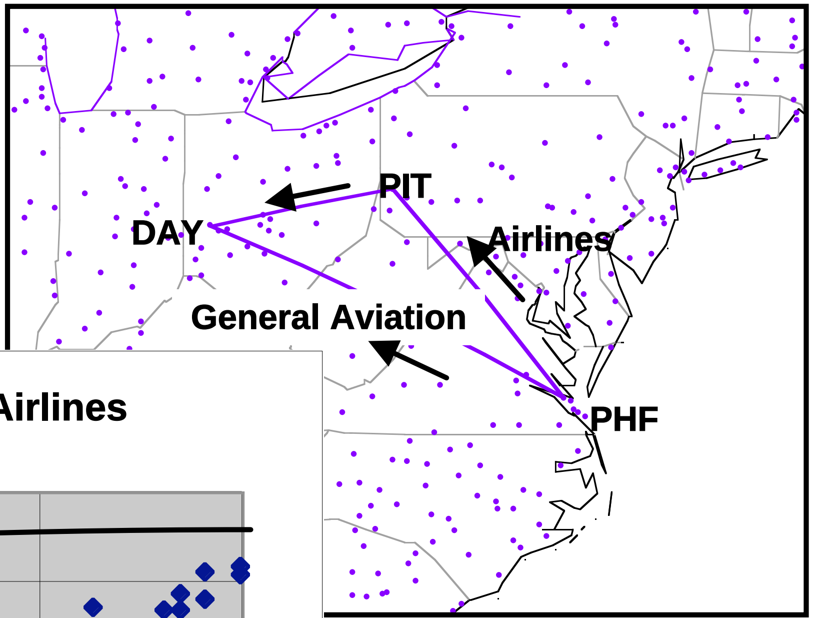
(at equivalent highway system costs, increasing mobility for all of the nation's communities through advanced small aircraft transportation).

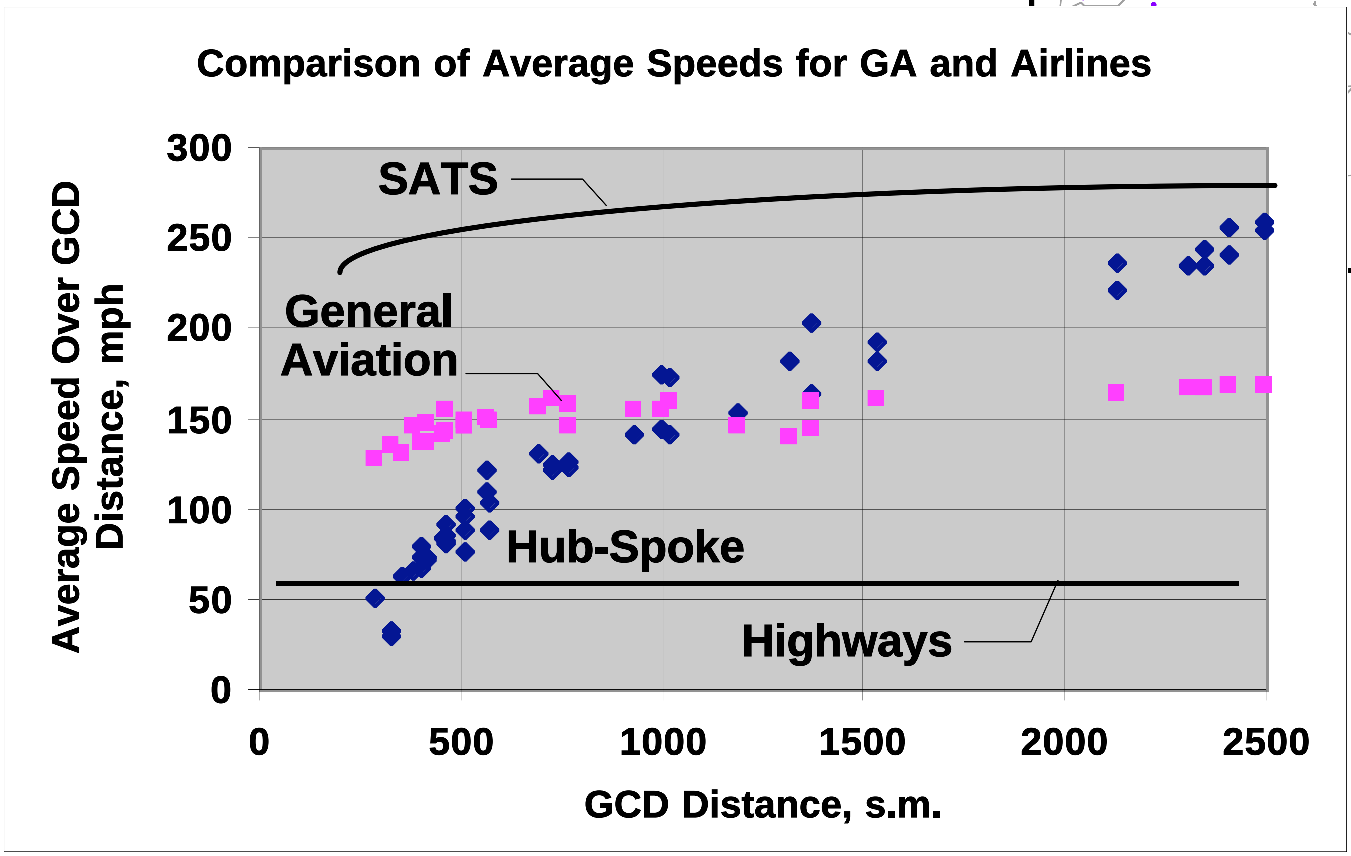


Smart Air Transport System Speed

"Reduce public travel times by half in 10 years. . ."

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



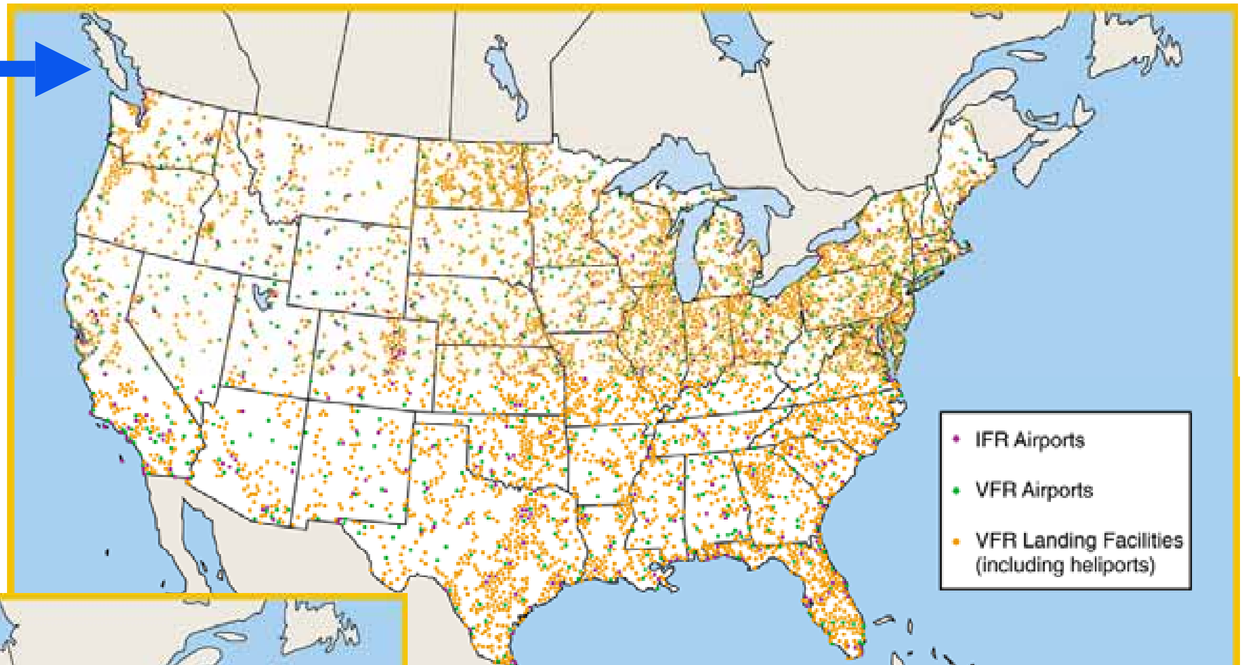


- Hub-Spoke: OAG times for 28 destinations
- General Aviation: time-optimized flight plans
- Including intermodal penalties (:45 +:45 for airline & :30+:30 for GA departure & arrivals)
- No GA destination benefit (for proximity of airports)
- SATS with new GAP engines: costs equal current General Aviation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

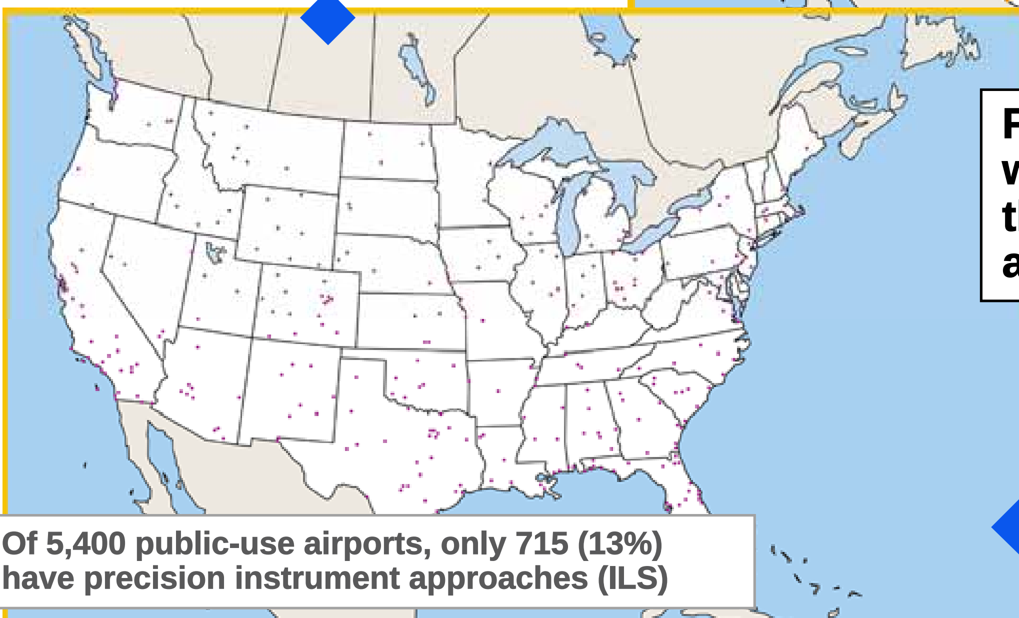
SATS Increases Accessibility and Mobility

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

Expanded Accessibility to several times more destinations



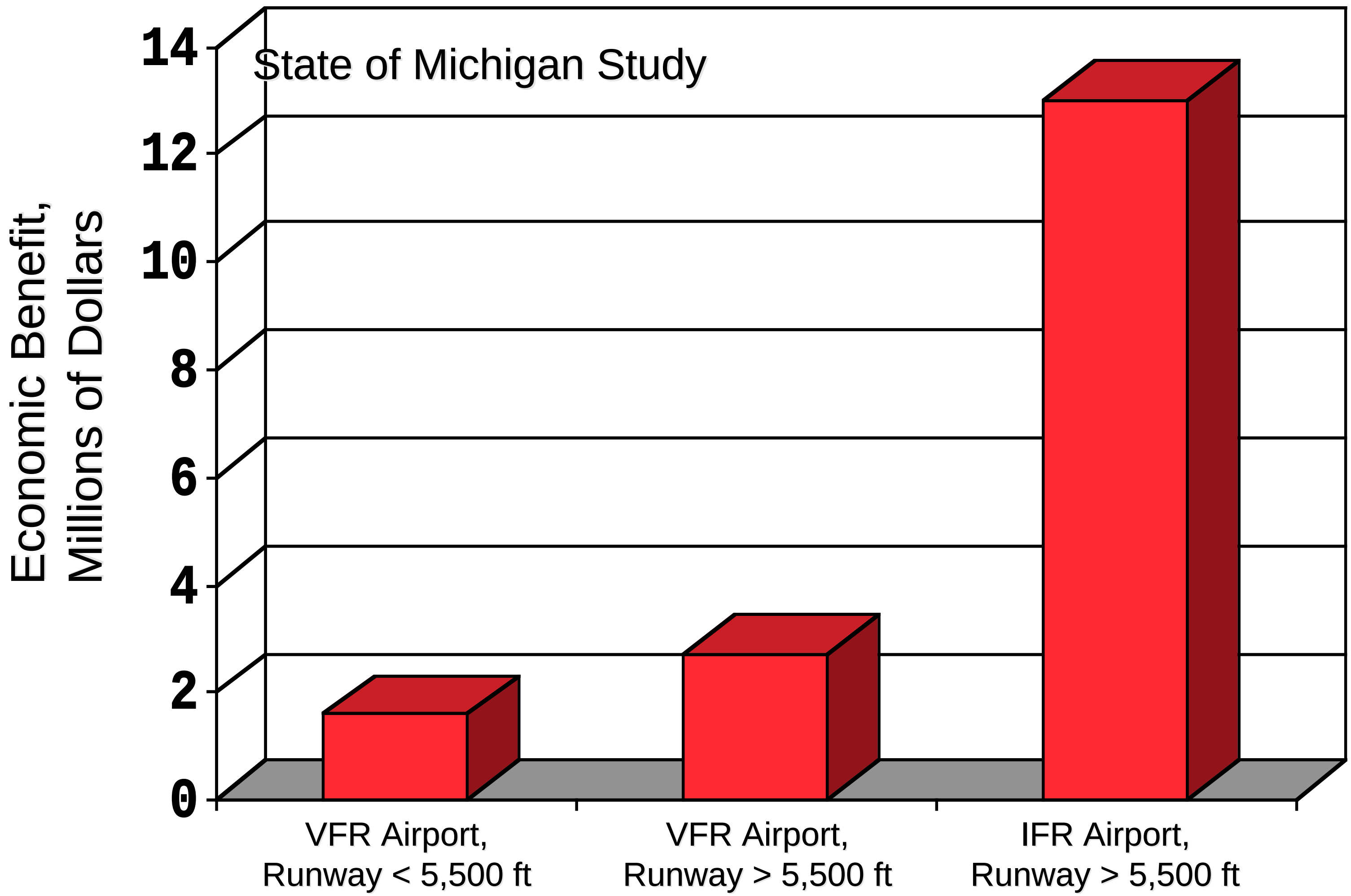
Fully utilized 5,400 public-use near-all-weather landing facilities can increase theoretical NAS Throughput by more than an order of magnitude



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

Improved Mobility saving more travelers more time

All-Weather Accessibility Means Economic Development



VFR - Visual Flight Rules
IFR - Instrument Flight Rules

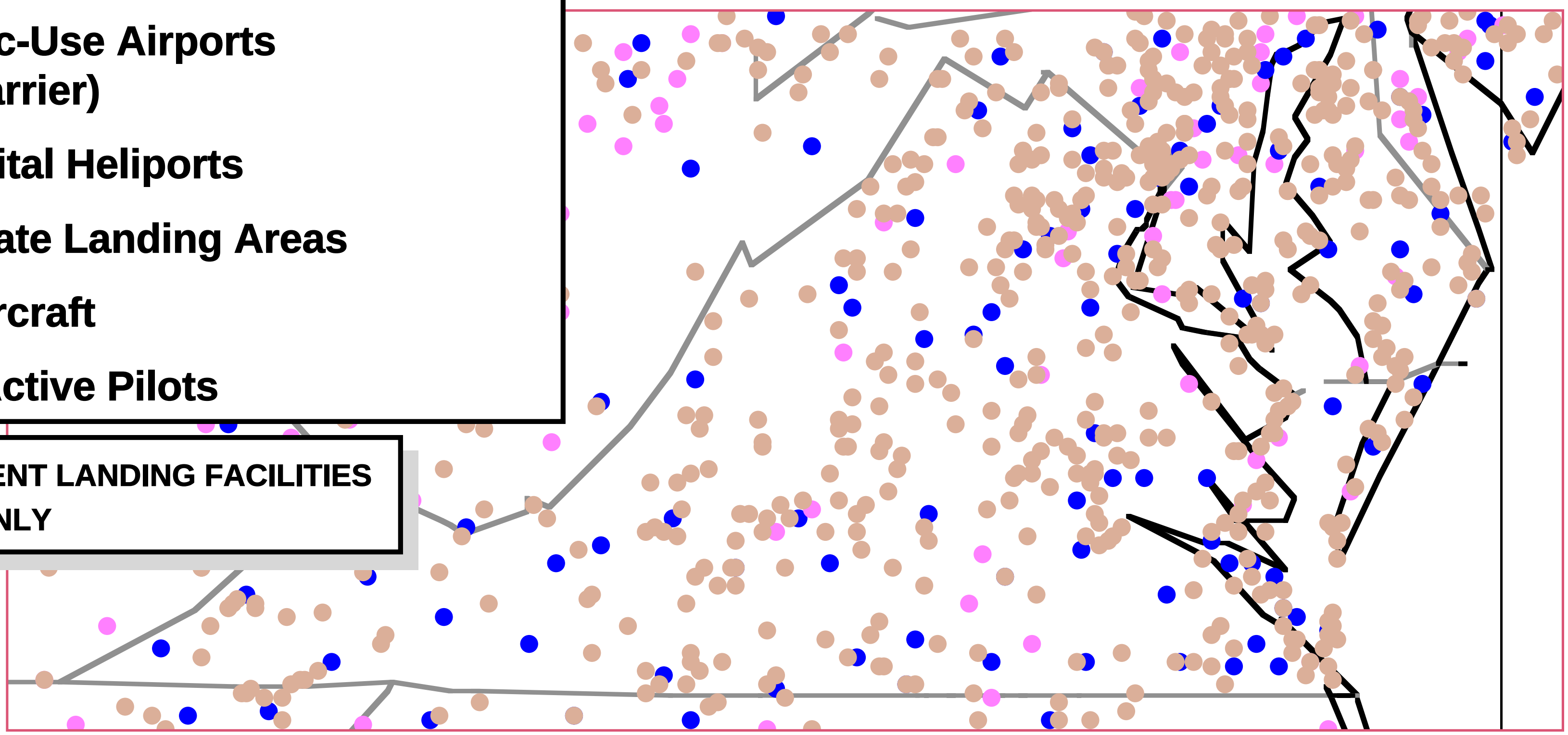
SATS Accessibility = Economic Development

Example for one state

Virginia General Aviation Today

- **~$175 Million in Economic Impact** (Primary & Secondary)
- **2,400 jobs from General Aviation** (Primary & Secondary)
- **68 Public-Use Airports (9 Air Carrier)**
- **54 Hospital Heliports**
- **227 Private Landing Areas**
- **4,104 Aircraft**
- **15,525 Active Pilots**

SATS will enable ~90% more accessibility by air for all Virginia's communities, expanding economic opportunities for all regions



- **INSTRUMENT LANDING FACILITIES**
- **VISUAL ONLY**

Systems Engineering Products

SATS Features & Capabilities Matrix

Concept Of Operations

- End State
- Transportation Services/User Matrix

System Architecture

- NAS
- Aircraft
- SATS Facilities
- Training

Operational Requirements

Functional Descriptions of Features:

- ATM
- Vehicle
- Landing Facilities
- Operator Training

Technical Requirements

- Technical and Performance Specifications for Capabilities

Interface Requirements

- System Synthesis and Integration

Technology Products

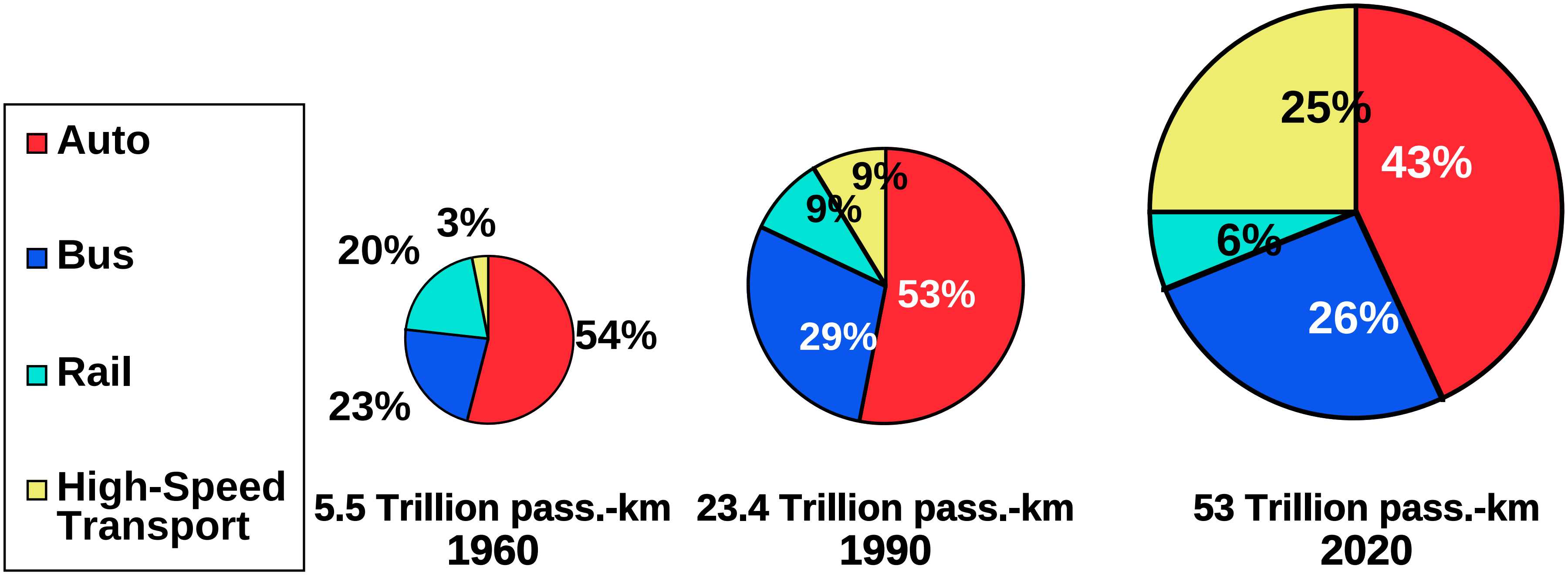
- Design Guidelines
- Systems Standards
- Certification Methods

Strategic Planning Tenets

- **The innate <u>human desire for personal command of time</u> and space creates demand for distributed (personal) transportation systems.**
- **The Information Age will usher in a new magnitude for the <u>value of time</u>.**
- **The Baby Boom generation's <u>peak spending (traveling) period</u> coincides with saturation of the hub-spoke airway and interstate highway systems.**
- **The <u>Third Migration Wave</u> (beyond the suburbs), coupled with tele-commuting, creates new transportation demand and challenges.**
- **The <u>revolution in digital bandwidth</u> redistributes intelligence from centralized to distributed system nodes, enabling the aviation transition from centralized to distributed air traffic management (free flight).**

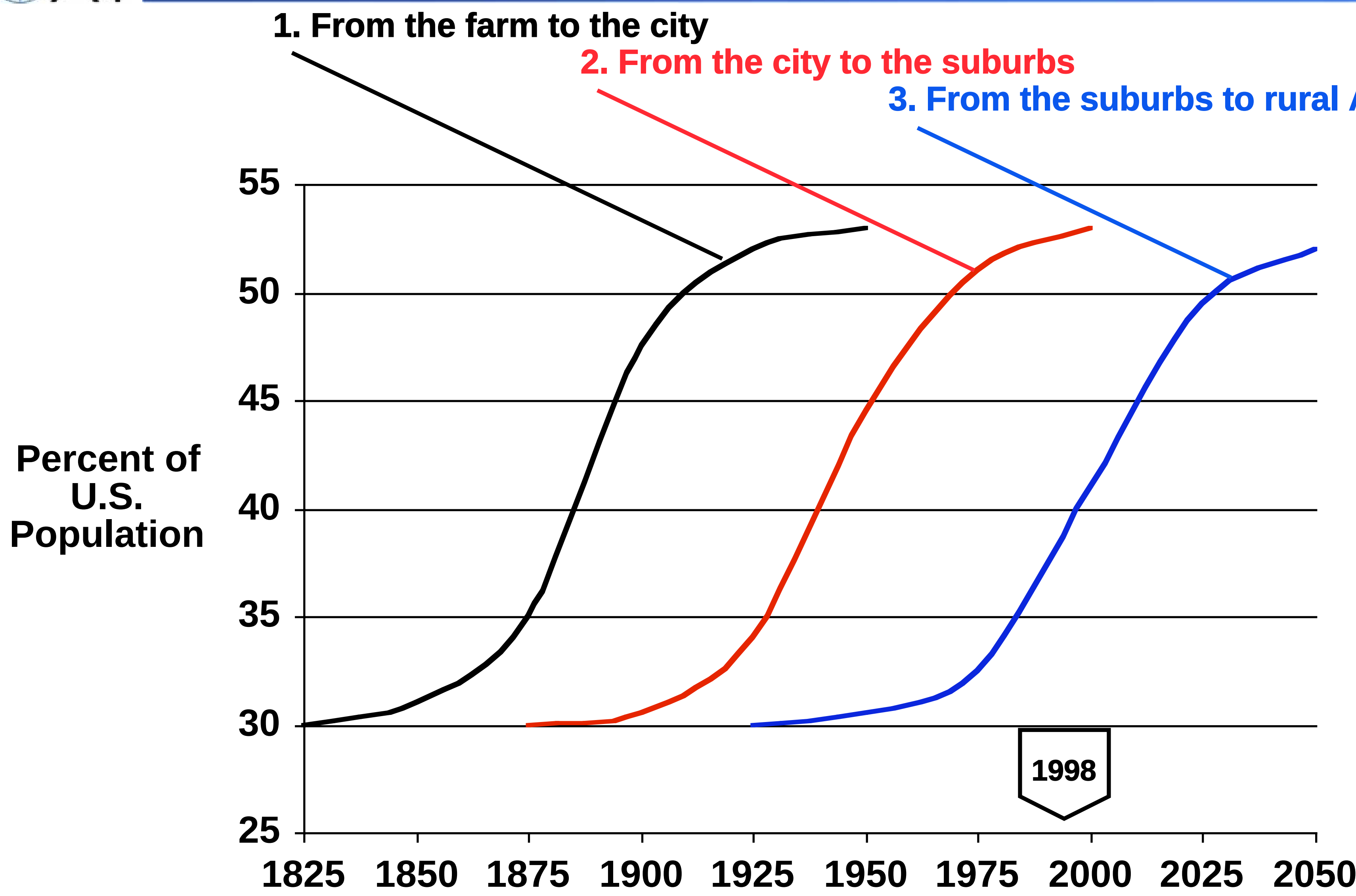
The Pig in the Python

As *per capita* income rises,
***per capita* annual travel rises,**
personal daily travel time budgets remain constant,
and
high-speed modes gain market share
(Schafer and Victor, Sci. Amer., Oct. 1997)



Global Travel Mode Shares will be driven by
the largest population and spending wave in history:
The Baby Boom

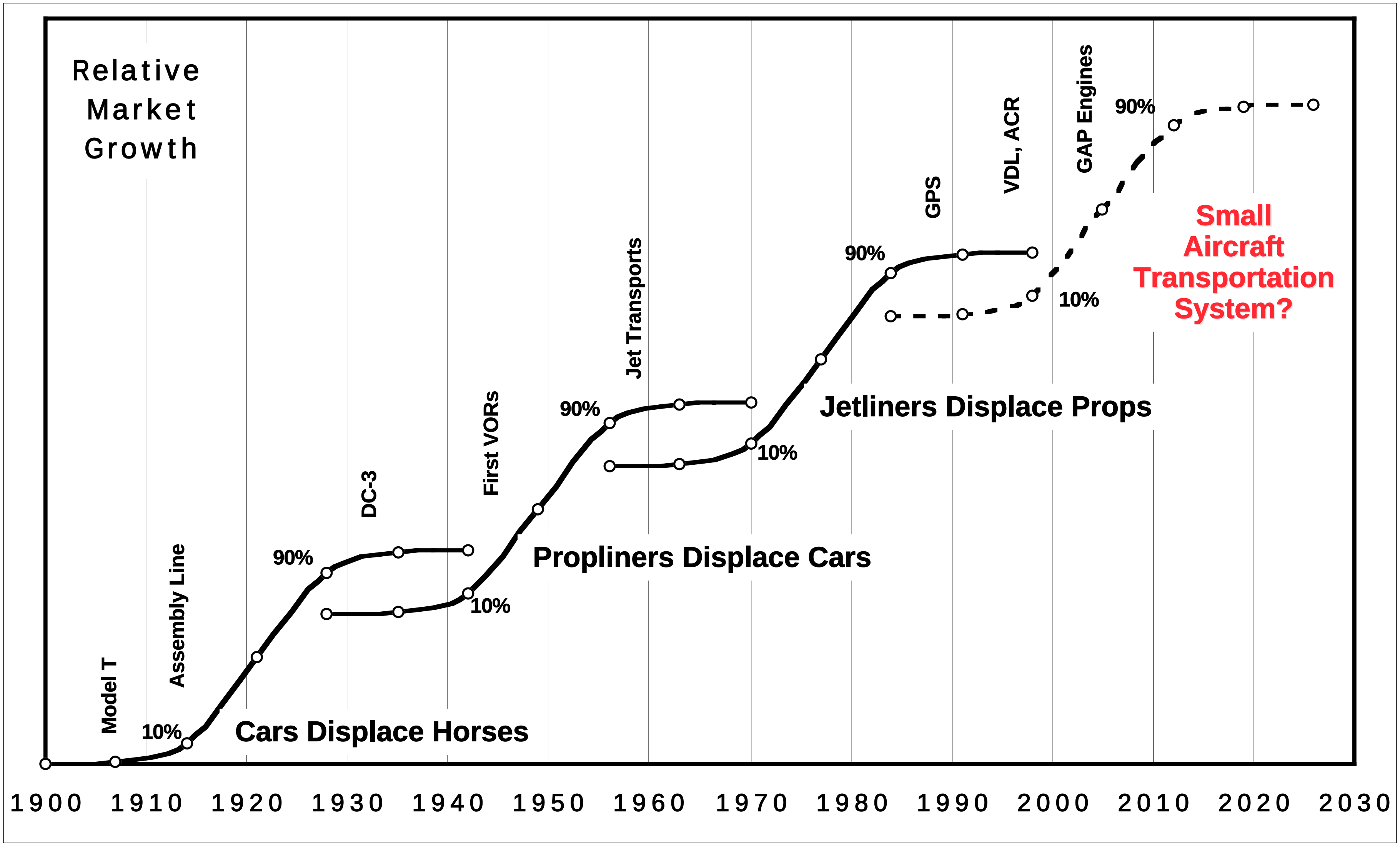
The Third Migration Wave



(R)evolutions in Higher Speed Travel

What is Next? More Speed to More Destinations

The "Atomic Structure" of Business Innovation Cycles



REDAC SATS Review
Terms of Reference

1. **SATS OpsCon relationship to RTCA Free Flight and NAS 4.0**
   - Executive Summary
   - SATS-NAS4.0 "Gap" Analysis
2. **NAS Plan/Architecture SATS requirements**
   - FAA Mission Need Statement
   - FAA Rough Order Magnitude SATS "gap" cost estimate
3. **Program advocacy action planning**
   - NASA-FAA Executive Committee: SATS Tasking
   - NRC SATS Study
4. **FAA RE&D requirements and actions for SATS**
   - FAA Lines of Business Roles in SATS Program
   - NASA-FAA partnership options
5. **Regulatory Issues for SATS**
   - Aircraft, Airports, Procedures, and Pilots
   - AIR AGATE model for SATS
6. **FAA support for NRC Study**
   - ARX Analyses
   - Policy Review