



A Small Aircraft Transportation System...

Small Aircraft Transportation System



And it Can Be Networked...

A Presentation
for
The Transportation Leadership Forum



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A Small Aircraft Transportation System...

Small Aircraft Transportation System



**Additional information
and copies of presentation slides**



SATS.nasa.gov
Airborneinternet.com
Sats2005.com



We'll Discuss...

Small Aircraft Transportation System



- *The National Transportation Crisis*
- *Vision - and its Role in Public Investment*
- *Introduction of Innovation into the Market*
- *SATS, Vision, Project and Why*
- *Aircraft (and Airports) Can Be Networked*
- *Collaboration Challenges*
(Public/Private Partnerships or "Herding Cats")

*Need to shake your paradigm re:
...the Transportation Space!!!*

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"Transportation is critical to the nation's economy and our quality of life...but today we are straining its capacity limits, producing delays and congestion..."



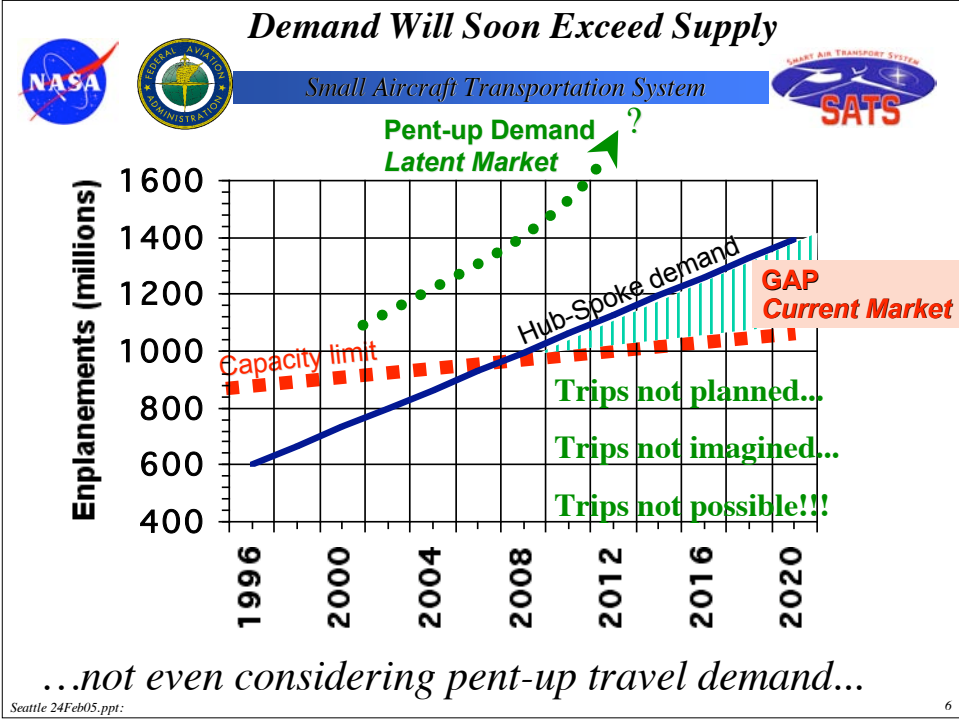
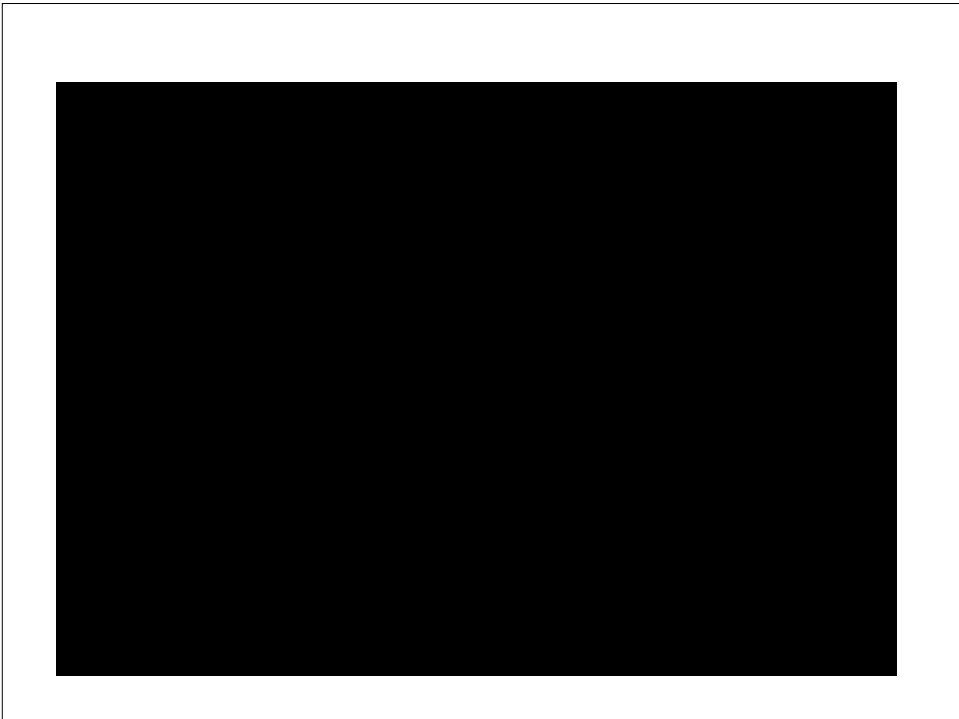
- Capacity
- Reduced travel times
- Efficiency
- Access and mobility

Where today have we discussed non-surface solutions and integration into transportation?



How should small aircraft/airports be included in transportation options being considered?

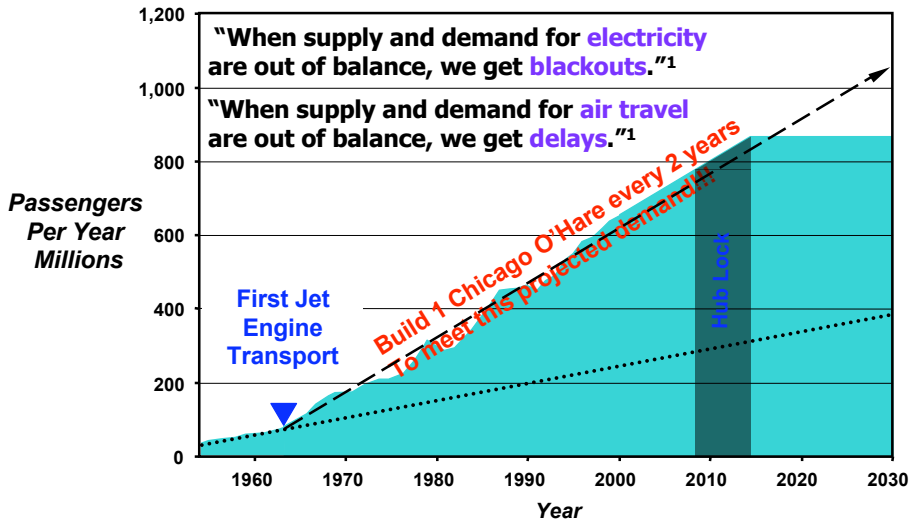
*Robert Spitzer, Chair (Federal Transportation Advisory Group)
"Vision 2050, An integrated National Transportation System"





Hub Airports Nearing Capacity Limits

Small Aircraft Transportation System

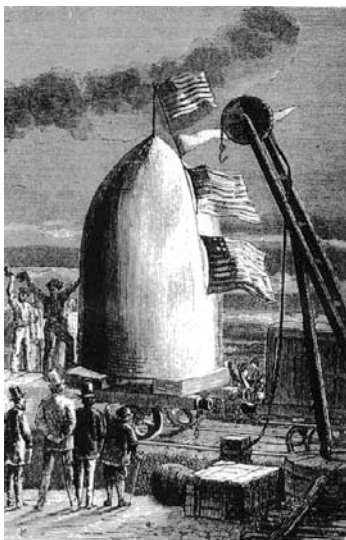


¹ Steve Morrison, Northeastern University economist Seattle 24Feb05.ppt:

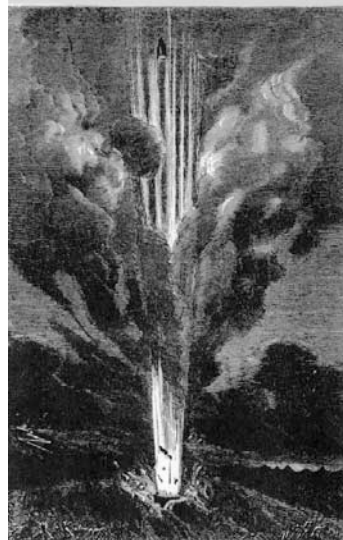
“It is the human nature to dream...”



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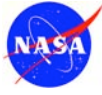
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and to imagine not what is but what might be...”

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“...in ten years, to put a man on the moon...”



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Look what we did?

*Look where we've come?**

* REDAC ATS SC Participant, 4 Mar '03



REALITY!!!

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Why Would anyone want to build a path for that?



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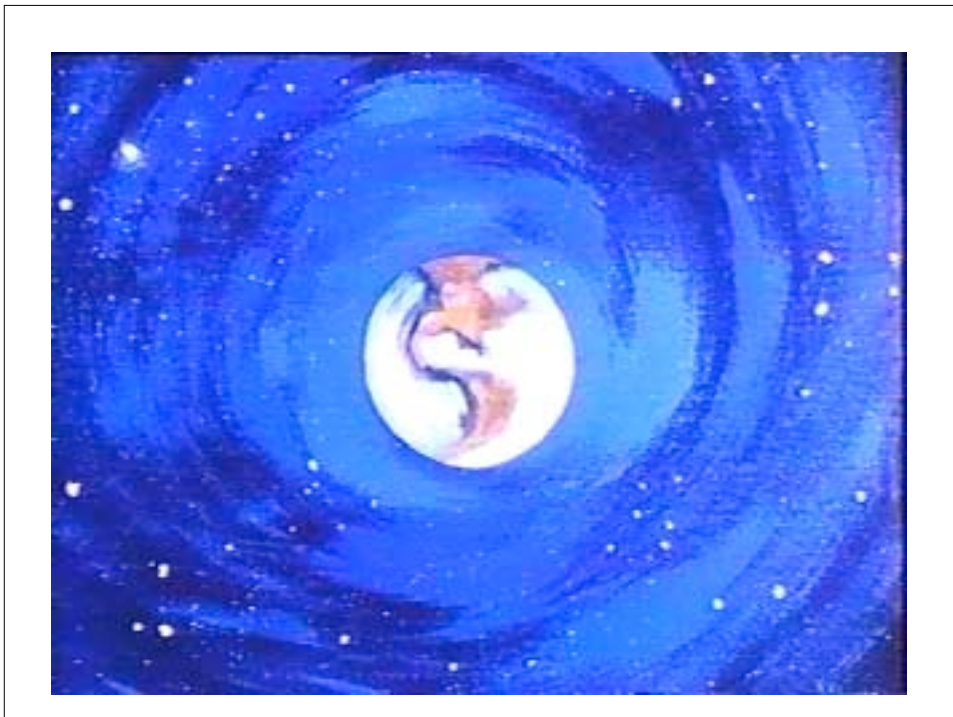
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The age of a flying car in every garage may be dawning.

"Mark my word: A combination airplane and motor car is coming. You may smile. But it will come."

-- Henry Ford, 1940



Imagine what the future could be...??



GM Composite Car built by Scaled Composites, 420 lb body

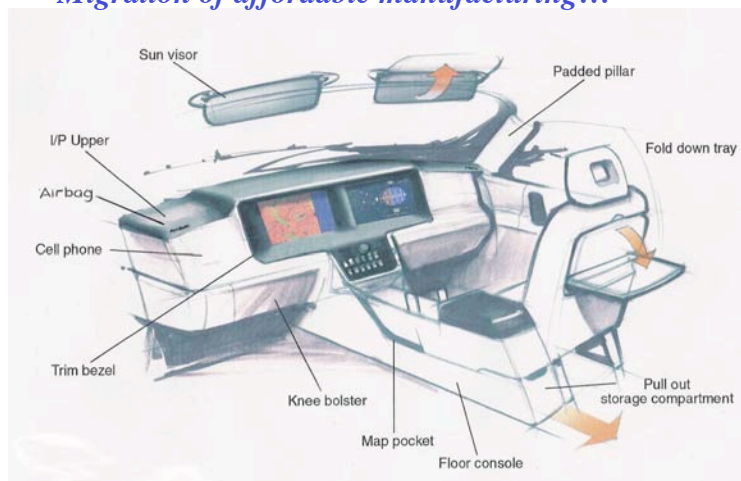
New Safety and Comfort!



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Migration of affordable manufacturing...



...from cars to planes.



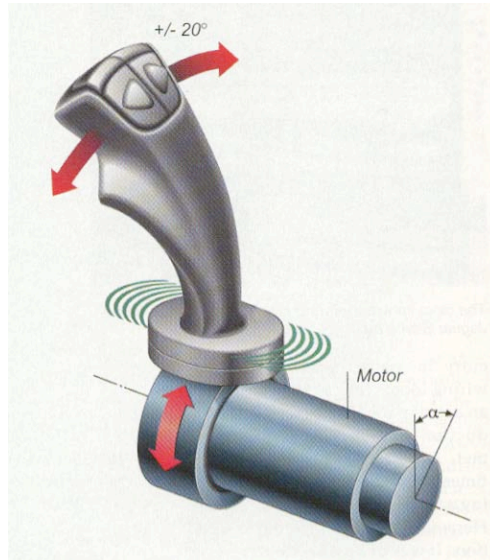
New/Simplified Controls

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Imagine (in your car):

- Single control
- Intuitive
- Cruise control like
- All axis control



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Migration of technologies

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Cockpit to auto to cockpit



Affordable “Heads-up Display and vision enhancements

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Airborne Internet enabled....

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Communications to PDA-like devices for:



- Flight information
- Traffic Information
- Commercial Info

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Tomorrow's transportation system...

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...must be "intermodal!"

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Technical Context for SATS

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Moore's Law on microprocessor performance

Computing power will double each 18 months

Gilder's Law on bandwidth performance

Communication power will double each 6 months

Metcalf's Law on network performance

Value of network proportional to terminal squared

The unwritten law of abundance

We waste what we have in abundance

The unwritten rule of gridlock

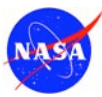
Every added mile creates more demand

Kurzweil's Law of Accelerating Returns

More technology in next decade than past century

Golden Rule of the information age

Treat other people's time as ...



The Difficulty About Predictions...

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"The telephone has too many shortcomings to be seriously considered as a means of communication."

– Western Union executive, 1876

"The problem with television is that the people must sit and keep their eyes glued on a screen; the average American family hasn't time for it."

– NY Times, 1939 (World's Fair)

"I think there is a world market for maybe five computers."

– IBM Chairman Thomas Watson, 1943

"Computers in the future may weigh no more than 1.5 tons."

– Popular Mechanics, 1949

"There is no reason for individuals to have a computer in their home."

– DEC Chairman Ken Olson (DEC), 1977

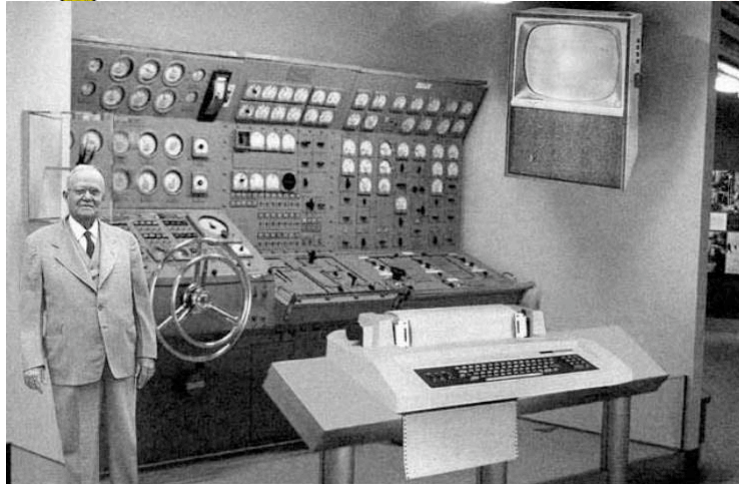
"64,000 bytes of memory ought to be enough for anybody."

– Microsoft Chief Software Architect Bill Gates, 1981

"...Gates later said, that PCs by 2006 will have a processor of between 4GHz and 6GHz, more than 2GB of memory, a terabyte or more of storage, and graphics chips three times as powerful as today's." 10/2003



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Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 30 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use.

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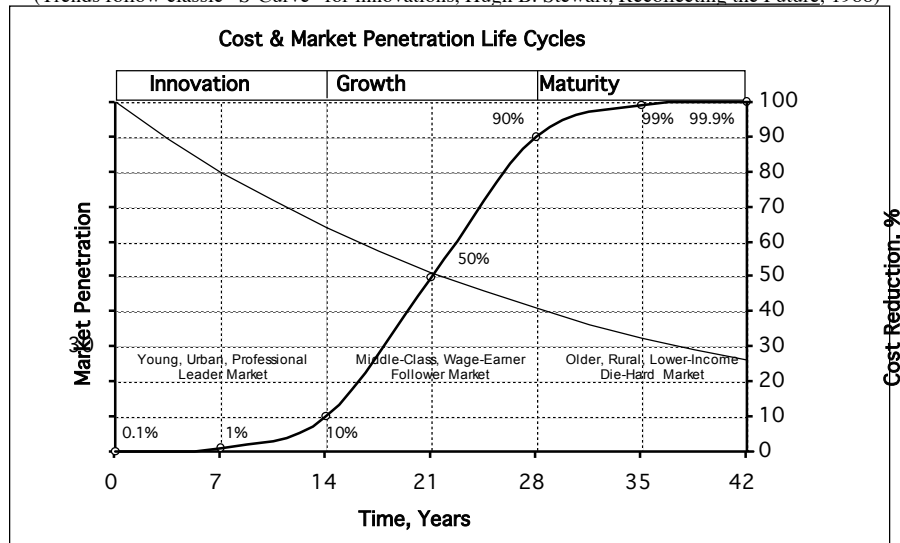


Innovation and Cost Life Cycles

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(Trends follow classic "S-Curve" for innovations, Hugh B. Stewart, Recollecting the Future, 1988)



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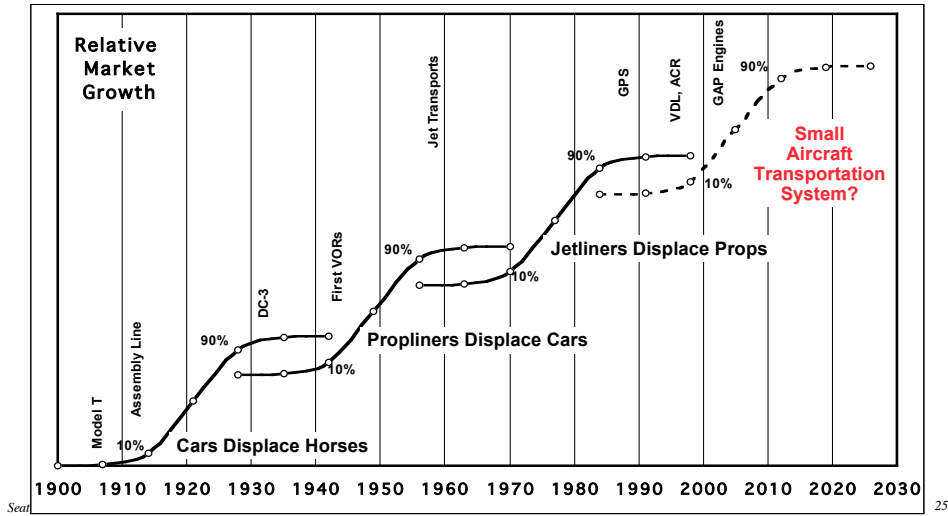


(R)evolutions in Higher Speed Travel

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What is Next? More Speed to More Destinations
The "Atomic Structure" of Business Innovation Cycles



Small airplane utility today...



...and the impact of mid-20th Century technologies...



...on the cost of 21st Century utility!!!

The future Generation of Cockpits, Propulsion, and Aircraft



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Lancair Columbia 300

FJX-2



Cirrus SR-20



Eclipse 500



FJX-2

And others....



Toyota



Market Pull for Increased Mobility

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- **Booming Business Aircraft Market**
 - Dramatic growth in fractional ownership (50%/year)
- **New class of micro-jets / prop aircraft**
 - Low-cost: about \$1.50/aircraft-seat mile
 - Designed to access small airports
 - On-demand services emerging in market



And others....

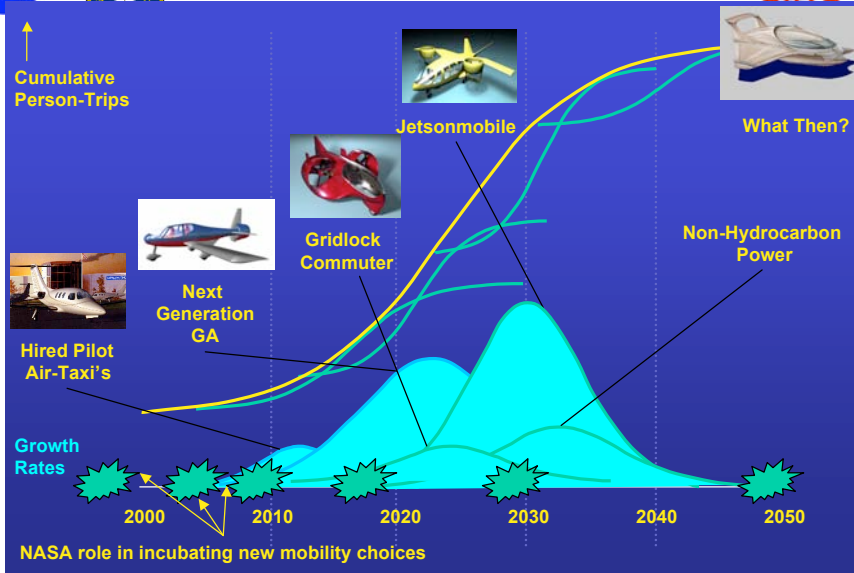
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Hypothetical Roadmap

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Vertical Flight will be necessary
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The Instrument Panel of 1940...

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...and still today!



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What's Different This Time?

These are disruptive innovations, and...




- New aircraft*
- New entrepreneurs*
- New production system architectures*
- New customers*




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IT Revolution in the Cockpit?

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"Where am I?"
 "Where is the weather?"
 "Where is the terrain?"
 "Where is the traffic?"
 "Where do I go next?"



**Datalink
Databus
Database**

**Intuitive
Information
Through
Bandwidth**

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Highway-in-the-Sky Guidance Displays



Image Courtesy of NAV 3D

Underutilized Airports and Airspace

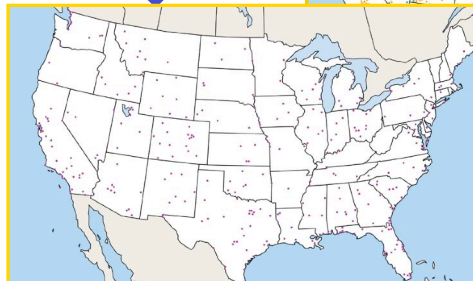
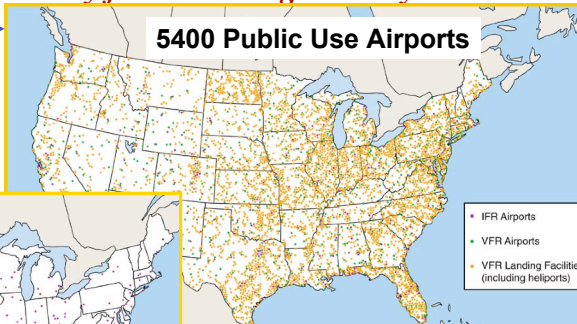
Same equity of access as to surface travel



... an Opportunity for Increasing Mobility

Expanded Accessibility to several times more destinations

5400 Public Use Airports



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

Near all-weather accessibility to 5,400 public-use airports?

- 22% within 30 minutes of major/hub airport
- 41% within 30 minutes of any commercial airport
- 93% of population within 30 minutes of SATS-type airport

Or 3222 NPIAS Airports?



High Affordability Concept: Small Aircraft Transportation System



Passenger size of 5 seats is most attractive size to consumer

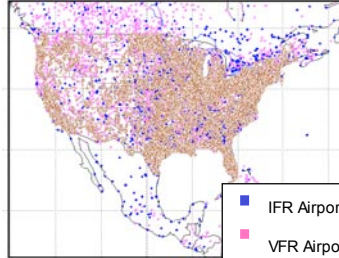
- ~40% of all GA shipments (A. D. Little)

Can use small airports that average 23 miles apart (SATS)

Initially uses existing small airports

- Under utilized airspace and infrastructure
 - 18,345 facilities, 12,465 greater than 3000' length, others heliports.
- STOL variant lowers runway requirement
 - Easier to accommodate
- Possible transition to airpark operations
 - Currently only an option for the wealthy and/or retired
 - Reduces need for intermodal connection

When critical mass occurs, new small airport construction could be attractive instead of airparks, business campus, mall locations



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• Program is a series of flight experiments leading to integrated flight demonstrations in FY2004-5 delivering:

- **Flight validation of enabling airborne technologies**
 - Revolutionary Integrated Flight Deck
 - Automated Flight path Management
 - Experimental Data Relevant to Certification
- **System Impact Analysis**
 - System cost/performance
 - Environmental/economic impact
- **Technology Infusion/Transfer**
 - Vested industry partners ready to implement
 - Accelerated technology commercialization



Resources:
\$69 million NASA
50/50 Cost Share
NASA/FAA/Industry Partnership
5 years, FY2001-2005
138 CS FTEs


SATS 5 Year Program Operating Capabilities

- Higher-Volume Operations in Non-Radar Airspace at Non-Towered Facilities:
Reliable Access to More Destinations through Efficient Use of Underutilized Airspace
- Lower Landing Minimums at Minimally-Equipped Landing Facilities:
More Landing Facilities Available More Often At Less Cost
- Increase Single-Pilot Crew Safety & Mission Reliability:
Safer Small Aircraft Operations, Greater Throughput in Underutilized Airspace
- Enroute Procedures & Systems for Integrated Fleet Operations:
Increased Mobility Without Sacrificing Capacity


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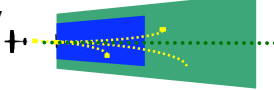
SATS Operating Capabilities
Small Aircraft Transportation System




Higher Volume Operations in Non-Radar Airspace and at Non-Towered Airports




Lower Landing Minimums at Minimally Equipped Landing Facilities



Increase Single-Pilot Crew Safety & Mission Reliability




En Route Procedures & Systems for Integrated Fleet Operations



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Connection to National Grid
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The Airborne Internet (AI)



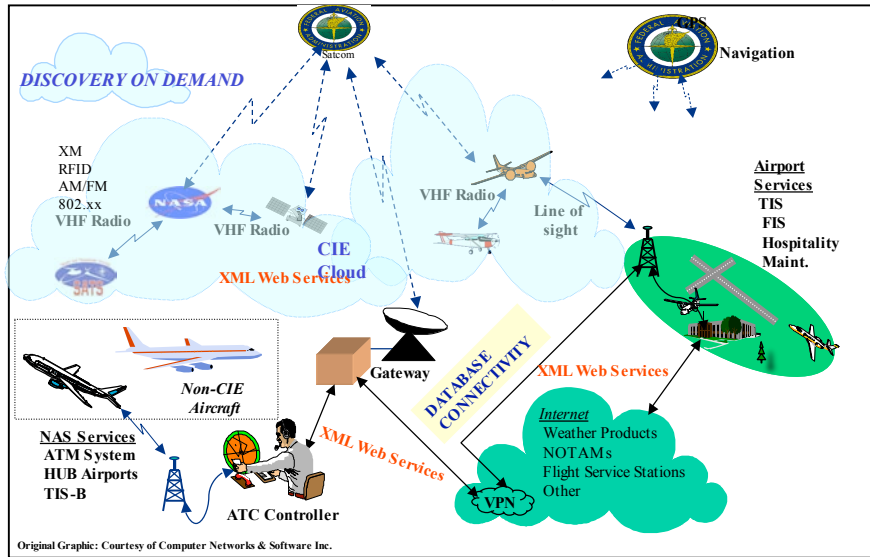
Where Current aviation voice comm is VHF...with no inherent location info, limited range and data, AI offers:

- Voice but emphasize data and voice over IP
- Continue VHF but add Satellite
- User **Optimization BOTH** to maintain connectivity, speed of communication, message cost, safety of flight messaging
 - + Provides equipment and frequency diversity
 - + Spectrum efficient
- **Report position data continually to network**

WE HAVE TO EXPAND OUR THINKING BEYOND "LEGACY TECHNOLOGIES/OR TODAY'S TRANSPORTATION MODES"

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Collaborative Information Environment (Airborne Internet)



Collaboration and Partnership...

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AI Capabilities/Benefits

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- **Data transfer and applications available**
 - **Spectrum efficient: many functions over a single/dual frequency**
 - **Minimizes the number of radios and antennas on vehicles (aircraft)**
 - **Voice (where still needed) over IP**
 - **Provide surveillance for vehicles/aircraft in most environments, without expensive ground infrastructure**
 - **Surveillance augmentation (Gulf of Mexico/ Oceanic)**
 - **Tracking of vehicles, aircraft, containers (“Smart dust”)**
- BUT, ITS ABOUT CONNECTIVITY, NOT “MODE LOYALTY”**

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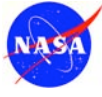
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Airborne Internet....Communications with...



....Robust Protection against attack from any source!!!

Consortium Membership



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Why Consortium?



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- **Leverage resources.**
- **Join common interests for greater impact**
- **Establish a legal entity for funding and information sharing during development**
- **Collaborate to produce guidelines and standards that will provide a roadmap to FAA certification (GS&Cs)**
- **Individual participants/contributors will enjoy early market deployment opportunities.**

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HOW YOU MIGHT WANT TO VIEW SATS?

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Time will be (is) the most valued commodity of this Century.
We “planners/policy makers” must **FIRST** satisfy public need.

The national transportation and economic imperative has to “drive” planning and investment.

SATS seeks to exploit existing, perhaps underutilized, NAS resources, as well as emerging technologies.

Transportation leaders **MUST** include inter/multimode considerations in planning...

SATS is not the “solution” for all NAS challenges but must be one alternative, “visioned” future , for public investment.

The SATS *public/private partnership* model is a key discovery and project deliverable.



Is this “vision” enough?

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“Vision” can be a powerful aiming point for research and new business opportunity!

We can not permit our vision of transportation’s future to merely be a more efficient past!

FAA’s Pete McHugh...

...loudly and often!!!

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Why set ambitious transportation goals!?

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For me, this little guy (and his sister) are reason enough!

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A Small Aircraft Transportation System...





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