SkyTower High Altitude Platform Stations (HAPS)

for Fixed Wireless Broadband & Other High-Value Applications

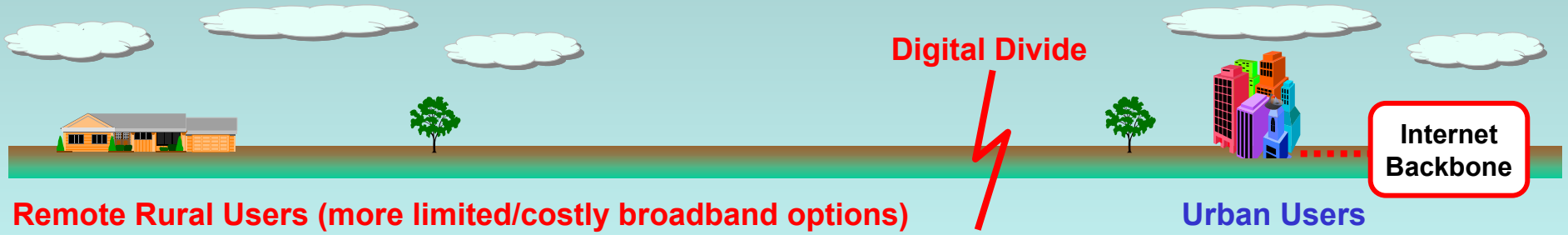
Contact: **Stuart Hindle, VP of Strategy & Business Development, 825 Myrtle Avenue, Monrovia, California 91016 USA**
ph:+1-626-357-9983 hindle@skytowerglobal.com www.skytowerglobal.com

AeroVironment's Revolutionary Helios Stratospheric Multi-Use Platform

- **Developed by AeoVironment, working with NASA/DoD**
- **Single technology platform can provide each region with multiple, high value commercial/civilian services -- complement DoD/ISR capabilities**

"Digital Divide" Economic/Political Issue Created by Last Mile Barriers

- **Broadband needs unmet by existing approaches**
  - Internet users expected to exceed 1 billion worldwide by 2005
- **Last Mile which connects users to rest of network has highest costs / least bandwidth (bottleneck)**
- **Increasingly cost-prohibitive outside metro areas**



- **Not only an issue in developing countries**
  - Broadband penetration only 5-20% in European Union & U.S.

Conventional Wireless Approaches Overcome Some of the Barriers

Terrestrial Wireless attractive if one could eliminate:

- ☒ Excessive hub-site / backhaul costs & zoning issues
- ☒ Line-of-sight / coverage constraints due to low elevations
- ☒ Lengthy build-out schedules for RF planning / site acquisition

Satellites attractive if one could eliminate:

- ☒ Capacity limitations & latency issues due to high elevation
- ☒ Excessive build / launch costs & risks
- ☒ Technology obsolescence & maintenance inaccessibility

IMPOSSIBLE TO ACHIEVE?

What if You Had a 12-Mile High Aerial Tower/Satellite?

SkyTower's Stratospheric Telecom Platforms

- ✓ Fraction of Cost per subscriber and scalable
- ✓ Rapidly Deployable - eliminate local backhaul
- ✓ Exceptional Coverage - up to 90^{o} look angle

- ✓ Reliable
- ✓ Maintainable / Upgradable / Relocatable
- ✓ Spectrum Efficient - can share with terrestrial/satellite
- ✓ Over 1,000 X Bandwidth Density of GEO satellites (MHz/mi^2)

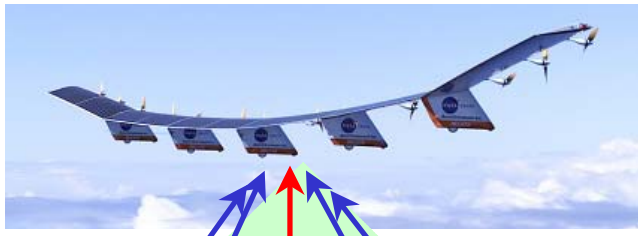
Revolutionary Technology for Bridging the Last-Mile

SkyTower Telecommunications System

- connects users directly into fiber backbone -

Helios UAV
Unmanned Solar/Hydrogen Aircraft
+
Communications Payload(s)

- ✓ ***Fraction of deployment cost of DSL, cable, satellite ($/sub)***
- ✓ ***>1000 X bandwidth density of geo satellite (MHz/km²)***



- ***Operates at >60,000 ft altitude***
- ***Above weather & air traffic***
- ***Weeks/months flight duration***
- ***Appears geostationary***
- ***Eliminates local backhaul needs (including for Wi-Fi hot spots)***
- ***Replacement platforms ensure continuous service year-round***

Fixed Communications

Mobile Communications

Gateway Station

7” to 18” stationary antenna dish size

Internet PSTN

25⁰ to 90⁰ typical look angles

Fixed User Equipment

Mobile User Equipment

← 50-mile diameter typical metro coverage (250-mile regional coverage) →

✓ 2-Way Broadband ✓ Broadcast Video/Audio ✓ Narrowband/Voice

AeroVironment's Unmanned Helios Aircraft Performance

1st Production Specifications

- >60,000 ft operating altitude
- >100 knots max flight speed
- 250-ft wingspan; 2500kg wt.
- 7 to 10 day flight duration
- Year-round global operation

- **Extensive stratospheric flight experience**
  - Maximum 96,863 ft (30 km) altitude
  - Routine operations at 60,000 – 70,000 ft
  - Telecom/other capabilities validated
- **Extreme duration of weeks/months**
  - Enabled by solar & fuel cell systems
- **Significant payload capabilities at >60k ft**
  - 100 to 250kg weight; 1 to 5 kW power
- **Excellent station-keeping capabilities**
  - Fast enough to overcome strong winds
  - Slow enough to appear geostationary
- **Flexible but very robust structure**
- **Minimum moving parts / high redundancy**
- **Zero pollutants (water vapor only emission)**

Overview of AeroVironment

"New Technologies for a Better World"

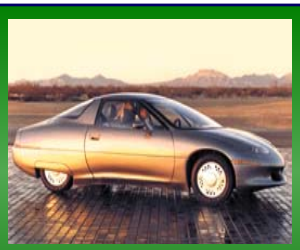
1971 Science Research Prototypes → **1993** R & D Products → **2000** R & D Products New Businesses

Core Competencies : Unmanned Aerial Vehicles & High-Efficiency Power Technologies

- Airplane Design & Development
- Electric Propulsion Systems
- Systems Integration
- Alternative Power Sources
- Battery & Fuel Cell Management
- Simulation & Test
- Embedded Controls
- Power Electronics
- Airplane Controls & Communications
- User Interface Software
- Battery Charging
- Lightweight System Design
- Fluid & Aero Dynamics


Gossamer Condor


Sunraycer


Impact


PosiCharge

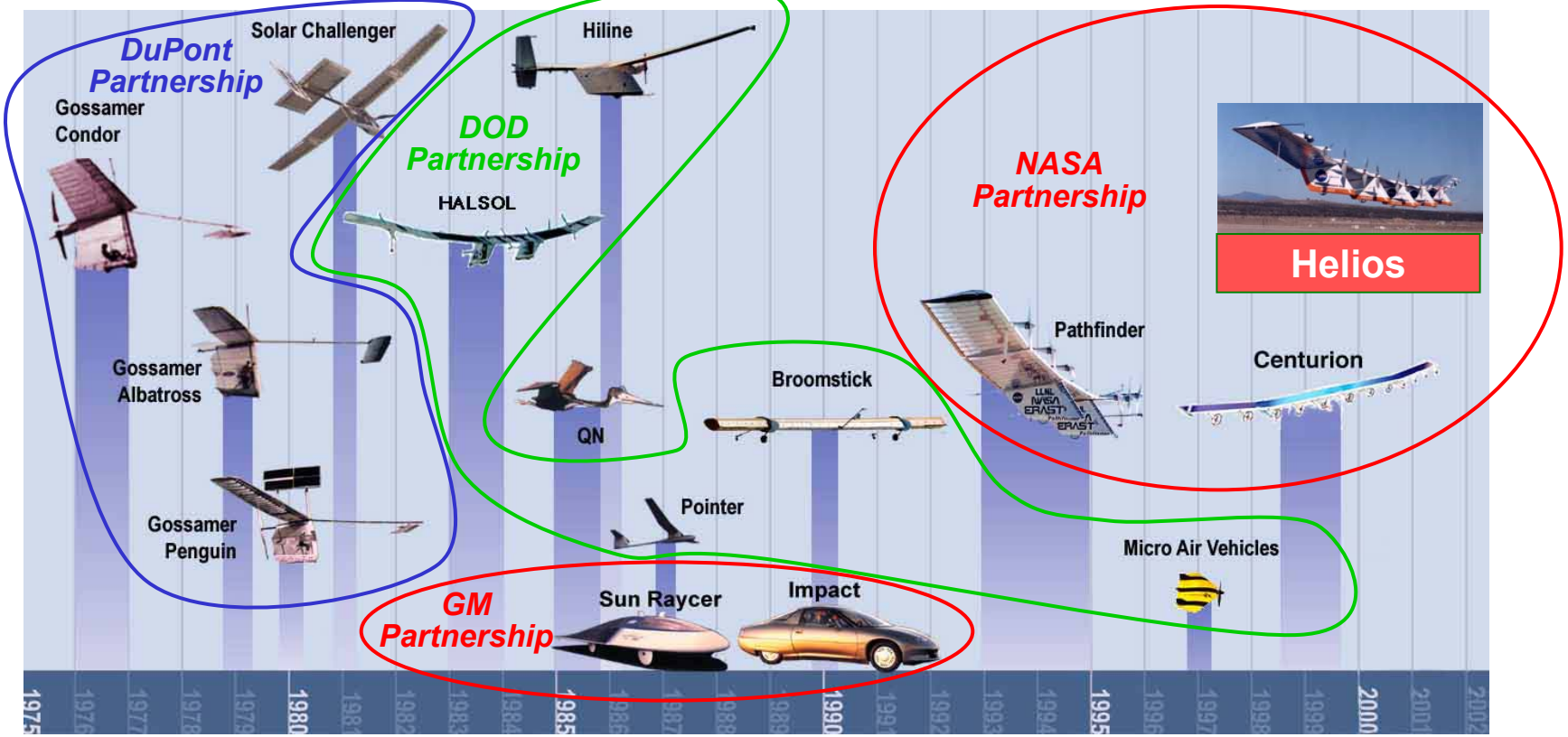

iPower


Helios

Customer Examples : Commercial and Government

NASA, American Airlines, Toyota, Department of Energy, DTE Energy, Hydro Québec, GM, Ford, Continental Airlines, Department of Transportation, Office Depot, Delta, LA DWP Los Angeles Department of Water & Power, Department of Defense

Over 25-Year History of AV Vehicle Development, Production & Operation



1977 & 1980 - World's first human-powered & manned solar-powered aircraft

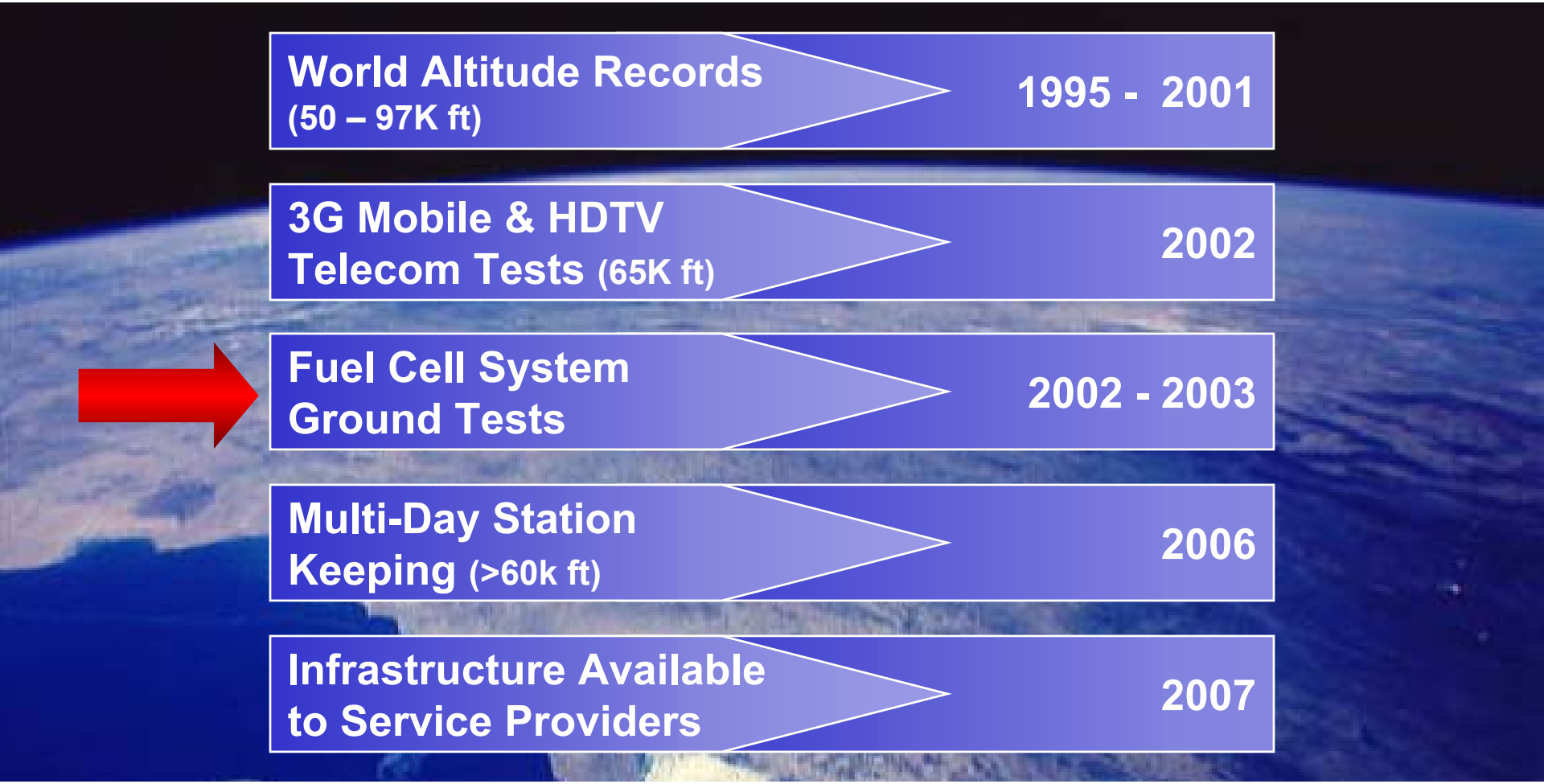
1981 - World altitude/duration record for manned solar-powered aircraft

1983 - First flight of HALSOL (goal: extreme duration stratospheric UAV)

1995 to 2001 - Multiple world altitude records (50K to 97K ft in altitude)

2002 to 2003 - Successful fuel cell system bench testing & telecom demos (65K ft)

SkyTower/Helios Milestones
($100M invested to date by AV/NASA)



SkyTower has already proven platform viability to >96,000 ft, well above planned 60,000 to 65,000 ft for telecom service.

Flight Tests / Telecom Demos

- **Extensive NASA testing in stratosphere has proven viability**

Year	Platform	Record Altitude
1995-97	Pathfinder	50,500 - 71,500 ft
1998	Pathfinder Plus	80,200 ft
2001	Helios	96,863 ft

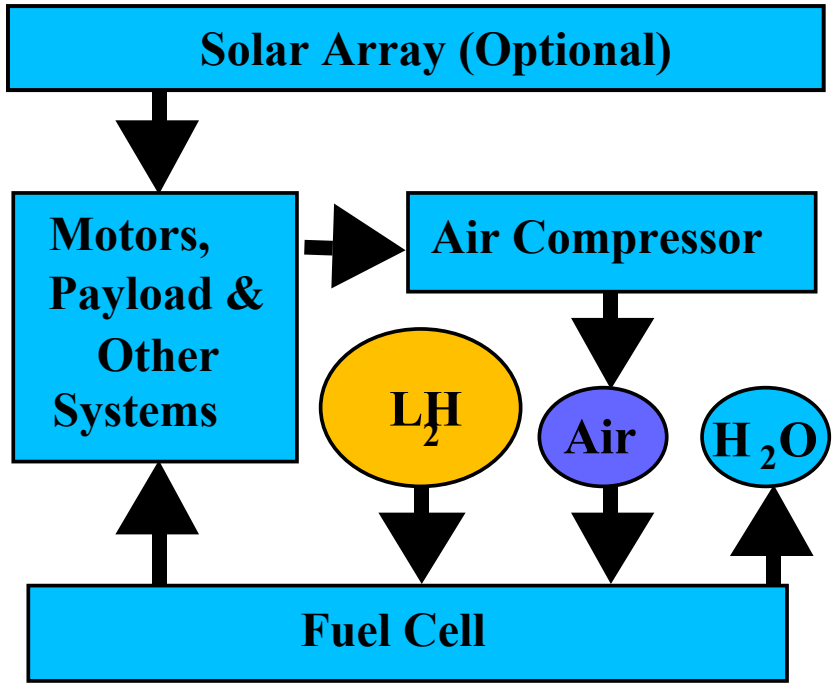

- **Successful 2002 telecom tests in Hawaii with Japan Ministry**
  - **IMT-2000 (3G Mobile) Voice/Video/Data and Digital Broadcast (HDTV)**
- **Multi-day flight and broadband testing next key milestones**

World's First Telecom Tests from > 65,000 ft in Stratosphere (2002)

- High Definition (HDTV) Broadcast testing using UHF channel
  - 19 Mbps data rate achieved using under 100 Watts of power
- IMT-2000 (3G Mobile) testing using 2 GHz bands
  - Voice/video/data with off-the-shelf NTT DoCoMo 3G handset

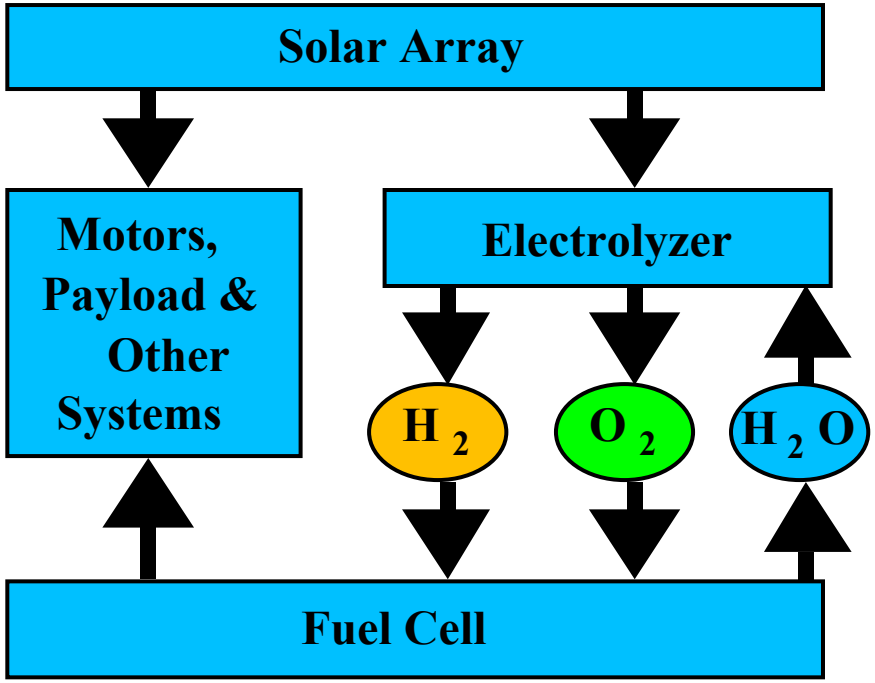
- Co-sponsored by SkyTower/AeroVironment, Japan Ministry of Post & Telecommunications (CRL/TAO), and NASA
- HDTV & 3G mobile payloads developed by Toshiba & NEC
  - Broadband payloads now being developed by Toshiba & Mitsubishi

Two Fuel Cell Systems Enable Flight Durations of Weeks to Months



Primary Fuel Cell System (LH2)

- Duration - up to 14 days
- Liquid hydrogen fuel

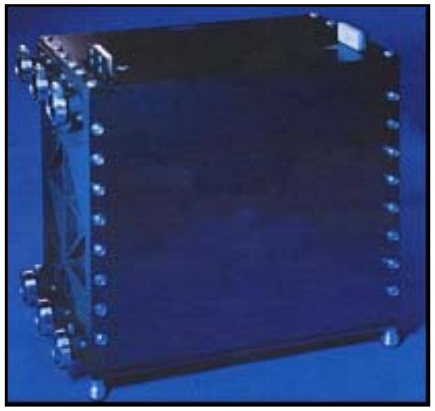


Regenerative Fuel Cell System (RH2)

- Duration - up to 6+ months
- No fuel except sunlight

- Both systems successfully bench tested for multi day/night flight cycles
- LH2 to be deployed first - more flexible latitude & payload capability

Fuel Cell System Development Status



Primary System (LH2)

- Existing automotive (GM/Hydrogenics) fuel cell stacks procured and tested
- Other subsystems custom built/procured and tested
- Conducted successful system bench testing to simulate multi-day flight in stratosphere
- Flight-ready system completed and flown in stratosphere (ancillary systems tested)*

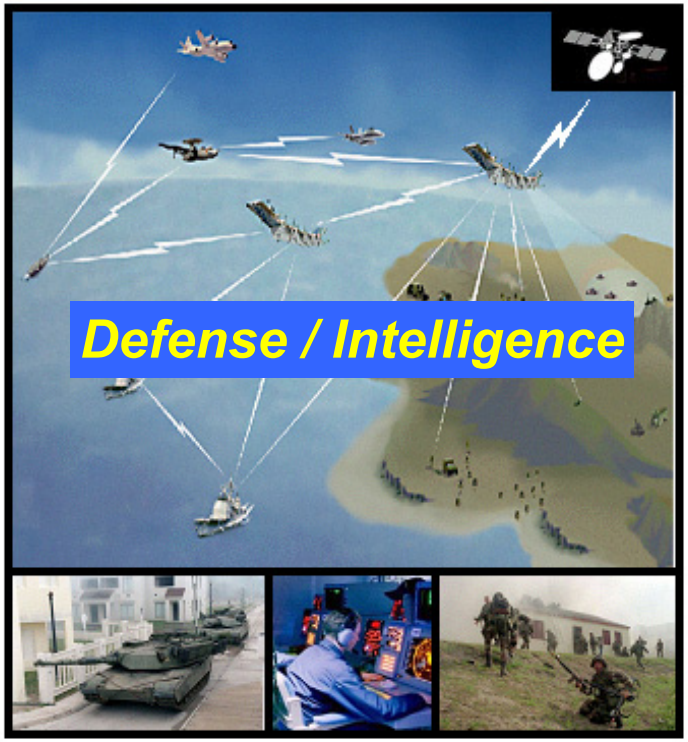
Regenerative System (RH2)

- Flight weight fuel cell and electrolyzer developed, custom built, and tested
- Other subsystems custom built/procured and tested
- System integration and assembly efforts completed
- Conducted successful system bench testing to simulate multi-day flight in stratosphere

**Due to test flight mishap in 2003 unrelated to fuel cell, system will now be replicated for multi-day flight testing (AeroVironment & NASA now planning follow-on program)*

Other Helios Application Examples

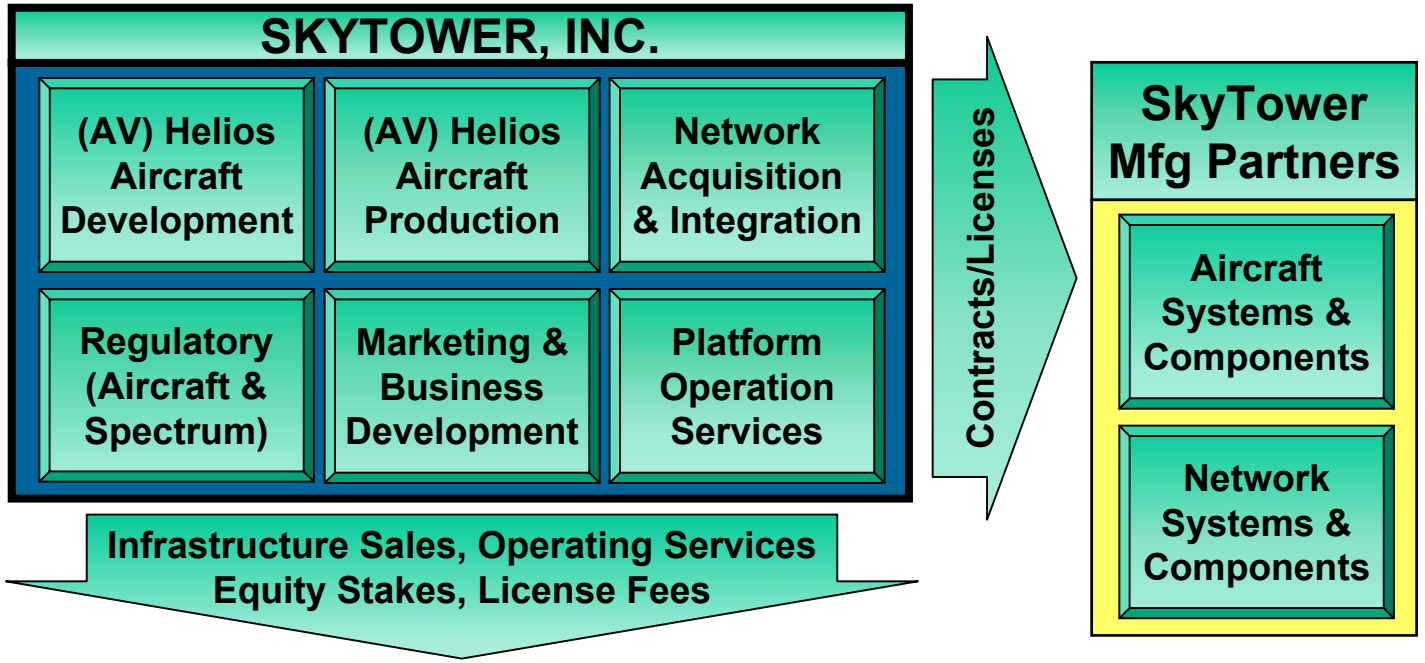
(stand-alone or piggybacked on same platform)



SkyTower Telecom Business Structure

Regional Partner Focused

SkyTower will sell infrastructure/services & lease wholesale capacity to service providers



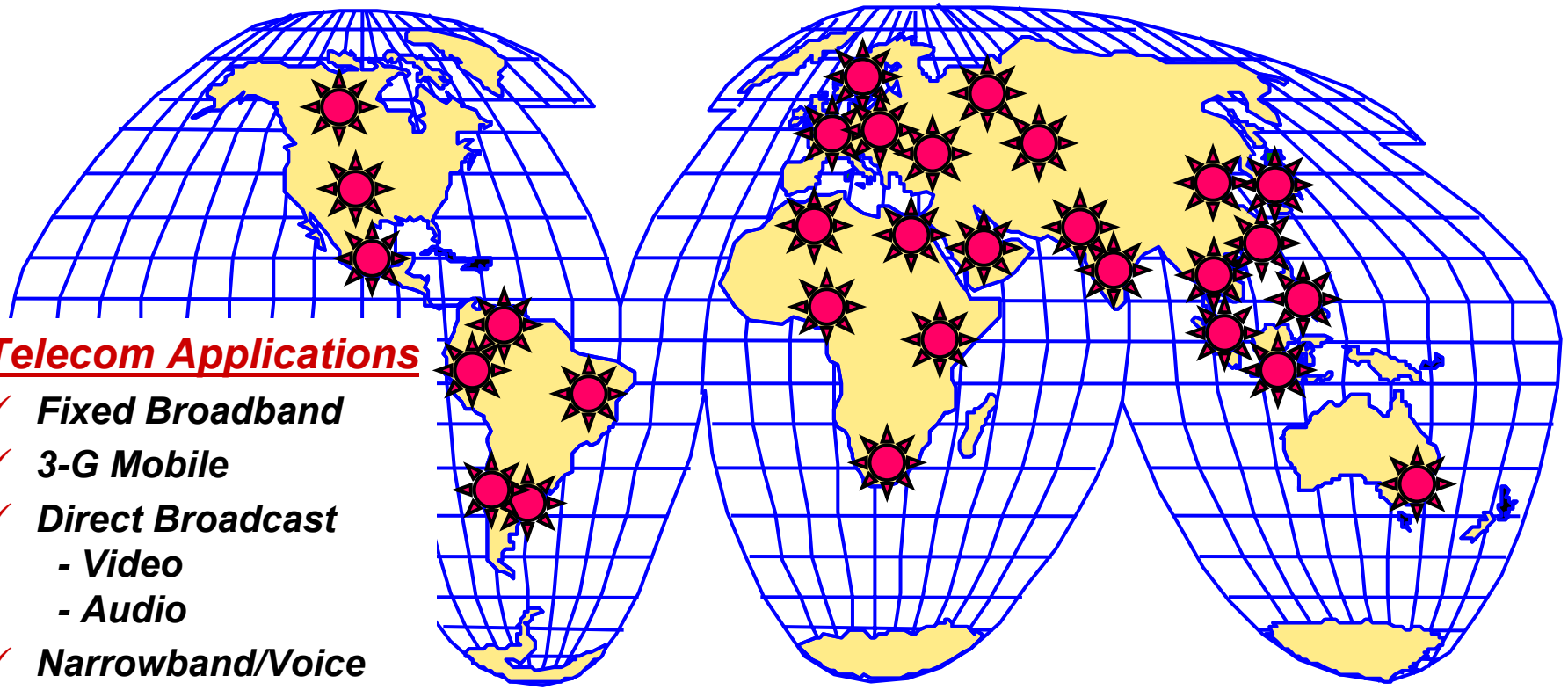
Regional Service Providers ***(examples only)***

US / Canada	Latin America	Europe	Asia-Pacific
• Fixed Broadband	• Fixed Broadband	• Fixed Broadband	• Fixed Broadband
• Next-Gen Mobile	• Next-Gen Mobile	• Next-Gen Mobile	• Next-Gen Mobile
• Direct Broadcast	• Direct Broadcast	• Direct Broadcast	• Direct Broadcast
• Narrowband	• Narrowband	• Narrowband	• Narrowband

Flexible: infrastructure owned by SkyTower or regional partners

SkyTower Global Market Potential... Pursued Regionally

Over 60 countries have expressed interest -- in discussions with partners/customers/investors in multiple markets



Telecom Applications

- ✓ ***Fixed Broadband***
- ✓ ***3-G Mobile***
- ✓ ***Direct Broadcast***
  - ***Video***
  - ***Audio***
- ✓ ***Narrowband/Voice***
  - ***Fixed***
  - ***Mobile***
- ✓ ***Other***

- Examples of Regions Interested in SkyTower

Examples of Print Media Coverage
(AeroVironment Helios Aircraft / SkyTower News)

Nikkei, Japan

Focus, Germany

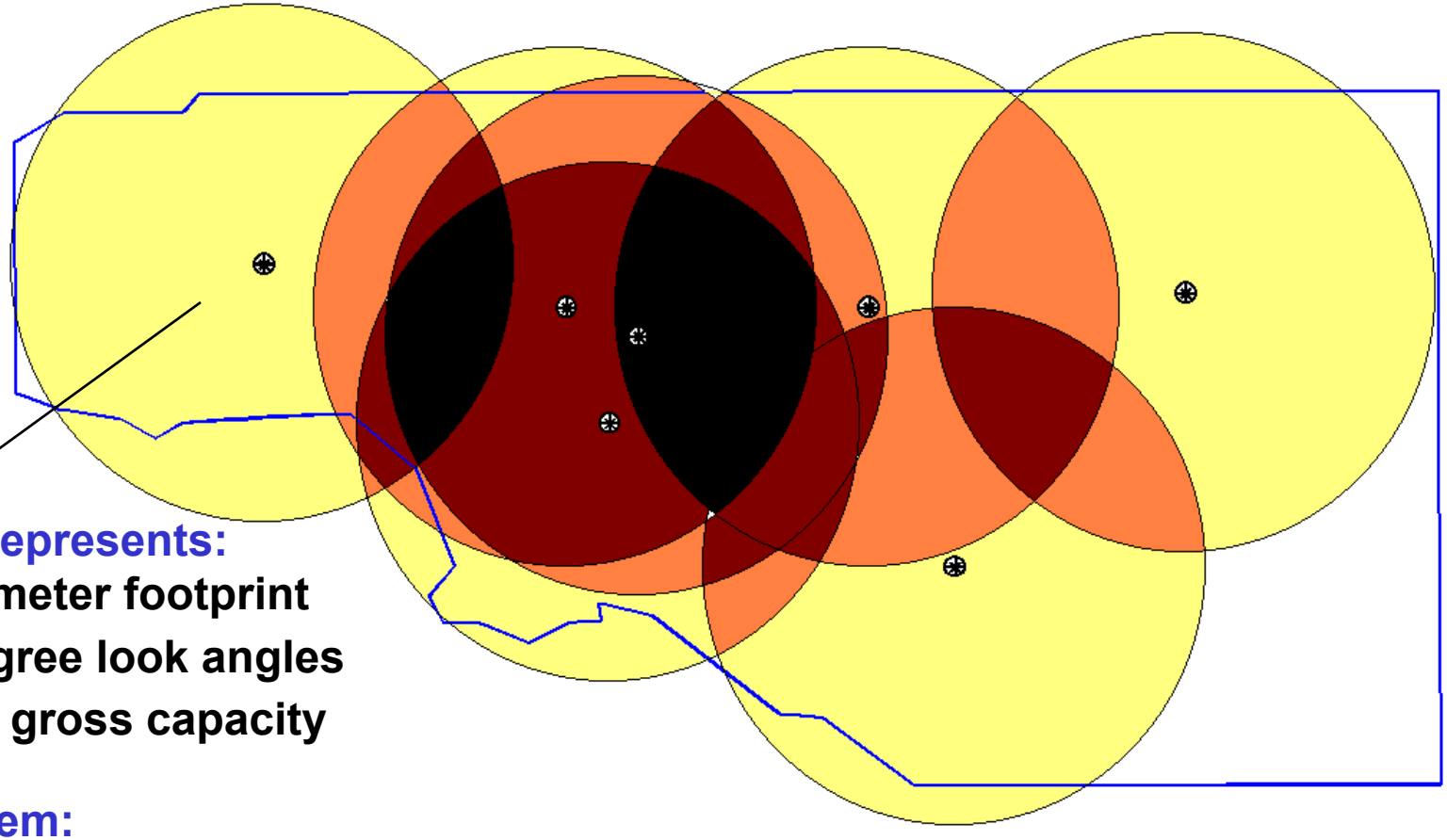
Los Angeles Times, USA

Wired Magazine, USA


Economist.com
SCIENCE & TECHNOLOGY
Suspended Animation
Jul 3rd 2003
From The Economist print edition
Economist, UK
Unmanned craft loitering in the stratosphere may soon supplant satellites

Business 2.0, USA

Broadband Deployment Example #1: Metro Los Angeles



Each Circle Represents:

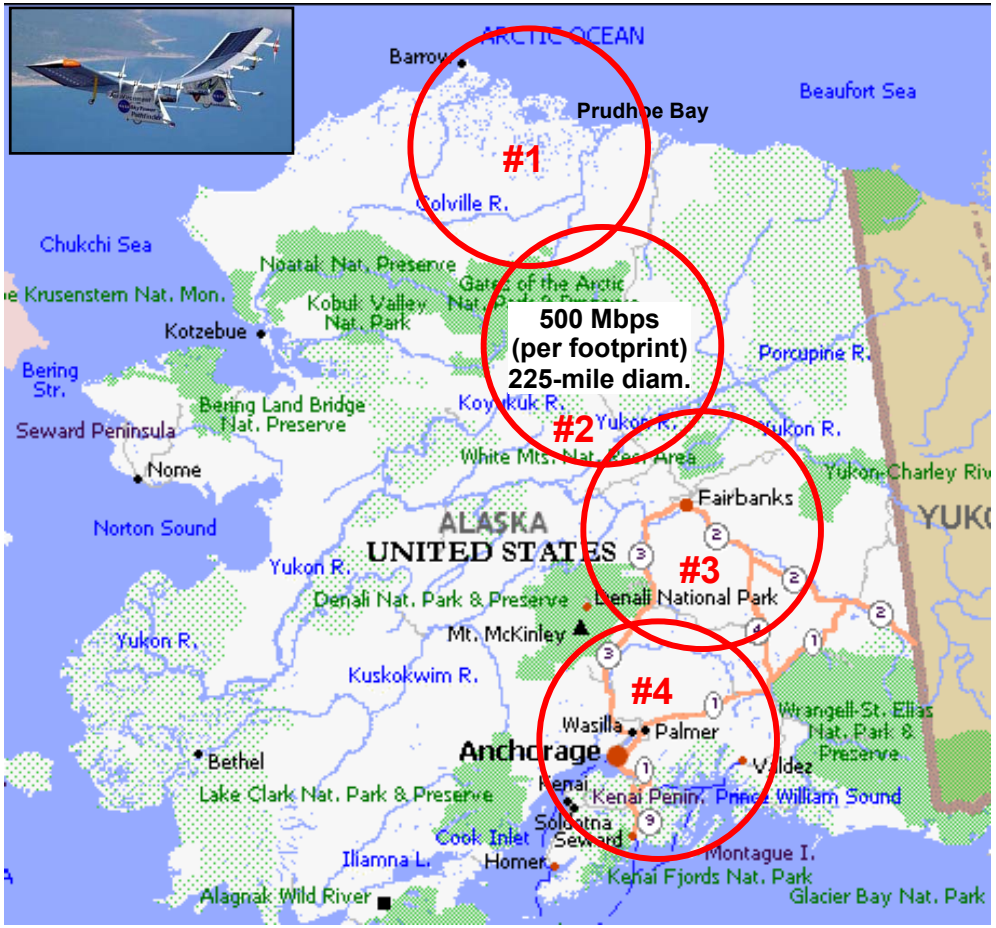
- 50-mile diameter footprint
- 24 to 90 degree look angles
- 5,000 Mbps gross capacity

Scalable System:

- Could start service with one platform, then expand coverage/capacity to meet market demand as required
- Bandwidth density increased in overlapped regions & enabled by spatial diversity of platforms--allows multiple operators as well

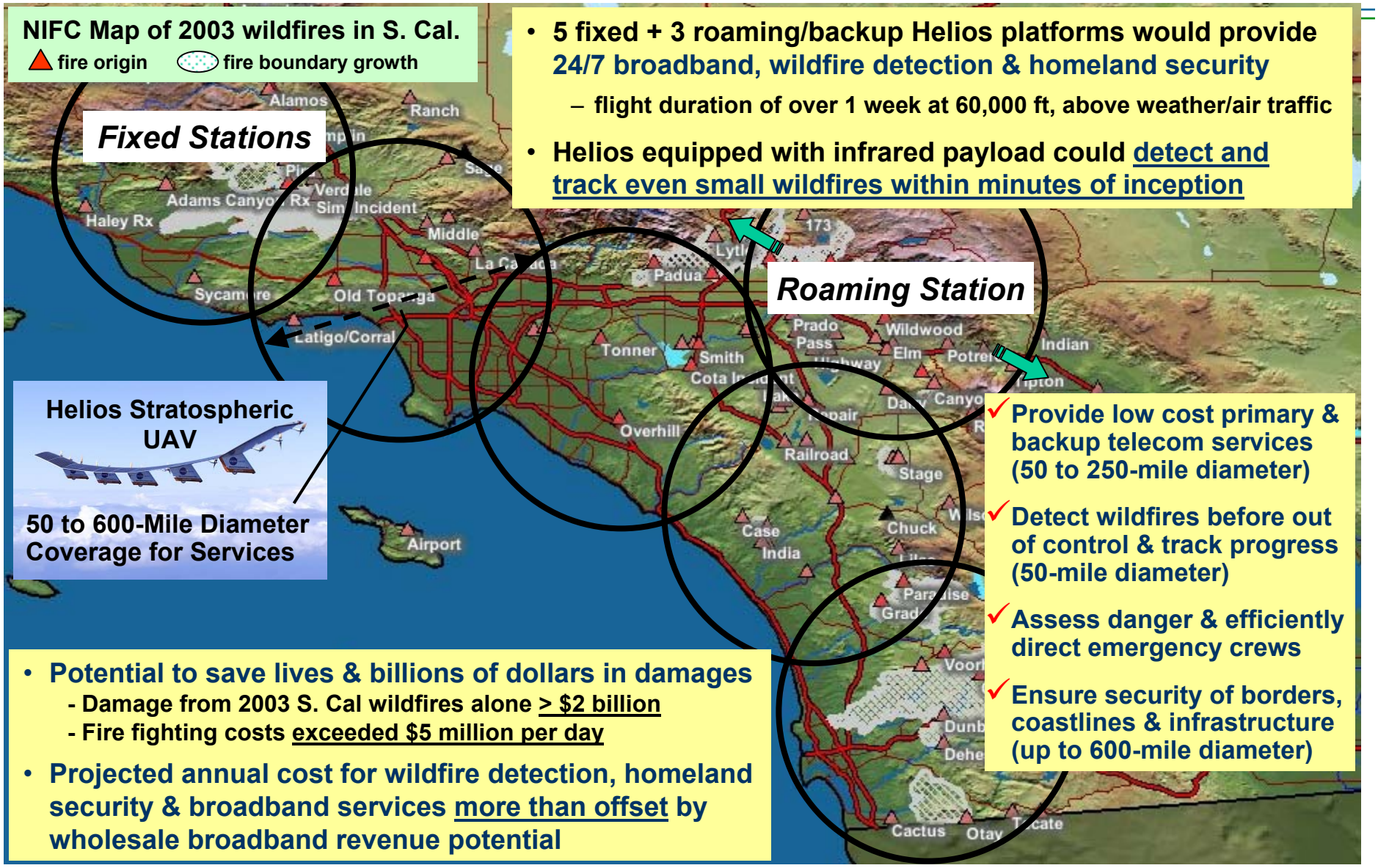
Broadband Deployment Example #2: Rural Alaska (includes other applic's)

Deployment of 4 platforms (+ backups) across Alaska:



- **Provides multiple uses**
  - **broadband local access at fraction of satellite cost ($/bps)**
  - **trans-Alaska aerial backbone**
  - **pipeline & port monitoring**
  - **distance learning/telemedicine**
  - **weather tracking/disaster mgmt**
  - **arctic/stratospheric research**
- **First station deployed ties Barrow into Prudhoe fiber**
- **Fourth enables complete aerial backbone alternative**

Example: Helios Broadband, Homeland Security, and Wildfire Detection over S. California



- 5 fixed + 3 roaming/backup Helios platforms would provide 24/7 broadband, wildfire detection & homeland security
  - flight duration of over 1 week at 60,000 ft, above weather/air traffic
- Helios equipped with infrared payload could detect and track even small wildfires within minutes of inception

- ✓ Provide low cost primary & backup telecom services (50 to 250-mile diameter)
- ✓ Detect wildfires before out of control & track progress (50-mile diameter)
- ✓ Assess danger & efficiently direct emergency crews
- ✓ Ensure security of borders, coastlines & infrastructure (up to 600-mile diameter)

- Potential to save lives & billions of dollars in damages
  - Damage from 2003 S. Cal wildfires alone > $2 billion
  - Fire fighting costs exceeded $5 million per day
- Projected annual cost for wildfire detection, homeland security & broadband services more than offset by wholesale broadband revenue potential

AeroVironment: Partner of Choice

- **The only company with combined experience in solar/electric powered aircraft technologies:**
  - Extremely light aircraft structures & low speed aerodynamics
  - Light weight, highly reliable control systems/avionics
  - Light weight, highly efficient power electronics & propulsion systems
  - High efficiency solar cell and fuel cell systems
  - Systems integration / optimization
  - Stratospheric flight operations
- **Uniquely successful stratospheric flight experience and world altitude record holder (flying in stratosphere for 8 years)**
  - Experience gained is invaluable for successful deployment planning and flight operations to support commercial service
- **Skilled in the development, production, and operation of a broad range of aircraft systems (solar/electric aircraft, other UAVs, etc.)**
  - AV is now the largest-volume UAV manufacturer supplying US Army, Marines, and special operations warfighters

AV is the only organization to fly solar-electric UAVs into the Stratosphere