



Space Data[®]

TAKING **INGENUITY** TO NEW HEIGHTS

Near Space Technologies for the Deployable Aerial Communications Architecture

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Space Data's Near Space Platforms & Heritage



Near Space: layer above planes / below satellites

- 65,000-130,000 ft altitude, 2x-3x higher than aircraft

Based on weather balloon technology & regulations

- However vent / ballast enables wind-steering control

Space Data has many Near Space Platforms:

- **SkySite**[®]: commercial M2M wireless started in 2004
- **SkySat**[™]: Beyond Line of Sight Comms-on-the-Move to DoD radios via \$49M contract awarded in 2006
 - 400 ft. tethered mode: 30 mi. range in low winds
- **SkyEye**[™]: EO (visible) & IR demos underway

Space Data's Near Space Platforms are Proven

- 5+ years of 24/7 operations & 250,000+ flight hours
- Deployed by US Air Force, Nat'l Guard, & US Marine Corps with trials underway with US Navy & US Army
- Has operated on five different continents:
 - From the Equator to north of the Arctic Circle
- Success in all environments: at sea, desert heat, high mountain plain, arctic cold, typhoons, rain forest ...



Tethered Mode
in Afghanistan



Near Space Launch
By Marines at Sea

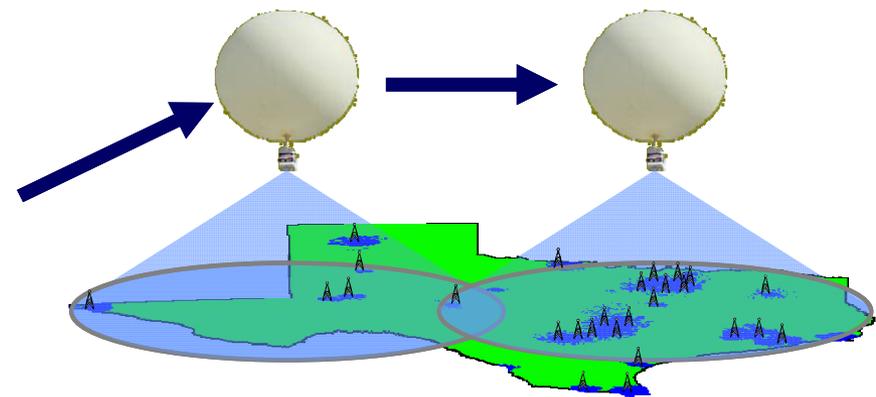
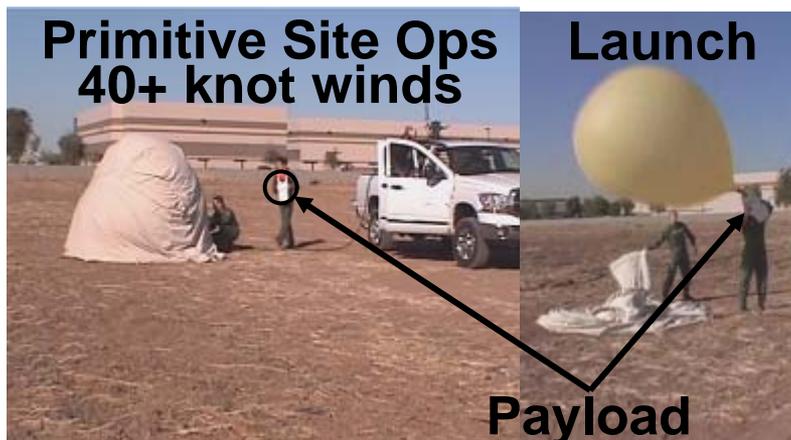
Deployable, satellite-like coverage, but to standard terrestrial wireless devices

- Payloads operating at VHF thru 5.8 GHz have been flight demonstrated
- Protocols successfully flown include: P25 digital, iDEN, CDMA 1XRTT, DMR/MotoTRBO, two-way paging, SCADA, 802.11 WiFi, and Broadband OFDM Point-to-Point

SkySites: Wide coverage, Rapidly Deployable, FAA Compliant



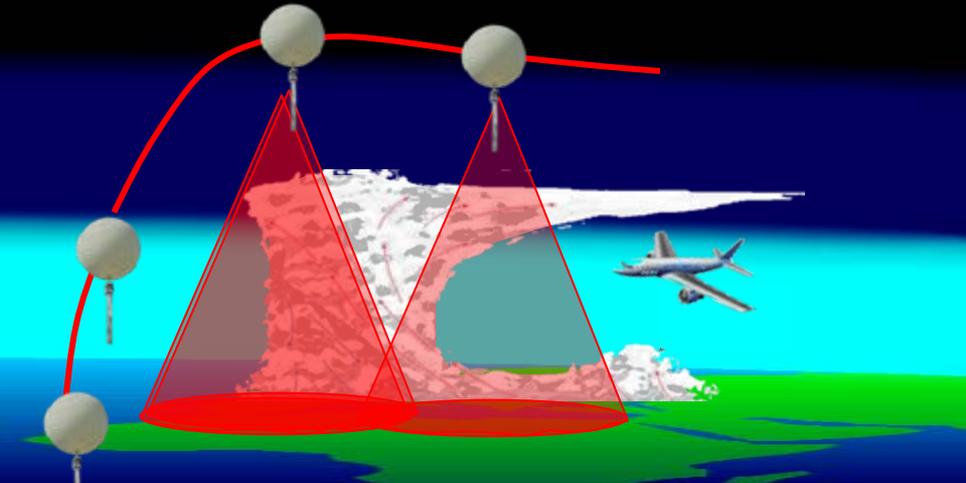
- A wireless network consisting of balloon-borne transceivers that operate above all weather
 - Coverage Diameter: M2M 420 mile, 3G voice 170 mile, 4G broadband 120 mile
- *SkySite* life cycle: 15 min. prep, 60 min. to altitude, 12-24 hrs. at altitude, 30 min. to descend on parachute; then >90% recovered, refurbished and re-launched in 2 weeks
- Control of altitude allows selection of wind layer required either footprint disaster area
- Nat'l Airspace System (NAS) use by unmanned free drifting balloons permitted if:
 - 1) *Total payload < 12 lb* 2) *Each package < 6 lbs* 3) *Must separate with 50 lb force*
- Sense & Avoid is not needed for balloons as balloon has the right-of-way over other aircraft
- Supplies for 6 launches fit in one SUV with two people required for launch
- Existing 102 NOAA weather balloon sites could inventory systems for instant response



Up to 600-mile-Diameter Coverage to Terrestrial Devices



Launched Outside Affected Area



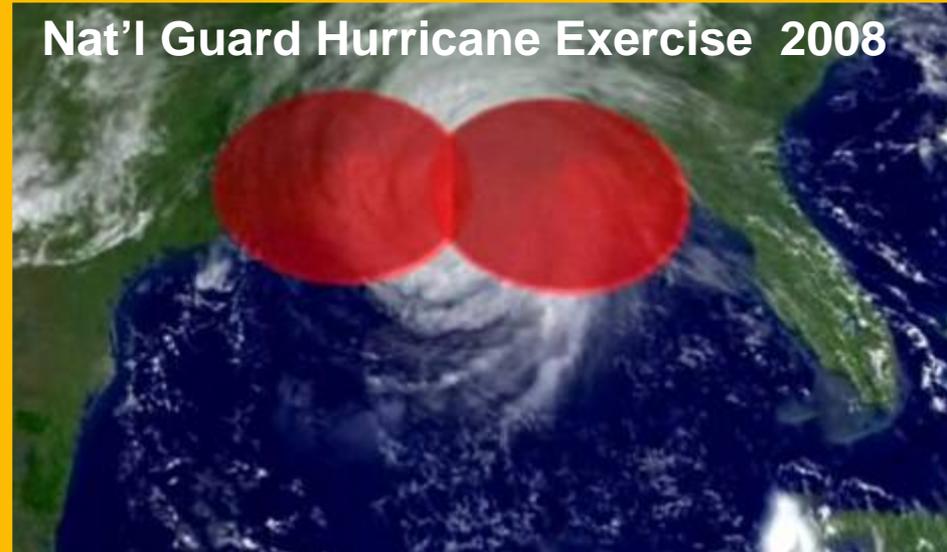
Commercial M2M 24/7 Coverage



HI Earthquake / Tsunami Exercise 2007



Nat'l Guard Hurricane Exercise 2008



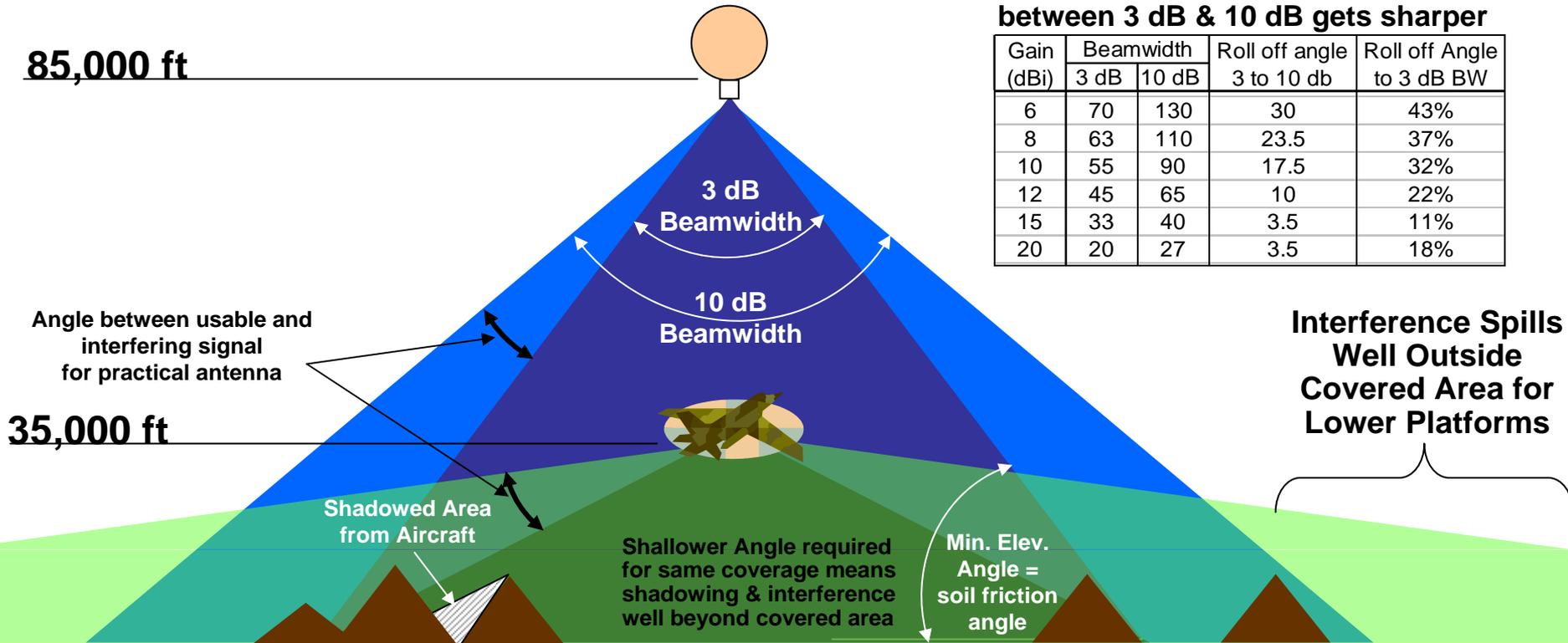
Higher Altitude Enables Better Frequency Reuse

Frequency use confined more effectively by antenna pattern high altitude:

- Near Space: narrower beam allow faster antenna roll off to isolate spectrum use
- Lower Altitude: wider antenna beam is required to obtain same coverage area, this results in interference spreading farther due to insufficient gain roll-off with practical antennas

As Antenna Gain increases, roll off between 3 dB & 10 dB gets sharper

Gain (dBi)	Beamwidth		Roll off angle 3 to 10 db	Roll off Angle to 3 dB BW
	3 dB	10 dB		
6	70	130	30	43%
8	63	110	23.5	37%
10	55	90	17.5	32%
12	45	65	10	22%
15	33	40	3.5	11%
20	20	27	3.5	18%



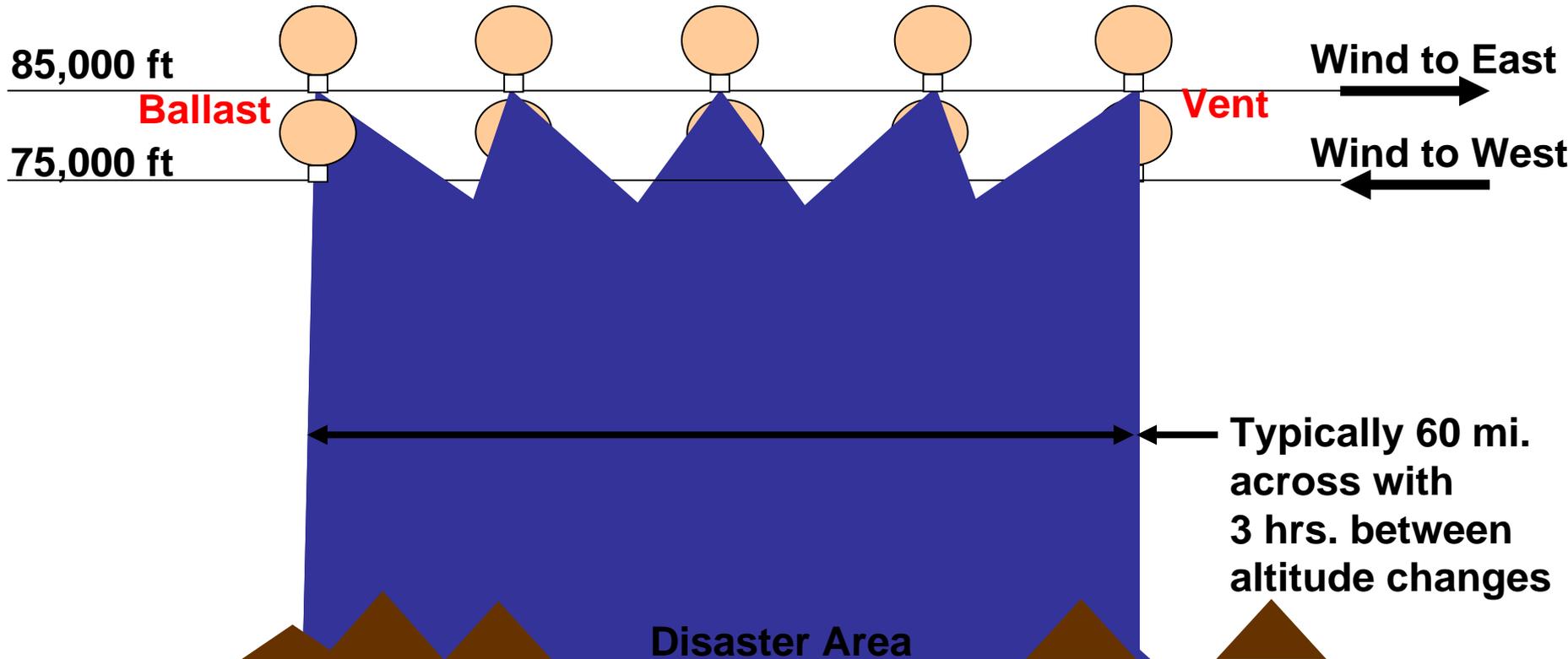
Wind Steering Allows Coverage to Dither over Area

Stratosphere: many strata of wind with various directions/speeds to select from

- Venting to descend or ballasting to ascend selects a desired wind layer
- Mid-winter/mid-summer winds all in one direction: need 2-4 launches/day then

Platform is stable enough to point directional antenna at center of disaster area

- Directional antenna beam can spotlight area to restrict spectrum area of use



APCO P25 Texas National Guard Demo 6/11

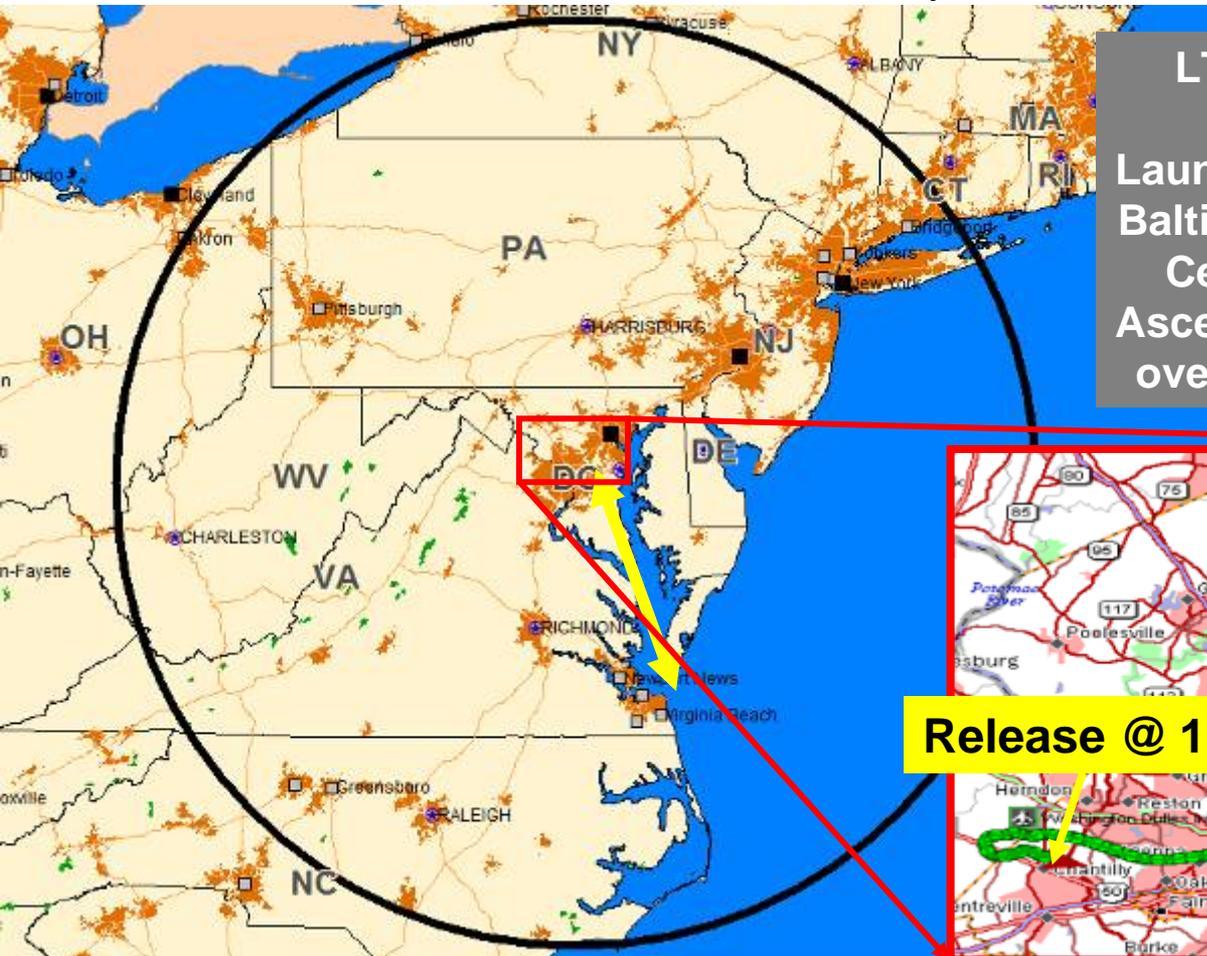


Coalition Warrior Interoperability Demo (CWID) showed that the TX Nat'l Guard can talk directly to any disaster area in TEXAS from the State Capital

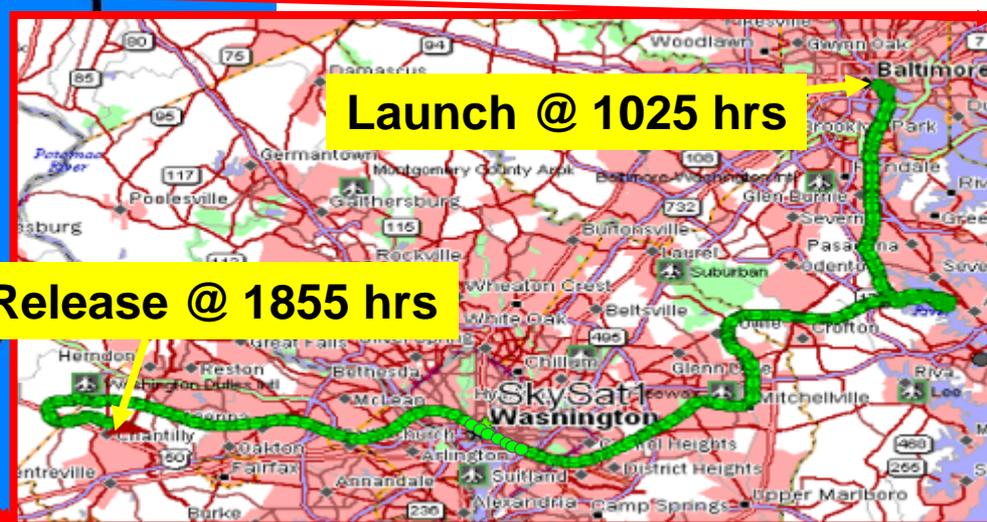


Recent Coverage Examples from 65,000 ft. over Washington

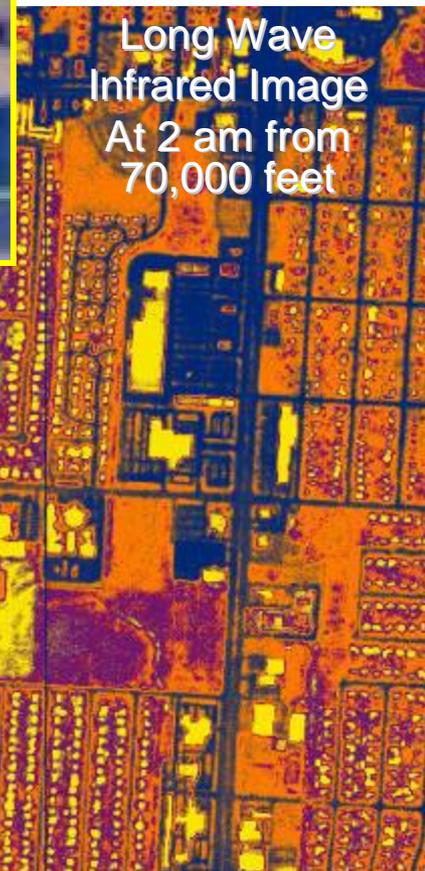
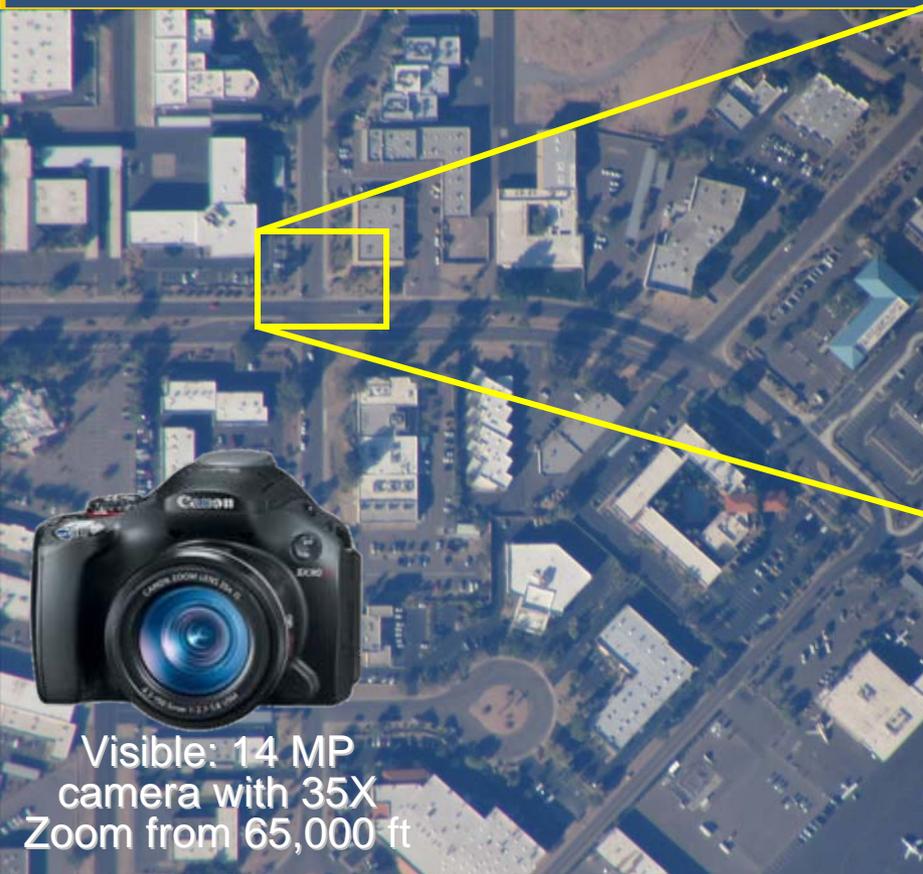
- Aug 2011, launched SkySat from DISA conference at Baltimore Conv. Center
- After FCC Sept. 2011 Open Meeting, demonstrated voice communications between FCC & VA Beach via 900 MHz SkySite launched at Oxon Hill, MD



LTG Pollett, USA
Director DISA
Launches SkySat from
Baltimore Convention
Center 17 Aug 11.
Ascends to 65,000 feet
over Washington DC



Near Space Imaging Requires Broadband Downlink



- 5.8 GHz, 70 Mbps downlink
Point-to-Point OFDM link
- Wide Area, 1.7 km² per image,
with 6 inch resolution

Comparison of Communications Platforms



- SkySat™ is economical on both an acquisition and an operational basis
 - Offers unique ability to surge capacity due to ease of launch / low acquisition cost

Communications Platform	Altitude (km)	Persistence Without Replenishment	FOV * with 2 deg. Min Elev Angle (dia. in mi.)	Acq. Cost (\$ M)	Cost per Flt. Hr.
Tallest Tower	0.6	30 years	21	\$ 3.00	\$ 11
TARS Aerostat	5	30 days **	131	\$ 4.00	\$ 400
Predator UAV	8	16 hours	200	\$ 40.00	\$ 5,000
JSTARS or RC-135	13	11 hours	300	\$ 244.00	\$ 20,000
Global Hawk UAV ***	20	35 hours	405	\$ 67.00	\$ 26,500
U-2	21	10 hours	427	\$ 400.00	Expensive
Combat SkySat ****	26	12 hours	544	\$ 0.01	\$ 833
LEO: Iridium, ISR, DMSP	781	8 years	3,500	\$2,640.00	\$ 37,671
HEO: TacSat-4 constellation	12,223	1 year	10,000	\$240.00	\$ 27,397
MEO: GPS	20,355	7.5 years	10,265	\$ 227.00	\$ 3,455
GEO: DSP, SATCOM	35,795	12 years	10,971	\$ 250.00+	\$ 2,378

* Field of View is smaller in complex terrain if local terrain obstructs line of sight elevation angles to greater than 2 degrees

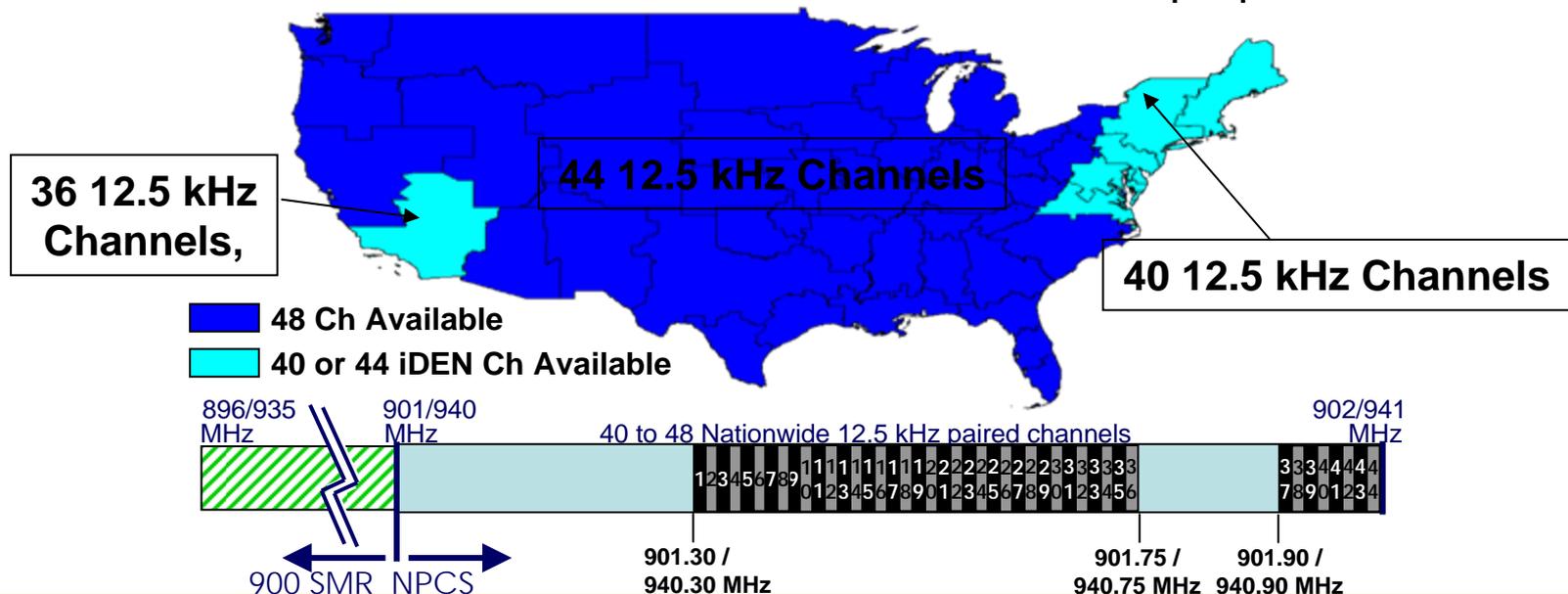
** Note: Aerostat Persistence is weather dependent, historical availability < 60%

*** See <http://www.globalsecurity.org/org/news/2006/060806-flying-robots.htm> for costs per flight hour per air frame

**** Combat SkySat cost per flight hour is based on no recovery, recovery in the commercial system is 87% in disaster areas that permit recovery

Potential Spectrum for Near Space Platforms

- **Narrowbanding could create wide-area, Public-Safety-compatible channels**
 - For example FORTY narrowband Federal VHF and UHF channels were identified for interoperability during emergencies by the FCC, in cooperation with NTIA, in Public Notice DA 01-1621, dated 13 July 2001
- **Space Data is licensee of approx. Forty 12.5 kHz channel pairs at 900 MHz:**
 - While traditionally used by two-way paging, Space Data has worked to expand the use of the NPCS band to include: P25, iDEN, DMR, and MotoTRBO Push-to-Talk voice / data radios as well as several data-only radios
 - Some channels could be available for DACAs under a proper economic model



- **Compatible:** terrestrial devices work like satellite devices, but with in-building coverage; no new device to buy, carry or learn
- **Lower power:** extends radio battery life of user devices
- **Responsive:** prepare, launch and at altitude all within 2 hours
- **Rapidly deployable:** air transportable in checked luggage
- **Simple logistics:** open field launch in high wind w/ 2 people
- **No impact by poor access:** deployed outside affected area
- **Secure:** supports encrypted traffic as required
- **Interference controlled:** pointing narrow beam antenna
- **Flexible:** Demonstrated in multiple bands and protocols
- **All weather ops for Near Space,** tethered in good weather
- **Military version in production now / deployed worldwide**
- **Capacity/services increasing:** macro→micro→pico→femto→

THANK YOU