Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Utilizing Rapidly Deployable Aerial Communications Architecture in Response to an Emergency	)))))))	PS Docket No. 11-15

COMMENTS OF SPACE DATA CORPORATION

Space Data Corporation ("Space Data") is pleased to submit these comments in the above-referenced proceeding,[1] and supports the efforts of the Federal Communication Commission ("FCC") to explore improving public safety communications during the critical restoration period after a major disaster through the use of deployable aerial communications architecture ("DACA"). Space Data has developed a network of "near space" DACA platforms that can provide communications services, such as secure, beyond line of sight, push-to-talk voice, broadband, and packet data services, that are essential after a disaster when terrestrial networks may be inoperable. As a leading innovator in near space communications with systems that have been used by the U.S. Marine Corps, U.S. Army and U.S. Air Force to rapidly deploy communications in and to remote austere locations, Space Data applauds the Commission's initiatives. DACA technologies can help ensure the uninterrupted delivery of wireless communications during and immediately after a catastrophic event, an essential component of rescue and recovery efforts.

[1] *Utilizing Rapidly Deployable Aerial Communications Architecture in Response to an Emergency*, Notice of Inquiry, PS Docket No. 11-15, FCC 12-53 (rel. May 24, 2012) ("DACA NOI").

I. INTRODUCTION.

Space Data has developed a robust near space[2] communications system that can rapidly deliver critical communications during and after a catastrophic event. For example, Space Data's commercial network utilizing its near space technologies continued operations during and after Hurricane Katrina. Space Data's near space technologies also are a standard tool for U.S. Marine Corps units for such missions as humanitarian assistance, disaster relief, and tactical recovery of aircraft and personnel recovery missions. Space Data's system effectively ties together mission components at sea, on the ground and in the air to rapidly accomplish military missions, and proved to be a critical asset for the U.S. Marines in Libyan operations in 2011. Space Data's DACA technology can similarly help first responders and other emergency personnel in the aftermath of a natural disaster, terrorist strike, or other emergency.[3] In fact, Space Data's technology could provide communications coverage for first responders within 30 minutes of a catastrophe with no reliance on terrestrial infrastructure. Space Data's near space technology is referred to a SkySite® platform for commercial and public safety applications and a Combat SkySat™ platform for military purposes.

II. TECHNOLOGY OVERVIEW.

Space Data has developed and deployed a balloon-borne wireless network that enables the delivery of wireless services in geographic areas that are not served or are poorly served by

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[2] "Near space" is a term that encompasses proven technologies that have been integrated into a new type of wireless infrastructure platform: (1) weather balloons that have flown for more than 80 years at a rate of over 800,000 launches per year from 880 sites throughout the world; (2) GPS receivers that allow the weather balloons to be controlled at a specific altitudes above 65,000 feet; and (3) picocells and femtocells that are now of the weight and power class needed to turn a weather balloon into a 20-mile high wireless site. Near space technologies, which many companies are pursuing, can take several forms, including tethered blimps, high-altitude manned airplanes, high-altitude unmanned airships, unmanned solar airplanes and Space Data's balloon-borne miniature wireless base stations.

[3] Space Data's near space system also is being considered by countries on six different continents to help solve communications needs for homeland security and disaster response.

existing wireless technologies and service providers. Space Data's SkySite network uses a balloon-borne lift method that has proven reliable for more than half a century. Every day for more than 60 years, at nearly one thousand sites worldwide, governments have launched weather balloons to gather atmospheric data for weather forecasts. These balloon launches are performed reliably on a coordinated basis in all weather conditions. Space Data has developed the expertise to adapt this field-proven concept for commercial and government applications.

As part of its ongoing engineering and manufacturing efforts, Space Data has produced a SkySite platform that weighs less than six pounds, and incorporates the functions of balloon control, telemetry relay and wireless messaging. This development effort reflects Space Data's expertise in RF engineering and miniaturization, environmental protection against the effects of temperature and pressure at various altitudes, and power management. In addition, Space Data has developed the capability to design and manufacture its own synthetic latex balloons, allowing the company to respond to different environmental and operational requirements in short order. The Federal Aviation Administration ("FAA") has approved the use of SkySite Platforms and has determined that their small size presents no danger to aircraft and that their launching requires no preflight coordination. SkySite Platforms can be easily launched by one or two person teams every 12 to 24 hours to create a redundant constellation of SkySite Platforms. After 24 to 36 hours, the SkySite Platforms parachute safely back to the ground and can be recovered and reused. GPS receivers on the SkySite Platforms also allow tight control of

transmissions, protocol timing, and power near service area borders.[4] Because of the altitude at which SkySite Platforms fly, they are not affected by adverse weather conditions.[5]

Space Data's SkySite technology is very versatile. This proven technology has been used at frequencies as low as a 2 MHz up to 5.8 GHz in both point-to-multipoint and point-to-point broadband data systems, push-to-talk voice systems, narrowband PCS two-way paging networks, cellular networks, and aerial imaging systems that use a wireless downlink. It is technologically agnostic and is adaptable in terms of frequency and protocol – e.g., it can support CDMA, W-CDMA, WiMAX, LTE, and can keep pace with technology developments. As discussed further below, the U.S. military also has found Space Data's technology ideal for its communications needs.

III. SPACE DATA'S NEAR SPACE SYSTEM HAS SIGNIFICANT MILITARY APPLICATIONS.

Space Data was initially contracted by the Air Force Space Battlelab ("AFSB") to demonstrate the ability of a balloon-borne repeater to extend radio communications beyond line of sight. Since then, active programs have been started with the U.S. Army, U.S. Marines and the U.S. Navy. Initial proof-of-concept flights with commercial radio repeaters were accomplished in March 2005, proving that radio repeaters in near space could extend the range of standard hand-held radios from a typical 10 miles to over 400 miles.

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[4] Further information regarding Space Data's SkySite network is available in the construction showing for one of Space Data's narrowband PCS licenses. *See* ULS File No. 0001900882 (filed Oct. 13, 2004, accepted Jan. 13, 2005).

[5] As previously noted, Space Data's network operated without interruption, including over much of Louisiana, during Hurricane Katrina. *See* Statement of Gerald Knoblach, Space Data, before the Commission's Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks (Mar. 7, 2006 & Supp. Nov. 18, 2005), *at* http://www.fcc.gov/pshs/docs/advisory/hkip/GSpeakers060306/ACT1046.pdf and http://www.fcc.gov/pshs/docs/advisory/hkip/GSpeakers060306/ACT1049.pdf.

Following its initial work with the AFSB, Space Data was invited to participate in the 2006 Joint Expeditionary Force Experiment (JEFX-2006). This exercise, sponsored by the Chief of Staff of the Air Force, showcased new technologies that can be rapidly deployed to help the warfighter. To support JEFX needs, Space Data modified its existing SkySite Platform technology to produce the Combat SkySat Repeater System. Each Combat SkySat payload is a single unit that integrates in-house designed radio repeaters, command and control and power supply into a six-pound package. The Combat SkySat is a low-cost system that allows for rapid deployment in support of a wide range of operations. Figure 1 shows launches of a Combat SkySat payload.

Figure 1. Examples of launches of a Space Data's Near Space Payloads include: Lieutenant General Pollett, Director of the Defense Information Services Agency, launching from the Baltimore Maryland Convention Center, U.S. Marines launching off the deck of an amphibious assault ship while at sea, and a solider launching at a Forward Operating Base in Afghanistan.

In August 2006, Space Data was awarded a $49 million USAF contract in connection with its near space technology (called Combat SkySats), which permits the use of the

Department of Defense's existing inventory of tactical radios while extending coverage across an entire theater for both ground-to-ground and ground-to-air communications. A Combat SkySat currently operates as an FM repeater in the range 225 MHz to 375 MHz, and can be adapted to operate in other frequency bands or modulation schemes, as required by the end user. Regardless of configuration, Space Data's system effectively turns a standard portable radio into a wide-area communications device, producing effects that mirror satellite communications at a fraction of the program complexity and cost.

In 2011, the U.S. Marines also deployed Combat SkySats from ships in the Mediterranean Sea to facilitate communications with jets flying over Libya in lieu of flying E-3 Airborne Warning and Control System aircraft because the cost of Space Data's system was much less expensive and was considered a safer option for military personnel.[6]
The system is designed to be launched from a single vehicle by a two-person team, and controlled via a ground station contained in that vehicle. This can be accomplished in 40 knot winds from an open field if necessary. The lifting gas used in the system is hydrogen or helium, readily available from a variety of sources.

The Combat SkySat system was tested extensively in the military UHF bands for both voice and data transmissions. Voice testing incorporated analog and digital transmission methods, and the digital voice tests used both encrypted and unencrypted links. These tests supported ground-based users with military portable radios such as the PRC-148, PRC-117, PRC-152 and ARC-210. Currently, more than 100,000 compatible handsets are in the U.S.

[6] *Marines Use Helium Balloons to Talk to Harrier Jump Jets Over Libya*, DefenseTech, March 26, 2011, available at: http://defensetech.org/2011/03/26/marines-use-helium-balloons-to-talk-to-harrier-jump-jets-in-libya/#ixzz1IPFNe4HW.

military inventory. During a June 2011 Coalition Warfighter Interoperability Demonstration,[7] a near space payload floating around 79,000 feet above Texas enabled public safety communications between National Guard troops in Austin to U.S. Northern Commend personnel along the border near El Paso, as well as various participants across the state, the results of which are shown in Figure 2 below. The near space payload implemented APCO Project 25 (P25) communications in the VHF frequency band to standard Motorola handheld public safety radios. Both analog and digital voice and data communications were conducted via the high altitude P25 repeater platform used during the demonstration.

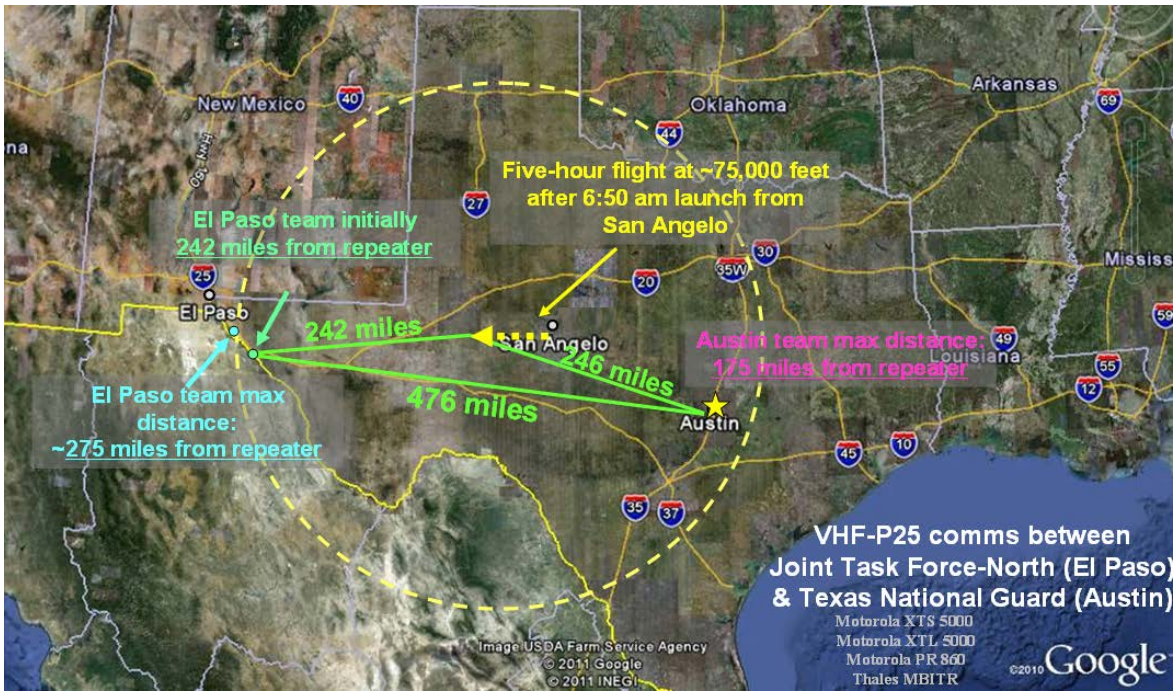

Figure 2. The Coalition Warrior Interoperability Demonstration showed that the Texas National Guard can talk directly to any disaster area in Texas from the State Capital. Space Data's near space payload provided P25 VHF communications to various standard public safety handheld radios to distances of up to 476 miles.

[7] The demonstration is an annual event held at the direction of the Chairman of the Joint Chiefs of Staff that engages cutting-edge information technology, focusing on operational shortfalls identified by combatant commanders and government agencies. Technologies are approved for participation because they address a new information sharing capability or potentially improve an existing capability.

IV. FREE-FLOATING SOLUTIONS ARE MORE PRACTICAL THAN TETHERED SOLUTIONS.

Space Data also produces a version of its Combat SkySat in a tethered mode that is used by the U.S. Marines and the U.S. Army. This system tethers the transceiver on a small (13 foot diameter) helium filled aerostat on a 1,000-foot tether that is deployed from a winch that fits into a standard receiver hitch on a truck. Figure 3 below shows the U.S. Marines using the tethered system.

Figure 3. Example launches of Space Data's Tethered Payloads include: Marines deploying a tethered Combat SkySat system during training and Marines in Afghanistan using the tethered Combat SkySat.

A tethered system can be quickly deployed to form a tower-like capability with up to a 500 foot altitude above ground level which provides line of sight out to 27 miles over water or in areas of flat terrain, and can be quickly reeled in once a day to top off helium and swap rechargeable batteries. However, there are significant disadvantages to a tethered solution. For example, its range can be limited to five to 10 miles in areas where there is terrain blockage or ground clutter. Consequently, there could be logistical issues to getting a truck with the tethered

system within five to 10 miles of where coverage is necessary, which may not be feasible in disaster areas. Tethered systems also are more susceptible to unpredictable weather conditions.[8] In addition, FAA rules prevent a tethered system like Space Data's Combat SkySat system being flow at altitudes above 500 feet in the U.S. or being flown within three miles of any airport.[9] Furthermore, applicable requirements prevent operations above 150 feet unless proper notice is given 24 hours before beginning operation.[10] Moreover, the tethers for even the smallest of aerostats have a breaking strength of 1700 pounds, and thus can represent a significant potential hazard to helicopters and fixed wing aircraft that are often part of a recovery effort after a disaster.

In contrast, Space Data's near space SkySite platforms operate within the standard aviation regulations the govern weather balloon operations.[11] There are nearly seventy weather balloon launch stations in the continental United States that have been launching weather balloons twice per day for the better part of a century without incident. Although the FAA restricts balloon payloads to two six-pound packages per balloon, Space Data's SkySites already

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[8] Small dust devils and localized downdrafts have been known to damage tethered systems of small aerostats as well as the larger Tethered Aerostat Radar System (TARS) that has operated for decades along the US-Mexico border. *Aerostat Balloon Crashes into Neighborhood, Power Lines*, Tucson News Now, May 9, 2011, available at: http://webcache.googleusercontent.com/search?q=cache:PRGRj-xjLFYJ:sierravista-fthuachuca.tucsonnewsnow.com/news/news/aerostat-balloon-crashes-neighborhood-power-lines/48817+sierra+vista+arizona+aerostat+crash&cd=1&hl=en&ct=clnk&gl=us

[9] See Federal Code of Regulations Section 101.13 available at http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgFAR.nsf/0/3fa243e56a63c13786256eec00537979!OpenDocument.

[10] See Federal Code of Regulations Section 101.17 available at http://rgl.faa.gov/REGULATORY_AND_GUIDANCE_LIBRARY%5CRGFAR.NSF/0/D94348B45EED6A7B86256EEC0053F079?OpenDocument. It would not be advisable for the proper aviation authorities to waive normal regulations during an emergency because rescue and recovery efforts could result in increased air traffic.

[11] See Federal Code of Regulations Section 101.1(a)(4) available at http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgFAR.nsf/0/4d5db7354c4541ee86256eec004ec67a!OpenDocument

satisfy this condition. As electronic devices continue to shrink in size and battery performance continues to improve, SkySite platforms will over time become even more efficient.

V. NEAR SPACE EQUIPMENT CAN PROVIDE COMMUNICATIONS DURING EMERGENCIES.

Emergency response communications are characterized by two major problems. First, terrestrial communications networks and infrastructure often sustain damage from natural disasters or other catastrophic events, which render them ineffective or inoperable for the first 72-96 hours after the incident. Second, personnel responding to incidents are drawn from multiple agencies, and often have communications equipment that is incompatible with other groups. Space Data's technology can restore wide area communications, and provide interoperability between radio equipment using different frequencies and/or modulation schemes.

A. SkySites Can Be Easily Prepositioned and Deployed.

SkySite platforms are ideally suited to provide wide-area communications support immediately after an emergency. The system offers rapid deployment, and minimal personnel and logistical requirements. SkySite platforms, comprising payloads, command and control equipment and associated hardware, can be deployed by air or ground transportation on short notice. A standard pallet could contain enough equipment for a week of 24/7 coverage. Equipment for one day of 24 hour coverage is easily transported in carry-on luggage. With its wide coverage area and operating altitude above terrestrial weather, a SkySite can be launched outside the affected area, even before a predicted incident, providing communications support before, during and after any disaster. Figure 4 shows an example of coverage that could have been provided during Hurricane Katrina.

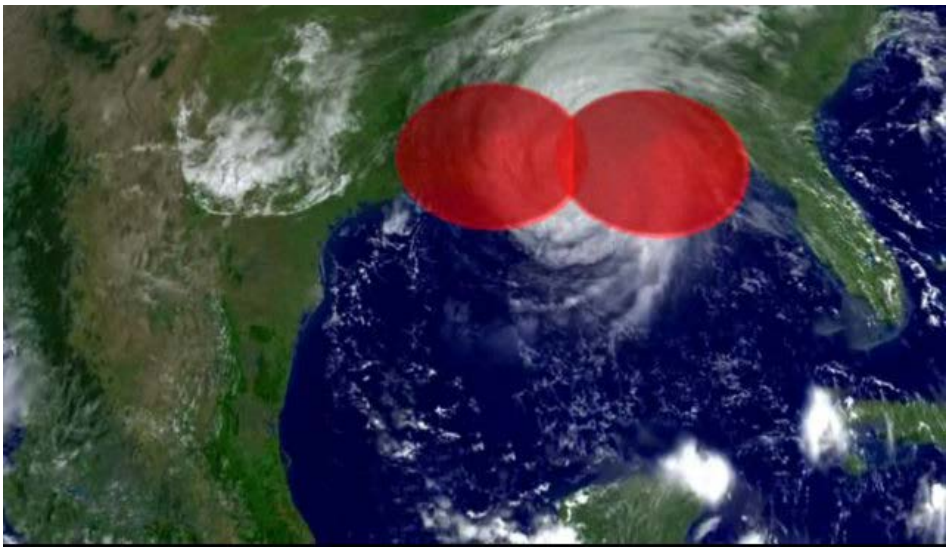

Figure 4. Coverage During Hurricane

SkySites can be launched with a two-person crew from a vehicle in an open field with 40 knot winds. If the winds are strong, a launch bag is used to protect the balloon from the winds during the 15 minute fill procedure. Figure 5 shows the launch bag with a balloon being filled.

Figure 5. A launch bag is used in high winds (up to 40 knots) to launch a SkySat platform from an open field in 15 minutes. Once one and a half tanks full of lifting gas are filled into the balloon, the payload is attached, checked out by the ground station and the Velcro flap is pulled open to launch the SkySat.

The SkySite rises at approximately 1,000 feet per minute. Thus, it hovers off above 20,000 meters (65,000 feet) in about an hour. After that, it can persist in the stratosphere until batteries or ballast sand is used up. The platform can change altitude by either venting lifting gas from the neck of the balloon to descend or turning an auger to sprinkle out sand ballast to ascend. The stratosphere above 60,000 feet consists of many strata of different winds. It is typically possible to wind steer the SkySite platform to maintain its coverage over a given area, as shown in Figure 6 below.

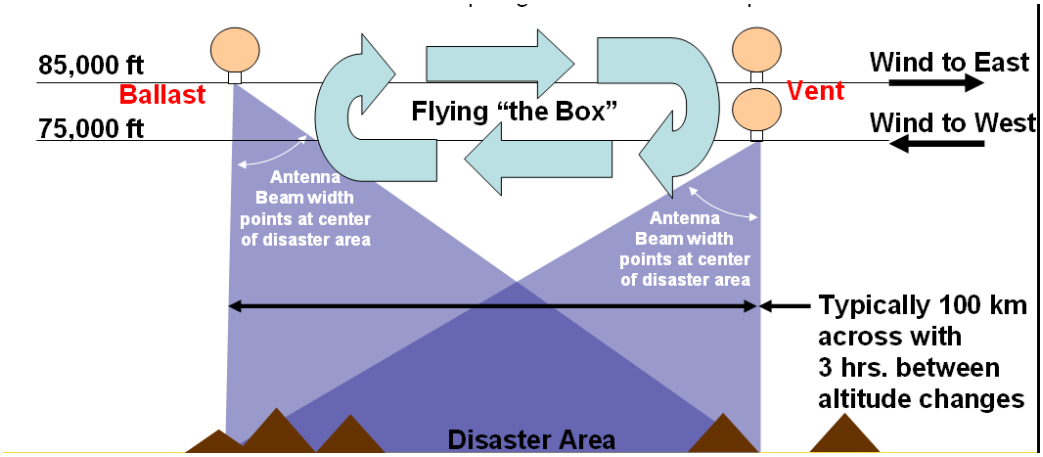

Figure 6. The various strata of winds in the stratosphere typically allows an operator to wind steer a SkySite to "fly a box" which means the SkySite is flown at an attitude where the wind layer drifts it slowly over a disaster area, then a couple hours later the SkySite altitude is changed to a different wind layer that takes the SkySite in nearly the opposite direction back over the disaster. In this manner, a SkySite can dither roughly 30 miles back and forth over a disaster area which is only a small percentage of its potential 600 mile diameter coverage area. If the desire is to constrain spectrum use into a smaller area than a 600 mile diameter, a direction antenna can be pointed from the SkySite to spotlight communications into the desired area on the ground as shown above.

SkySites are very deployable and can be carried in luggage onboard commercial aircraft. Upon arriving at the launch location, all that is needed to launch a SkySite is a couple cylinders of helium or hydrogen lifting gas, which is widely available.

An alternative for faster response is to have the DACA platforms prepositioned. One possibility for Space Data's near space platforms is to preposition the platforms at the National Oceanographic and Atmospheric Administration (NOAA) weather balloon launch sites run by

the National Weather Service (NWS). Figure 7 shows the active NWS weather balloon launch sites in the continental U.S.[12] These sites have launched weather balloons twice per day for decades in most cases. Each site could include the basic lifting gas, facilities and trained personnel to launch Space Data's DACA platforms.[13]

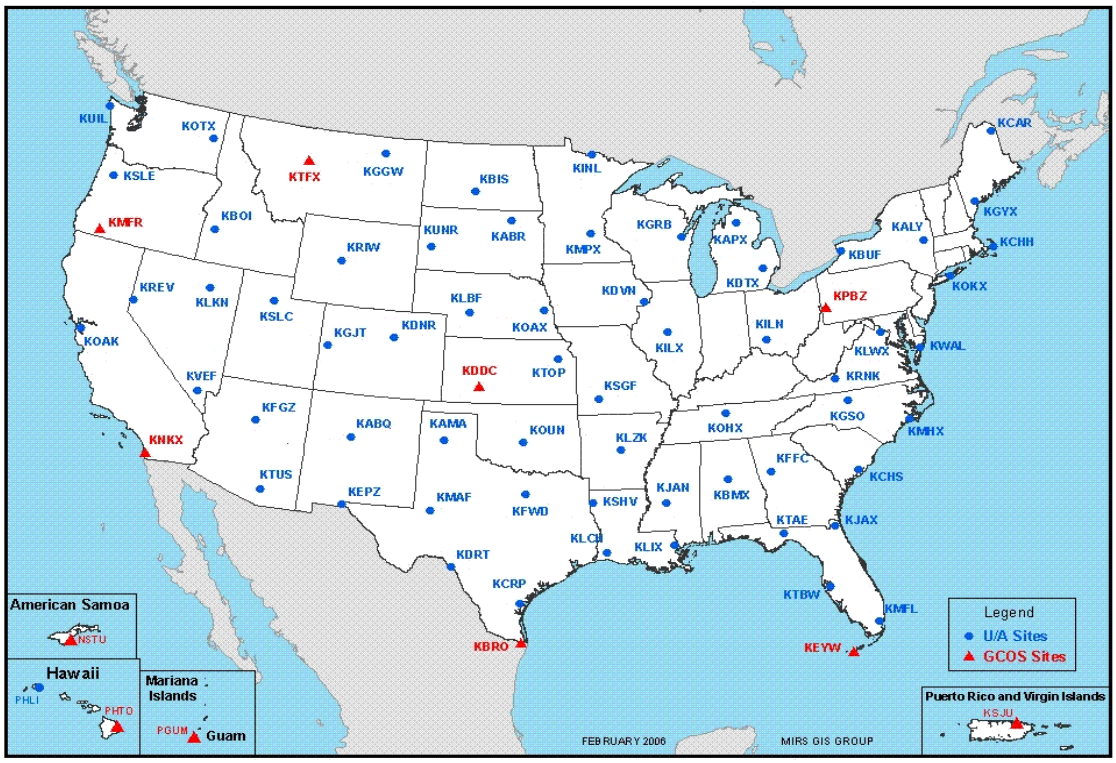

Figure 7. Location of current NWS weather balloon launch sites which could be leveraged as DACA near space platform launch sites for immediate response to disasters if DACA payloads were prepositioned at these sites.

[12] Available at http://www.ua.nws.noaa.gov/nws_upper.htm.

[13] For example, the NWS launches weather balloons twice per day from Miramar Naval Air Station near San Diego. In the event of an earthquake in Southern California, personnel at Miramar could immediately launch a DACA near space platform on a weather balloon. While it would take a bit over an hour for this platform to fully hover off at altitude, it would be at 10,000 feet only 10 minutes after launch. From that altitude it could be providing communications to an area up to 230 km (140 miles) in diameter. The potential coverage diameter (if not constrained by a spotlight directional antenna) could grow to cover all areas potentially affected very quickly even while the initial damage assessments are being reported.

Alternatively, payloads, associated hardware and helium and/or hydrogen tanks could be stored at selected locations (e.g., fire or police stations) for immediate access in an emergency. Using Hurricane Katrina as an example, payloads could have been launched from the Florida Panhandle to provide 24/7 coverage. Once the system is deployed, first responders would be able to access these wide-area channels using the mobile radios that they currently carry. The channels provided by the system could be used for extended coverage on emergency calls, communications from the field to headquarters, or any other function currently provided by the existing radio infrastructure. For example, in June 2007, the Combat SkySat system was used by Air National Guard teams from California, Arizona and Hawaii in support of a simulated earthquake emergency centered at Hilo, Hawaii. With launches from the island of Hawaii, communications coverage was demonstrated across the entire state.

B. SkySite Platforms are Technologically Agnostic and Adaptable In Terms of Frequency and Protocol.

It is technologically agnostic and is adaptable in terms of frequency and protocol – e.g., it can support CDMA, W-CDMA, WiMAX, LTE, and can keep pace with technology developments.

1. Voice and SMS.

Space Data has developed a prototype payload for CDMA and iDEN cellular technologies. These payloads have shown in flight testing the capability of covering a 170 mile diameter area for standard wireless phones operating in the 1900 and 900 MHz bands. In a crisis, these wireless capabilities can provide first responders and affected citizens a means to summon help and get word out to others. The short message services supported by the voice protocols are ideal for post-disaster communications when capacity efficiency is critical.

2. 4G Broadband.

Space Data is actively working with various communications infrastructure and user device manufacturers to develop and test fly a Fourth Generation ("4G") Long Term Evolution (LTE) version of the SkySite by the end of this year.[14] The LTE protocol standard allows for links of up to 100 km before experiencing various propagation delay issues. From an LTE SkySite at 20,000 meters (65,617 feet), this theoretically provides a coverage diameter of 196 km (122 miles), and potentially up to a coverage diameter of 236 km (147 miles) with some timing offset. Even at the edge of coverage, the SkySite is approximately 10 degrees above the horizon, which is geometrically equivalent to standing about 0.3 km (0.2 miles) from a 61 meter (200 foot) tall tower. This high elevation angle is one of the main advantages of flying the base radios at high altitudes because it essentially removes the losses that typically are present in a terrestrial link due to terrain, ground clutter and multipath fading. Figure 8 shows the geometry of an LTE base station at near space altitudes with the limit of 100 km imposed by the protocol.

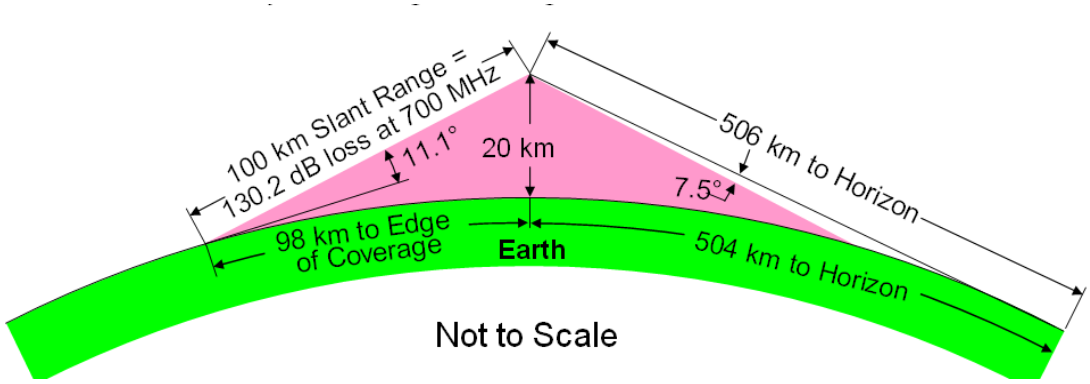

Figure 8. Geometry of an LTE SkySite at 20,000 meter (65,617 feet) altitude and limited by the 100 km propagation delay allowed by the LTE protocol. The SkySite is likely to have three 120 degree sector antennas with a gain of about 10 dB.

[14] This is an extension of the work Space Data has done in past years where it successfully flew CDMA payloads in the 1900 MHz Broadband PCS band in cooperation with a terrestrial licensee. Specifically, in 2009, the company flew a picocell CDMA base station to 75,000 feet and demonstrated communications to standard cell phones within a 280 km (165 mile) coverage diameter in a remote area of southern Utah that otherwise lacked terrestrial wireless coverage.

The realization of a near space LTE 700 MHz broadband network could have significant benefits to the new FirstNet LTE-based network in both reducing deployment costs and increasing coverage in rural areas. A significant cost driver in deployment of the FirstNet network is hardening each terrestrial site to a public safety grade of robustness. The backup power, back up backhaul links and physical robustness required to enhance network survival during various disasters significantly adds to the overall construction and maintenance costs of the FirstNet network according to current economic models. A DACA-based LTE network can effectively create a level of redundancy for every terrestrial FirstNet site in its footprint. Indeed, keeping a DACA system in reserve can fill in the coverage of any terrestrial site that could fail and provide the desired level of reliability with a lower level of robustness at each terrestrial site. In rural areas where there will simply be not enough funds to deploy the FirstNet LTE-based network, a DACA LTE broadband network also could provide coverage on an interim basis in the case of a disaster in a remote or rural area. As the LTE infrastructure equipment ecosystem evolves to produce smaller and less expensive cells sites, it may be economically feasible in remote and rural areas to have a near space DACA LTE network fill in coverage gaps on a continuous basis. This would eliminate the need for potentially thousands of terrestrial LTE sites, which would again make the deployment of the FirstNet network more affordable.

Space Data has been successful at stabilizing the balloon at altitude to allow pointing of a directional antenna to within a 1 degree accuracy of a point on the ground. While the balloon may look chaotic and highly unstable during ascent, once it has achieve stable float at altitude the balloon is very stable and rotates about a nearly perfect vertical axis every couple minutes. This rotation can easily be mechanically despun using various methods. This antenna pointing capability has allows us to use unlicensed point-to-point microwave links to establish a backhaul connection between the base radio on the SkySite and a backhaul site on the ground. Each end

has a directional antenna with approximately an 8 degree beam width. This backhaul link allows traffic from the SkySite to be integrated with a terrestrial switch. However, the rapid pace at which microprocessors are progressing is opening up the potential for the switch to be carried on the SkySite as well. This would eliminate the need for a backhaul to the ground and the LTE SkySite could operate as an independent network during the initial phases of a disaster until a broadband backhaul is established.

C. A SkySite Bridging Repeater Can Facilitate Interoperability.

A conventional repeater re-broadcasts transmissions on a single network, allowing police officers to talk with other police officers, border patrol agents to talk to other border patrol agents, and so on. One of the major problems with disaster response is that different emergency response groups need to interact and coordinate their recovery and relief efforts, but their respective radio equipment is not compatible. A paramedic and a National Guardsman could be 100 yards away from each other, yet unable to communicate. Space Data has developed another type of repeater that offers a fix to the problem – the "Bridging Repeater."

The Bridging Repeater carries two or more radio transceivers to "bridge" radio communications networks, thus offering interoperability. With this payload in the air, different groups on the ground could tune to one of their existing radio channels and have their communications re-broadcast on the other network. This enables police to talk to firefighters, FBI to talk to local law enforcement, or the National Guard to talk to the Border Patrol.
This Bridging Repeater concept was demonstrated in 2005 in conjunction with the AFSB. In those demonstrations, the payload could link an FM network at one frequency to an AM network at another frequency.

VI. IMPLEMENTING DISASTER RESPONSE.

In the initial hours after a disaster, chaos reigns and even with carefully planned coordination with other spectrum users the coordination to use vacant channels takes some time to gain approval. It is key that all interested parties – including public safety users, commercial operators, and government regulators – work together now to implement processes to help ensure communications are possible after an emergency and restoring affected networks, as well as after the event itself.

Spectrum channels could be set aside for DACA that are specifically for use after a disaster. For example, certain frequencies were identified by the FCC, in cooperation with NTIA, in a 2001 Public Notice.[15] Further detail on the use of these frequencies is contained in the NTIA Manual of Regulations and Procedures for Federal Frequency Management in its January 2006 revision. To Space Data's knowledge, formal implementation of this concept was never completed, but the concept bears reexamination by the government.

In particular, the frequencies set aside in the 2001 Public Notice were intended for intermittent interoperability between Federal and non-Federal public safety entities, a common requirement in responding to emergencies and disasters that extend beyond a localized area. More importantly, these are frequencies over which the Federal government maintains direct control and can, therefore, facilitate their use in emergency response situations. The interoperability frequencies support ten repeater pairs each in both the 162-174 MHz (VHF) and 410-420 MHz (UHF) ranges. A survey of modern synthesized VHF or UHF public safety radios indicates their ability to handle both standard state and local public safety frequencies and these Federal frequency allocations in a single unit without modification. As a key part of

[15] FCC Public Notice, *Federal Government Spectrum Available for Public Safety Interoperability Communications*, DA No. 01-1621 (rel. July 13, 2001).

implementing the interoperability concept outlined in the 2001 Public Notice, these ten repeater frequency pairs, as well as the ten simplex frequencies for each band, would be programmed into every public safety radio. In that way, there is no need to reprogram radios once a crisis situation arises. While these NTIA channels are only narrowband and may not offer much capacity compared to the normal terrestrial networks in a large urban area, after a major disaster something is better than nothing. These NTIA channels could be used as a communications path to coordinate the implementation of wider bandwidths for DACA use under pre-arranged agreements between the responsible government agencies and spectrum licensees whether they are public licensees or commercial licensees.

To further support broad emergency response and interoperability requirements, it is suggested that this issue be further addressed by regional, local, and organizational frequency coordinating bodies to set aside additional nationwide or regional broad-area frequencies under their control. Again, pre-planning for crises in the form of programming radios in advance for these special purpose frequencies is paramount.

Alternatively, DACA payloads could scan frequencies after an emergency and determine which are vacant for purposes of DACA operations. For example, Space Data envisions the launch of the first DACA weather balloon-based platform in most cases would occur as soon as possible after an emergency. Each DACA payload could include a scanner that would scan the desired bands of frequencies to see if they are actively being used by public safety or commercial users. This scanner data could be downlinked to the launch site to compare with a database of what frequency use was before the disaster. (This would of course require flying a scanner-only DACA payload on a periodic basis to update the database.) If the DACA payload finds that there are channels that were normally active but are now quiet, those could be candidate channels for the DACA network to operate on without interfering with other users. This phase of

operation is likely to only last for the initial couple hours. The DACA payload could operate in various degraded modes that would protect terrestrial users from interference. For instance, once scanning has located a vacant radio channel the DACA could start using that channel to re-establish communications with the users on that channel. Then after some period of time, the DACA could stop transmitting and listen to see if the terrestrial towers are trying to re-establish links on the channel. If it senses that towers are coming up, it could mute its transmitter or tune to the next vacant channel on the priority list.

After a couple hours, incident communications officers should be active and pre-arranged agreements with terrestrial users should be able to be implemented. If the terrestrial networks have been completely disabled as in a major disaster, then it may be that DACA is the primary mode of communications on several radio channels. Then as logistics are restored, and Cell on Wheels (COWs) and Cell on Light Trucks (COLTs) are able to be brought into the area, channels can be turned down on the DACA network as they are turned up on the terrestrial disaster response network. Finally, at the end of a disaster, the terrestrial network has been reconstituted and the last radio channel is moved from a DACA transmitter to a terrestrial transmitter. At this point the DACA's job is done until the next disaster strikes.

This phased approach is necessary especially for wideband communications where it is likely not feasible to allocate a significant number of dedicated channels to DACA. As the bandwidth of the DACA network increases, it will be more and more difficult to set aside channels for DACA in today's spectrum constrained world. (However, for narrowband communications it may be possible to set aside some channels, as discussed above.)

The ability to communicate with and coordinate first responders, for example, offering assistance from well outside the affected area can be a significant advantage. But Space Data acknowledges that public safety entities may prefer an approach that provides a more

concentrated / confined radio footprint from the near space platform, although the approach limits the benefits of a large footprint. This can be accomplished with more directional antennas, which also has the benefit of reducing power requirements for the payload and user radios. In short, Space Data's SkySite technologies can be adapted to the particular need or interest of first responders.

VII. FREQUENCY MANAGEMENT AND INTERFERENCE MITIGATION.

Space Data's payloads provide a large coverage footprint when operating at high altitude, which is generally a benefit when coordinating first responder efforts across a wide area. However, Space Data recognizes that large footprints can sometimes be a detriment, particularly in scenarios when frequency reuse over broad geographic areas is a necessity. Space Data has a number of solutions for addressing this issue.

An advantage of operating at higher altitude, like Space Data's near space SkySite platforms, is that it allows for more directional antennas that can spotlight an area with a strong signal, yet the antenna pattern can limit the signal outside the area of interest. This, of course, helps limit interference and allows spectrum to be reused more frequently, thus providing for higher bandwidth with the available spectrum. SkySites are very stable platforms – they drift with the winds in a layer of the atmosphere that has little turbulence because it is above all clouds and other weather. The slow rotation of the balloon also can easily be counteracted with small gears to point an antenna within one degree of direct line of sight to a location on the ground. Space Data has done this in the 5.8 GHz band with 23 dBi panel antennas used by various point-to-point, multi megabit per second microwave radios.

The advantage of this approach over a lower aerial platform is shown in Figure 9 below. Lower altitude aerial platforms require wider angle antennas for the same coverage because they are closer to the area. This means interference more readily spills outside the area of interest

because a practical wide angle antenna pattern does not roll off quickly enough to prevent the spill over. The more directional the antenna, the more tightly the antenna pattern rolls off and this effect can be used to limit interference outside the area of interest if the aerial platform is at a high enough altitude to use a narrower beam antenna.

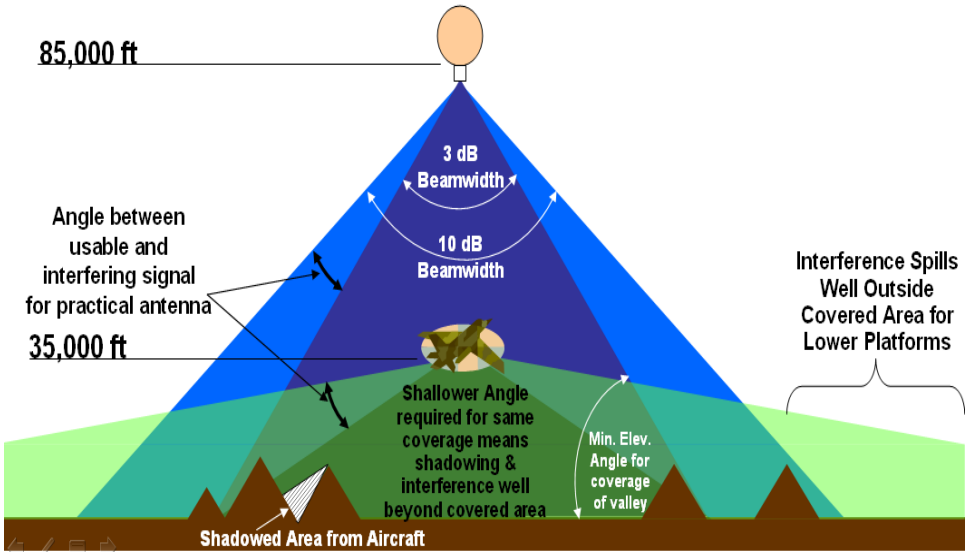

Figure 9. Lower altitude aerial platforms require wider angle antennas for the same coverage which tends to spill interfering signals into area beyond the area of interest.

While Figure 9 shows the antenna from the SkySite directed straight down, this need not be so. If the SkySite were east or west of the area of interest the antenna beam can tilted left or right so it is centered on the area of interest as shown in Figure 10. These methods are easier to implement at higher frequencies where the directional antennas are physically smaller due to the smaller radio wavelength. As microelectronics continue to progress and MicroElectroMechanical (MEMs) radio components are further developed, much of this antenna steering can be done electronically.

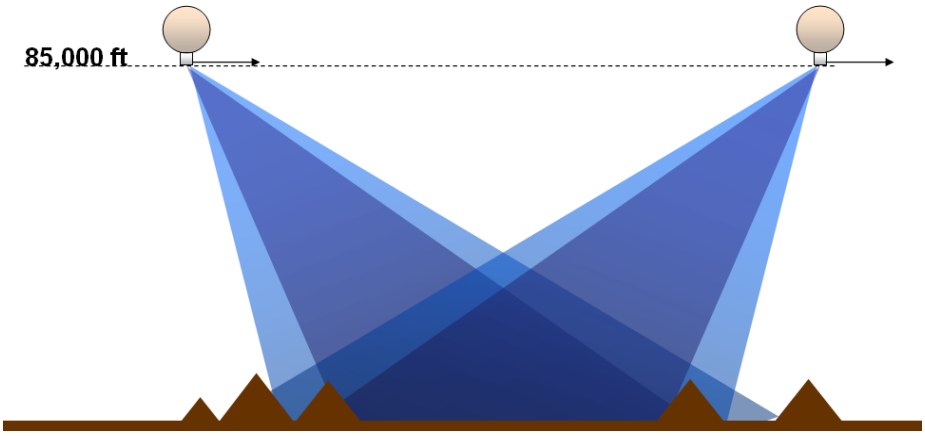

Figure 10. SkySites are stable enough to point highly directional antenna at an area of interest and track that area as the SkySite drifts slowly by over several hours.

VIII. CONCLUSION.

Public safety and commercial users could significantly benefit from innovative and novel technologies such as near space platforms. The Commission should ensure that its rules provide maximum flexibility for public safety entities to take advantage of such technologies, including Space Data's near space SkySite platforms, which, are well suited for rapid deployment in an area to provide wireless coverage in the first few hours after the area is affected by a disaster or emergency.

Respectfully submitted,

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