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September 8, 2017

BY ECFS

Marlene Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: **Elefante Group Notice of Oral *Ex Parte* Presentation; GN Docket Nos. 17-183, 14-177, IB Docket Nos. 17-95, 15-256, 97-95, 16-408, RM-11-664, and WT Docket No. 10-112**

Dear Ms. Dortch:

On September 6, 2017, Jeff White of Elefante Group, Edward A. Yorkgitis, Jr. and Joshua Guyan of Kelley Drye & Warren LLP, on behalf of Elefante Group, Inc. ("Elefante Group") and Jennifer Warren, Scott Kotler, and Dr. Michael Hicks, of Lockheed Martin Corporation ("Lockheed Martin") (collectively, the "Representatives") met with Nese Guendelsberger, Charles Mathias and Linda Chang from the Wireless Telecommunications Bureau ("WTB") to discuss Elefante Group's and Lockheed Martin's (the "Companies'") plans for persistent stratospheric-based communications and infrastructure. In the meeting, the Representatives laid out the vision toward which the Companies are exerting concerted design, development, collaboration, and marketing efforts to deploy stratospheric airships in the next several years that will help advance many of the Commission's and the Administration's objectives not achievable solely through other existing and planned terrestrial and satellite-based solutions. In so doing, the Representatives touched upon matters raised in the above-referenced dockets as summarized herein.

A copy of the written presentation materials used in the meeting is attached hereto (the "Attachment").

Chairman Pai has said "repeatedly that [his] number one priority is closing the digital divide and bringing the benefits of the Internet age to all Americans."[1] Among the items approved at the August 2017 open meeting during Rural Broadband Month at the Commission was the Mid-Band Spectrum Notice of Inquiry ("NOI"). In that NOI, the Commission seeks "input on potential opportunities for additional flexible access – particularly for wireless broadband services – in spectrum bands between 3.7 and 24 GHz (mid-band spectrum)."[2] The Commission correctly observed in that NOI that "[w]ireless broadband – whether fixed or mobile, terrestrial or satellite – represents a critical component of economic growth, job creation, public safety, and global competitiveness."[3]

Elefante Group and Lockheed Martin submit that, in order to fully achieve these and other important Commission goals, a stratospheric-based communications and infrastructure solution is an essential element, bringing advantages missing from other delivery solutions, which the Companies acknowledge are also important parts of the total fabric necessary to realize the Chairman's vision. The Companies are optimizing the Elefante Group system architecture to derive additional uses of already encumbered spectrum, thereby advancing another critical objective in this spectrum-hungry era by maximizing spectrum utilization through spectral efficiency and well-planned spectrum sharing. The Companies are focusing on bands between 17.8 and 24 GHz to enable low-latency, high capacity communications between user terminals and platforms, although the Companies' ongoing efforts to maximize compatibility may reveal the need for consideration of supplemental spectrum from other bands. In so doing, Elefante Group adds its voice to Lockheed Martin and other parties that urge the Commission to adopt and implement spectrum policies that are technology-neutral and support flexible use of frequencies by a variety of "competitive and complementary platforms."[4]

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1 *See* Bridging the Digital Divide for All Americans, available at https://www.fcc.gov/about-fcc/fcc-initiatives/bridging-digital-divide-all-americans.

2 *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, GN Docket No. 17-183, 32 FCC Rcd 6373, Notice of Inquiry, ¶ 1 (rel. Aug. 3, 2017).

3 *Id.* ¶ 5.

4 *Ex Parte* Submission of the Satellite Industry Association, GN Docket No. 14-177, at 4 (filed Aug. 4, 2017) ("[A]s the Commission continues its analysis in the Spectrum Frontiers proceeding, it is critical to ensure that sufficient spectrum is available *for all competitive and complementary platforms*, including satellite, across multiple frequency bands." (emphasis added)). *See also, e.g.,:* Statement of Jennifer A. Manner, Senior Vice President of Regulatory Affairs, EchoStar Corporation, *Facilitating the 21st Century Wireless Economy: Hearing before the Subcomm. on Communications and Technology of the H. Comm. on Commerce*, 115th Cong. at 4 (Apr. 5, 2017) ("With all wireless services requiring access to increased spectrum to meet

Elefante Group Background and Business Mission

Elefante Group, a United States corporation founded in 2015, aspires to be the world leader in persistent stratospheric-based communications infrastructure. Drawing closely on Lockheed Martin's long-acknowledged expertise and experience with lighter-than-air platforms and communications systems,[5] the Elefante Group airship platforms and communications payloads are being designed, developed, and will be eventually manufactured and deployed, to support high-density, high-frequency re-use terrestrial broadband communications and Internet of Things ("IoT")-enabling solutions for the communications, government, institutional, and enterprise sectors.

The Representatives of Elefante Group explained its plan to deploy platform-enabled solutions that will make possible:

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the needs of the 21st century digital wireless economy, it is important that Congress and the FCC follow the long established principle of technological neutrality."); Comments of Lockheed Martin Corporation on the *Spectrum Frontiers* Reconsideration Petitions, GN Docket No. 14-177, at 10-11 (filed Jan. 31, 2017) ("[T]he Commission should recognize that a variety of terrestrial, airborne, and satellite system architectures may emerge in order to maximize use of the spectrum resources made available by the Commission in [the *Spectrum Frontiers*] bands."); Reply Comments of the Satellite Industry Association on the *Spectrum Frontiers* Further Notice of Proposed Rulemaking, GN Docket No. 14-177, at 7 (filed Oct. 31, 2016) ("To achieve the full promise of a 5G future, the Commission's plan for these bands must accommodate the needs of satellite, maritime and airborne platform, and terrestrial wireless operators, which can be accomplished through reasonable and equitable sharing approaches in certain portions of [the] spectrum . . .."); and Comments of Lockheed Martin Corporation on the *Spectrum Frontiers* Further Notice of Proposed Rulemaking, GN Docket No. 14-177, at 13 (filed Sept. 30, 2016) ("Lockheed Martin encourages the Commission to rethink its current preference for rigid measures designed to advance the competitive interests of terrestrial mobile broadband, and re-center its focus on a broader public interest – which, in this area, requires flexible and adjustable arrangements that maximize both the efficient use of the spectrum and the prospects that those technologies prepared to adapt and innovate will be the ones that the markets may consider.").

[5] For example, Elefante Group and Lockheed Martin are developing systems that are a continuation of the scientific and technological advances that Lockheed Martin first demonstrated through its HALE-D and Aerostat projects.

- high-speed broadband connectivity to residences and businesses with cost and performance advantages over other solutions, including fiber connections, which have middle mile requirements that drive high subscription rates;

- ultra-high capacity broadband connectivity to establish secure private lines and networks for enterprises to reduce total cost of network ownership;

- wireless carrier backhaul for connecting small cells to network infrastructure to meet network densification needs of 5G with many advantages over alternatives; and

- IoT-enabling applications combining sensing and communications capabilities for control, location, aggregation, processing and packaging of data across large and/or remote geographic areas to meet the projected growth in IoT devices and increased data usage.

The Representatives explained that the Companies have refined an innovative design that possesses exceptional flexibility and yields superior capacity while maximizing spectrum efficiency and frequency band utilization by a variety of users. Elefante Group's platform-enabled solutions will advance the achievement of numerous high-priority objectives of the Commission, including private investment in high speed broadband infrastructure, closing the digital divide, densification and deployment of 4G, 5G, and IoT-enabling technologies, maximization of spectrum efficiency and band utilization, forward-looking spectrum sharing, rapid deployment/restoration of communications capabilities enhancing public safety and disaster relief, and the creation of tens of thousands of American jobs in areas such as engineering, construction, and operations. Elefante Group is targeting full commercial operations in the United States commencing within the next few years subject to obtaining the spectrum access rights and other regulatory approvals that will be required. (In the meeting, the Representatives discussed their intention, as the program moves forward toward eventual commercial launch, to request and obtain experimental licenses in a phased approach to support, confirm, and test design and operational elements of the payloads and platform but also to demonstrate in real-world scenarios spectrum compatibility and sharing capabilities.)

In the meeting, the Representatives noted that Elefante Group plans to provide its platform-user communications solutions as Fixed Services primarily in select bands between 17.8 and 24.0 GHz as detailed in the Attachment, innovating to use these encumbered bands in a spectrally compatible manner with existing licensees taking into account initiatives in existing Commission proceedings that may affect allocations and access to these bands, including the

ongoing *NGSO Rulemaking*.[6] The Representatives explained that their ongoing analysis and modeling and design efforts may reveal the need to supplement use of these bands with spectrum from other frequency bands in order to meet Elefante Group's platform-level performance requirements.

Of critical importance, Elefante Group and Lockheed Martin have been designing for spectral efficiency and compatibility from the outset.[7] The communications payloads deployed on Elefante Group's stratospheric platforms will rely on advanced waveforms and phased array antennas –which will generate a high degree of frequency reuse within an operating radius of up to 70 kilometers – to achieve a high level of spectrum efficiency.[8] The Representatives described how the design of Elefante Group's system will permit a high level of spectrum compatibility with other terrestrial systems, including other stratospheric deployments serving the same geographic areas, as well as the Fixed Satellite Service ("FSS") and other users of the radio frequency spectrum.

Basic Characteristics of the Platform

Building on earlier Lockheed Martin lighter-than-air successes, Elefante Group explained that its stratospheric platform is being designed in a progression from a stratospheric prototype to a prototype system to an operational system. The operational platform will operate at an altitude of approximately 19.5 km.[9] Its operating footprint will be up to 70 km radius for communications and up to 150 km radius for IoT enablement (sensing and communications

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6 *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, IB Docket No. 16-408, Notice of Proposed Rulemaking, FCC 16-170, 31 FCC Rcd 13651 (2016).

7 This compatibility is achieved in large part because of the high-altitude platform geometry, creating directional and spatial diversity relative to incumbent uses, and the small size of the platform's beams which enables considerable flexibility in beam lay-down patterns and a high level of frequency reuse. The Companies will rely upon the application of other mitigation methods to enhance compatibility.

8 The Companies are designing communications payloads to reuse each channel in a cellular pattern of spot beams, each only a few kilometers in diameter, as many as 180-to-200 times within the footprint of each platform. The payloads will thus achieve approximately 500 bps/Hz on an aggregate basis across a single platform's service area.

9 The Elefante Group platforms are being designed to maintain altitudes *below 20 km* for optimal airship performance and efficiency, taking into account the weather conditions at various altitudes based on the analysis of years of data. For this reason, they fall outside the regulatory definition of high altitude platform stations, or HAPS, which specifies stations operating between 20 and 50 km. *See* 47 C.F.R. § 2.1(c) (definition of "High Altitude Platform Stations").

functionalities combined). Elefante Group's system requirements are a total throughput of 1 Tbps per platform for communications between the platform and user terminals at the time of launch of commercial operations with future growth in capacity planned leveraging a variety of methods. (Feeder links and cross inks, i.e., inter-platform links will meet other requirements of the platforms and network.)

The platforms, which will depend principally upon solar power, possibly augmented by fuel cells and other methods in some circumstances, will operate persistently for periods of six to nine months or longer. The platforms, once they achieve altitude and reach station, will maintain a nominally fixed position within less than ten kilometers (10 km) the vast majority of the time, allowing for some variation based on local atmospheric conditions. As an operational matter, as necessary for airship or payload maintenance or upgrades, platforms will be replaced by other platforms in a "hot" transfer that will avoid disruptions in communications and other functions (e.g., sensing), constituting a truly persistent long-term infrastructure and communications solution wherever the platforms are deployed. As a result of the stratospheric-airship architecture, the backbone of an entire communications "network" over a service area within a radius of up to 70 km radius can effectively be instantaneously upgraded as a result of leveraging a regular platform hand-over for service and maintenance reasons.

Spectrum Requirements to Meet Market Growth and Advance Commission Objectives

To address industry and marketplace requirements – and advance Commission objectives to close the digital divide and achieve the deployment and densification of 4G, 5G, and IoT-enabling technologies – there will be demand for significant additional baseline communications capacity on a non-oversubscribed basis in many of the markets in the United States over the next few years. Elefante Group had modeled the additional demand that will be generated by upgrades to next generation systems and concluded that serving these requirements will necessitate more than 1 Tbps additional baseline capacity per metro area that can be flexibly deployed at the time of projected initial deployment of Elefante Group's airship solutions.

The Representatives explained that the Companies have been examining spectrum options and designing Elefante Group's communications payloads in order to satisfy the need for this additional 1 Tbps of capacity in a spectrally efficient manner. Based on significant analysis to date and present understandings of the Companies about achievable spectrum compatibility in the bands they have been examining, each airship platform will require, in an ideal deployment, use of at least 1.25 gigahertz of spectrum in each direction for both platform-to-user and user-to-platform communications.[10] This includes at least one gigahertz total bandwidth in each

[10] The Representatives explained that these spectrum requirements are independent of the requirements for gateway links. In addition, as the Companies' Representatives noted, the

direction for regular operations and 250 megahertz bandwidth required for platform handovers to support servicing and upgrades and ensure there is no disruption in service. Further efforts to achieve compatibility may reveal the need for consideration of supplemental spectrum from other bands to achieve performance requirements.

Candidate Bands That Best Satisfy Performance Requirements

The Representatives explained that Elefante Group and Lockheed Martin have carefully reviewed candidate spectrum bands and selected targeted bands based on an analysis after considering many factors, including the available component base, prospects for operational compatibility with existing uses and platform and payload size, weight and power ("SWaP") considerations. The candidate selection analysis also accounts for the fact that the planned stratospheric platform communications fall within the Fixed Services given the fixed location of user ground station and gateway terminals. The customer communications provided through the platforms will principally either be between user terminals or between user terminals and gateways.[11] Further, the platform stations themselves, which operate as routers and/or relays, will be maintained at nominally fixed locations while operating.[12]

Elefante Group and Lockheed Martin believe, based on considerable technical analyses, that the following spectrum bands are the most promising to achieve all, or nearly all, of the platforms' communications requirements as part of an initial deployment.

- Customer terminal-to-platform links (uplinks): 17.8-18.3 and 19.3-19.7 GHz, which have existing Fixed Service primary allocations, and portions of 18.3-19.3 and/or 19.7-20.2 GHz, which do not have existing Fixed allocations and would require waivers or rule changes to make the spectrum available for use. Platform-to-Customer terminal links (downlinks): 22.5-23.6 GHz and portions of 22.0-22.5 and/or 23.6-24.0 GHz.[13] Elefante Group and Lockheed Martin explained that access to these bands for uplinks and

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platforms will also have requirements for cross-links and command and control links, which are addressed below.

[11] Cross-link communications between platforms may also be used, as appropriate, to support the relay of customer communications exchanged between user terminals and the platforms.

[12] As noted earlier, the platform stations will not be operating communications paths during ascent and descent and while *en route* to the nominally fixed station.

[13] The first two of these bands already have a Fixed allocation.

downlinks would maximize technology delivery through potential spectrum access opportunities and suitable propagation losses.[14]

- Gateways (feeder links between the platforms and global and carrier customer networks): 71-76 and 81-86 GHz are the best target bands because of their large bandwidth and availability for Fixed Service point-to-point links, attenuation is better than in surrounding bands, and propagation characteristics will allow for multiple feeder links to each platform.

- Cross-links (inter-platform communications): Using free space optical links complemented by radio frequency links.

- Command and control ("C2"): C-Band within radio line-of-sight ("RLOS") from launch until the platforms reach altitude and again on descent to the landing stations; third-party satellite services to support C2 beyond RLOS while the platform is at altitude (i.e., after ascent and before descent) and moving to and from the platform's nominally fixed station position; and in-band spectrum and through third-party satellite services while station-keeping and during handovers between platforms.[15]

Spectrum Compatibility with Existing Services and Licensing

The design of Elefante Group's system is intended to permit a high level of spectrum compatibility with other terrestrial systems, including other stratospheric deployments serving the same geographic areas, as well as the FSS and other users of the same spectrum. Therefore, the Representatives explained that the airships will not require exclusive access to spectrum among co-primary users, even among stratospheric platforms. Therefore, the sort of mutual exclusivity that might trigger consideration of spectrum auctions will not be present.

Elefante Group and Lockheed Martin described the status of their compatibility analysis in several key scenarios, as set forth in the Attachment. They described the focus of further analysis to confirm results and the effectiveness of interference mitigation methods as well as the

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[14] The Representatives noted that these candidate bands (and the candidate user downlink bands) leverage the existing component base, have lower atmospheric and weather losses than higher bands, and the candidate uplink bands are the reverse of FSS downlinks in the same frequencies thereby avoiding in-line interference events despite similar overhead geometries.

[15] The platforms will not communicate on platform-user (uplink or downlink) or gateway links while the airships are ascending, descending, or moving at altitude to and from station. Communication at these paths will only occur at station.

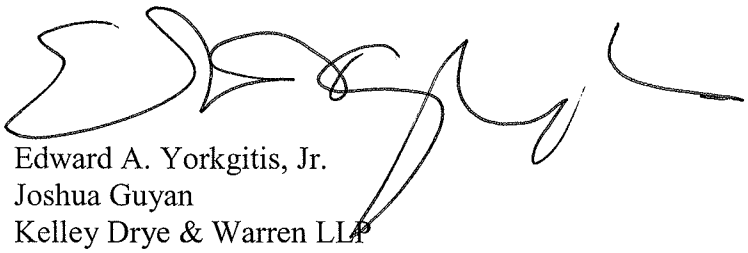
development of risk-based interference criteria. They also explained that the Companies intend to engage with incumbent users to further refine compatibility solutions.

Elefante Group explained in the meeting that any licensing framework for platform-user communications in the target bands, if the Commission makes them available, should reflect the extensive sharing realities in those bands. Elefante Group submitted that licensing should be in the Fixed Services, as discussed earlier, and on a non-exclusive, rolling basis because there is no mutual exclusivity. Stratospheric platform systems in these bands would be operating in spectrum shared with ground-based fixed services, satellite systems in many of the bands, and other incumbents such as the Radio Astronomy Service ("RAS") and Earth Exploration-Satellite Service ("EESS") operations. Further, as the Representatives demonstrated, multiple co-frequency platforms can serve the same area using the same spectrum resources. The mutual exclusivity threshold condition for considering auctions under the Communications Act of 1934, as amended, even ignoring the other co-primary (or possible primary) users of the band, simply will not be present.

Elefante Group continues to develop a licensing framework proposal that it will share with the Commission in the near future, along with a more detailed proposal in general, but that it tentatively believes that licensees for stratospheric stations should be granted authority on a first-come, first-served basis and be obligated to coordinate with existing and later stratospheric platform entrants. Elefante Group proposes that licensees on stratospheric platforms in the target bands should be required to modify their operations to accommodate other platform stations serving the same area only at the time that the later system is ready to deploy. Moreover, the rules should create adequate incentives to ensure that ensure licensees are serious about accessing the spectrum and do not needlessly inject uncertainty into the operations of other stratospheric users of the band.

Pursuant to Section 1.1206(b) of the Commission's rules, this letter is being filed electronically.

Respectfully submitted,



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Elefante Group, Inc. and Lockheed Martin Corporation: Stratospheric Platform Communications and Infrastructure for the 21st Century

September 6, 2017
Meetings with the FCC
Office of Engineering and Technology and
Wireless Telecommunications Bureau

This presentation was prepared specifically for use in discussions with the FCC in connection with the positions of Elefante Group and Lockheed Martin in present and potential future regulatory proceedings and is not to be used or relied upon for any other purpose.

ELEFANTE GROUP

LOCKHEED MARTIN

Agenda and Objectives for the Meeting

Elefante Group and Lockheed Martin Appreciate the Opportunity to Meet with the FCC Staff to Share Their Vision for a New Era of Persistent Stratospheric Communications and Internet of Things (IoT) Enablement

- Elefante Group's Business Mission and Plan
- Characteristics of the Elefante Group Platform
- Spectrum Requirements of the Platforms and Terminals
- Spectral Efficiency and Other Operational Advantages
- Optimal Candidate Bands That Satisfy Performance and Permit Spectrum Compatibility
- Licensing Considerations in a Shared Environment

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Overview of Elefante Group's Business Mission and Plan

Elefante Group aspires to be the **world leader** in persistent stratospheric-based communications and IoT-enabling solutions

- To provide **wholesale communications services**, including broadband connectivity, wireless/enterprise backhaul and 5G access
- To provide **IoT-enabling applications** combining sensing and communications capabilities for control, location, aggregation, processing and packaging of data
- To sell our services to **communication and digital service providers** as well as **government and defense** customers

Elefante Group has an **experienced leadership team** and is in discussions with communications and digital service providers

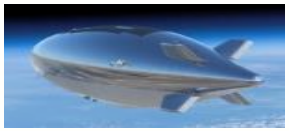
Elefante Group is working with Lockheed Martin to be the **first company to bring a stratospheric solution to market**

Elefante Group has **met** funding milestones enabling an aggressive execution with Lockheed Martin of the development program and future commercial operations

A Fully Engineered Solution and a Defined Path to Operations Building on Lockheed Martin's History and Industry Leadership

Our systems are a continuation of the scientific and technological advances that Lockheed Martin first demonstrated through the HALE-D and Aerostat projects

Platform Technical Specifications

	 HALE-D	 Aerostat	 Stratospheric Prototype	 Prototype System	 Operational System
Description	Less than 1 M ft^3 Airship designed for UAS operation of weeks duration at ~18 km altitude	Less than 100k ft^3 tethered Airship designed for UAS operations at up to 1.6 km altitude	Approximately 1 M ft^3 Airship designed for UAS operation of a week duration at ~18 km altitude	Greater than 9 M ft^3 Airship designed for UAS operation of multiple months duration at ~19.5 km altitude	Greater than 9 M ft^3 Airship designed for UAS operation for many months duration at ~19.5 km altitude

Initial Operational System Capabilities

The Elefante Group operational system has been designed to deliver the following capabilities to our customers:

- ✓ Operating footprint of up to **70 km radius for communications and 150 km radius for IoT-Enablement**
- ✓ **Total throughput of 1 Tb/s per platform** at launch of commercial operations with future growth planned
- ✓ Delivery of a **"full service"** to customers, including network connectivity, user terminals and ops centers
- ✓ The ability to **introduce a IoT-Enablement payload** in combination with a communications payload

Elefante Group Platform Solutions Advance Commission Objectives

- Significant investment in high speed broadband infrastructure developed in the USA
- Capability to deploy innovative broadband solutions in both urban and rural areas to help close the Digital Divide
- Densification of 4G, 5G and IoT with greater flexibility and lower cost
- Maximize spectral utilization with significant frequency reuse
- Systems architecture optimized for deriving additional uses in encumbered spectrum while sharing spectrum with existing services
- Enablement of continuous market-wide technology upgrades with modular payloads in multiple bands
- Rapid restoration of communications for public safety and disaster relief
- Tens of thousands of U.S. jobs in engineering, construction, and operations

Innovative Elefante Group Technologies and Services Will Redefine "First Mile" Communications and Advance Commission Goals

Elefante Group will deliver innovative wholesale solutions to communications and digital service providers which can close the Digital Divide, support rapid 5G deployment and upgrades, and enable and enhance IoT

	 Residential Broadband	 Enterprise Broadband	 4G / 5G Backhaul	 Internet of Things (IoT) Enablement
What is the Problem?	Rural / remote high cost independent middle mile projects driving high costs for subscriptions	Enterprise cloud adoption is growing strongly, but WAN budgets are declining	Network densification requires a ~10x increase in distribution costs and significant capex	Growth in IoT devices and increased data usage create control and management challenges
What is the Solution?	A low cost broadband link which works across urban, suburban and rural geographies	Reducing total cost of network ownership by adopting multiple links to behave as one secure WAN link	Low cost, ultra-high capacity, multi-tenant SDN mesh backhaul solution for small cells	Wide area, moderate speed, low cost solution for connectivity and control of devices
Elefante Group Product Synopsis	High capacity data services delivered direct to homes as a substitute for fiber connections	Ultra-high capacity broadband connectivity to establish secure private lines and networks	Ultra-high capacity alternative to fiber for connecting small cells to network infrastructure	Single solution for connectivity and control across large and/or remote geographic areas

Capacity and Spectrum Requirements to Meet Industry Growth and Commission Objectives

To address industry needs and advance Commission objectives, Elefante Group will deliver approximately 1 Tbps baseline communications capacity on a non-oversubscribed basis within platform footprint at the time of projected initial deployment

- Elefante Group has modeled the 5G backhaul and fixed broadband access needs and projects that serving these requirements will necessitate flexible deployment of more than 1 Tbps additional capacity per metro area
- Other assessments corroborate EG's conclusions:

FCC 2016 Measuring Broadband America Fixed Broadband Report p6, "Major Findings of the Report"

"The median speed across all consumers this year is 39 Mbps which represents a 22% increase to last year's value of 32 Mbps, indicating that consumer speeds are continuing to increase."

Wells Fargo June 22, 2017 "5G Forum Highlights" Report - ZAYO's management estimates

"that each national carrier would likely need 150-400K small cell sites each over time, which would equate to 600K-1.6MM in total across the Big 4."

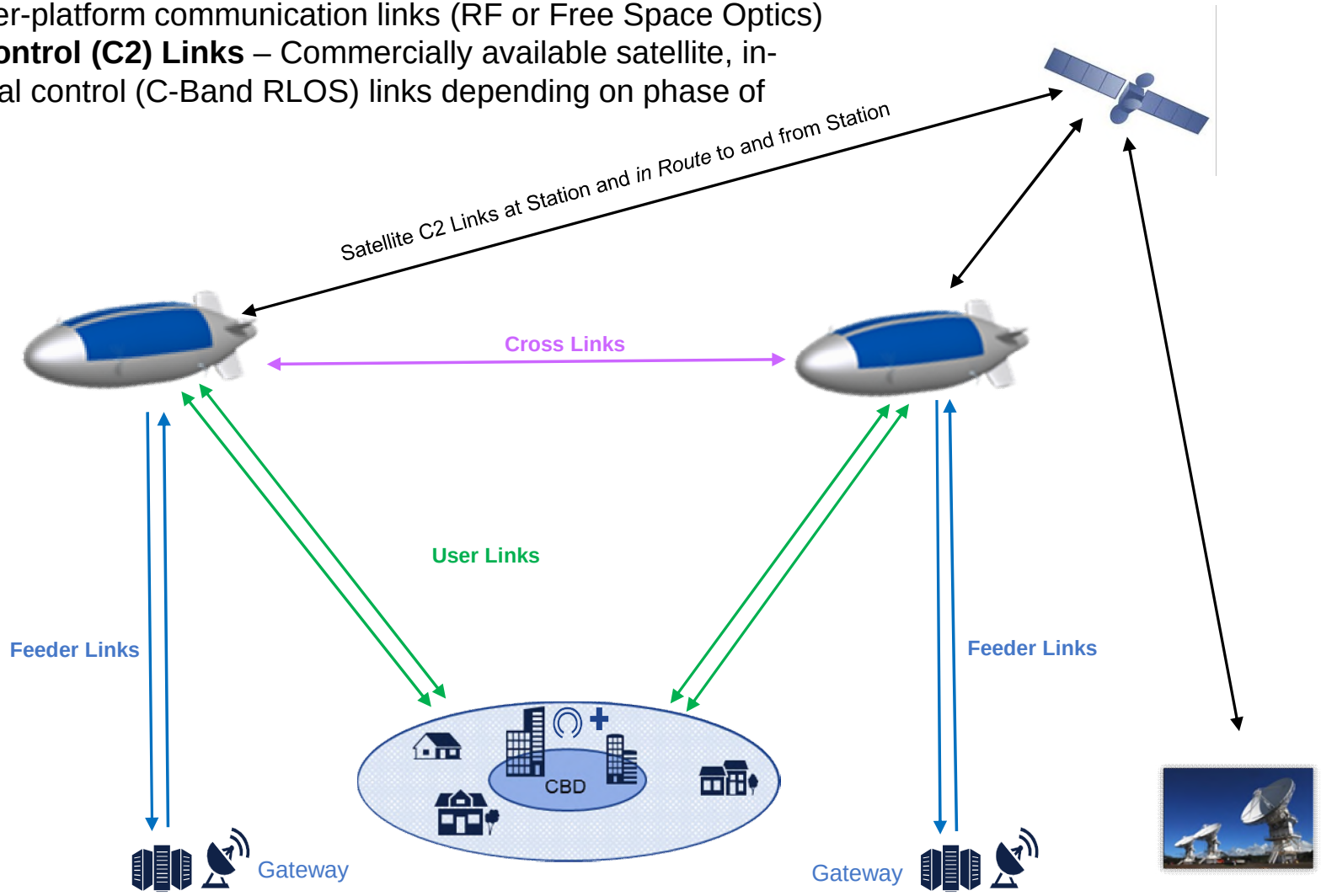
- A stratospheric solution can satisfy these needs with advantages over other delivery methods

To meet 1 Tbps capacity requirements per platform, using spectrally efficient communications payload design, Elefante Group will utilize a minimum of 1.25 gigahertz in each direction for both platform-to-user and user-to-platform communications

- At least one gigahertz total bandwidth in each direction for continuous operations
- 250 megahertz bandwidth required for station hand-overs to support servicing and upgrades in each direction

Elefante Group Platform Communications Architecture Drives Spectrum Requirements

- **User Links** - Access and transport/backhaul to customers
- **Feeder Links** – Customer to global network / datacenter connections
- **Cross Links** – Inter-platform communication links (RF or Free Space Optics)
- **Command and Control (C2) Links** – Commercially available satellite, in-band, and terrestrial control (C-Band RLOS) links depending on phase of airship operations

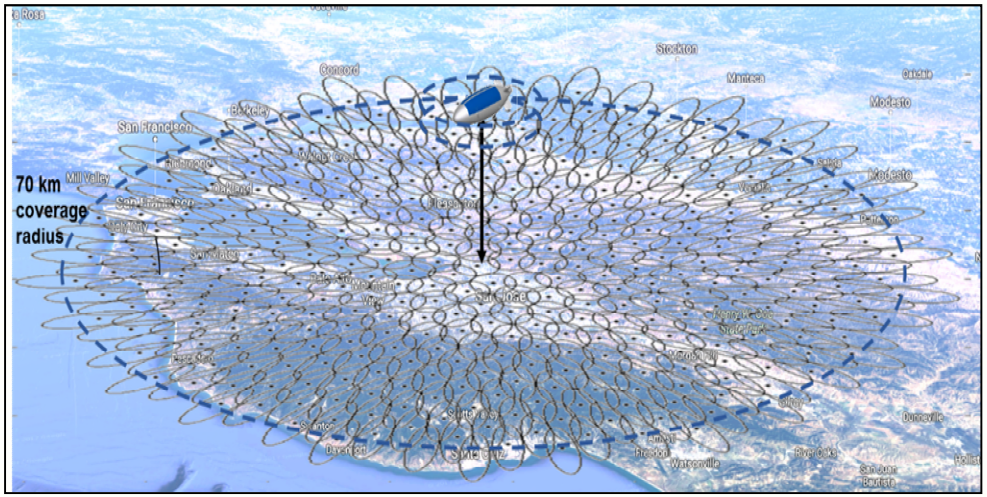


Elefante Group Adopting a Spectrally Efficient Communications Payload Design to Minimize Spectrum Requests

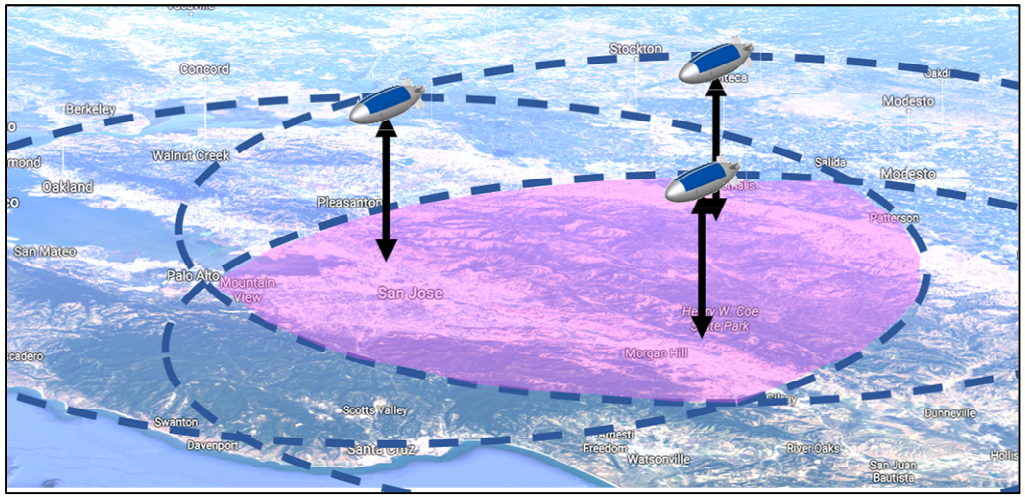
Elefante Group and Lockheed Martin are incorporating spectrum efficiency and compatibility into the design from the outset

- Performance characteristics and waveforms allow almost 6 bps/Hz per beam
- 100's of beams within a platform footprint enable enormous frequency re-use
- Frequency re-use permits ~500 bps/Hz aggregate over the platform service area

Multiple platforms can completely re-use spectrum, providing overlapping coverage



100's of beams enable significant re-use by one platform



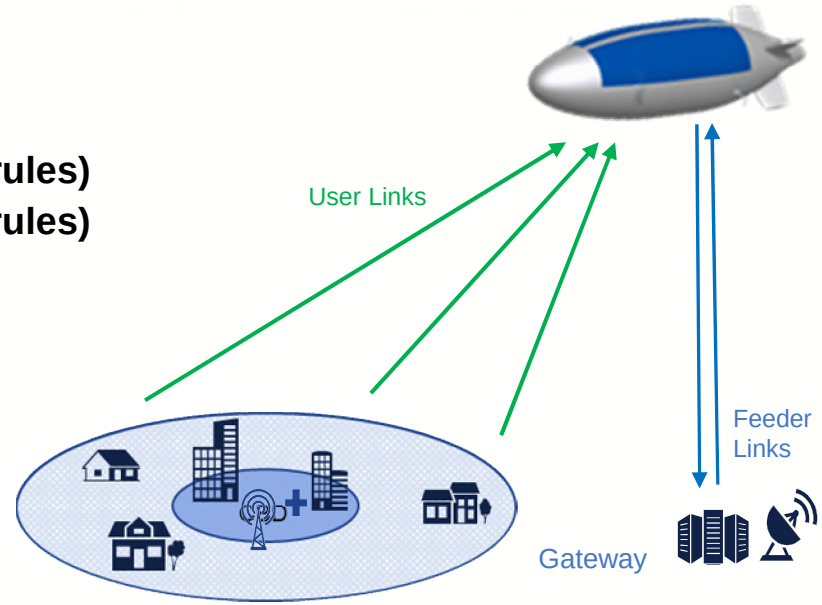
Overlapping coverage for further spectral re-use by multiple platforms

Elefante Group is committed to working with incumbents to ensure compatibility

Target Bands to Satisfy User-to-Platform Uplink Spectrum Requirements

User uplink candidate bands

- **17.8-18.3 GHz (FS allocation)**
- **19.3-19.7 GHz (FS allocation)**
- **18.3-19.3 GHz (waivers or new rules)**
- **19.7-20.2 GHz (waivers or new rules)**



Feeder link bands

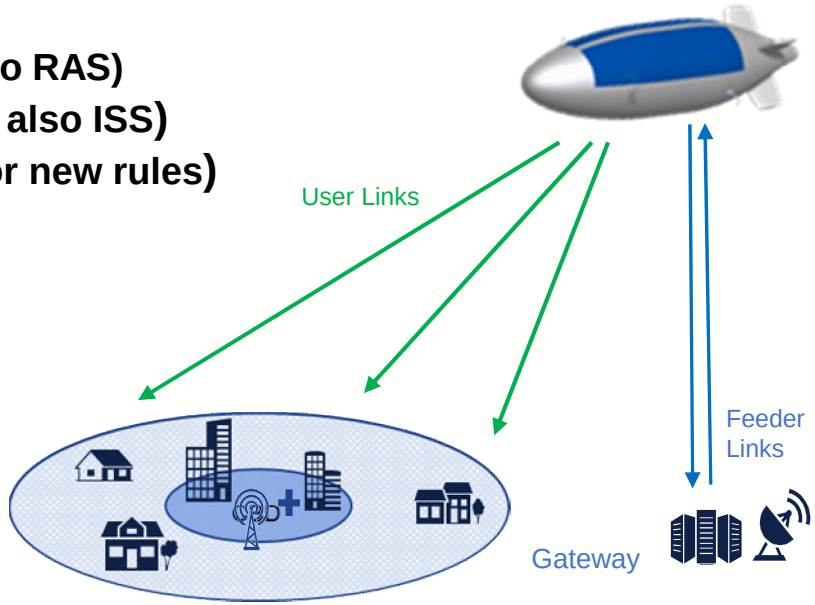
- **71-76 GHz**
- **81-86 GHz**

- Ka-band maximizes technology delivery through potential spectrum access opportunities and suitable propagation losses
  - Contemplated Elefante uplink bands reverse direction from FSS downlinks to avoid in-line interference events with GSOs and NGSOs with similar overhead geometry
  - Spatial isolation from ground-based fixed services achievable
- Additional engineering analysis and optimization could require consideration of supplemental use of portions of other bands

Target Bands to Satisfy Platform-to-User Downlink Spectrum Requirements

User downlink candidate bands

- **22-22.55 GHz (FS allocation; also RAS)**
- **22.55-23.55 GHz (FS allocation; also ISS)**
- **23.6-24 GHz (RAS/SR; waivers or new rules)**



Feeder link bands

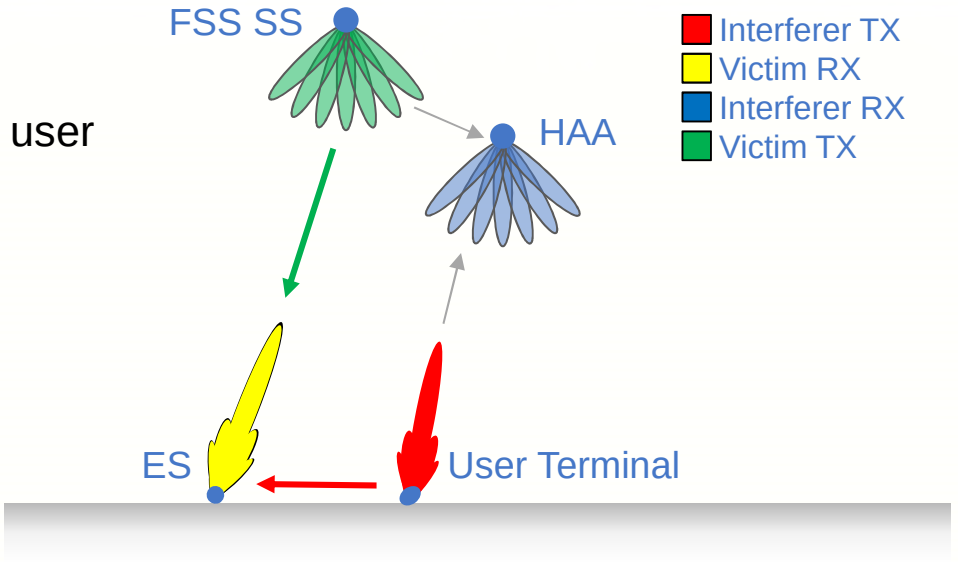
- **71-76 GHz**
- **81-86 GHz**

- Ka-band maximizes technology delivery through potential spectrum access opportunities and suitable propagation losses
  - No FSS in 22.0-24.0 GHz
  - Spatial isolation from ground-based fixed services achievable
  - Considering bands having RAS/passive service allocations only for airship handovers
- Additional engineering analysis and optimization could require consideration of supplemental use of portions of other bands

Spectrum Compatibility Considerations with Fixed Satellite Services In Target User UL Bands: 17.8-20.2 GHz

Objective:

- Demonstrate absence of harmful interference from EG user terminals into
  - blanket licensed FSS receive terminals
  - expected characteristics of NGSO systems in design
  - ESIMs
- Demonstrate interference from space station beams into EG outer beams is acceptable

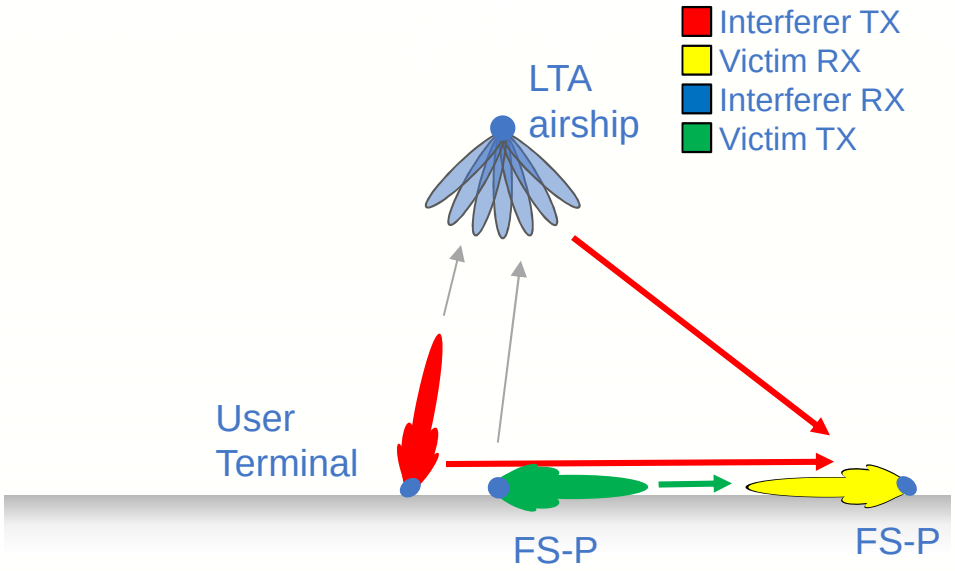


- **Approach**: Achieve performance objectives and ensure technical compatibility
- **Analysis Status and Next Steps:**
  - Potential harmful interference to FSS stations can be relegated to controllable geometries
  - Evaluating performance using TX EIRP pattern and various mitigation approaches to ensure compatibility with current FSS terminals
  - Determine risk-based harmful interference metrics for compatibility criteria

Sharing Considerations with Fixed Service In Target User UL/DL Bands: 17.8-20.2, 22-23.55 GHz

Objective:

- Demonstrate absence of harmful interference from EG user terminals and platforms into point-to-point links
- Demonstrate interference from point-to-point links can be mitigated through frequency planning and resource management

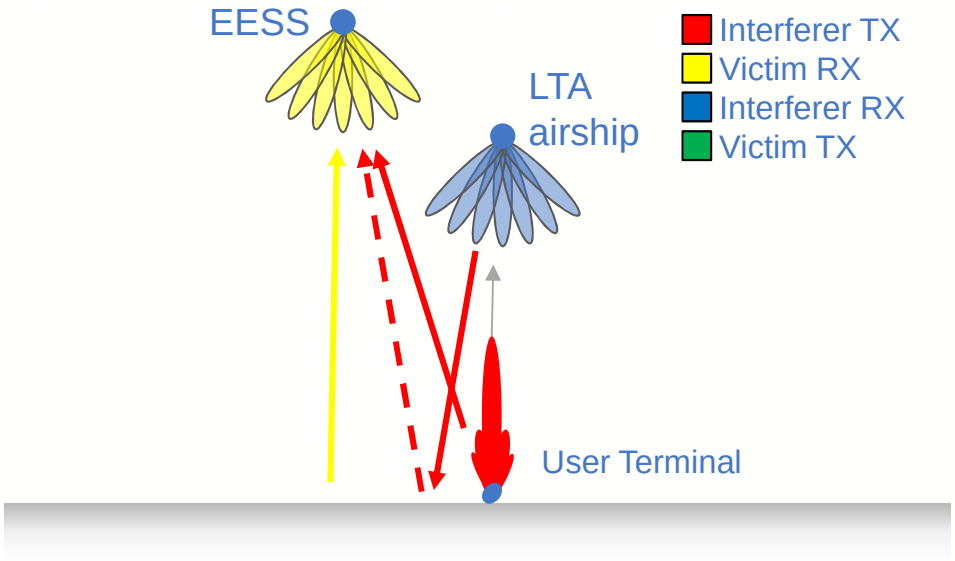


- **Approach**: Manage EG system deployments given licensed point-to-point receivers
  - Using suitable separation distances for EG user terminals from P2P receivers
    - Interference to FS terminals minimized by operating geometry and installation standoff
  - Relying on PFD limits for EG downlink beams
- **Analysis Status and Next Steps:**
  - Confirm with incumbents real world operating assumptions
  - Determine risk-based harmful interference metrics for compatibility criteria
  - Assess separation from FS transmitters to mitigate potential harmful RFI, capacity impacts, etc.
  - Assess effects of mitigation strategies on performance vs density of P2P deployments

Sharing Considerations with Earth Exploration and Space Research In Target User UL/DL Bands: 17.8-20.2, 22-23.55 GHz

Objective:

- Demonstrate absence of harmful interference from EG user terminal and user downlink reflections into passive EESS/SRS sensors



Approach:

- Technical analysis to confirm interference sufficiently below % time allocation

Analysis Status and Next Steps:

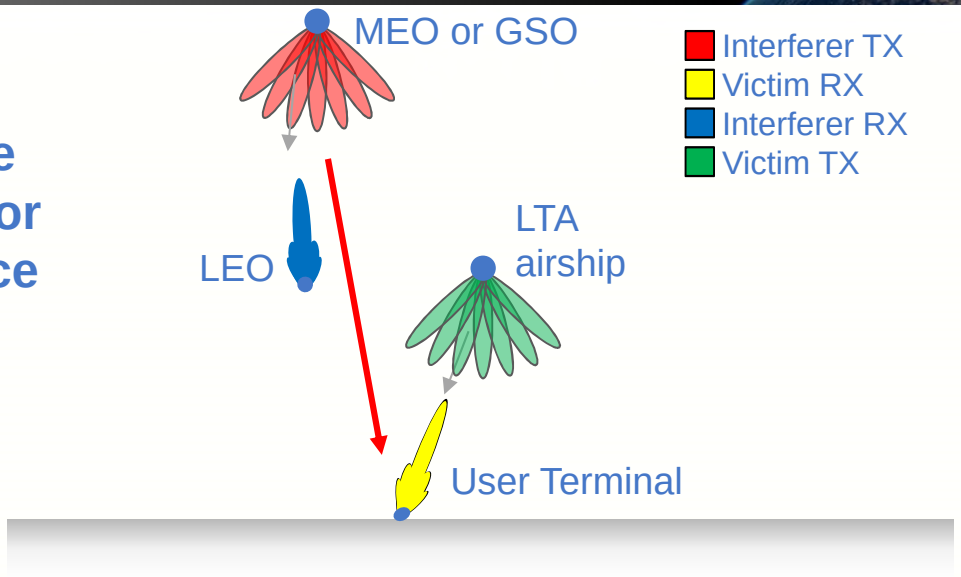
- EG coverage area presents statistically small effect on satellite-based scanning sensors
  - Example 70 km radius coverage area in view ~0.0018% of time
- Modeling aggregate effect of multiple deployed platforms
- Determining level of any compatibility impacts from use of frequency over entire platform coverage area, using higher elevation links toward center of area, and short-term platform handover
- Detailed User UL model and bi-static model for impacts, if any, from User DL reflection

Sharing Considerations with Inter-Satellite Service In Target User DL Bands: 22.55-23.55 GHz

Objective:

- Demonstrate absence of harmful interference into ISS receivers from user downlinks
- Mitigate potential interference from satellites using ISS

Negligible Potential for Interference from EG



Approach:

- Overhead geometry otherwise clear, but Earth-directed ISS beams operating near same ground PFD limit present harmful interference risk to EG

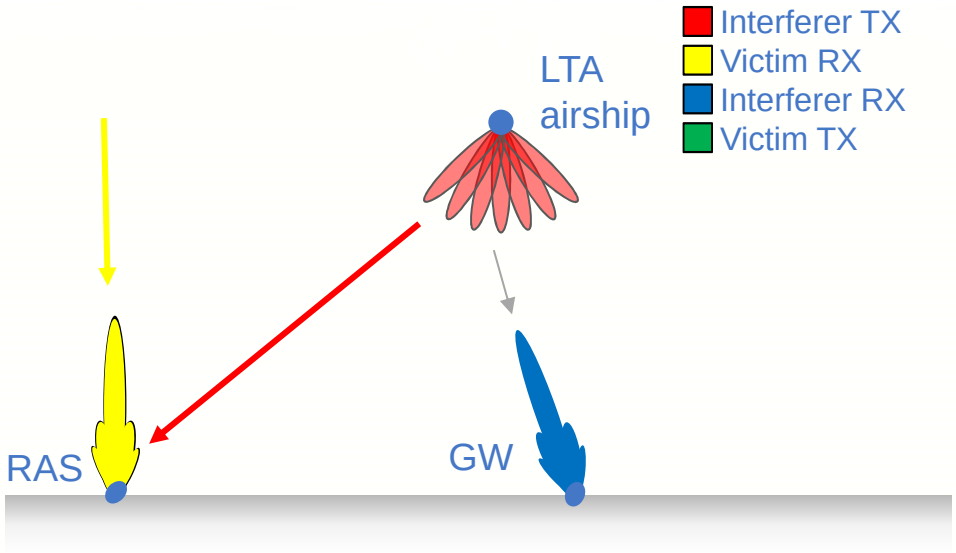
Analysis Status and Next Steps:

- Complete analysis with existing systems
- Examine mitigation options with proposed systems

Sharing Considerations with Radio Astronomy Service In Target User DL Bands: 22.0-22.5 GHz, 23.6-24.0 GHz

Objective:

- Demonstrate absence of harmful interference from EG user downlink into Radio Astronomy
- Maintain potential incidence of harmful interference sufficiently below % time allocation to RA sites



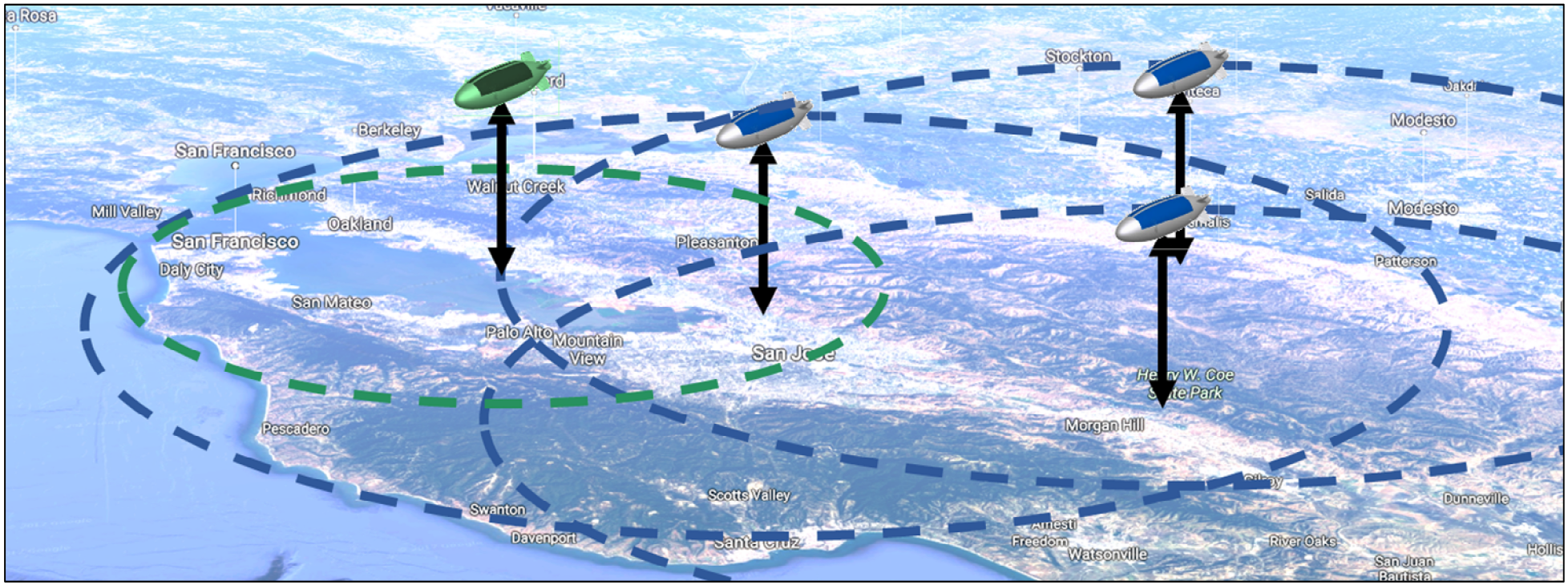
- **Approach**: In affected locations, develop coordination methods for infrequent, scheduled airship handovers
- **Analysis Status and Next Steps:**
  - Have determined that over-the-horizon standoff is necessary to prevent harmful interference from edge of coverage beams
  - Confirm whether beams with greater spatial isolation would exceed interference threshold
  - Determine handover duration times, leading toward risk-based interference analysis

Spectrum Utilization Is Maximized by Multiple Platform Re-use

Stratospheric platform geometry permits complete spectrum re-use on a coordinated basis

- Relying on spatial diversity, multiple airships can serve overlapping geographic areas in the same frequency bands

Mutual exclusivity does not arise between platforms



Complete spectrum re-use by multiple platforms with overlapping coverage. Separation distance to EG or other similarly licensed platforms dependent on coverage area radius

Licensing Considerations for Stratospheric Platform Systems

- Licensing framework should reflect sharing realities
  - Stratospheric platform systems to operate in shared spectrum with ground-based and satellite systems
  - Multiple co-frequency platforms can serve same area; threshold condition for auctions – mutual exclusivity – not present
- Elefante Group continues to develop licensing framework proposal
  - Operation as a fixed service
  - Processing of applications on a rolling basis
  - Licensees to coordinate with existing and later entrants; obligations to modify operations effective only at the time second or later system ready to deploy
  - Effective bringing-into-use obligations, transfer restrictions, and financial incentives (e.g., performance bonds) should apply
- Licensees can choose to operate as a private carrier or a common carrier

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