Aerostar is looking to conduct a single, 1-2 day flight test in Northeastern New Mexico that will validate a new, innovative antenna and radio system that could be used to provide wireless services for populations experiencing critical natural disasters (like floods, hurricanes, or tornados). High-altitude balloons have been previously used to provide disaster relief wireless services (for example, over Puerto Rico during Hurricane Maria). A test of this antenna and radio system will further this technology. A concept of the flight test operations is demonstrated below in Figure 1. The system is equipped to determine the direction to the mobile ground station based on the position of the mobile ground station and the flight vehicle system. Transmission will only occur when the mobile ground station is within range and will only occur in the direction of the mobile ground station. Because the balloon system is mobile, and dependent on stratospheric wind patterns, the application lists a very wide operational area. However, the area affected by the transmission will be small, as the main lobe of the antenna is small.

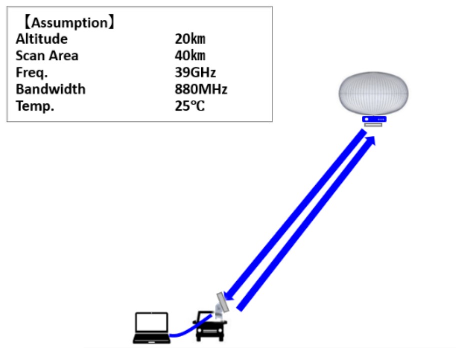

Figure 1 Operational concept

The Upper Microwave Flexible Use Service was chosen per ITU's recommendation that high-altitude platforms should target the use of 38-39.5GHz, during WRC-19. In addition, the goal of the Upper Microwave Flexible Use Service is to support innovative mobile terrestrial wireless services, which pairs well with the purpose of this flight test.
The target capacity of the system is 2Gbps. Link budgeting calculations show the required power to support this bandwidth are shown in Fig 2.

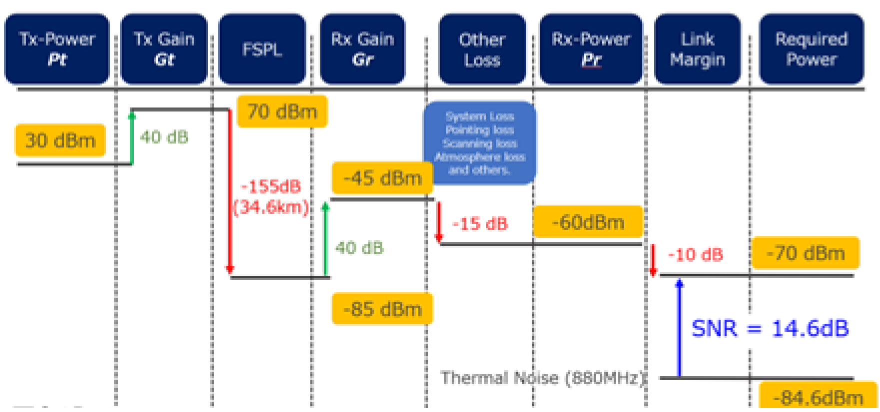

Figure 2 Link budget calculation

The antenna is a phased array antenna that is fixed in the nadir position and steerable using the phased array up to an angle of 50 degrees. The pattern generated at nadir and 50 degrees is shown in Fig 3 below.

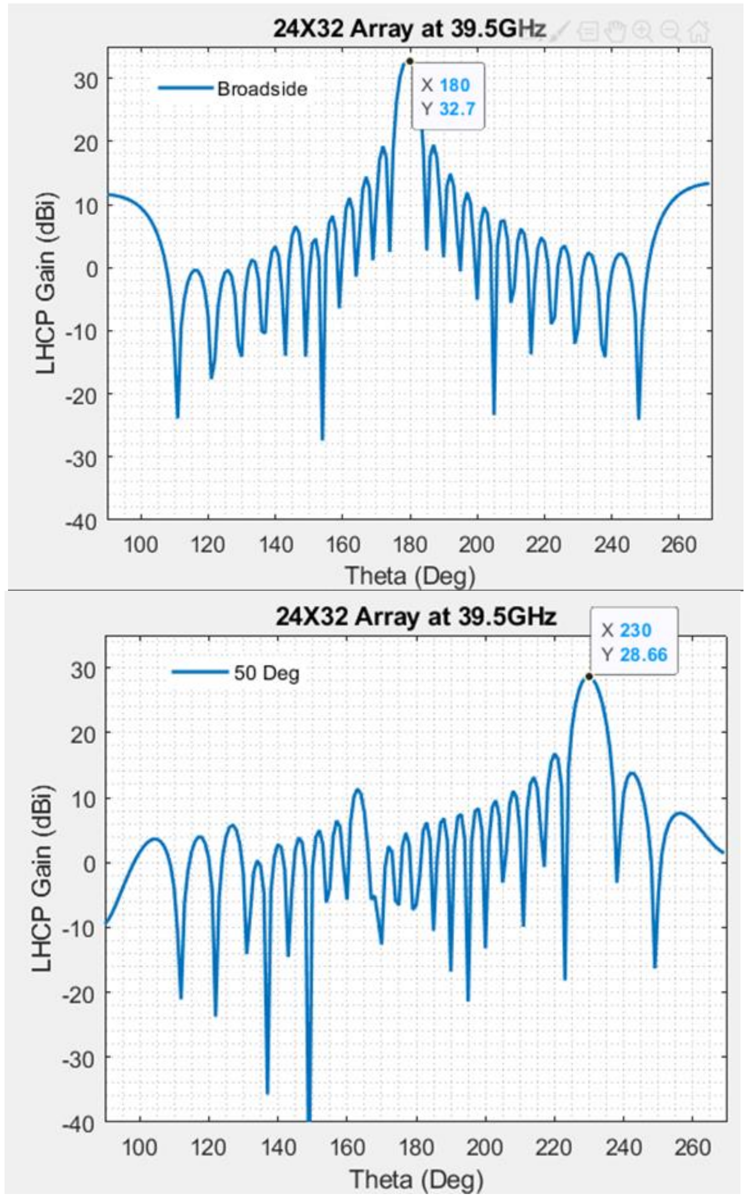

Figure 3 Antenna pattern

With the high free-space and atmospheric loss at the frequencies proposed, there should be limited interference with incumbent systems. Fig 4 shows a physical depiction of the antenna side lobes at 0 deg and 50 deg beamforming, and the table following shows the output of an analysis of the received RSSI at different standoff distances from the balloon system, at 50 degrees beamforming (worst case).

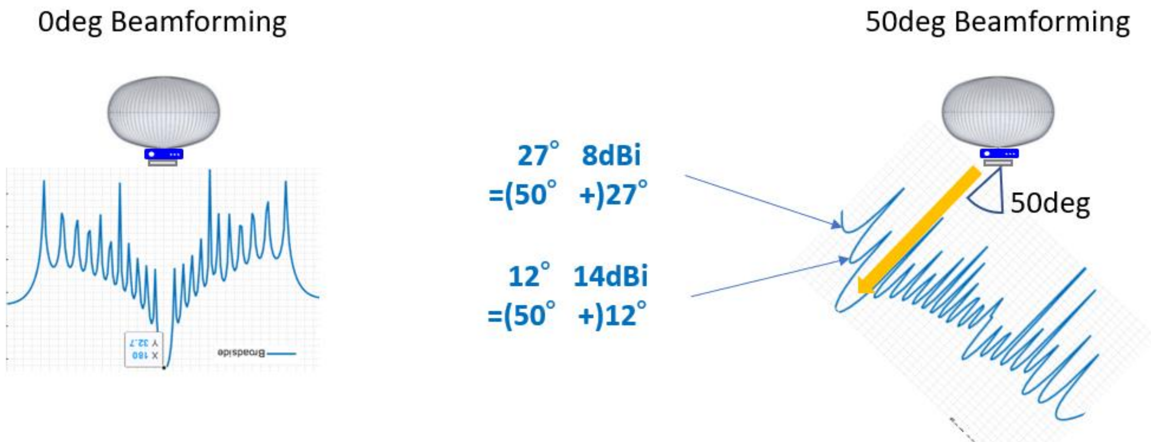

Figure 4 Antenna pattern shown physically on the balloon system

50deg Beamforming Linear completion	delta angle	-77	-76	-75	-74	-73	-72	-71	-70	-69
	radius[km]	**86.63**	**80.2**	**74.6**	**69.7**	**65.4**	**61.6**	**58.1**	**54.9**	**52.1**
	direct distance[km]	88.9	82.67	77.27	72.56	68.41	64.72	61.43	58.48	55.81
	FSPL[dB]	163.0	162.4	161.8	161.3	160.7	160.3	159.8	159.4	159
	Tx Ant Gain(specified direction)[dB]	8	8.4	8.8	9.2	9.6	10	10.4	10.8	11.2
	Rx Ant [dB]	0	0	0	0	0	0	0	0	0
	Received RSSI[dBm]	**-125**	**-124**	**-123**	**-122**	**-121**	**-120**	**-119**	**-119**	**-118**

50deg Beamforming Linear completion	delta angle	-68	-67	-66	-65	-64	-63	-62	0
	radius[km]	**49.5**	**47.1**	**44.9**	**42.9**	**41**	**39.3**	**37.6**	**23.8**
	direct distance[km]	53.39	51.19	49.17	47.32	45.62	44.05	42.6	31.11
	FSPL[dB]	158.6	158.2	157.9	157.5	157.2	156.9	156.6	153.9
	Tx Ant Gain(specified direction)[dB]	11.6	12	12.4	12.8	13.2	13.6	14	29
	Rx Ant [dB]	0	0	0	0	0	0	0	0
	Received RSSI[dBm]	**-117**	**-116**	**-115**	**-115**	**-114**	**-113**	**-113**	**-95**

The Very Large Array (VLA) in Socorro, New Mexico, has been mentioned as potential victim of interference from this flight. Aerostar proposes to implement an operational standoff distance of 61.6 km.. The area of operations has been drawn to include this recommendation for standoff distance. Aerostar is also actively trying to engage with frequency coordinators to discuss any other time or space deconfliction that would allow this short 1-2 day test to occur.