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April 17, 2014

VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: Ex Parte Comment in ET Dockets 10-28 and 11-90

Dear Secretary Dortch:

Further to the Ex Parte Notice filed April 3, 2014, in the above-referenced dockets, Mantissa Ltd. ("Mantissa"), through its undersigned counsel, provides herewith for inclusion in dockets ET 10-28-and 11-90 additional information regarding the company's miniature fixed radar sensors for perimeter security, operating in the 76.0-77.0 GHz spectrum band. Mantissa respectfully submits that the information accompanying this submission supports the need for further proceedings in the above-referenced dockets, consistent with the pending Petition of NavtechRadar, to consider amendment of Federal Communications Commission Rule 15.253(c) (47 C.F.R. §15.253(c)) to enable operation within the 76.0-77.0 GHz band for fixed radar sensors in settings not limited to airport locations. Mantissa anticipates that the opportunity for additional public comment on this topic will further illuminate:

(1) the very strong public interest in the use of fixed radar sensors for important security applications, and

(2) that fixed and vehicle-mounted radar systems can co-exist in the 76.0-77.0 GHz band without significant risk of interference.

General Description of the Mantissa Radar Sensors

The product for which Mantissa desires to use the 76.0-77.0 GHz band is the MSHRS-300X radar sensor, depicted below. The recently developed MSHRS-300X device is a millimeter wave miniature radar sensor designed for perimeter security applications. The sensors are highly effective for the purpose of detecting the presence of people at locations where they are not supposed to be, for example approaching or climbing over border fences around critical infrastructure. As such, they are extremely well suited for a host of homeland and commercial security applications, including monitoring of boundaries along railroad lines, pipelines, and airports, and protection of facilities such as power plants, water treatment plants, transit stations, storage depots, military installations, and government buildings. The Mantissa radar sensors are short range, low power, relatively low cost, and can be arrayed to provide continuous, cost-effective security coverage around the entirety of a perimeter. The MSHRS-300X can be precisely mounted and aimed, avoiding interference with vehicle-mounted radar systems on adjacent roadways and other allowed uses of the 76.0-77.0 GHz band.

The Mantissa radar sensors provide a highly reliable detection system that can complement or even sometimes replace ubiquitous video cameras. Unlike cameras, short range radar technology enables detection regardless of weather or lighting conditions (day and night are the same to the radar sensor), and can be arrayed to follow even an irregular perimeter, irrespective of features such as curves, turns, hills, creeks, etc. Radar sensors operating in the 76.0-77.0 GHz millimeter wave band are especially useful for security applications because of the fine resolution they provide, which is vital for distinguishing among stationery and moving objects, and between animals and people. Radar sensors are significantly less susceptible than other perimeter security measures to "false positives," increasing their utility. Following, in Figure 1, is a generic diagram of a typical critical infrastructure protection array using a combined network of Mantissa's millimeter wave radar sensors and traditional security cameras.

Figure 1

Technical Specifications

The MSHRS-300X radar is technologically very similar to the vehicle-mounted radar devices already approved for use in the 76.0-77.0 GHz band. The Mantissa device emits a beam of low energy electromagnetic waves in a limited frequency band between 76 and 77 GHz. Physical objects in front of the radar and within its fixed receiving antenna aperture reflect back a fraction of the emitted energy, and in this way are accurately detected and measured. The measured parameters include time delay, frequency shift (Doppler), and signal intensity. Using these measurements, exact range, velocity and angle of the detected objects (or persons) can be determined, accurately positioned, and tracked. A DSP (digital signal processor) inside the radar then builds a "map" of detected objects (or tracks), and further analyzes which of these detections are in restricted or banned areas.

To fully cover a perimeter, several of these radar sensors may be connected as a network. The network utilizes an RS-485 communication protocol and a physical three-wire bus that connects to a central command and control center. At the command and control center, the various tracks reported by each of the deployed sensors are presented over a unified display, providing for the operator a clear picture of the area to be protected and any possible security breaches.

The MSHRS-300X is a small-size fixed antenna radar sensor, transmitting 8 dBm peak power. The sensor is powered by 12 Volts DC and consumes 7.5 Watts. The total weight of the sensor is 1.3 lbs and its general cylindrical shape is less than 8 inches long by 4 inches diameter at its widest cut. Its case is mainly made of plastics except for an aluminum collar at the front. The small shape and low weight of the sensor, made possible due to the high frequency band used for its operation, enables it to be concealed when installed, which is a desirable feature in security applications. The antenna comprises an array of elements, generating beam width of 12 degrees in azimuth by 5 degrees in elevation and producing gain of 24 dbi. The peak effective isotropic radiated power (EIRP) is 32 dBm, significantly below the ETSI EN-301 091-1 limit of 55 dBm for fixed antenna equipment. The "duty factor" of the transmitted waveforms is below 10%, which renders the mean transmitted power well below the ETSI standard's 50 dBm limit. The MSHRS-300X also complies with ICNIRP guidelines for safe human exposure (2-300GHz). It generates less than 3.5 V/m, at 1 meter from the sensor's antenna (compared to the permitted level of 61 V/m).

The transmitted wave form is repeated FMCW, with up and down chirps. Being digitally controlled, all waveform parameters such as sweep time, frequency bandwidth, chirp rate, number of sweeps, start/stop frequencies and others, can be programmed and swiftly changed according to operational and algorithmic needs. Typical operation parameters are: chirp bandwidth of 50 to 250 MHz, number of up and down chirps 4 to 16, and total integration time between 1 and 8 milliseconds. Nominally, the sensor performance figures are: maximum range 600 feet (man walking), range resolution 3.3 feet, and velocity resolution 0.8 ft/sec.

The sensor applies advanced signal processing algorithms that exploit the fine range and Doppler resolution of millimeter waves to accurately track objects of interest and distinguish between them and nuisance detections. Mantissa's agile waveform change capabilities and advanced signal processing techniques make it possible to operate in harmony with other radar sensors in the 76.0-77.0 GHz frequency band while maintaining full operational functionality.

Specific Technical Advantages of the Mantissa Radar Sensors

Staring antenna. Mantissa's MSHRS-300X is a staring antenna radar sensor. Unlike scanning antenna radars, staring antenna devices can be easily installed and positioned such that the beam of the antenna illuminates a pre-defined selected area, optimized towards maximum functionality under the constraint of minimal interference with other nearby radiators. For fixed radar applications, like the MSHRS-300X, this feature coordinates well with "space" mitigation methods to address potential interference.

Wider beam width. In addition, staring antenna systems like the MSHRS-300X, and most of the automotive radar sensors, have wider antenna beams compared to scanning antenna radars. One of the consequences of using wider beam antennas is that the EIRP is less than that of scanning antennas. The MSHRS-300X uses a 12 degrees azimuth by 5 degrees elevation beam width antenna, which together with the 8 dBm nominal transmitting power yields a total of 32 dBm EIRP. This figure is comparable to that of the automotive radar sensors and is much less than that of some FOD systems licensed to operate in airports.

Agile chirp processing. The MSHRS-300X implements an all-digital waveform synthesis and signal processing. It can adapt quickly (on a sweep to sweep basis) to developing situations in order to maintain concurrently full functionality as well as eliminating any interference (if interference occurs) with other devices sharing the 76.0-77.0 GHz spectrum band. Specifically, by multiple concurrent FFTs (Fast Fourier Transforms) that the internal digital signal processor is computing on every transmit-receive batch, any abnormal disturbance is immediately detected, and if necessary a switch to a different frequency sub-band can be immediately made, prior to the next batch transmission. Thus, any potential interference is readily avoided from both the victim radar as well as the sensor itself.

Off road installations. In its intended applications, the MSHRS-300X would typically be installed at a distance from roadways; therefore, because propagation of millimeter waves is physically limited to relatively short range and line of sight, interference with vehicle-mounted radars is highly unlikely. However, even in locations where the road approaches a secured zone or runs parallel to a secured fence, the fixed security radar devices are installed at a position 5 to 10 times higher than that of vehicle-mounted radars, and the fixed antenna beam can be directed to avoid interference with vehicles.

Low Likelihood of Interference With Other Uses of 76.0-77.0 GHz Band

Comments in the Commission's proceedings addressing Rule 15.253(c) have noted concerns regarding potential interference between vehicle-mounted and fixed radar systems, and have cited to the interference study conducted by MOSARIM – a European Community funded consortium of automobile manufacturers and others with an interest in vehicular radar systems, which focused on interference among vehicle-mounted radar sensors. Mantissa has familiarized itself with this study, which identified both a number of potential interference issues and mitigation measures to resolve them. According to Figure 17 on page 13 of the MOSARIM final report dated December 21, 2012,[1] there are "9 most promising" techniques for radar-to-radar interference mitigation. Mantissa's MSHRS-300X sensor can readily implement most of these techniques. Many of these techniques are software-based adjustments done in real time, which pose no special challenge to modern radar systems. Furthermore, the mitigation technique ranked first by the MOSARIM report is the CFAR (constant false alarm rate) detection algorithm. Mantissa notes that this basic mitigation technique is as old as radar itself, and is commonly applied in virtually every modern radar system. This might explain, at least in part, why there are

[1] Last accessed April 17, 2014: https://assrv1.haw-aw.de/index.php/wp-6-deliverables

no reports in the record of actual malfunctioning of vehicle-mounted radars due to mutual interference among them.

In view of the technological similarity between Mantissa's MSHRS-300X device and vehicle-mounted radar systems, Mantissa can apply the same mitigation techniques identified in the MOSARIM study final report to mitigate any potential interference issues. At worst, potential interference between the MSHRS-300X devices and automotive radar sensors is the same as the potential interference among automotive radar systems, which has been successfully addressed. In practice, however, the potential interference between the MSHRS-300X devices and automotive radar sensors should be significantly less than among vehicle-mounted radars, since the MSHRS-300X is intended to be installed primarily off roads, mounted 5 to 10 times higher than typical vehicular radar mounting height, and with a well-defined, relatively narrow, and specifically directed antenna beam width. In comparison to the main lobe to main lobe close and direct illumination which is likely to happen among the vehicle-borne radars themselves, the interference from off road surveillance radars is much less significant. In addition, as noted above, in the MSHRS-300X device, by use of multiple concurrent FFTs (Fast Fourier Transforms) that the internal digital signal processor is computing on every transmit-receive batch, any abnormal disturbance is immediately detected, and if necessary a switch to a different frequency sub-band can be immediately made, prior to the next batch transmission. In this way, any potential interference is readily avoided.

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Please direct any questions to the undersigned, and we will be pleased to respond.

Respectfully submitted,

L. Elise Dieterich
Counsel to Mantissa Ltd.