Trimble Navigation, Ltd.
FCC Form 442
Exhibit 1
17 February 2006
Amended 1 March 2006

Comment [NA1]:

DESCRIPTION OF PROGRAM OF EXPERIMENTATION

In this application, Trimble Navigation, Ltd. ("Trimble") requests authority to establish a two-year program of research and experimentation that utilizes six (6) individual devices that re-radiate signals received from the satellites of the Global Positioning System ("GPS") and augmentations. As Trimble explains below, the proposed devices are to be used as experimental radionavigation-satellite service ("RNSS") test equipment for the purpose of testing GPS receivers and GPS systems in a commercial environment. Trimble is one of the country's largest manufacturers of GPS equipment and systems, and the use of its six (6) proposed fixed indoor location GPS signal re-radiation devices at its Sunnyvale, California, controlled access industrial facility is essential to enable Trimble safely and comprehensively to test the GPS equipment it manufactures and the GPS systems it develops. Trimble has an extremely keen interest in ensuring that the use of GPS signal re-radiation devices, under the strictly controlled environment that Trimble will establish at its facility, will advance the state of the art in GPS receiver equipment without causing any risk to the safe and reliable operation of GPS equipment already deployed.

In 2005, the National Telecommunications and Information Administration ("NTIA") adopted a revision to the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management ("NTIA Manual") that addresses the regulation of the use and conditions for approval for devices that re-radiate signals received from the Global Positioning System. *See* Memorandum from Fredrick R. Wentland, Associate Administrator, NTIA Office of Spectrum Management, Doc. 34350/1 (May 3, 2005) (Adding Section 8.3.28 to NTIA Manual). NTIA indicated that it recognizes the need for federal and non-federal users to operate GPS signal re-radiation devices in order to test GPS receivers, and stated that it is "prepared to support requests from [the] FCC that meet these criteria." *Id.* Trimble believes this can be accomplished best through the filing of an application, such as the instant one, and for the FCC to issue an experimental license to qualified commercial entities.

As Trimble explains below, it not only meets the NTIA criteria in new Section 8.3.28 of the NTIA Manual, it finds the maximum equivalent isotropically radiated power ("EIRP") criterion that NTIA established for GPS re-radiators to be used by non-commercial U.S. Government applications and by its contractors for these purposes are not appropriate for commercial uses of GPS re-radiators. Trimble does not suggest nor seeks a change to the criterion developed by NTIA for use in authorizing U.S. Government radiation devices (or by its contractors in furtherance of Government applications). Commercial re-radiation devices, however, potentially will be deployed inside facilities in urban environments where broad mobile public and private sector GPS use is already deployed and will not be subject to the same

environments of operation as Government applications. In order to provide adequate protection of deployed mobile GPS receivers from commercial applications of re-radiation devices, Trimble believes that commercial re-radiators must be subject to a maximum EIRP limit different from that used in authorizing U.S. Government re-radiation devices. Thus Trimble holds itself to – and demonstrates compliance with – a maximum EIRP criterion of -97 dBm/24MHz in the GPS L-1 band and of -98dBm/24 MHz in the GPS L-2 band. These criteria are significantly more stringent than the one devised by NTIA. Trimble strongly believes that the commercial introduction of GPS re-radiators should not also introduce potential "zones" of harmful multipath disruption of GPS and its augmentation signals to any existing GPS users in the vicinity of commercial facilities where these devices would be commercially operated.

Trimble's demonstration of exceeding the NTIA criteria for authorization of GPS signal re-radiation devices in the context of the instant application follows:

NTIA Criterion No. 1: Individual authorization is necessary for each device at a site-specific location:

Trimble proposes to install the six (6) fixed indoor location experimental ("XT") GPS signal re-radiation devices for which it presently seeks authorizations in the engineering first floor of a controlled access building located on the premises of its facility in Sunnyvale, California. The building in question is used exclusively for Trimble operations, including engineering research and development (R&D), design, and test located on the first floor of a two story building that is under the exclusive control of Trimble. The zone of potential interference from the proposed fixed indoor location GPS re-radiation devices – the fixed transmitting antennas of which will be located indoors – is limited to an immediate area in engineering operations on the first floor within the building in which the device will be located. The locations and descriptions of the devices are as follows:

XT Station Location	User	Latitude	Longitude
1. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 20" W
2. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 20" W
3. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 20" W
4. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 19" W
5. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 19" W
6. 935 Stewart Drive	Trimble Engineering	37° 23' 6" N	122° 0' 19" W

All transmitting devices are of Trimble's construction according to Attachment 1 of this exhibit.

NTIA Criterion No. 2: Application for frequency assignment should be applied for as an XT station with a note indicating that the device is to be used as an "Experimental RNSS Test Device for the purpose of testing stand-alone GPS receivers or GPS receivers that are an integral component of an equipment under test".

Trimble will strictly limit the use of the fixed indoor location GPS re-radiation devices it proposes here to activities in direct furtherance of its business of developing and manufacturing GPS receivers and systems that use GPS signals and augmentations. The RNSS test devices Trimble proposes in this Experimental Radio Service application are strictly for the purpose of Trimble's testing stand-alone GPS receivers and GPS receivers that are an integral component of equipment or systems under test. This engineering test capability is increasingly important as the basic GPS service is upgraded to include new civilian signals and as additional augmentation systems become available (e.g., EGNOS, GAGAN, QZSS, etc.), these signals and systems are declared experimental until they reach Initial Operational Capability (IOC) and Full Operational Capability (FOC). The GPS system is in a state of dynamic development and change that requires on-going testing and experimentation. Advancing the utility of these new GPS capabilities is important to advancing the art of radio receivers.

NTIA Criterion No. 3: **Approved applications for frequency assignment will be entered in the GMF.**

The frequency assignment of each of the six (6) proposed fixed indoor location GPS signal re-radiation devices at the three XT station locations in No. 1 above is at the GPS L1-band center frequency of 1575.42 MHz and the GPS L2 band at the center frequency at 1227.6 MHz.

NTIA Criterion No. 4: **The maximum length of the assignment will be two years, with possible renewal.**

Trimble requests authorizations with a license term of two years, with the possibility of renewal.

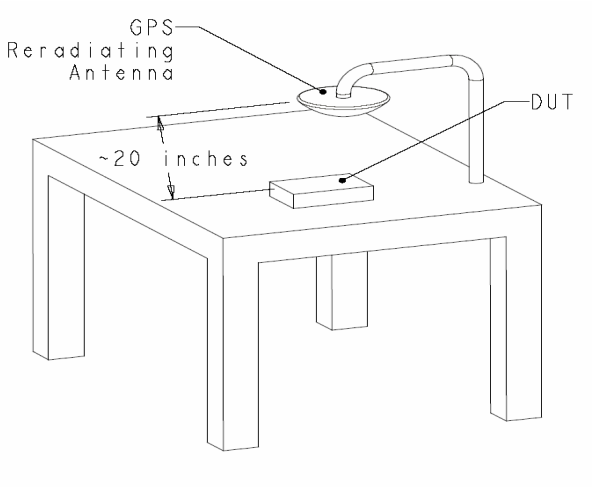
NTIA Criterion No. 5: **The operation must be at a specified fixed location and mobile operation is not authorized.**

The locations of the six (6) GPS signal re-radiation devices proposed by Trimble are fixed at the specific indoor locations identified in No. 1 above.

NTIA Criterion No. 6: **The area of potential interference to GPS reception (e.g. military or contractor facility) has to be under the control of the user.**

As indicated above, the first floor of a two-story controlled access industrial building in which all six (6) proposed fixed indoor GPS signal re-radiation devices are to be located is used exclusively for Trimble engineering operations, including testing, and the entire building is under the exclusive control of Trimble. The zone of potential interference from the proposed fixed indoor location GPS signal re-radiation devices – and the fixed indoor location transmitting antennas– is limited to a specific immediate area located within engineering operations on the first floor of the controlled access building in which the device will be located. (see No. 7 below). The fixed indoor location each of the six (6) proposed GPS re-radiation devices will be

suspended approximately 20 inches above the desk of an engineer within a cubicle that is located at a minimum distance of 8 feet from the exterior wall of the controlled access building. All doors to this facility remain closed as required by controlled access. The Trimble engineer who occupies the cubicle in which a re-radiation device is installed maintains operational control of the device. The cubicle test area is depicted in the diagram below. "DUT" stands for Device Under Test.



NTIA Criterion No. 7: **The maximum equivalent isotropically radiated power must be such that the calculated emissions are no greater than -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the application for frequency assignment and should be based on free space propagation with no allowance for building attenuation.**

The maximum equivalent isotropically radiated power ("EIRP") from the proposed re-radiation device is such that the calculated emissions are substantially more restrictive than -140 dBm/24 MHz at a distance of 30 meters established in Section 8.3.28 of the NTIA Manual and thus more than meets the NTIA values. Attachments to Exhibit 1 include Trimble's calculations showing how this determination was made. Trimble notes that the determination was based on free space propagation, and did not include any allowance for building attenuation.

Trimble is a manufacturer of GPS devices and systems and therefore has a very strong vested interest in ensuring that no action is taken that causes interference to deployed GPS devices. As indicated above, Trimble believes that the EIRP limit adopted by NTIA for GPS signal re-radiation device use is not sufficiently stringent for use in authorizing commercial applications of re-radiation technology. A signal at an EIRP level of -140 dBm/24 MHz 100 feet away from a building could very well interfere with the reception of desired GPS signals in a non-Governmental setting. Trimble believes that a more appropriate standard for the protection of GPS would specify that the EIRP level of a commercial, non-Governmental GPS re-radiation device does not **exceed -140 dBm/24 MHz at a distance of 2.5 meters (8 feet) from the device**

which is located at a minimum distance of 8 feet from the exterior wall of the building structure where the tests are being conducted. Attachment 2 to Exhibit 1 includes Trimble's calculations showing how this determination was made. Trimble notes that the determination was based on free space propagation, and did not include any allowance for building attenuation. Trimble's GPS re-radiation devices will operate at power levels of -97 dBM/24MHz EIRP in the L-1 GPS band and -98dBM/24Mhz in the GPS l-2 band, which results in less than -140 dBM/24 MHz at a distance of 8 feet from the radiating antenna.

Thus, Trimble's proposed devices all comply not only with the NTIA requirement, but also with this additional, self-imposed requirement that Trimble maintains is necessary to ensure the protection of GPS operations outside of Government-controlled environments. Trimble believes that the standards set Section 8.3.28 of the NTIA Manual, when applied by the FCC in processing applications and granting licenses for commercial uses of GPS re-radiation devices, should be more stringent as demonstrated by Trimble in this application.

NTIA Criterion No. 8: **GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.**

Trimble will post signs in the specific immediate zone [within the building] where there is potential of interference from the GPS re-radiation devices proposed here to GPS reception. GPS users external to this facility will not be affected since the zone of potential interference is located within the facility.

NTIA Criterion No. 9: **The use is limited to activity for the purpose of testing RNSS equipment/systems.**

Trimble will strictly limit the use of the GPS re-radiation devices proposed here to activities in direct furtherance of its business of developing and manufacturing GPS receivers and systems that use GPS equipment.

This test program is increasingly important due to the advent of new civilian signal (L2C) and new augmentation systems (e.g., EGNOS, GAGAN, etc.) which will have experimental status for several years.

NTIA Criterion No. 10: **A "Stop Buzzer" point of contact for the authorized device must be identified and available at all times during GPS re-radiation operation of the device under any condition.**

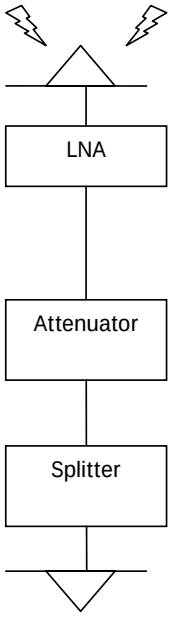
Each re-radiation device is used by, and under the control of, a single engineer in whose cubicle the device is installed. Point of Contact: Charles Maniscalco at fcclicenseliaison@trimble.com

ATTACHMENT 1 TO EXHIBIT 1

Trimble re-radiation network

The proposed re-radiators consist of a rooftop antenna and low-noise amplifier (LNA) that receive existing GPS signals, followed by a distribution system (which consists of cables, splitters and amplifiers), an attenuator, and a passive re-radiating antenna which includes an L1/L2 splitter. The re-radiating antenna is pointed downward approximately a foot above a desk in an engineering cubicle. The system gain of a re-radiator is shown in the diagram below.

	L1	L2
Received power	-128.5dBm	-130dBm
LNA Gain	+50db	+50 db
Distribution network, minimum loss	-5.5db	-5 db
Attenuator	-10 db	-10db
L1/L2 splitter	-3db	-3db
Antenna 1.5m above ground, pointed down, <0dBi horizontal antenna gain	0db	0db
Net radiated power (sum of columns)	-97dBm	-98dBm



ATTACHMENT 2 TO EXHIBIT 1

Compliance with NTIA EIRP limit

Path loss is calculated from the standard equation below

$$P_d = P_r - 20\log(\frac{d * 4\pi}{\lambda})$$

Where P_d is the power of the signal at distance d, and λ is the wavelength of signal.

For our calculations, P_r is net power radiated from Attachment 1 (-97dBm for L1 and -98 dBm for L2); while λ is 0.1904 meters for L1 and 0.2444 meters for L2. Using these figures, we find the following for P_d :

Calculation of power level at 2.5 meters

Band	L1	L2
Radiated power	-97dBm	-98dBm
Path loss at 2.5 meters	-44.3db	-42.2db
Power level at 2.5 meters	-141.3dBm	-140.2dBm

Calculation of power level at 30 meters

Band	L1	L2
Radiated power	-97dBm	-98dBm
Path loss at 30 meters	-65.9db	-63.8db
Power level at 30 meters	-162.9dBm	-161.8dBm

From this it can be seen that the proposed re-radiation network meets the NTIA standard of -140dBm at 100 feet, with over 20db of margin to protect the external use of GPS. This calculation is made based on free space propagation. No allowance is made for the walls of the building. If the walls of the building were not present, radiation would be at or below -140dBm where the walls presently stand. Furthermore, the radiation beyond the limits of the facility (building plus parking lot) will always be below -160dBm, again without accounting for building walls.