Exhibit 1 – Description

The GPS re-radiation equipment will be used inside the Union Pacific Center, 1400 Douglas St Omaha, Ne 68179, to test GPS receivers installed on locomotives and railroad equipment buildings. The GPS re-rad systems will allow synchronization of both time and location for validation testing with the railroad systems. The GPSroof-6thfloor lab will also be used to provide indoor access to GPS signals.

Exhibit 2 – New Calculation Compliance with NTIA Guidelines

GPS Roof to Penthouse Communication Room	Signal Level	Manufacturer	Part Number
GPS Roof Antenna Average Receive Power GPS Signal Input ($P_{R.20}$)	-130		
Roof Antenna Gain ($G_{T.20}$)	38	GPS Source	GPSRKL1
Roof Antenna Cable ($L_{C.20}$) (9dB/100FT)	-6.75	Davis RF	Bury-flex
Penthouse Lightening Arrestor ($L_{A.20}$)	-0.1	Polyphaser	dgxz-06nfnf-b
Penthouse Splitter ($G_{SP.20}$)	0	GPS Source	S12-P110/5-M-NF
Penthouse Amplifier ($G_{AMP.20}$)	15	GPS Source	A11M-V15-BDC-NF-S
Penthouse GPS L1 Repeater Antenna, passive ($G_{RT.20}$)	3	GPS Source	L1P
Total penthouse system gain	49.15		
Effective Radiated Power ERIP, GPS_{Roof} Transmit Power	-80.85		
(average receive power + total system gain)			
Radiation point from wall = 10 feet			

Penthouse GPS Re-radiator Signal Strength Calculation for L1	
100 feet free-space calculations from radiation point + distance from radiation point to wall	110
1 mile	5280
Frequency, MHz	1575.42
Effective Radiated Power	-80.85
20 * Log_{10} (frequency in MHz) + 20 * Log_{10} (Distance in Miles) + 36.6dB = $L_{FS.20}$	-66.92
Free space calculation 110' from radiation point, ERIP @ 100FT FROM bldg	-147.77

$P_{sig\_GPSroof\text{-}penthouse}$ (EIRP)
$= P_{R.20} + G_{T.20} + L_{C.20} + L_{A.20} + G_{SP.20} + G_{AMP.20} + G_{RT.20} + L_{FS.20}$
$= -130 + 38 - 6.75 - 0.1 + 0 + 15 + 3 - 66.92$
$= -147.77$ dBm/24 MHz

GPS on roof to 6th Floor Lab	Signal Level	Manufacturer	Part Number
GPS Roof Antenna Average Receive Power GPS Signal Input ($P_{R.20}$)	-130		
Roof Antenna Gain ($G_{T.20}$)	38	GPS Source	GPSRKL1
Roof Antenna Cable ($L_{C.20}$) (9dB/100FT)	-6.75	Davis RF	Bury-flex
Penthouse Lightening Arrestor ($L_{A.20}$)	-0.1	Polyphaser	dgxz-06nfnf-b
Penthouse Splitter ($G_{SP.20}$)	0	GPS Source	S12-P110/5-M-NF
Penthouse fiber optic media converter ($G_{MCR.6}$)	0	GPS Source	RMFOLTX-P110/5-SF
6th Floor fiber optic media converter ($G_{MCT.6}$)	3	GPS Source	RMFOLRX-P110/5-SF
6th Floor lab Repeater Antenna Cable ($L_{C.6}$) (9dB/100FT)	-4.5	Davis RF	Bury-flex
6th Floor lab Splitter Amplifier ($G_{SPA.6}$)	20	GPS Source	S12-A20dB-P110/5-M-NF
6th Floor lab Amplifier ($G_{AMP.6}$)	0.36	GPS Source	A11M-V15-BDC-NF-S
6th Floor Lab GPS L1 Repeater Antenna, passive gain ($G_{RT.6}$)	3	GPS Source	L1P
GPS roof 6th floor Lab total system gain	53.01		
Effective Radiated Power ERIP, $GPS_{6thfloor}$ Transmit Power	-76.99		
(average receive power + total system gain)			
Radiation point from wall = 30 feet			

Sixth floor lab GPS Re-radiator Signal Strength Calculation for L1	
100 feet free-space calculations from radiation point + distance from radiation point to wall	130
1 mile	5280
Frequency, MHz	1575.42
Effective Radiated Power	-76.99
20 * Log_{10} (frequency in MHz) + 20 * Log_{10} (Distance in Miles) + 36.6dB = $L_{FS.6}$	-68.37
Free space calculation 130' from radiation point, ERIP @ 100ft Bldg	-145.36

$P_{sig\_GPSroof\text{-}6thfloor\_lab}$ (EIRP)
$= P_{R.20} + G_{T.20} + L_{C.20} + L_{A.20} + G_{SP.20} + G_{MC.6} + L_{C.6} + G_{SPA.6} + G_{AMP.6} + G_{T.6} + L_{FS.6}$
= -130 + 38 - 6.75 - 0.1 + 0 + 3 - 4.5 + 20 + .36 + 3 - 68.37
= - 145.36 dBm/24 MHz

GPS Simulator 4th floor Lab to 4th Floor Lab	Signal Level	Manufacturer	Part Number
4th floor lab, GPS Simulator, Average Receive Power ($P_{RSIM.4}$)	-98.8	Spectracom	GSG-54
4th floor Lab Repeater Antenna cable ($L_{C.4}$) (9dB/100FT)	-1	GPS Source	GPSRKL1-V-P110/BCD-SF includes cable assembly
4th floor Lab L1 GPS Repeater Assembly, Variable 0-30 Gain, ($G_{AMP.4}$)	20	GPS Source	GPSRKL1-V-P110/BCD-SF
4th floor Lab total system gain	19		
Effective Radiated Power ERIP, $GPS_{Simulator\ 4th\ floor}$ Transmit Power	-79.8		
(average receive power + total system gain)			
Radiation point from wall = 40 feet			

Fourth floor lab GPS Re-radiator Signal Strength Calculation for L1	
100 feet free-space + distance from radiation point to wall	140
1 mile	5280
Frequency, MHz	1575.42
Effective Radiated Power	-79.60
20 * Log_{10} (frequency in MHz) + 20 * Log_{10} (Distance in Miles) + 36.6dB = $L_{FS.4}$	-69.02
Free space calculation 140' from radiation point, ERIP @ 100ft from Bldg	-148.62

$P_{sig\_GPSsim\text{-}4thfloor\_lab}$ (EIRP)
= $P_{Rsim.4}$ + $L_{C.4}$ + $G_{AMP.4}$ + $L_{FS.4}$ = -98.8 - 1 + 20 - 69.02
= - 148.62 dBm/24 MHz

Exhibit 3 – Section 8.3.28 of NTIA Manual

8.3.28 Use of Fixed Devices That Re-Radiate Signals Received From the Global Positioning System

Except as otherwise authorized under Part 7.14, Federal agencies and departments may, under the following conditions, operate fixed devices that re-radiate signals received from the Global Positioning System (GPS).

1. *Individual authorization is for indoor use only, and is required for each device at a specific site.*
   This request is for three systems. All are indoor applications located at Union Pacific Center 1400 Douglas ST., Omaha, Ne 68179.

2. *Applications for frequency assignment should be applied for as an XT station class with a note indicating the device is to be used as an "Experimental RNSS Test Equipment for the purpose of testing GPS receivers" and describing how the device will be used.*
   Each system will be used to test GPS receivers. The GPSroof-6thfloor lab will also be used to provide indoor access to GPS signals.

3. *Approved applications for frequency assignment will be entered in the GMF.* Expected

4. *The maximum length of the assignment will be two years, with possible renewal.*
   It is understood the license will require review and renewal after 2 years.

5. *The area of potential interference to GPS reception (e.g., military or contractor facility) has to be under the control of the user.*
   All GPS test equipment is located within the Union Pacific Center facilities and is under control Union Pacific Railroad.

6. *The maximum equivalent isotropically radiated power (EIRP) must be such that the calculated emissions are no greater than -140 dBm/24 MHz as received by an isotropic antenna 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 additional attenuation (e.g., building attenuation.)*

   See “Exhibit 2 – New Calculation Compliance with NTIA Guidelines”

7. *GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.*
   GPS users within the interference risk area will be fully informed of the operation of local GPS re-rad systems.

8. *The use is limited to activity for the purpose of testing RNSS equipment/systems.*
   Yes

9. *A "Stop Buzzer" point of contact for the authorized device must be identified and available at all times during GPS re-radiator operations.*

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