

### Exhibit 1 – Description

Request approval to use GPS re-radiation system inside Milwaukee Intermodal Station, located at 433 W St Paul Ave, Milwaukee WI, where current operation does not allow Amtrak Hiawatha trains to select track and be PTC (Positive Train Control) active inside the depot due to no GPS signal under the covered train station. This station is located under a large United States Postal Services facility built in concrete.

**This requires the locomotive occupy main track in a non-enforceable PTC state and is not currently FRA compliant.**

The Figure 1 is an example of train position measured by a GNSS receiver at the Milwaukee Train Station. On this Figure, we observe an area without GPS positioning. This area contains initialization points allowing to initiate train location in accordance with PTC state.



*Figure 1: no GPS signal area in the station*

Traditional GPS repeaters cannot be set-up in the station, by lack of access to a relevant place where an antenna with clear sky view could be placed.

Using the Subwave solution, Syntony proposed an GPS extension coverage for trains evolving within the Milwaukee station. The Subwave solution covers two small areas of synchronization around the center of the covered area.

As described in Figure 2, locomotive will stop at a posted initialization point under the depot canopy and receive a GPS signal for this location via a GPS repeater to be able to select track and be PTC active inside the depot.



Figure 2: Projected setup (two mini-zone setup)

The Figure 3. presents the two different positions of antenna's receiver on locomotive. The goal being to provide a true GPS environment where the locomotive stops to initialize its GPS receiver. Each mini-zone of the SubWAVE solution will be configured to cover of 7ft.

This will allow the solution to work with both types of locomotive (when the GPS receiver is mounted at the nose and also when it is on the roof of the locomotive). It considers a 2 feet accuracy for stopping position (ensured by the train control protocol). The solution is engineered only cover the 2 mini-zones, to not interfere in between mini-zones, and obviously not to leak outside.

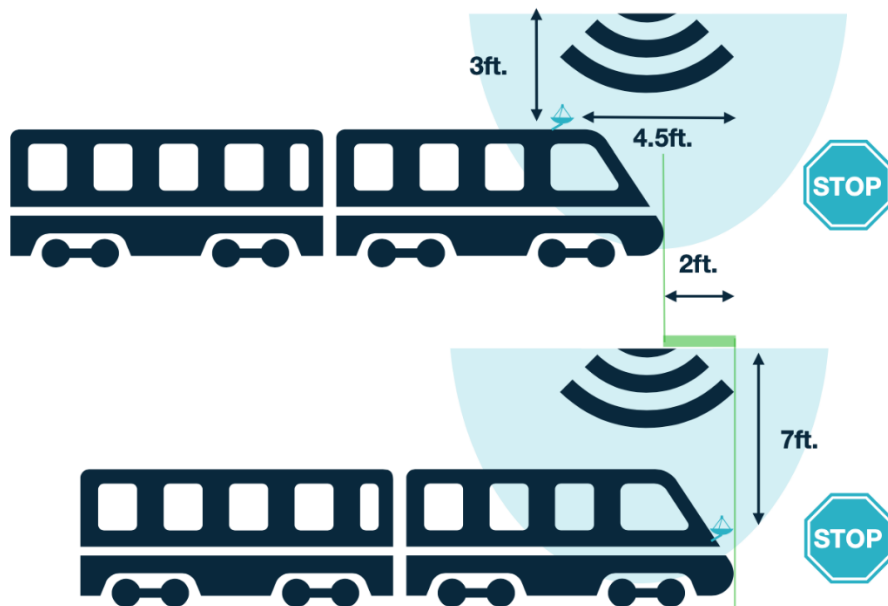


Figure 3: possible positions of GPS antenna's receiver on locomotive

In order to simplify the maintenance of the equipment, the antennas will be placed on a structure ensuring ~7ft. distance in between the receiver (worst case, receiver at the nose) and the active emitting antenna.

Exhibit 2 – ERP Calculation

	* cfg. Values								
<b>attenuation/gain:</b>									
QoS rack (attenuation, in dB)		6							
coax cable (attenuation, in dB)		8							
Antenna Gain (gain, in dB)		5							
<b>installation (SubWAVE units to emitting antenna):</b>									
SubWave Rack ---> QoS Rack ---> coax cable ---> Emitting Antenna									
Output SubWAVE rack (simulator)				-93 dBm					
Output QoS rack (redundant SubWAVE system)				-99 dBm					
Input of the antenna (end of the coax)				-107 dBm					
<b>Distance from Emitting Antenna</b>									
in meter (m)		in foot (ft)		Emitted SubWAVE signal power		equivalent GPS signal (carrier-to-noise ratio, in dB-Hz)			
				in dBm (from free space loss eq.)					
2		6.56168		-144.4163102		27.58368977			
3		9.84252		-147.9381354		24.06186459			
10		32.8084		-158.3957103		13.60428969			
20		65.6168		-164.4163102		7.583689774			
35		114.8294		-169.2770712		2.7229288			
50		164.042		-172.3751104					
70		229.6588		-175.2976711					
100		328.084		-178.3957103					
110		360.8924		-179.223564					
150		492.126		-181.9175355					

Exhibit 3 – NTIA Manual Section 8.3.28

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

Except as otherwise authorized under Section 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).

- Individual authorization is for indoor use only, and is required for each device at a specific site.  
*Proposed project is for two antennas inside Milwaukee Station (433 W St Paul Ave, Milwaukee WI), as detailed in Exhibit 1*
- 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.  
*System will test the extension of GPS coverage as detailed in Exhibit 1*
- Approved applications for frequency assignment will be entered in the GMF.  
*Expect to have the approved application added to the Government Master File (GMF)*
- The maximum length of the assignment will be two years, with possible renewal.  
*Acknowledged that approved license requires revision/renewal after two years*
- The area of potential interference to GPS reception (e.g., military or contractor facility) has to be under the control of the user.  
*Proposed system will be monitored, maintained and controlled by CP Rail, through its subsidiary SOO System Radio Communications Corp*

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.)

*Refer to Exhibit 2 – ERP Calculation*

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.

*Operation of this proposed re-radiation system will be communicated with any potential impacted GPS user*

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

Agreed

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

*24x7 PTC Desk: 403 319-7777 – Option 5 PTC\_IncidentTriage@cpr.ca*

*Alternate: DL\_EA\_IS\_PTC\_220\_Radio@cpr.ca*