Common Mode Protection

Richard Chadwick, Product Marketing Manager, ACData Solutions

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ACData Solutions recommends common mode AC surge protection be used at T-Mobile Cell Sites.

All North American Cell Sites use a TN-C-S grounding scheme where the neutral conductor is bonded to ground at Service Entrance. This means that neutral to ground (common mode) surges cannot propagate past the neutral ground bond at service entrance. As a result, it is not necessary to employ surge protection elements between neutral and ground when the surge protector is installed at Service Entrance in North America. (Note, for safety purposes, with international grounding schemes such as TT and IT, where there is no bond between the neutral and facility ground, the surge protector should always have neutral to ground protection elements).

When a line to neutral (normal mode) surge suppressor is installed downstream of the neutral to ground bond point, it creates a voltage drop across the neutral return wire. This voltage is the sum of the resistive and inductive voltage drops along the neutral wire.

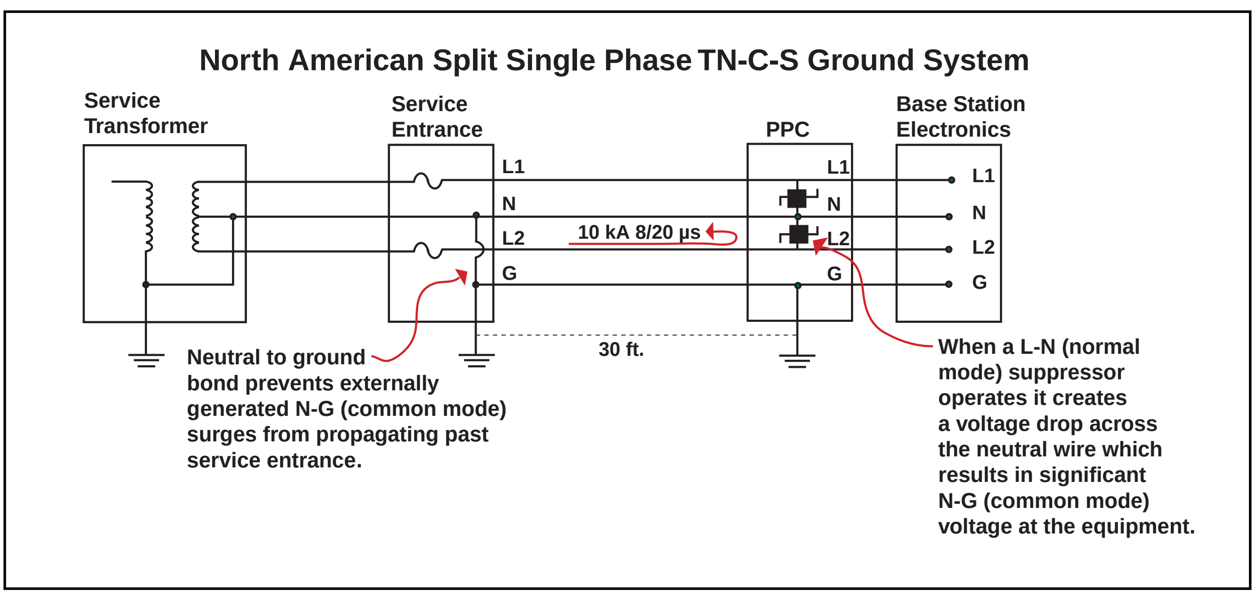

Figure 1: North American Split Single Phase TN-C-S Ground System

806 W. Clearwater Loop, Suite C ~ Post Falls, ID 83854 ~ Phone: 208-777-1166 ~ Fax 208-777-4466 ~ Sales: 800-890-2569 ~ Email: info@acdata.com

At standard power frequencies (50/60 Hz) both the inductive and resistive voltage drop along the neutral wire are negligible. At surge current frequencies, which range to over 100 kHz, the inductive voltage drop predominates and is large enough to create a safety concern. Inductive voltage drop is proportional to time rate of change of current times the characteristic inductance on the conductor. For an industry standard IEEE C62.41.2 (2002) 10 kA 8/20 µs waveform, the inductive voltage drop due to the high frequency wavefront is:

V = L di/dt = 10 kA / 8 µs
V = 1250 V/µH

Using the standard engineers rule of thumb that the self-inductance of open cable is 1 µH/m, this means that the inductive voltage drop is 1250 V/m or around 400 V/ft. ACData Solutions has performed laboratory surge testing using a one-foot length of various wire gauges. As shown in chart below the actual voltage drop ranges from 300 to 450 volts per foot, depending on wire gauge. For wire sizes typically used for 100-200 A services, the voltage drop is in the lower end of this range; approximately 300 volts per foot.

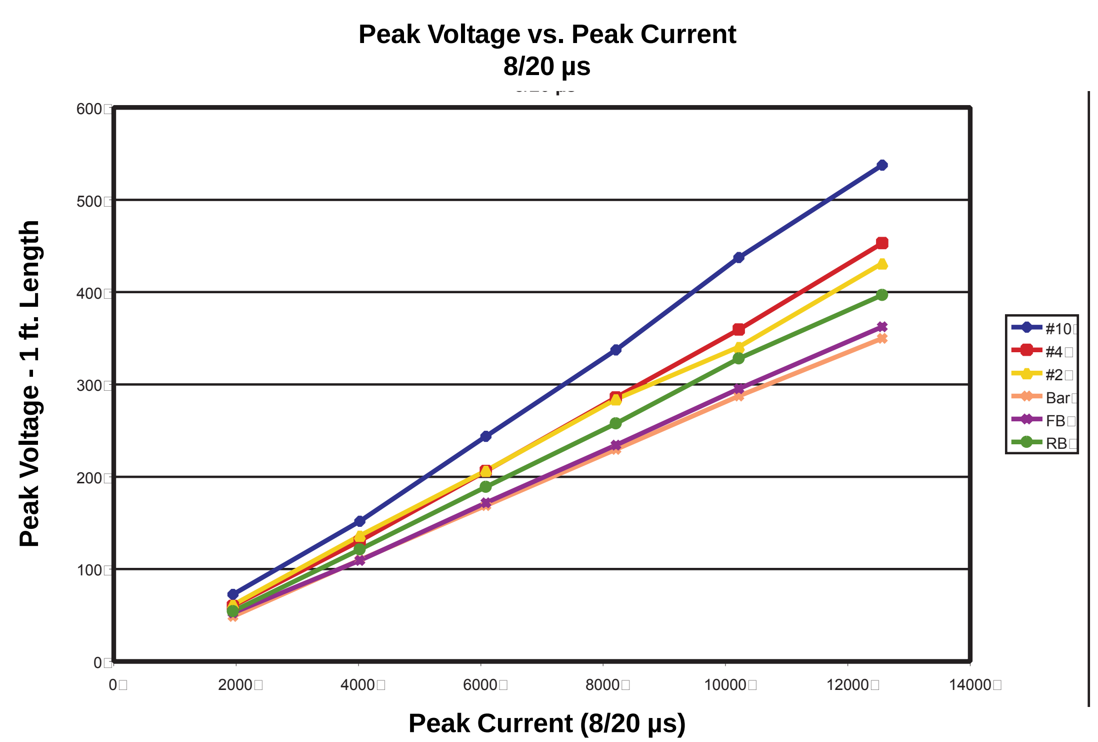

Figure 2: Graph which illustrates Peak Voltage vs. Peak Current.

For cell sites, it is common for the main service disconnect to be outside the fence to allow power company access. This results in the neutral to ground bond point being located at a significant distance from the surge protector. For the example below, with a distance of 30 feet between service entrance and the power cabinet containing the surge protector, an industry standard 10 kA 8/20 µs surge will result in a voltage drop of 9000 volts between the Neutral-Ground bond point. This voltage drop can cause a neutral to ground flashover and resultant shock or fire hazard. To prevent this hazard it is common engineering practice to employ neutral to ground (common mode) protection elements.

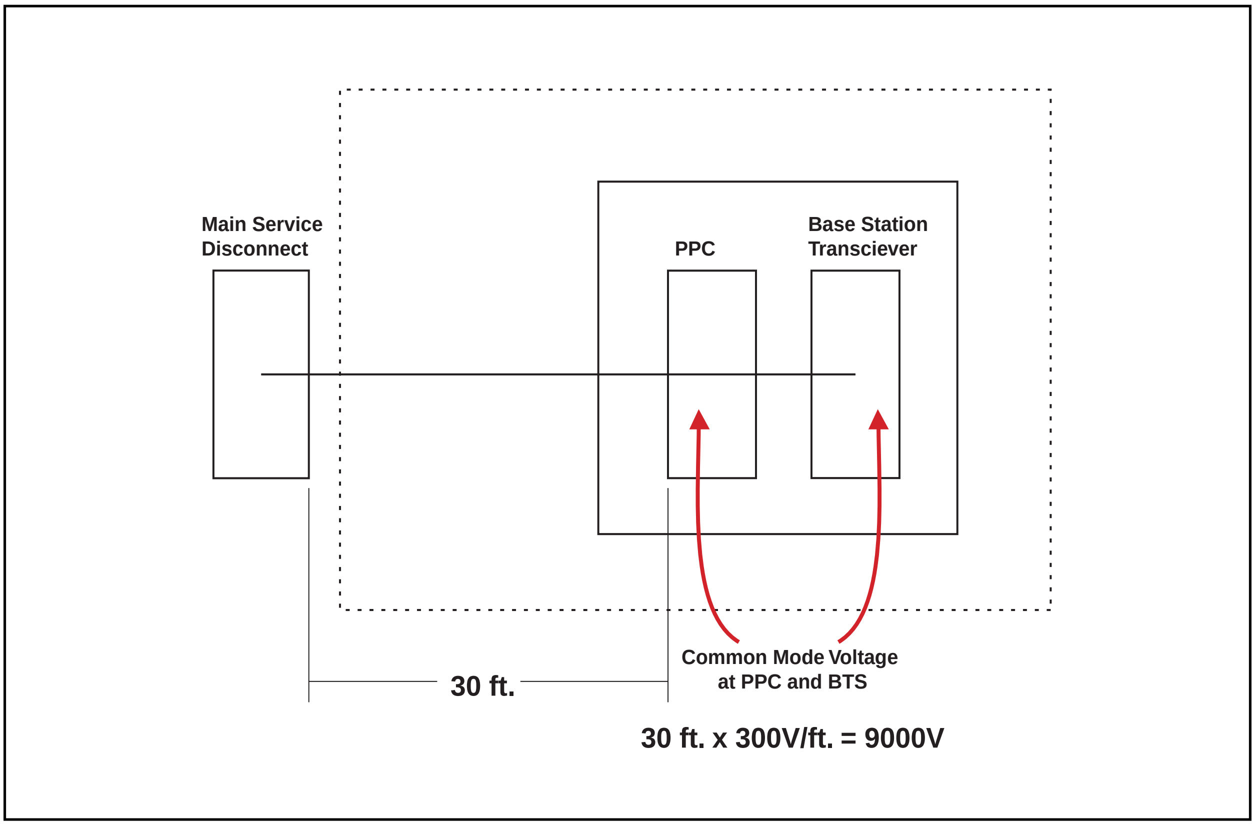

Figure 3: Common Mode Voltage.

Summary

Without neutral to ground (common mode) protection elements in the Power Protection Cabinet a line to neutral surge will result in a significant voltage between neutral to ground at the Power Protection Cabinet and the base station transceiver.

To protect against the surge generated neutral to ground voltage creating a safety hazard, ACData Solutions recommends neutral to ground (common mode) protection elements in the Power Protection Cabinet.