

Minimizing Vulnerability of the Growing 4G Infrastructure

Posted by Janine E. Mooney, Editor

by Jim Colby, Littelfuse

The 4G buildout continues at full speed. A major telecom equipment manufacturer has predicted that by 2020, “everything that benefits from a network connection will be connected,” and that the number of connected devices will reach 50 billion. The 4G piece of this is high-speed, mobile connectivity; basically providing broadband speeds without a wired connection to the Internet.

But 4G offers challenges to equipment designers. One example comes from the differences between 4G and 2G/3G node configurations. 2G and 3G systems use macrocells (conventional cell sites) that generally backhaul to the teleco infrastructure via fiber, microwave link or copper. 4G cost-effectively increases its reach and signal quality by using picocells, femtocells and WiMAX backhaul.

Picocells and Femtocells are localized cells that cost a fraction of a macrocell and make it possible to provide consistent 5-bar coverage to users. They can be located in homes, office buildings or campuses, and connect to ISPs via IP routers using Ethernet, DSL or CATV broadband infrastructure.

WiMAX backhaul hardware can be used to extend the network infrastructure in place of costly fiber or copper lines. They can be thought of like “repeaters” in that they convey information upstream and downstream without adding new connections. In addition, they may include some functions of base station controllers and mobile switching centers.

With growing use of these extenders comes an increasing need for ESD and lightning surge protection between the extender equipment and the cell station/switching/service provider network equipment, as well as ESD and power protection for the local equipment (picocells and femtocells) located on user premises.

This article examines the electrical vulnerabilities of the new equipment, and discusses how manufacturers can toughen their products against these threats.

Equipment to be protected

Picocells typically have a range of about 200 m — roughly one floor of a building — and are capable of handling up to several dozen users. They are used in office buildings, hospitals, shopping malls and public buildings, perhaps one per floor. Multiple picocells can be routed to a single base station controller; this arrangement is typically used in enterprise situations.

Minimizing Vulnerability of the Growing 4G Infrastructure

Published on Wireless Design & Development (<http://www.wirelessdesignmag.com>)

Femtocells typically have a range of about 10 m and are used in homes and geographically compact business applications. They can be set to handle up to four users in the home and up to 16 users in a business application. Informa Telecom & Media has forecast that 49 million femtocells will be installed by 2014.

WiMAX backhaul is used to allow clients/subscribers to access sections of networks with core switching and management equipment. The nodes are generally owned by telecom providers. WiMAX backhaul nodes are similar to a base station controllers. They communicate from point to point in a repeater fashion. They can handle up to 900 Mbps per channel, cost much less than either copper or fiber, and are easy and quick to deploy. Their connection to the telecom infrastructure is typically via Ethernet running into a base station controller.

ESD, lightning and other hazards

In some installations, femtocells and picocells must be protected from lightning as specified by GR-1089 on exposed Ethernet and datacom lines (at levels up to 2500 V and 500 A). There are also threats to data lines from AC power line interactions, either inductive or direct contact, as well as ground potential rise. Protective devices for data lines must provide sufficient protection, operate over a wide range of input voltages (including those used for Power over Ethernet), and not exhibit nonlinear effects that can cause signal distortion.

Power line surges

The recommended protection method for AC power inputs is a combination of fuses and high-power metal oxide varistor (MOV) devices. The MOVs clamp the overvoltages, then return to a nonconducting state when voltages return to normal.

For DC power lines the recommended protection is a combination of fuses and transient voltage suppression (TVS) diodes.

Data lines

Signal and data lines require somewhat more sophisticated protective measures. For HDSL lines, the protection of choice is a gas discharge tube (GDT), plus a pair of TSPDs (transient surge protective thyristors) to provide overvoltage protection; these are then backed up by a pair of fuses (one on Tip, one on Ring) to provide overcurrent protection. For the transceiver side of the coupling transformer, another TSPD can provide overvoltage protection.

ADSL lines have no need for longitudinal protection because they have no earth ground connections. The recommended protection uses a GDT or a TSPD, backed up by a fuse for metallic protection (Fig. 1). For ATUs not isolated from earth ground, see the HDSL protection topology.

Minimizing Vulnerability of the Growing 4G Infrastructure

Published on Wireless Design & Development (<http://www.wirelessdesignmag.com>)

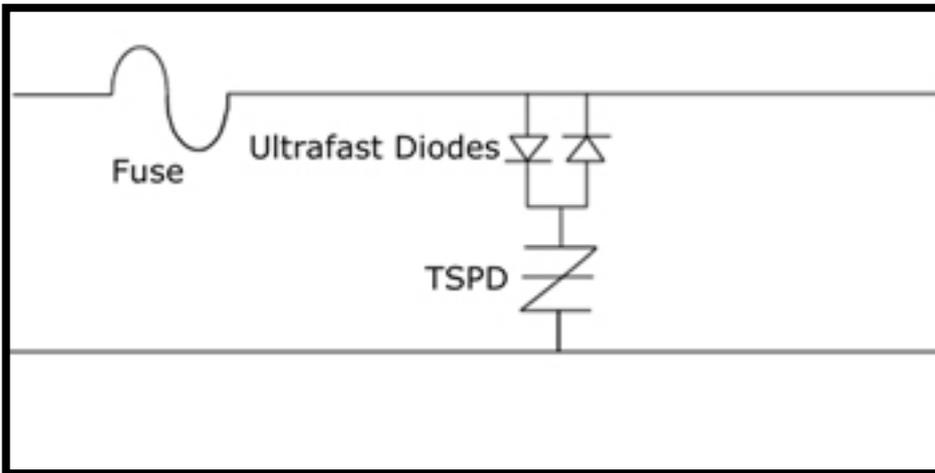
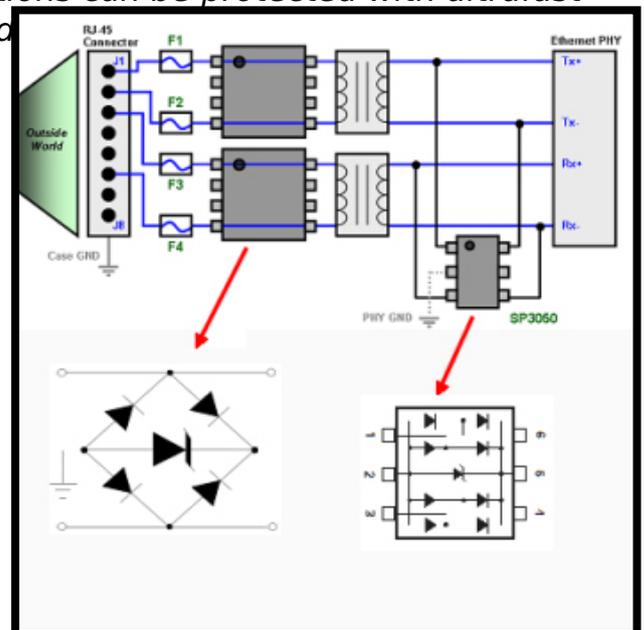


Fig. 1: The recommended protection for ADSL lines uses a GDT or a TSPD, backed up by a fuse for metallic protection.

The appropriate lightning protection for Ethernet lines depends on whether they run intra-building (potentially in picocells or femtocells) or inter-building (as in WiFi backhaul). In the former case protection can be achieved with ultrafast TVS diodes backed up with fuses. These are followed by ultra-low capacitance TVS diode arrays (with a capacitance of less than 10 pF to avoid excessive signal distortion) to suppress any let-through energy coupled through the transformer (Fig. 2). For inter-building applications the TVS diode arrays on the line side can be replaced with TSPDs. There will also be cases where the only threat is ESD. The protection in this case will be on the driver side, and will be an ultra-low capacitance TVS diode array.

Fig. 2: Ethernet lines in intra-building installations can be protected with ultrafast TVS diodes backed up with fuses and followed



by ultra-low capacitance diode arrays (with a capacitance of about 10 pF to avoid excessive signal distortion) for secondary protection.

WiMAX backhaul nodes are generally located outdoors (often mounted on existing structures such as water towers) and are exposed to the effects of nearby lightning strikes. They have three different points of vulnerability, all requiring protection: antennas, power lines, and Ethernet cables. Antenna lines must be protected

Minimizing Vulnerability of the Growing 4G Infrastructure

Published on Wireless Design & Development (<http://www.wirelessdesignmag.com>)

against lightning surges. It's recommended to use GDTs with a surge capability of at least 10 kA for an IEEE C62.45 8/20 μ s combination waveform. Protection for power lines is similar to that used for other types of nodes: for AC power inputs use fuses and high-power MOVs. For DC power inputs use fuses and high-power TVS diodes. As before, Ethernet lines can be protected using low-capacitance ultra-fast TVS diodes connected in inverse parallel.

Summary

The expansion of 4G networks cannot go forward without reliable equipment; an essential part of achieving that reliability is protection from electrical hazards. The proper choice of protective devices can help ensure that equipment survives and networks continue to provide reliable service.

Author Bio

James Colby is Manager, Business and Technology Development for the Electronics Division of Littelfuse, Inc. His responsibilities include identifying and developing strategic growth markets as well as introducing new products into those markets. He received his BSEE from Southern Illinois University (Carbondale) and MBA from Keller Graduate School of Management (Schaumburg). He has been with Littelfuse for over 10 years and in the electronics industry for 18 years, and can be reached at jcolby@littelfuse.com [1].

www.littelfuse.com [2]

Source URL (retrieved on 10/20/2014 - 7:58am):

<http://www.wirelessdesignmag.com/blogs/2011/11/minimizing-vulnerability-growing-4g-infrastructure>

Links:

[1] <mailto:jcolby@littelfuse.com>

[2] <http://www.littelfuse.com>