EMI and InfraStruXure

By Neil Rasmussen

Abstract

This application note addresses the questions regarding EMI.

Introduction

EMI is any unwanted electric signal that is emitted from an electronic component that can impede the functionality of surrounding or connected equipment. Three essential elements must exist for EMI to occur:

- Source: an electronic device emitting the electric noise
- Coupling path: the medium upon which the electric noise travels
- Receptor: an electronic device that is being affected by electric noise

In the data center environment, EMI can couple itself onto data lines and corrupt data packets being transmitted on that medium. This may cause corruption of the data that is being transmitted and stored. If the corrupt data is an address bit, or part of a computer command, it can cause "hanging" within a computer system or storage array.

Types of EMI

The coupling path for EMI can be radiated or conducted:

- Conducted coupling occurs when the source and receptor are connected via power or data cabling
- Inductive coupling occurs across a magnetic field surrounding a conductor. A magnetic field forms around any conductor that has current flowing through it. Magnetic field strength is directly proportionate to the level of current flowing through the conductor creating it. This magnetic field creates an EMI coupling path to any conductors that cross into it.
- Capacitive coupling can occur across an electrostatic field surrounding conductors. An electrostatic field forms between two conductors that are charged at different potentials. Electrostatic field strength is directly

proportionate to the difference in potential between conductors. This electrostatic field creates an EMI coupling path to any conductors that cross into it.

- Radiated EMI is emitted from a piece of equipment across the electro-magnetic field surrounding it. When magnetic and electrostatic fields occupy the same space, they create an electro-magnetic field.

Accepted Industry Standards/Best Practices

The Federal Communications Commission (FCC) has set forth requirements that limit the level of conducted and radiated emissions of all electronic devices sold in the United States. Equipment that is FCC Class-A compliant ensures that it will not produce excessive radiated or conducted EMI. This ensures Electro-Magnetic Compatibility (EMC) exists between equipment.

The European Committee for Electrotechnical Standardization (CENELEC) and International Electrotechnical Commission (IEC) have adopted similar standards to limit EMI in electronic equipment sold worldwide. IEC61000-4-8 is an international standard that limits the electromagnetic radiated field strength of equipment that is used in conjunction with a video monitor.

The NEC 1999 Handbook, article 800-52 requires that; data and power cables be separated by a barrier when sharing a raceway, compartments, or boxes. This is a legal requirement for any electrical installation for safety and prevents the physical contact of data and power cables.

The American National Standards Institute (ANSI) in conjunction with the Telecommunications Industry Association (TIA), Electronics Industry Alliance (EIA) and the Institute of Electrical and Electronics Engineers (IEEE) have released standards that address proper grounding techniques of electronic and telecommunications equipment. Proper grounding practices are essential to mitigate the effects of EMI. Clause 5.5.2.7 of ANSI/TIA/EIA – 607 and section 9 of ANSI/IEEE 1100 both state that cable installed in a fully enclosed grounded metallic raceway or installed close to a grounded metallic surface will limit radiated field noise coupling.

BICSI, a reputable telecommunications association, publishes the Telecommunications Distribution Design Manual (TDMM). The TDMM makes a recommendation that data cables should be routed a minimum of 12 inches from grounded conduits carrying power conductors. This will help to minimize the coupling of the radiated fields from the power conductors to data cabling.

For years, cable manufactures have used a twisted conductor design to minimize the magnetic field created. When conductors are twisted around each other, the magnetic fields of equal magnitude (including noise) will cancel. This idea was also adopted by the communication cabling industry to minimize cross talk and noise coupling between cable pairs. For data cabling applications, many states have stringent requirements about installations in buildings that they occupy based on these guidelines.

InfraStruXure design minimizes EMI

All components designed for use within the InfraStruXure architecture are compliant with the FCC Class-A requirements for electronic equipment. Specifically, the PDU utilized within an InfraStruXure Type B solution also meets the IEC61000-4-8 for class 3, which is described as a commercial environment.

The NetShelter SX enclosures, data cable partitions, and power cable troughs utilized in an InfraStruXure architecture are constructed of grounded conductive metal components. Utilizing these components ensures that radiated EMI will not pass between enclosures and interfere with adjacent equipment or conductor raceways. Data partitions and power cable troughs are grounded, conductive metal components that run parallel on the roof of each NetShelter SX enclosure. The adaptability of the design allows a distance of 12 inches to be allocated the two types of cables providing accordance with the BICSI recommendations. This design methodology provides a drain for the magnetic, electrostatic, and electromagnetic fields being produced by the conductors thereby reducing the ability of EMI coupling to other components. All components utilized in the InfraStruXure architecture are in accordance with the grounding recommendations set forth by ANSI/TIA/EIA and ANSI/IEEE for telecommunications environments.

The multi-branch whips that are used to distribute power in the InfraStruXure architecture are constructed of twisted-conductor flexible cord. This cable design provides cancellation of the magnetic fields being produced by the conductors. All cable terminations are locking type to provide a tight connection and eliminate arching which can also cause EMI emissions.

Conclusion

As with any electrical device, adherence to the manufactures recommendations concerning installation will result in the best performance and highest availability. Electro-Magnetic Compliance was a design criterion of the InfraStruXure architecture. By utilizing industry accepted standards, combined with proven design and installation practices, excessive EMI will not be a factor within the InfraStruXure architecture.

References

- FCC Code of Federal Regulations, Title 47, Part 15
- NEC 1999 Handbook
- ANSI/TIA/EIA – 607 Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/IEEE Std 1100 (1999) – IEEE Recommended Practice for Powering and Grounding Electronic Equipment
- BICSI, Telecommunications Distribution Design Manual
- IEC 61000-4-8 (1993) – Power frequency magnetic field immunity test. Basic EMC publication

About the Author:

Neil Rasmussen is an Availability Engineer for APC. He is responsible for providing availability consulting and analysis for clients' electrical architectures and data center design. John received a Bachelor's degree in Mechanical Engineering from XYZ University in 1995 and is a member of ASHRAE and the American Society for Quality.