Electromagnetic Interference (EMI)

OSI Layer Layer 1 - Physical Layer

Problem Description

Electromagnetic Interference (EMI) is a Layer 1 problem that occurs in networks as a result of the signals passing over the physical transmission medium being affected by external electromagnetic fields. UTP (Unshielded Twisted Pair) cables are particularly vulnerable to this interference.

EMI is emitted from sources such as electric motors, generators, fluorescent lamps, high voltage lines and radio frequency emitting devices. These interferences infiltrate network cables, causing signals to be corrupted and data packets to be transmitted incorrectly. This is manifested as CRC (Cyclic Redundancy Check) errors, disconnections, low data transmission rates, packet losses and general network instability.

EMI, which is invisible in the physical environment but seriously affects network performance, is often caused by poorly planned cabling routes or inadequate hardware protection. Therefore, EMI risks must be considered in network design.

Electromagnetic interference can be caused not only by man-made sources but also by natural phenomena. In particular, natural phenomena such as lightning strikes, solar flares, cosmic radiation and electrostatic discharges can cause serious EMI problems in data transmission. Such situations may cause temporary disconnections, momentary signal degradation and even complete failure of some devices. Therefore, not only the hardware layout but also the environmental conditions must be taken into consideration when performing EMI risk assessment.

Cause of the Problem:

Major sources of EMI:

-Industrial electric motors and generators: They produce high electromagnetic fields.

-Fluorescent lighting and neon lamps: Oscillations caused by alternating current can interfere with data signals.

-High voltage lines or power supplies: Network cables passing close to transmission lines may be affected by these areas.

-Poorly earthed or unshielded cable installations: Increases the effect of EMI.

This interference is added as noise to the signals in the data cable and can cause CRC (Cyclic Redundancy Check) errors, packet losses or disconnections. Especially in 10/100 Mbps Ethernet connections, such disturbances are observed more frequently.

Signs of Detection

-Sudden disconnections or complete disconnection

-Slow data transmission, especially noticeable performance degradation in applications such as file transfer or VoIP

-CRC (Cyclic Redundancy Check) errors, i.e. corruption of the integrity of the transmitted data

-Recurring packet losses or occasional "Request Timed Out" errors

-Increase in the number of errors on switch and NIC (Network Interface Card)

Admin Guide - Solutions and Precautions

Step 1: Cable route planning: UTP cables should be laid at least 1 metre away from sources of electromagnetic interference (EMI) (electric motors, generators, fluorescent lamps, high-voltage cables). To minimise the EMI effect, signal cables and power cables should not be laid in parallel, but should cross at right angles if possible.

Step 2: Choice of cable type: STP (Shielded Twisted Pair) or fibre optic cables should be preferred over unshielded UTP. Fibre optic cables are completely resistant to EMI and are not affected by electromagnetic interference.

Step 3: Shielding and Grounding: Network cables must be shielded and the shielding must be properly grounded. Lack of grounding can render EMI shielding non-functional.

Step 4: Use metal shielding conduits (Conduit): Network cables should be laid in metal conduits (EMT conduit) to provide additional protection against EMI sources. This both

provides electromagnetic shielding and increases physical durability. In addition, the cables should be properly aligned and the harnesses should be secured and not left loose at the connection points.

Step 5: Regular Maintenance and Monitoring: Since EMI-induced problems may increase over time, network performance should be monitored periodically, CRC error rates, connection interruptions and throughput drops should be recorded. Measurements should be made with special test devices on lines with suspected EMI.