

TechSafeSchools

A project of Grassroots Environmental Education, a non-profit organization

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Creating a Wired, High-Performance School

Purpose

The growing concern about the potential health impacts of constant exposure to radiofrequency radiation (RFR) and electromagnetic fields (EMF) in school environments has created a demand for safer wiring options for new and existing schools. Here we present some options for schools that are seeking to reduce exposures by providing wired connections throughout the facility.

Why Schools Are Considering Wired Networks

A growing body of scientific research and peer-reviewed, published studies are linking exposure to RFR with a range of acute symptoms, including headaches, nausea, dizziness, inability to concentrate and fatigue. Long-term illness associated with exposure include cancer, neurological and cardiovascular disorders and DNA damage. As with many environmental exposures, children and other vulnerable populations are particularly vulnerable.

[See our index of independent science on the TechSafeSchools website](#)

Advantages of Wired Networks

Wired networks are far superior to wireless in several important respects:

- More reliable and easier to troubleshoot than wireless
- More economical over time, especially if installed during initial construction
- More secure; student privacy is protected
- Significantly faster than wireless
- No health concerns

We note that the creation and maintenance of a fully wired high-performance school requires not only the convenient availability of wired connections, but efficacious and enforceable policies of the school that encourage the use of safe technology by students and staff. Such policies can be used as learning experiences for students regarding the science linking exposure with human health conditions.

The Advantages of Fiber Optics

A direct fiber optic connection is the optimal technical solution and most future-proof investment for connecting a school to the internet. Fiber connections are infinitely scalable in both size and speed.

While we know that other technologies (i.e., wireless) are improving in their speed capabilities, those technologies require fiber as their backbone, and require close proximity to fiber to realize high speeds. While wireless may be inexpensive, it's a relatively short-term solution and short-term investment, because the technology needs to be replaced every five or so years. We also note that many of the potential speeds that developers and manufacturers have achieved over wireless and other technologies in the laboratory are not actually replicable in the field.¹

Installing a Local Area Network (LAN)

To reduce exposure to RFR, schools should be designed with an integrated wired local area network (LAN) for internet access throughout all areas of the school. Usually a LAN is contained within a single building, but a LAN can extend to several buildings on a campus provided the buildings are close enough to each other (typically within 300 feet, though greater distances are possible with special equipment).

- Fiber optic connections should be installed in every classroom, gymnasium, office, cafeteria and other areas within the school. For new construction, this should be done in conjunction with the installation of electrical wiring.
- Classroom ports should be shielded Cat6 or greater. The number and placement of LAN ports may vary based on grade level and anticipated use of the facility, but should have sufficient flexibility to adapt to changing classroom designs and purposes.
- Installing power outlets with integrated shielded Cat6 connections can reduce installation costs.
- Once installed, LAN connections can be used with Ethernet switches to increase available connections within the classroom.

¹ A Model for Understanding the Cost to Connect Schools and Libraries with Fiber Optics Prepared for the Schools, Health & Libraries Broadband Coalition, October 2014 P.1

Classroom Layouts with LAN Ports

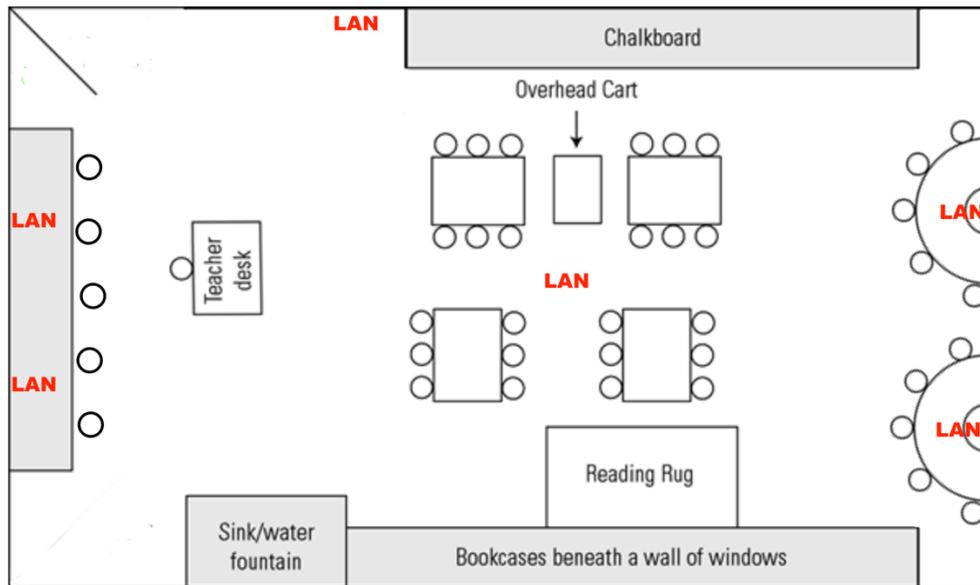


Illustration A – Elementary school classroom with perimeter ports and one floor port.

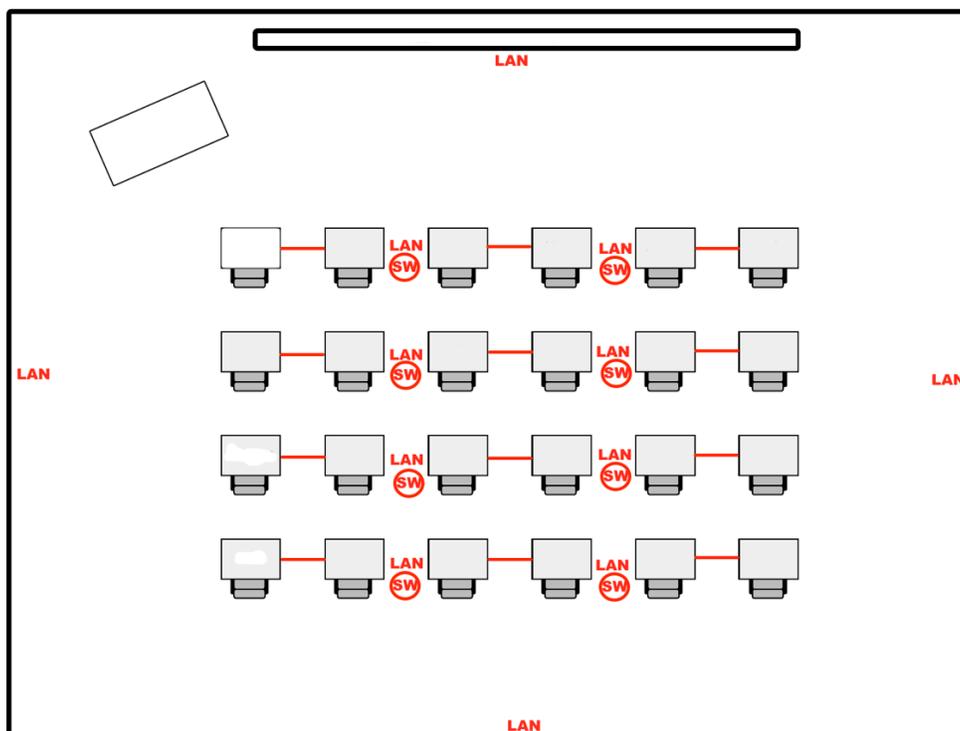


Illustration B: Secondary school layout with eight floor LAN ports connected to multi-port Ethernet switches (SW) mounted under desks. Ethernet cables between desks should be covered with ADA-compliant raceways.

Zone Cabling and Fiber Optics

Zone cabling refers to the installation of a single fiber optic cable to a consolidation point (“zone box”) near the user. In school construction, fiber optic cable may be installed to a consolidation point near a set of classrooms, from where it is distributed to individual classrooms through Ethernet cables.

The use of fiber optics and zone cabling enables schools to take advantage of prefabricated fiber optic cable systems. Cables can be factory terminated and the connectors enclosed in a protective boot for pulling. After the cable is pulled and secured, the boot is removed and connected to the zone box, and the cable is ready for use.

Prefabricated cable assemblies offer several advantages. They are faster to install and have no yield problems on the connectors since each one is factory made and tested. The total installed cost of the components is often less than field termination, but the price to the customer is the same, so they can be more profitable for the contractor. As a downside, they do require more care in installation to prevent damage to the connectors.²

Other Wireless Devices

Many security systems, HVAC controls, telephone systems, lockdown systems, cameras, and other controls and devices commonly found in school environments come factory-set for wireless operation. Once installed, these can be a significant source of unwanted RF radiation and can be difficult and expensive to re-wire. Design teams should ensure that the bid spec for all electrical and electronic equipment specifies that the device or equipment must not emit RFR, and shall be delivered ready for wired control.

Wi-Fi Free Zones

Schools should provide a wireless free zone where cell phones, cordless phones, and Wi-Fi enabled electronic devices shall not be permitted. Clear signage should be posted at the door to instruct users on how to disable the wireless transmitters on their personal electronic devices (power off or airplane mode) before entering this space.

Wireless Networks

If a wireless local area network (WLAN) is required for some reason within the facility, install the minimum number of access points and adjust the power output of each of the access points

² Fiberoptic Association Guide to Fiberoptic and Premises Cabling, accessed at <https://www.thefoa.org/tech/ref/appln/LANarch.html>

to the lowest maximum level required to meet the needs.

As a starting point, we recommend reducing the transmit power to 25%, increasing the beacon interval to 1000ms, and enabling only one radio per access point (2.4GHZ, 5GHZ, or 6GHZ radio).

- Access points shall be placed a minimum distance of 16-32 feet (5-10 m) from where students and staff spend the majority of their time.
- The power to the access points and Wi-Fi transmitters shall be able to be turned off when the equipment is not in use.
- Access points and transmitters should be clearly labeled with warning signs.

Best Practices for Electronic Devices in Classrooms

We recommend that the school adopt a policy regarding the use of electronic devices, in accordance with the following recommendations:

- All electronic devices shall be set to disable antennas and wireless functions.
- All electronic devices shall be operated on a desk where applicable; no devices shall be operated while on a user's lap.
- All electronic devices purchased by the school shall be TCO-certified or laboratory tested to meet TCO Criteria "Mandate A.4.2" for EMF emissions.
- All computers and laptops shall have an Ethernet port (or adapter for Ethernet) and shall operate on "battery" mode or be equipped with a 3-pin electrical connector.
- Tablets must be used with a USB Ethernet adaptor and operate only on "battery" mode; for clarity, tablets should not be used when connected to AC power.
- All devices need software and firmware updates from time to time. When this happens the wireless settings should be checked to ensure the software or firmware update did not change/reset the wireless settings (such as disabling Wi-Fi).
- We recommend the use of electronic devices that meet TCO standards for IT equipment. For more information please visit www.tcodevelopment.com.

Electrical Wiring to Reduce Electromagnetic Fields

The electrical wiring in all school rooms shall be compliant with the currently adopted US National Electrical Code (NEC) in the local jurisdiction, and applicable state electrical code.

All school rooms shall be free of the following common wiring errors:

- a. Improperly wired subpanels (neutral-to-ground bond);
- b. Incorrect three-way switch wiring;
- c. Incorrect wiring of switched outlet circuits;
- d. Neutrals from separate branch circuits that are connected anywhere beyond the panel of origin for the circuits;
- e. Neutral-ground shorts (intentional or inadvertent) anywhere in the system.

The correctness of the wiring shall be checked in each room and the ELF magnetic field exposure measured levels (tRMS) comply with 1 mG (100 nT) in new construction and 2 mG (200 nT) in existing school modernizations.

Care should be taken to avoid devices that are prone to producing “dirty” electricity. These include PV solar systems, fluorescent lighting, dimmers and VFD drives/motors, as well as devices that may have to be filtered, such as portable electronics while charging, projectors, smart screens, etc.

Design and Location Considerations

School districts should prohibit the construction or installation of cell phone towers, base stations or so-called “small cell” antennas anywhere on school buildings or school property. Ideally, schools should be sited more than 1 mile from cell towers, 2 miles from AM/FM/Digital TV broadcasts towers, and more than 6.25 miles from airport radar stations.

If school location is within these distances, design teams should consider integrating metal siding and roofing materials into school design, as this will reflect external RFR away from the school. There are also cost effective foil vapor barriers that are very efficient for RFR reduction. (Please note that use of these materials will also increase exposures from wireless access points *inside* the school as the RF signal is reflected.)

Electrical supply rooms and building power supply should be located adjacent to low occupancy areas.

This information was compiled by Grassroots Environmental Education as a basic guide for schools considering the construction of hardwired networks. We gratefully acknowledge the work of the Collaborative on High Performance Schools, on which much of this text is based. Additional material was obtained from EMF Aware, the Fiber Optic Association, the Molex Corporation and CTC Technology and Energy. This document is not intended to provide electrical engineering advice. Please consult a qualified electrical engineer for specific recommendations for your building project.