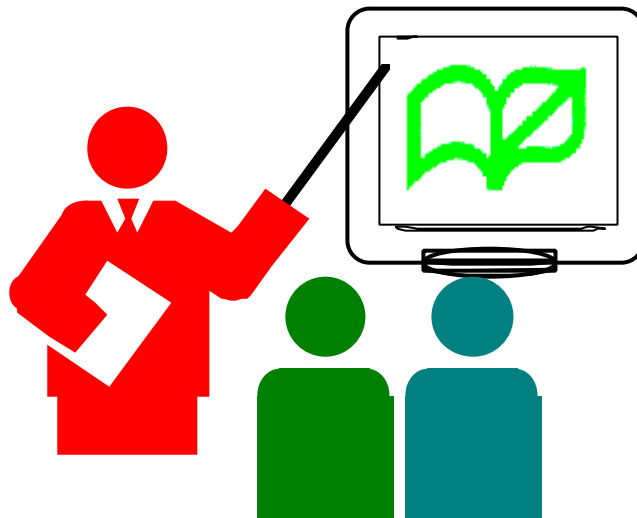


Information Technology in Education Project

# Acquisition Guidelines of a Wireless LAN in School

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The full text of this publication is available at the Information Technology Education Resource Centre home page at <http://ited.ed.gov.hk>

This document is intended to provide general guidelines for schools to choose and set up wireless LAN (WLAN) equipment in school. The following aspects will be covered:

- Basic WLAN components
- WLAN Standards and Features
- Security
- Installation

## Basic components for WLAN

When we wish to set up a typical wireless LAN (WLAN) infrastructure and connect the WLAN to the existing school network, we need to acquire Access Point(s) (APs) and Wireless LAN Clients.

### Wireless Access Point (AP)

There are 2 basic modes of interactions on client ends:

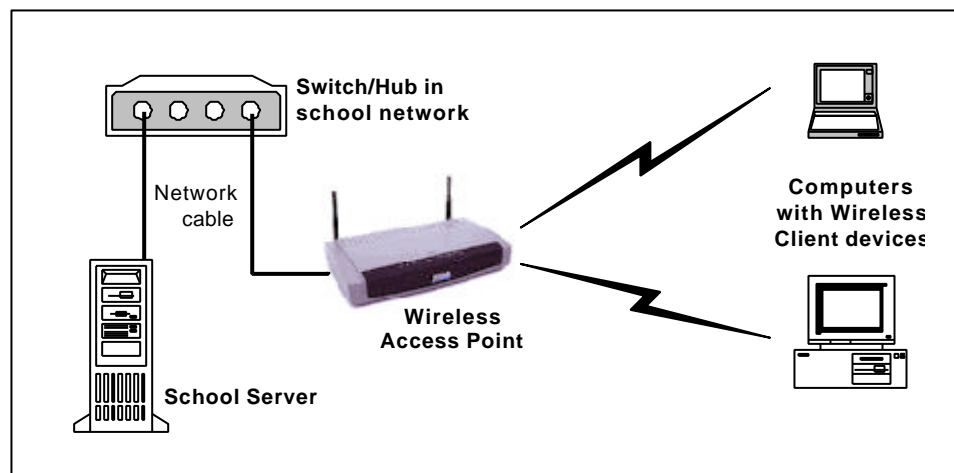
#### (1) Infrastructure

The wireless AP receives, buffers, and transmits data between the wireless devices with the wired LAN in schools.

#### (2) Peer to Peer

In the peer-to-peer mode of communication (ad hoc mode), AP is not required. In such case, users as the wireless clients cannot access the resources on the wired LAN in schools.





The following diagram illustrates how the AP is used for connecting computers wirelessly to the wired LAN in schools:



The AP is usually mounted high at the ceiling. In fact, it can be mounted anywhere for desired radio coverage.

## Wireless Client Adapter

A wireless client adapter has to be installed in each computer to convert it be functioned as a wireless device. There are various wireless client devices to cater for different computer types.

				
<b>Type</b>	<b>USB</b>	<b>PCI</b>	<b>PCMCIA</b>	<b>Compact Flash</b>
<b>Client Computer</b>	- <b>Desktop</b> - <b>Notebook</b>	- <b>Desktop</b>	- <b>Notebook</b> - <b>PDA</b>	- <b>PDA</b>

### a. Desktop Computer

Both PCI and USB adapters can be used. PCI adapter is preferred as it is installed inside the computer. However, USB adapter can provide higher setup flexibility (plug and play), given that both operating system and hardware of the computer could support USB. (For example, Windows NT does not support USB devices.)

### b. Notebook Computer

PCMCIA is usually the choice for notebook computers. If there is no free PCMCIA slot available, USB adapter can be used instead.

### c. Personal Digital Assistant (PDA)

Some PDAs can use the Compact Flash wireless client. PCMCIA wireless adapter is also applicable in the PDA with special PCMCIA expansion jacket installed.

### Antenna (Range Extender)

Antenna can be added to extend the working range of the wireless access point or client. The range can be extended from 15% to 50%, depends on the openness of the area.



## WLAN Standards and Features

### IEEE 802.11b

IEEE802.11a and IEEE802.11b are different standards for Wireless LAN. Below are the comparisons of their main features:

	802.11a	802.11b
<b>Frequency</b>	5 GHz	2.4 GHz
<b>Maximum Transfer Rate</b>	54Mbps	11Mbps
<b>Popularity</b>	Products are starting to be released	High


As 802.11a and 802.11b are standards working in different frequency ranges, they are NOT directly compatible with each other. Some bridging products, such as dual slots AP, are designed to support both standards.

However, nowadays only North America has approved the use of 802.11a frequency spectrum. In Hong Kong, we are still not yet allowed to use 802.11a frequency spectrum. .



- **Use 802.11b products for your wireless network**

### Wi-Fi

Wi-Fi (Wireless Fidelity) is the certification from the Wireless Ethernet Compatibility Alliance (WECA). In using wireless LAN products of different brands, some of the wireless access point of brand A may not work with the wireless client of brand B, even both follow the 802.11b standard. Wi-Fi certification aims to test and certify the interoperability and compatibility between the 802.11b products (network client and access point). The logo  can be found in the Wi-Fi certified products.

Hence, in choosing wireless LAN products, schools are advised to get Wi-Fi certified products in order to secure the compatibility of the 802.11b products. In the ED5 contract, all wireless AP and client are Wi-Fi certified.

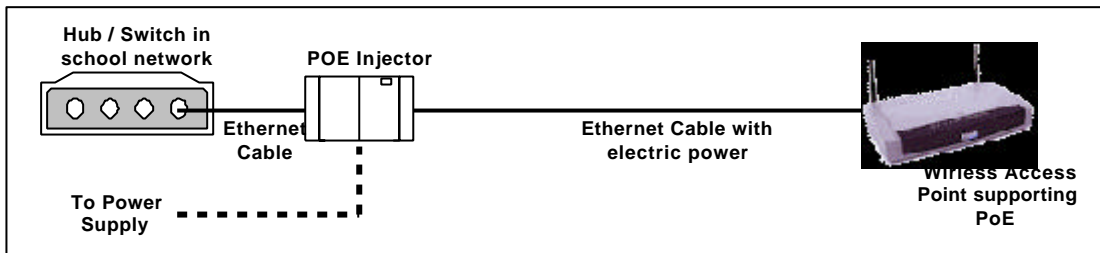


- **Choose the Wi-Fi certified products for better compatibility**

## Power over Ethernet (PoE)

PoE is an optional feature for wireless AP. By using PoE, a single Ethernet cable can be used to supply BOTH power and network connectivity to the wireless AP. The advantages are:

- *Higher flexibility* -- AP can be placed anywhere (e.g. roof and ceilings) without limiting by the electricity outlets.
- *Lower installation cost* -- power point is not required for each AP.



A **PoE Injector\*** is used for "injecting" power to the Ethernet cable. It can be installed in the FLEC (Floor Level Equipment Cabinet) or server room in schools. There are also multi-port PoE Injectors (see the following diagram) for installation of multiple wireless AP. When using PoE, school is required to choose the wireless AP which supports PoE. Otherwise a splitter is required for each AP to separate the power cable and the network cable.

*\* PoE injector is not an EDS contract item. Contractors may propose such equipment when necessary.*

**Multi-port PoE Injectors**



- **Use AP with Power over Ethernet (PoE) when it is difficult to install power point for the AP.**

## Security

In a wireless LAN, it is possible that hackers can eavesdropper or even access the network resources on air. Wireless LAN security is normally enforced through data encryption, usually in the form of 40-bit or 128-bit WEP (Wired Equivalent Privacy). WEP provisions are usually built into the wireless LAN products. For Wi-Fi certified products, they all support 40-bit WEP. Some wireless products can even support 128-bit WEP.

WEP was designed to provide the security for the wireless LAN equivalent to that of a wired LAN. However, it does not provide a very strong foundation for security. Nonetheless, all wireless clients must be security-enabled, that is at least using WEP, before they are allowed to participate in the network.

For higher security requirements, there are other ways for enhancement. For instance, registration of the MAC (Media Access Control) address of the wireless LAN client adapter by the AP can prevent the intrusion of unregistered wireless client. Also, adoption of Virtual Private Network (VPN) in the communication may also improve security. Schools may consult the vendor for the options.

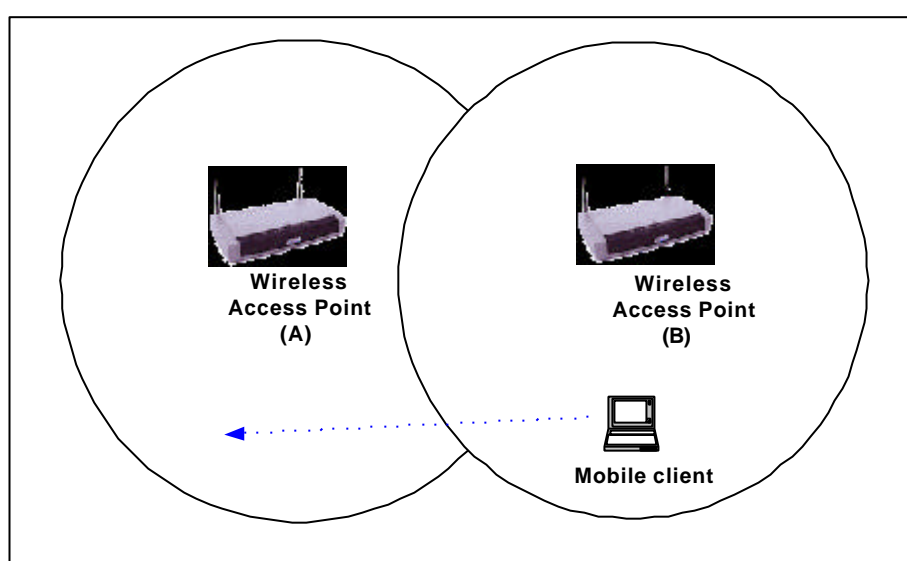


- **Enable the security features in the WLAN products to provide minimum protection.**

# Installation

## Roaming

Roaming allows wireless devices to access the schools' network as they move around the school premises. In this case, a number of APs have to be installed with their ranges overlapping. In moving, the wireless client will automatically establish the connection with one of the access points that provides the strongest signal.



The requirements of roaming have to be determined in advance, as it may incur extra cost and installation. In general, when the wireless clients have to be used in most areas within school premises, roaming is needed. If the area of using wireless network is limited, for instance, in a particular classroom or hall, then roaming may not be necessary.

It is important to note that access points from a single vendor should be used when implementing roaming, because currently there is no official standard for this feature. Before implementation, choosing a feasible radio channel and optimum AP position is recommended. A field test should be conducted to test the coverage of all the access points.



- **Consider the requirements on roaming of wireless clients in school.**
- **Use the access points from single vendor for implementing roaming solution.**

## Data Transfer rate of WLAN

For 802.11b networks operating at 11Mbps, the total throughput capacity of an access point is about 6Mbps. The degradation of data transfer rate is due to protocol overhead and access delays. Comparing with the Fast Ethernet with 100Mbps, the 802.11b has a considerable speed lag. Schools should note that wireless LAN cannot totally replace the wired Ethernet network, especially for delivery of bandwidth demanding applications such as video broadcasting to a large number of users.

## Field test

The coverage of wireless AP may be affected by many environmental factors. Simply speaking, the more openness the area, the larger the wireless coverage.

For indoor environments, the primary limitation is the signal attenuation by walls. Besides, schools have to take into account of factors such as the actual site layout, the materials in the buildings, the arrangement of furniture and inventory, and actual location of users. In a wireless network, multipath effect can also affect the transmission. Once the direct path encounters too much loss, the alternate multipath rays will carry the signal.

Therefore, there would be a great discrepancy between the predicted range and the actual range. It is hard to determine the effective range without a field test. Hence, a field test is highly recommended before implementation.



- **Before implementation, ask the contractor to conduct field test**