# Wireless Local Area Networks and the 802.11 Standard

**March 31, 2001**

Plamen Nedeltchev, PhD

# Table of Contents[1]

## Introduction

Support for wireless local area networks (WLANs) in corporate offices and employee's homes is becoming a necessary activity for networking professionals, requiring new knowledge and training. The purpose of the article is to provide readers with a basic understanding of the 802.11 techniques, concepts, architecture and principles of operations. The standard was designed as a transmission system between devices by using radio frequency (RF) waves rather than cable infrastructure, and it provides mobile, cost-effective solutions, significantly reducing the network installation cost per user. Architecturally, WLANs usually act as a final link between end user equipment and the wired structure of corporate computers, servers and routers.

The standard not only defines the specifications, but also includes a wide range of services including:

- support of asynchronous and time-bounded (time-critical) delivery services;
- continuity of service within extended areas via a Distributed System, such as Ethernet;
- accommodation of transmission rates;
- support of most market applications;
- multicast (including broadcast) services;
- network management services; and,
- registration and authentication services.

The target environment of the standard includes:

- inside buildings such as offices, convention centers, airport gates and lounges, hospitals, plants and residences; and
- outdoor areas, such as parking lots, campuses, building complexes, and outdoor plants.

In 1997, the IEEE released 802.11 as the first internationally sanctioned standard for wireless LANs, defining 1 and 2 Mbps speeds. In September 1999, they ratified the 802.11b "High Rate" amendment to the standard, which added two higher speeds (5.5 and 11 Mbps) to 802.11[1]. The basic architecture, features and services of 802.11b are defined by the original 802.11 standard, with changes made only to the physical layer. These changes result in higher data rates and more robust connectivity.

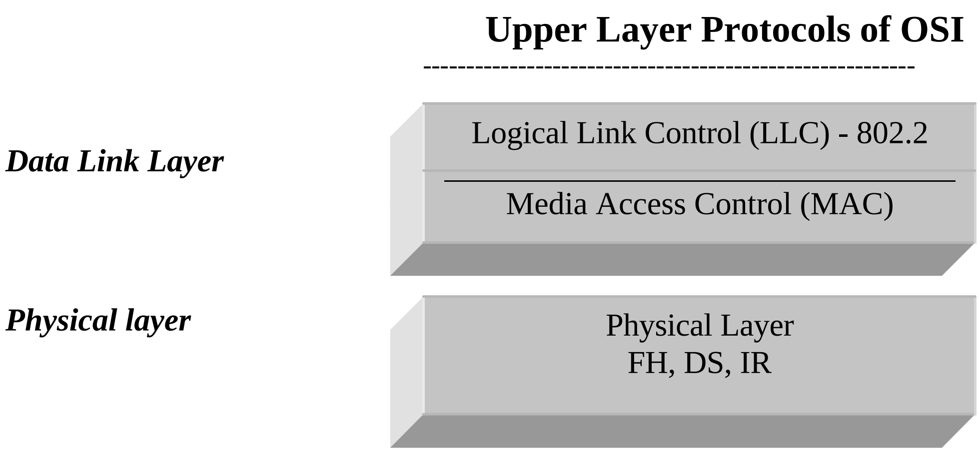


***Figure 1.*** 802.11 standard focuses on the bottom two levels of the ISO model: PHY and MAC

## WLAN Architecture

***WLAN topologies***

IEEE 802.11 supports three basic topologies for WLANs: the Independent Basic Service Set (IBSS), the Basic Service Set (BSS), and the Extended Service Set (ESS). All three configurations are supported by the MAC layer implementation.

The 802.11 standard defines two modes: *ad hoc/IBSS* and *infrastructure* mode. Logically, an *ad-hoc* configuration is analogous to a peer-to-peer office network in which no single node is required to function as a server. IBSS WLANs include a number of nodes or wireless stations that communicate directly with one another on an ad-hoc, peer-to-peer basis, building a full-mesh or partial-mesh topology. Generally, *ad-hoc* implementations cover a limited area and aren't connected to any larger network.

Using *infrastructure* mode, the wireless network consists of at least one access point connected to the wired network infrastructure and a set of wireless end stations. This configuration is called a Basic Service Set (BSS). Since most corporate WLANs require access to the wired LAN for services (file servers, printers, Internet links), they will operate in infrastructure mode and rely on an Access Point (AP) that acts as the logical server for a single WLAN cell or channel. Communications between two nodes, A and B, actually flow from node A to the AP and then from the AP to node B. The AP is necessary to perform a bridging function and connect multiple WLAN cells or channels, and to connect WLAN cells to a wired enterprise LAN.
An *Extended Service Set (ESS)* is a set of two or more BSSs forming a single subnetwork. *ESS* configurations consist of multiple BSS cells that can be linked by either wired or wireless backbones. IEEE 802.11 supports ESS configurations in which multiple cells use the same channel, and use different channels to boost aggregate throughput.

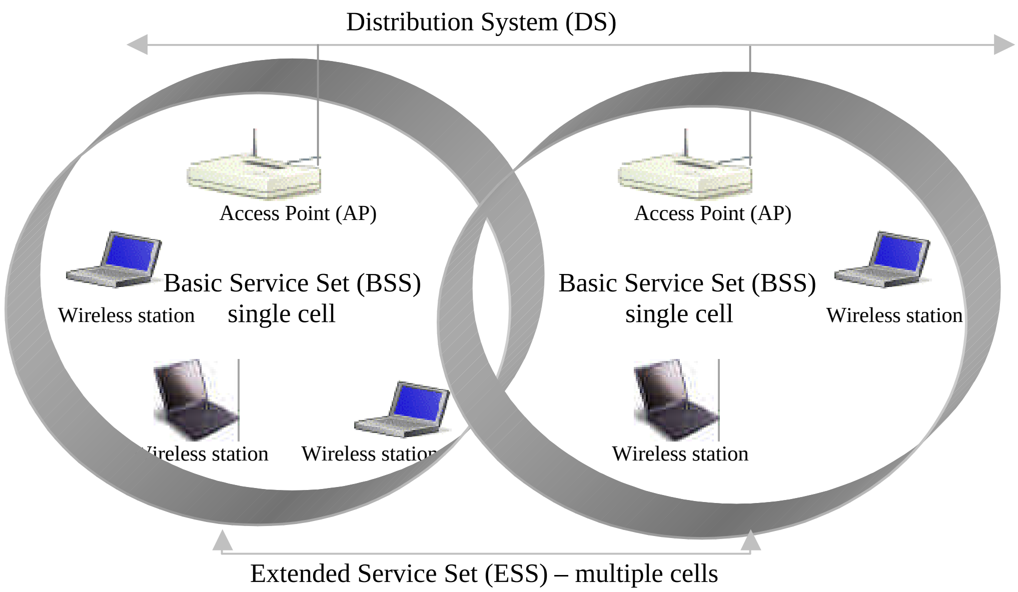


***Figure 2***. IEEE 802.11 BSS and ESS topologies

### *WLAN Components*

802.11 defines two pieces of equipment, a wireless *station*, which is usually a PC equipped with a wireless network interface card (NIC), and an *access point (AP)*, which acts as a bridge between the wireless and wired networks. An access point usually consists of a radio, a wired network interface (e.g., 802.3), and bridging software conforming to the 802.11d bridging standard. The access point acts as the base station for the wireless network, aggregating access for multiple wireless stations onto the wired network. Wireless end stations can be 802.11 PC Card, PCI, or ISA NICs, or embedded solutions in non-PC clients (such as an 802.11-based telephone handset).

An 802.11 WLAN is based on a cellular architecture. Each cell (BSS) is connected to the base station or AP. All APs are connected to a Distribution System (DS) which is similar to a backbone, usually Ethernet or wireless. All mentioned components appear as an 802 system for the upper layers of OSI and are known as the ESS.

The 802.11 standard does not constrain the composition of the distribution system; therefore, it may be 802 compliant or non-standard. If data frames need transmission to and from a non-IEEE 802.11 LAN, then these frames, as defined by the 802.11 standard, enter and exit through a logical point called a *Portal*. The portal provides logical integration between existing wired LANs and 802.11 LANs. When the distribution system is constructed with 802-type components, such as 802.3 (Ethernet) or 802.5 (Token Ring), then the portal and the access point are the same, acting as a *translation bridge*.

The 802.11 standard defines the distribution system as an element that interconnects BSSs within the ESS via access points. The distribution system supports the 802.11 mobility types by providing logical services necessary to handle address-to-destination mapping and seamless integration of multiple BSSs. An access point is an addressable station, providing an interface to the distribution system for stations located within various BSSs. The independent BSS and ESS networks are transparent to the LLC Layer. http://wwwin.cisco.com/cct/data/itm/wan/sdlc/wtsdllca.htm.

## IEEE 802.11, 802.11b and 802.11a Physical Layer

### *802.11 Physical Layer*

At the Physical (PHY) layer, IEEE 802.11 defines three physical techniques for wireless local area networks: diffused infrared (IR), frequency hopping spread spectrum (FH or FHSS) and direct sequence spread spectrum (DS or DSSS). While the infrared technique operates at the baseband, the other two radio-based techniques operate at the 2.4 GHz band. They can be used for operating wireless LAN devices without the need for end-user licenses. In order for wireless devices to be interoperable, they have to conform to the same PHY standard. All three techniques specify support for 1 Mbps and 2 Mbps data rates.

***Photonic Wireless Transmission - Diffused Infrared (IR).*** The only implementation of these types of LANs use infra-red light transmission. Photonic wireless LANs use the 850 to 950 Nm band of infra-red light with a peak power of 2 Watts. The physical layer supports 1 and 2 Mbps data rates. Although

DOCKET ALARM

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

**LAW FIRMS**

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

**FINANCIAL INSTITUTIONS**

Litigation and bankruptcy checks for companies and debtors.

**E-DISCOVERY AND LEGAL VENDORS**

Sync your system to PACER to automate legal marketing.

**WHAT WILL YOU BUILD?** | **sales@docketalarm.com** | **1-866-77-FASTCASE**

fastcase®
Smarter legal research.