Announcements

1. Midterm #2 next Wednesday

2. Lecture #19 today @ 3:30 pm

Note: You may have 2 pages front/back for exam
Decoding the IEEE 802.11a Standard

Learning Objectives:

Explain the organization of the IEEE 802.11a standard.

Find relevant information from the standard and implement in the lab.
IEEE 802.11a

- IEEE 802 LAN, MAN
  PHY, MAC, Link layer
- 802.11 WLAN working group
- Many subgroups
  802.11: 11 Mbps, FHSS, DSSS, IR option
  802.11a: OFDM, 54 Mbps, 5GHz
Standard and amendments

Within the IEEE 802.11 Working Group,[6] the following IEEE Standards Association Standard and Amendments exist:

- **IEEE 802.11-1997**: The WLAN standard was originally 1 Mbit/s and 2 Mbit/s, 2.4 GHz RF and infrared (IR) standard (1997), all the others listed below are Amendments to this standard, except for Recommended Practices 802.11F and 802.11T.
- **IEEE 802.11a**: 54 Mbit/s, 5 GHz standard (1999, shipping products in 2001)
- **IEEE 802.11b**: Enhancements to 802.11 to support 5.5 and 11 Mbit/s (1999)
- **IEEE 802.11c**: Bridge operation procedures; included in the IEEE 802.1D standard (2001)
- **IEEE 802.11d**: International (country-to-country) roaming extensions (2001)
- **IEEE 802.11e**: Enhancements: QoS, including packet bursting (2005)
- **IEEE 802.11g**: 54 Mbit/s, 2.4 GHz standard (backwards compatible with b) (2003)
- **IEEE 802.11h**: Spectrum Managed 802.11a (5 GHz) for European compatibility (2004)
- **IEEE 802.11i**: Enhanced security (2004)
- **IEEE 802.11j**: Extensions for Japan (2004)
- **IEEE 802.11-2007**: A new release of the standard that includes amendments a, b, d, e, g, h, i and j. (July 2007)
- **IEEE 802.11k**: Radio resource measurement enhancements (2008)
- **IEEE 802.11n**: Higher throughput improvements using MIMO (multiple input, multiple output antennas) (September 2009)
- **IEEE 802.11p**: WAVE—Wireless Access for the Vehicular Environment (such as ambulances and passenger cars) (July 2010)
- **IEEE 802.11r**: Fast BSS transition (FT) (2008)
- **IEEE 802.11s**: Mesh Networking, [Extended Service Set](#) (ESS) (July 2011)
- **IEEE 802.11t**: Wireless Performance Prediction (WPP)—test methods and metrics Recommendation cancelled
- **IEEE 802.11u**: Improvements related to HotSpots and 3rd party authorization of clients, e.g. cellular network offload (February 2011)
- **IEEE 802.11v**: Wireless network management (February 2011)
- **IEEE 802.11w**: Protected Management Frames (September 2009)
- **IEEE 802.11y**: 3650–3700 MHz Operation in the U.S. (2008)
- **IEEE 802.11z**: Extensions to Direct Link Setup (DLS) (September 2010)
- **IEEE 802.11-2012**: A new release of the standard that includes amendments k, n, p, r, s, u, v, w, y and z (March 2012)
- **IEEE 802.11aa**: Robust streaming of Audio Video Transport Streams (June 2012)
- **IEEE 802.11ad**: Very High Throughput 60 GHz (December 2012) - see [WiGig](#)
- **IEEE 802.11ac**: Prioritization of Management Frames (March 2012)

In process

- **IEEE 802.11ac**: Very High Throughput <6 GHz;[28] potential improvements over 802.11n: better modulation scheme (expected ~10% throughput increase), wider channels
(estimate in future time 80 to 160 MHz), multi user MIMO;[29] (~ February 2014)

- **IEEE 802.11af**: TV Whitespace (~ June 2014)
- **IEEE 802.11ah**: Sub 1 GHz sensor network, smart metering. (~ January 2016)
- **IEEE 802.11ai**: Fast Initial Link Setup (~ February 2015)
- **IEEE 802.11mc**: Maintenance of the standard (~ March 2015)
- **IEEE 802.11aj**: China Millimeter Wave (~ October 2016)
- **IEEE 802.11aq**: Pre-association Discovery (~ May 2015)
- **IEEE 802.11ak**: General Links

To reduce confusion, no standard or task group was named 802.11l, 802.11o, 802.11q, 802.11x, 802.11ab, or 802.11ag.

802.11F and 802.11T are recommended practices rather than standards, and are capitalized as such.

802.11m is used for standard maintenance. 802.11ma was completed for 802.11-2007 and 802.11mb was completed for 802.11-2012.

**Standard vs. amendment**

Both the terms "standard" and "amendment" are used when referring to the different variants of IEEE standards.

As far as the IEEE Standards Association is concerned, there is only one current standard; it is denoted by IEEE 802.11 followed by the date that it was published. IEEE 802.11-2012 is the only version currently in publication. The standard is updated by means of amendments. Amendments are created by task groups (TG). Both the task group and their finished document are denoted by 802.11 followed by a non-capitalized letter. For example **IEEE 802.11a** and **IEEE 802.11b**. Updating 802.11 is the responsibility of task group m. In order to create a new version, TGm combines the previous version of the standard and all published amendments. TGm also provides clarification and interpretation to industry on published documents. New versions of the **IEEE 802.11** were published in 1999, 2007 and 2012.

The working title of 802.11-2007 was 802.11-REVma. This denotes a third type of document, a "revision". The complexity of combining 802.11-1999 with 8 amendments made it necessary to revise already agreed upon text. As a result, additional guidelines associated with a revision had to be followed.
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