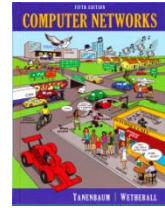# Solutions – 802.11

The solutions below are based on our capture and use of tools. Your answers will differ in the details if they are based on your own capture and use of tools in a different network setting. Nonetheless, we expect our solutions to help you understand whether your answers are correct.

Step 3: 802.11 Physical Layer

Answers to the questions:

1. The Channel frequency is 2462 MHz, or 2.462 GHz. It is known as "802.11b/g channel 11".
2. The rates are 1, 6, 12, 18, 24, 38, 48, and 54 Mbps. This is most of the possible 802.11b/g rates.
3. The RSSIs range from -44 dBm (strongest) to -69 dBm (weakest signal). This is a variation of 25 dB or around a factor of 300 in the SNR.

Step 4: 802.11 Link Layer

Answers to the questions:

1. By inspecting the address fields on frames, the AP has a BSS ID of 00:16:b6:e3:e9:8f.
2. There are 1783 Data frames, or 48% of the total (3731) frames. The most common Data frame is simply called "Data" with subtype 0. The fraction of Data frames will depend heavily on whether there are active data transfers during the trace; there is a small transfer during this trace.
3. There are 1391 Control frames or 37% of the total. The most common Control frame is the Acknowledgement frame with subtype 13. The fraction of Control frames should be comparable but likely lower than the fraction of Data frames due to Acknowledgements (as each non-broadcast Data frame is acknowledged).
4. There are 557 Management frames or 15% of the total. The most common Management frame is the Beacon frame with subtype 8. Management frames are likely to occur at a regular background rate due to Beacons. The fraction of the trace they occupy depends on whether there are active data transfers.
5. The fields are Frame Control (2 bytes), Duration (2 bytes), Receiver Address (6 bytes), and Frame Check Sequence (4 bytes).
6. There are 1430 original Data frames and 353 retransmission Data frames. Our estimate of the retransmission rate is 353/1430 or 25%. This is not surprising – many packets do need to be retransmitted due to errors, but packets still have a reasonable chance of correct reception.
7. 16 out of 822 or 2% of the frames sent to the AP have their power management bit set, indicating that they are about to sleep. This is a low fraction; it would likely be higher if the trace included mobile phones or other devices that sleep more frequently, and it is likely to grow higher in the future as mobile devices make greater use of power saving technologies.

Step 5: 802.11 Management

Beacon frames:

1. The SSID is "djw". This can be seen in the tagged parameters, or in the Info field.
2. Beacon frames are sent by the "djw" AP every 102.4 milliseconds, or a rate of roughly 10/second. Beacons show up regularly in the trace, and when there is no active data transfer they are often the main traffic.
3. The AP supports 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mbps. The rates are given in two tagged parameters as supported rates and extended supported rates (since there are many of them). The 1, 2, 5.5, and 11 Mbps rates are marked "B", meaning that they are 802.11b legacy rates rather than 802.11g rates.
4. The Beacon frames for this AP are all transmitted at a rate of 1 Mbps. This is typical. A low rate is used to allow the Beacons to be received over a larger area around the AP (since a lower rate can generally be received with a weaker signal).

Association frames:

5. Association Request is Type 0 (Management) and Subtype 0. Association Response is Type 0 (Management) and Subtype 1.

Probe frames:

6. Probe Request is Type 0 (Management) and Subtype 4. Probe Response is Type 0 (Management) and Subtype 5.

[END]