TDD Signal Analysis with Spectrum Compact

Comparison between FDD and TDD Transmission

Frequency Division Duplex (FDD)

FDD requires two separate communications channels (i.e. transmit frequencies) spaced with a guard band in-between to minimize co-channel interference (Fig. 1). Good filtering, diplexers, and possibly in radio shielding are a must to ensure the transmitter does not desensitize the adjacent receiver. FDD radios are constantly transmitting in both directions to deliver full duplex capacity thru the radio link.

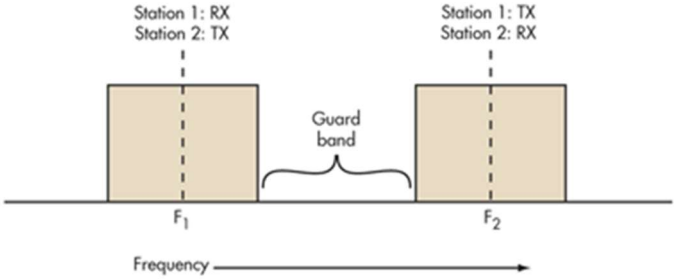


Fig. 1. FDD requires two symmetrical segments of spectrum for the uplink and downlink.

Time Division Duplex (TDD)

TDD uses a single frequency band for both transmit and receive by assigning alternating time slots to transmit and receive operations (Fig. 2). The information to be transmitted—whether it's voice, video, or computer data—is in serial binary format. Each time slot may be 1 byte long or could be a frame of multiple bytes.

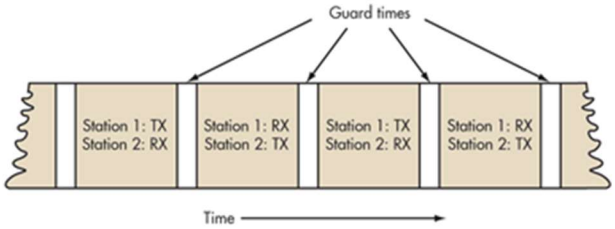


Fig. 2. TDD alternates the transmission and reception of station data over time. Time slots may be variable in length.

In some TDD systems, the alternating time slots are of the same duration or have equal download and upload time slot, however, TDD systems do not have to be 50/50 symmetrical. Systems can be designed for asymmetrical operation (typically 75/25 or 90/10 for instance) or dynamic based on traffic conditions.

TDD Spectrum Scans Using Spectrum Compact

Time Division Duplex radio systems transmit physical frequency carrier changes quickly in the time domain. To be able to display this type of signal on Spectrum Compact`s screen it is necessary to configure your Spectrum Compact accordingly.

1. Disable “Signal ID” mode under TOOLS → SETTINGS
2. To ensure maximum reading speed, use 100MHz SPAN. It is possible to set 100MHz span under “SPAN” menu by pressing “MIN SPAN” button. Using larger SPAN value than 100MHz will result in a longer scan refresh period and thereby increase the time which is necessary for an accurate measurement.
3. Because of the frequency carrier hopping nature of TDD signals (OFDM modulated carriers for instance), it is necessary to accumulate Spectrum Compact scans over time. It is possible to use “MAXHOLD” or “CUMULATIVE” traces under “TRACE MODE” menu from the home screen. SAF recommends to accumulate a minimum of 100 scans regardless of SPAN selection.

MAXHOLD trace

A blue trace shows the highest level detected since sweeping commenced. During each sweep, only the frequency points with highest power levels are updated. Tapping the MAXHOLD button repeatedly resets the MAXHOLD trace. A counter in blue below the grid shows the number of sweeps since the beginning of the latest MAXHOLD mode. Above the grid there's an indication in blue of the CENTRE and MARKER (if activated) frequencies' power levels.

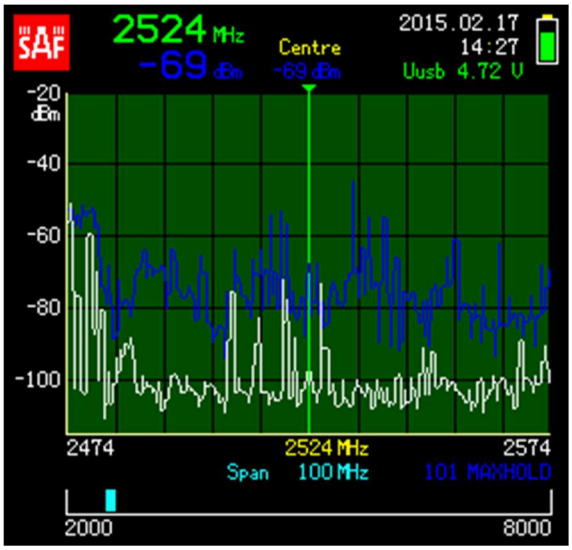


Fig. 3. Showing WIFI signal readings in “MAXHOLD” trace mode

CUMULATIVE trace

Shows in green the power levels of each frequency for all previous sweeps since sweeping commenced. During each sweep, only the frequency points with previously unsaved levels are updated.

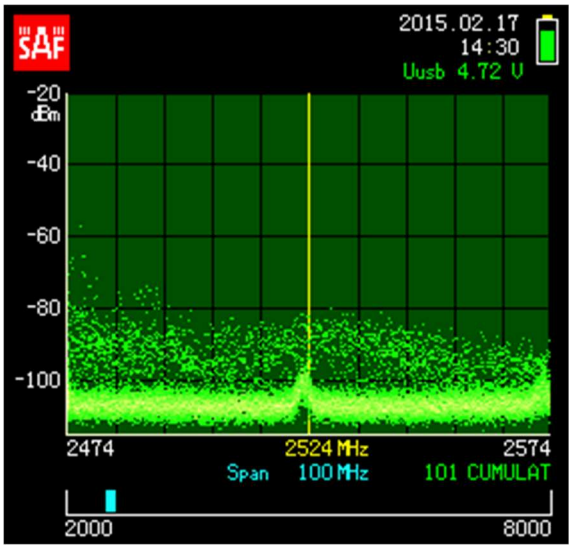


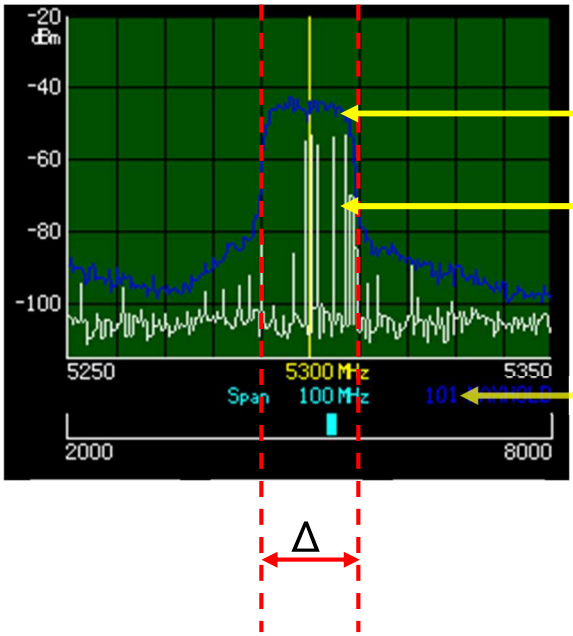
Fig. 4. Showing WIFI signal readings in “CUMULATIVE” trace mode

It is possible to use Spectrum Compact for a list of TDD applications, such as:

- interference and available channel detection;
- relative power observation between different TDD signals;
- channel bandwidth determination;
- traffic intensity survey for TDD signals (for instance with frequency hopping systems);
- finding a TDD signal source by using Point-to-Point narrow beam external antenna.

Use example

In the next two figures spectrum scan for a 5GHz Point-to-Point (PtP) radio device which utilizes TDD transmission is displayed and explained in detail. Please note, that in most cases it is not possible to observe accurate PtP TDD signal by connecting spectrum analyzer directly to the radio unit as most TDD radios start transmitting in the full channel bandwidth and frequency range only when a link between the master and slave (PtP) or access point and client (Point to Multipoint or PtMP) is established.



Blue line represents the "MAXHOLD" trace.

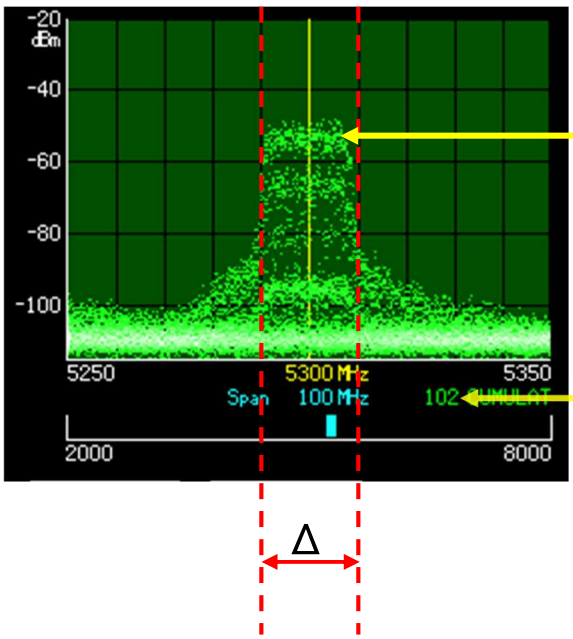
White line shows the latest spectrum scan. It consists of multiple TDD carriers represented as spikes.

Number which shows from how many consecutive scans the "MAXHOLD" line has been drawn. In the example Spectrum Compact has accumulated 101 spectrum scans.

Δ – channel bandwidth of the TDD signal. As Spectrum Compact is set to 100MHz SPAN, each cell of grid is 10 MHz wide. In the example signal occupies 2 cells which means that the studied channel is 20MHz wide.

Fig. 5. PtP 5GHz TDD radio signal scan using "MAXHOLD" trace mode

Fig. 6. shows the same situation as in Fig. 5., but with "CUMULATIVE" trace mode being used. The "CUMULATIVE" trace mode allows to see more precise how the scanned spectrum is occupied and how the signal energy is divided within the spectrum.



Green points represent the power levels of each scanned frequency for all previous sweeps since the sweeping commenced.

Number which shows that spectrum curve has been drawn from 102 consecutive "CUMULATIVE" scans.

Fig. 6. PtP 5GHz TDD radio signal scan using „CUMULATIVE" trace mode