LANCOM Techpaper
Active Radio Control

Flexible and reliable design of wireless networks becomes more important with a steadily increasing number of clients. The main goal for network administrators always remains to set up a smoothly running Wi-Fi network for an optimal user experience.

LANCOM Active Radio Control (ARC) is an intelligent Wi-Fi optimization concept which supports you in improving the radio field and minimizing noise sources within the Wi-Fi. Active Radio Control offers several complementary functionalities within the LANCOM firmware LCOS which sustainably increase the performance of your Wi-Fi.

This techpaper introduces the functionalities of ARC and guides you with instructions to professionally optimize your Wi-Fi.

Challenges for Network Administrators

- Many Wi-Fis overlap each other on individual channels
- Wi-Fi clients compete for the available bandwidth
- Wi-Fi clients associate with far-off access points
- Foreign Wi-Fis disturb the own radio field
- Other non-Wi-Fi sources of interference temporarily compromise the performance of the Wi-Fi

LANCOM Active Radio Control

Full Control over the Wi-Fi

LANCOM Active Radio Control provides the following professional and practical functionalities that optimize the Wi-Fi radio field:

- Managed RF Optimization
- Adaptive RF Optimization
- Airtime Fairness
- Band Steering
- Client Steering
- Adaptive Noise Immunity
- Adaptive Transmission Power
- Spectral Scan

All ARC functionalities are included free of charge within the LANCOM firmware LCOS and can be operated via the respective management tools.

LANCOM Systems

Managed RF Optimization

By choosing a Wi-Fi channel, the part of the frequency band an access point uses for its logical Wi-Fis is defined. With Managed RF Optimization the administrator can also trigger the configuration of optimal Wi-Fi channels via a WLAN controller. For logical reasons, the optimization process is started manually by the administrator when putting the Wi-Fi network into operation. In the first step, the channel lists of the access points are deleted and prepared for a new definition. After that, the WLAN modules are shut off and successively turned on again. In turning on, the modules automatically search for a free channel and thus optimize the distribution of the channels in the radio field. The module with the highest measured interference is prioritized for channel selection. RF Optimization can be activated for all access points managed by a WLAN controller or specifically for individual devices.

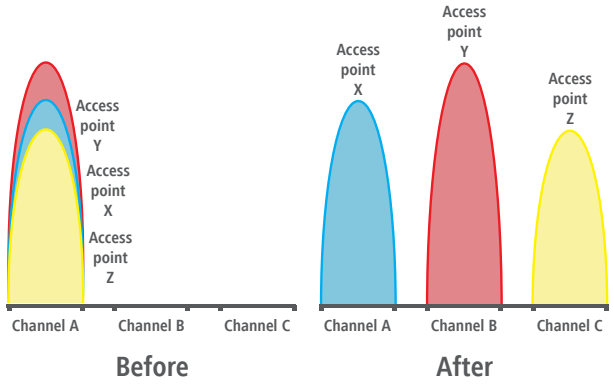

Figure 1: Channel distribution by Managed RF Optimization

Configuration

Managed RF Optimization is started easily via LANmonitor: with a right mouse click on the list of active access points or on a specific device you choose “Start automatic radio field optimization” from the context menu.

Adaptive RF Optimization

In order to flawlessly operate a Wi-Fi in reach of another access point, each access point should be using a separate channel – otherwise the Wi-Fis have to share the bandwidth of the channel (shared medium). For this purpose, LANCOM access points use the feature Adaptive RF Optimization: The access point permanently scans the radio field for interfering signals. If a certain threshold based on the Wireless Quality Indicators (WQI) has been exceeded in the currently used Wi-Fi channel (e.g., the media load or the amount of RX/TX errors), the access point automatically switches to a qualitatively better channel. By setting thresholds manually, the admin can configure necessary channel changes to occur as late as possible. This intelligent functionality enables the access point to dynamically adapt to an ever-changing radio field in order to maximize the Wi-Fi’s robustness.

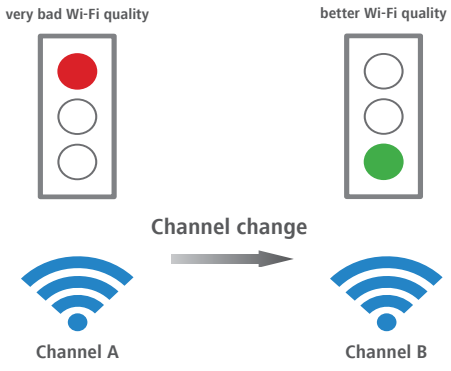

Figure 2: Automatic channel change by Adaptive RF Optimization

Configuration

Adaptive RF Optimization is activated via LANconfig: Therefore, you select in the section Wireless LAN > General > Physical WLAN Settings the required radio module and activate the function in the tab “Adaptive RF Optimization”.

Airtime Fairness

Especially in Wi-Fi scenarios with a high client-density, the devices compete for the available bandwidth. Thereby the sending opportunities are passed around the active clients – without considering necessary transmission times. This leads to slower (legacy) clients slowing down faster clients during the transmission of data packets, although the faster ones could finish their data transmission earlier. The Airtime Fairness feature ensures that the available bandwidth is efficiently used. For that purpose, Wi-Fi transmission times (“airtimes”) are fairly distributed among the active clients. The consequence: Thanks to all clients being provided with the same airtime, faster clients can achieve more data throughput in the same amount of time accordingly.

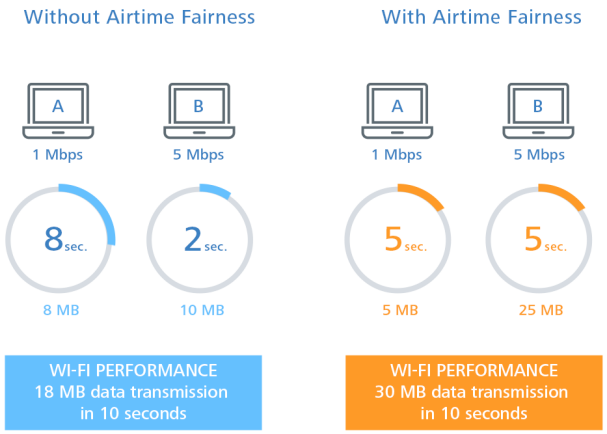

Figure 3: Airtime Fairness

Configuration

Airtime Fairness is activated by default for all WLAN modules. In addition to that the mode can be adapted for special cases via LANconfig: Go to Wireless LAN > General > Physical WLAN Settings, select the radio module and go to the tab „Performance“ where you can set the Airtime Fairness mode for the chosen radio module.

Band Steering

Due to the higher distribution of clients supporting 2.4 GHz Wi-Fi, a Wi-Fi operating on this frequency band can be heavily loaded by a large number of clients. This is further increased by clients which do support 5 GHz but preferably log in via 2.4 GHz. In consequence the available bandwidth at 2.4 GHz is shared by many clients, while there is still enough capacity at 5 GHz. In order to achieve a more equal load in the Wi-Fi and thus a more stable and faster connection for all clients, Band Steering is an efficient solution. The access points have to transmit the same SSID at both 2.4 GHz and 5 GHz. Therefore Band Steering can only be utilized by access points with two radio modules. When a client establishes contact, the access point checks its internal data whether the client has already been seen in the 5 GHz frequency. If this is the case, the access point will not answer probe requests of the client at 2.4 GHz and instead only answer via 5 GHz. This way, the client is effectively steered towards the 5 GHz frequency band.

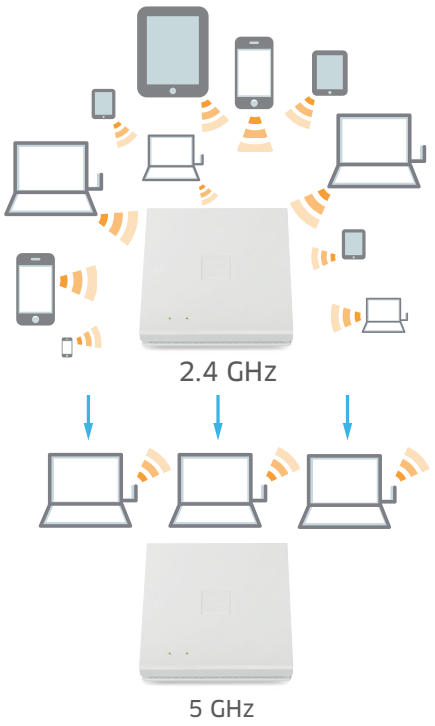

Figure 4: Band Steering

Configuration

The configuration of Band Steering for LANCOM access points or WLAN controllers is conducted comfortably via LANconfig. The necessary settings are found under Wireless-LAN > Band Steering. Here you can choose the preferred frequency band and activate Band Steering. Note: Make sure that the same SSID is configured on both 2.4 GHz and 5 GHz.

Client Steering

Thanks to an active steering of Wi-Fi clients to the most ideal access point, the Wi-Fi performance in controller-based networks is significantly increased. Especially in Wi-Fi scenarios with a high number of end devices, Client Steering is ideal for an optimized load balancing. Depending on predefined scenarios or individually set parameters such as signal strength, frequency band or number of associated clients, end devices are associated to the most suitable access point and thus benefit from the full bandwidth potential. All of this takes places automatically, without the need of changing the clients' configurations.

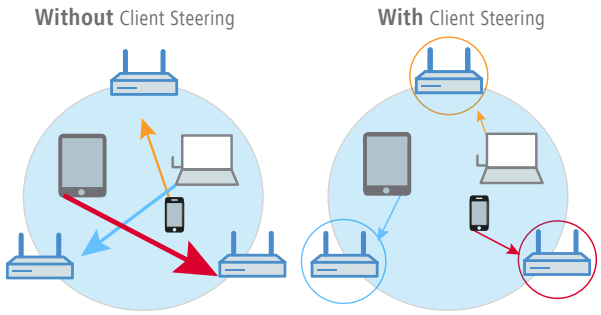

Figure 5: Client Steering – based on signal strength

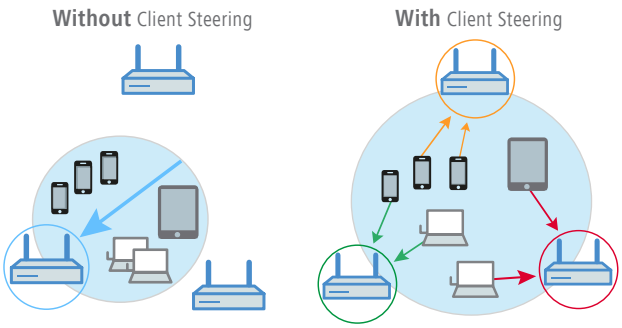

Figure 6: Client Steering – based on number of connected clients

Configuration

Client Steering is configured via the WLAN controller and is activated by default. If further adjustments for individual access points are required, they can be implemented to new or existing Client Steering profiles via WLAN Controller > AP Configuration > Client Steering Profiles.

Adaptive Noise Immunity

Wi-Fis often operate in challenging environments with many different sources of interference, compromising the performance of the own Wi-Fi. Potential sources of interference may be other Wi-Fi signals or other radio signals such as Bluetooth devices, wireless cameras, and microwave ovens which may have significant influence on the Wi-Fi. By activating Adaptive Noise Immunity, an access point ignores sources of interference in the radio field and only focuses on Wi-Fi clients with sufficient signal strength. This process is based on measured values of the WLAN module with regard to interferences in the radio field. If a defined threshold is exceeded, the reception sensitivity of the WLAN module will be reduced by LCOS respectively. Therefore, the probability is increased that the WLAN module will ignore intereferences while searching a free transmission slot, due to the "Carrier Sense Multiple Access / Collision Avoidance" procedure. These adaptive changes of the reception sensitivity, based on the permanent check of the radio field, the optimal operation of the WLAN module is induced.

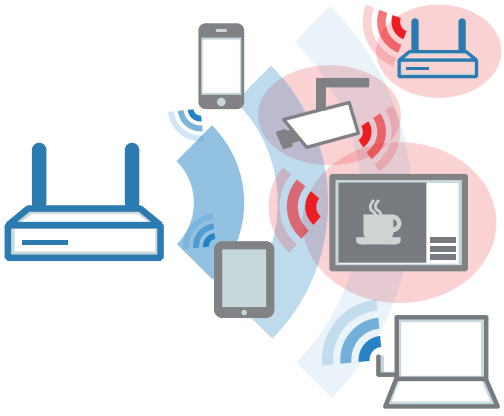

Figure 7: Adaptive Noise Immunity

Configuration

You can activate or deactivate Adaptive Noise Immunity with just one click in LANconfig under Wireless-LAN > General > Interfaces > Physical WLAN settings. Adaptive Noise Immunity is activated for both the 2.4 GHz and 5 GHz frequency bands by default.

Adaptive Transmission Power

Ideal for Wi-Fi backup scenarios: If one access point fails, the transmission power of the remaining ones can be increased to grant Wi-Fi coverage within the subsidiary. For that, all access points are positioned so that full Wi-Fi coverage is given even with reduced signal strength. With the help of constantly updated information about the currently active access points, the transmission power reduction of all reachable access points can be adjusted on any change, so that gaps within the coverage area can be eliminated. As soon as the full number of access points within the network is available again, the initial transmission power reduction will be used again.

Note: To grant a reliable illumination, a higher number of access points has to be planned than would be necessary with unreduced signal strength.

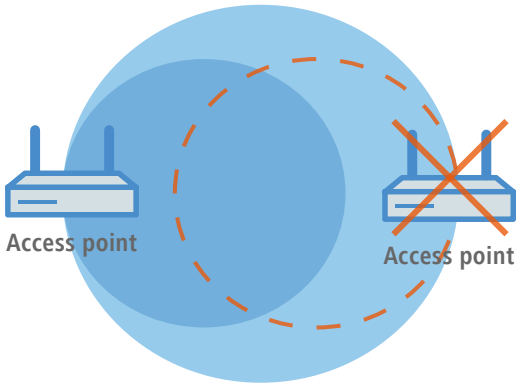

Figure 8: Adaptive Transmission Power

Configuration

Configuration of Adaptive Transmission Power is easy. The settings are found in LANconfig under Wireless LAN > General. Select the button „Expert WLAN settings“ under „Extended Settings“ and first choose the appropriate WLAN interface if your access point has got more than one.

Then enter the number of expected access points, and the Backup TX power reduction under the conforming tab. The default TX power reduction can be configured under Wireless LAN > General > Interfaces > Physical WLAN settings (if necessary select the WLAN interface) within the „Radio“ tab.

Spectral Scan

Despite activated Adaptive Noise Immunity, Wi-Fi performance may be compromised by further sources of interference, especially in the 2.4 GHz frequency band. Interferences range from microwave ovens, wireless phones, Bluetooth devices or video transmitters, sending signals via 2.4 GHz. Such interferences can lead to the loss of data packets or of entire connections. If the overlap is too strong, the result may even be total failure of the Wi-Fi. Spectral Scan enables a manual, professional analysis of the radio field, and is suited for noise sources classification. For this reason, it is a powerful troubleshooting tool. The load of individual channels at a certain point of time is graphically illustrated and can be monitored historically. This way, the administrator can detect that a certain channel in the 2.4 GHz frequency band is heavily loaded during a certain time period. The conclusion could be that a source of interference has been operating during this time period, for instance a microwave oven during lunch time or a gaming console. With this information the administrator can take countermeasures by changing the used channel or by eliminating the source of interference. In contrast to a fully automated, program-controlled switching of channels, this active intervention by the administrator has clear

advantages: no undesirable configuration changes occur, for instance by switching to an already heavily loaded channel. Another advantage is the possibility to start Spectral Scan via WEBconfig – ideal for a remote operation without a technician on-site.

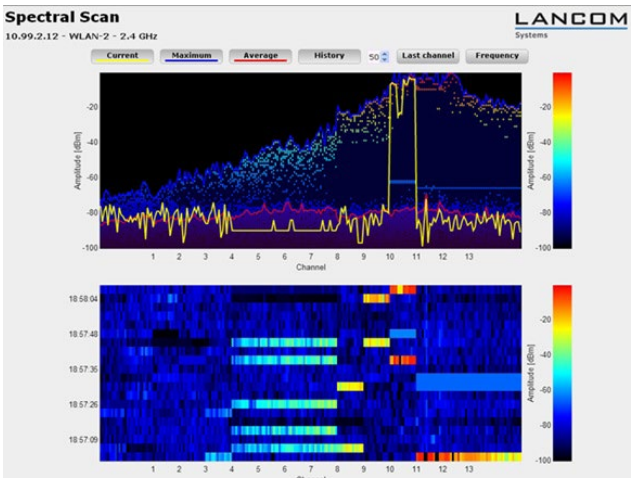

Figure 9: Spectral Scan

Configuration

Spectral Scan can be easily started via LANmonitor. Right-click the respective device in the list and select "Show Spectral Scan" in the context menu. Here you select the WLAN module to be analyzed as well as the sub-band, if necessary. With a click on "Start" you activate Spectral Scan. Note: During the analysis the scanning WLAN module neither transmits any data, nor an SSID.

Conclusion

With the intelligent Wi-Fi optimization concept LANCOM Active Radio Control (ARC) you get a lasting radio field optimization, avoid noise sources proactively and thus take advantage of the full performance of your Wi-Fi!

Benefit from:

- Increased Wi-Fi throughput thanks to less channel overlapping by administrator-triggered automatic selection of the best Wi-Fi channels (Managed RF Optimization)
- Increased Wi-Fi throughput thanks to less channel overlapping due to the dynamic selection of the best Wi-Fi channels by the access point (Adaptive RF Optimization)
- Better utilization of the available bandwidth thanks to a fair allocation of the Wi-Fi transmission times for the active clients (Airtime Fairness)
- Optimum Wi-Fi load-balancing due to an active client redirecting to the less busy and more powerful 5 GHz frequency band (Band Steering)
- Optimum Wi-Fi user experience due to active client steering to the best access point (Client Steering)
- Considerably more throughput for clients in heavily loaded Wi-Fi environments with a high amount of interfering signals (Adaptive Noise Immunity)
- Reliable Wi-Fi backups on access point malfunction (Adaptive Transmission Power)
- Efficient Wi-Fi troubleshooting due to identification of noise sources within the Wi-Fi (Spectral Scan)

With that, LANCOM ARC leads to the best Wi-Fi experience.