



Open AFC Software Architecture

TIP Open AFC Software Project Group



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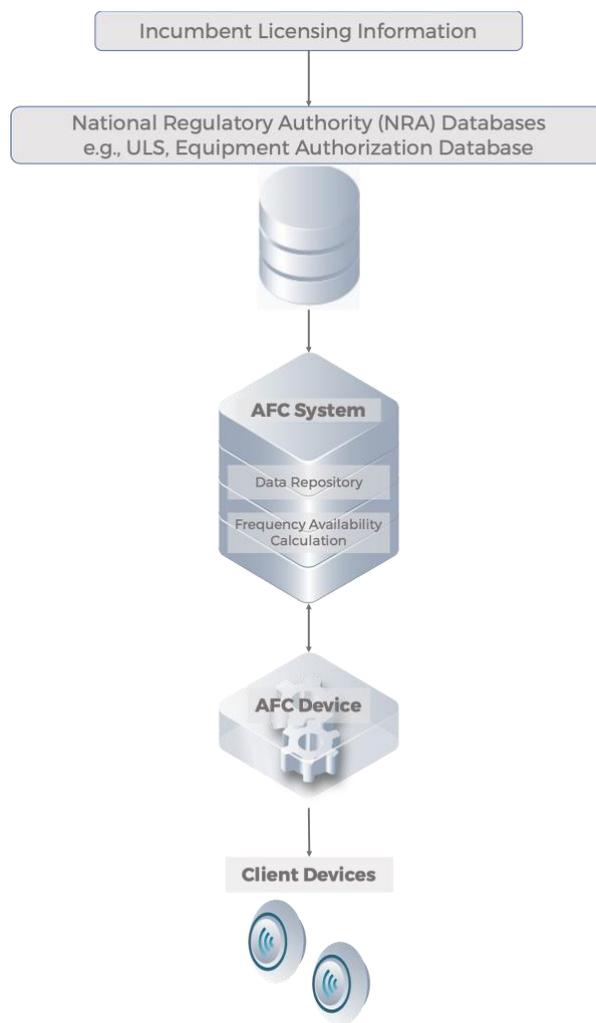
Introduction

The Open AFC Software project is a dedicated open-source community within the Telecom Infra Project (TIP) committed to the design and development of Automated Frequency Coordination (AFC) software for unlicensed services in the 6 GHz band. More than thirty companies participate in the Open AFC Working Group. Open AFC seeks to accelerate the standard power RLAN (Radio Local Area Network) market globally, by providing an open-source repository that can be modified for various markets and regulatory requirements. This document provides a high-level description of the Open AFC's system architecture. The description is generalizable to any jurisdiction. Specific jurisdictional requirements may be cited by way of example or for illustration.

Open AFC Software

The Open AFC Software is a modular reference software system for use by AFC operators. AFC System Operators may extend the capabilities provided by Open AFC to address various market requirements.

Diagram 1 illustrates the complete 6 GHz AFC architecture to contextualize the position and role of an AFC System integrating Open the AFC Software.





AFC Component	Description
Incumbent Licensing Information*	Licensed incumbents' RF operational parameters for designated incumbent systems with superior spectrum rights. For example, if so designated, data about 6 GHz fixed microwave links would include licensing information such as transmitter and receiver locations, frequencies, bandwidths, polarizations, transmitter EIRP, antenna height, and the type of equipment used from a National Regulatory Authority (NRA) database (e.g., ULS). This also includes information about microwave operations in border areas or specific exclusion areas if required by the NRA.
National Regulatory Authority (NRA) Databases*	Databases maintained by the NRAs of jurisdictions that permit AFC operations and that allow the information in the databases to be extracted for the purpose of administering AFC Systems. NRA databases would generally be of two types – databases that contain Incumbent Licensing Information and databases containing equipment authorization records.
AFC System	The AFC system of an individual AFC Operator that has been approved by an NRA, which integrates the Open AFC system software, potentially combined with additional system elements particular to the AFC implementation of that AFC Operator such as security or administrative tools.
AFC System Data Repository	Open AFC operations related to collecting, maintaining, and provisioning data. See Diagram 2 for additional information.
AFC System Frequency Availability Calculation	Open AFC operations related to employing Incumbent Licensing Information acquired through NRA Databases to calculate the maximum power at each frequency available for AFC Devices operating at a particular location. See Diagram 2 for additional information.
AFC Device*	An AFC-governed 6 GHz license-exempt access point, proxy device, or network control device that is lawfully marketed in accordance with the regulations of the relevant NRA.
Client Devices*	6 GHz license-exempt client devices under the control of an AFC Device.



**Included for completeness. Describes functions required for a complete automated frequency coordination process. Currently outside of scope of TIP Open AFC group.*

Operators of devices in a licensed service - such as Fixed Services - apply for licenses to an NRA based on the technical characteristics of their systems. These licensees provide information to the relevant NRA as part of this process (Incumbent Licensing Information) and must maintain the accuracy of this information with subsequent submissions to the relevant NRA. NRAs maintain these data in databases (NRA Databases), such as the ULS database maintained by the U.S. Federal Communications Commission (FCC).

NRAs approve or certify one or more entities to be AFC Operators. These AFC Operators use Incumbent Licensing Information provided through NRA Databases to comply with the responsibilities imposed by NRA regulations on AFC Operators.



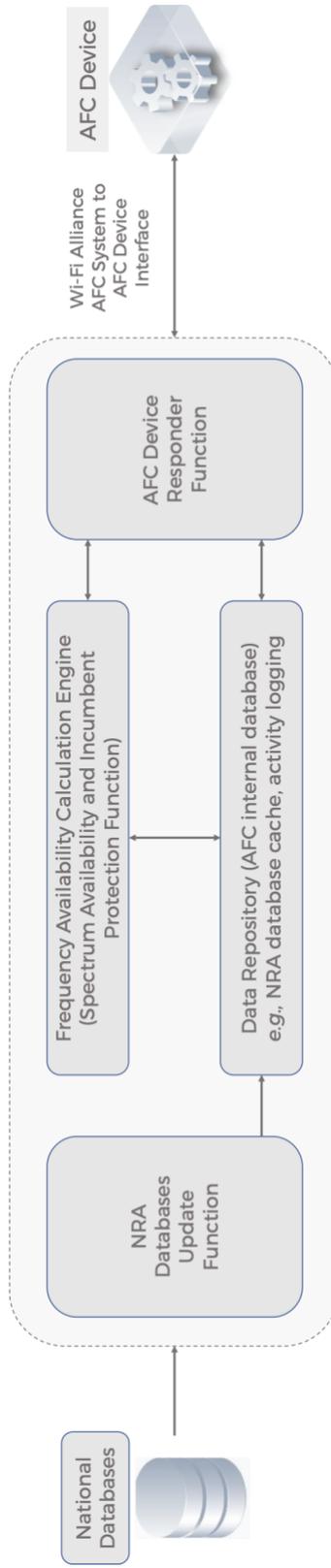
Open AFC System

The Open AFC System is an open-source software that can be customized by AFC Operators to:

1. Import and update data from NRA Databases identified by a national regulator (e.g., the ULS database in the United States and the Equipment Authorization System);
2. Acquire, register, and maintain information (e.g., serial number) from license-exempt AFC Devices (APs);
3. Validate the AFC Device by verifying the NRA Device ID (e.g., FCC ID) and ensuring the device is not on the AFC system's internal deny list, or a record of devices identified as unauthorized or prohibited by the NRA;
4. Respond to queries from AFC Devices with a data transmission providing the maximum allowed powers at each frequency as required by national regulatory requirements;
5. Provide a list of all permissible frequencies within the 6 GHz band to validated authorized AFC Devices; and
6. Retain necessary information to allow an AFC Operator to carry out AFC functions, comply with the recordkeeping requirements of an NRA, respond to NRA requests, and implement NRA mandates.

An AFC Device querying the AFC System using the Open AFC Software provides geographic location information to the AFC System. It may only select from the permissible frequencies and transmit power levels identified by the AFC System at that geographic location, A Client Device operates under the control of an AFC Device and may operate only at the allowed power levels indicated by the AFC Device, with a maximum power level that is consistent with NRA regulations for Client Devices.

Diagram 2 provides an overview of the Open AFC Software's functional architecture.



AFC Component	Description
NRA Database Update Function	This function imports data from the relevant NRA Database to determine if there are any changes to Incumbent Licensing Information, additions of information related to temporary fixed microwave links, changes to information related to border operations, and changes to the list of devices authorized/certified by the NRA to operate as AFC Devices. The Open AFC System will use this function to populate, update, and maintain databases (1) and (2) in the Data Repository Function.
Data Repository Function	This function houses three core datasets: (1) a database of incumbent services; (2) a database of access points that are authorized/certified to operate as AFC Devices, including specific AP identifiers and NRA authorization/ certification identifiers; and (3) a database of activity logs pertaining to frequency calculations and AFC Device activity to comply with NRA recordkeeping regulations. The Open AFC Software will update and maintain databases (1) and (2) through its NRA Database Update Function.
AFC System Frequency Availability Calculation Function	This function performs calculations to identify frequencies and power levels that are permissible for AFC Device operation at specific geographic locations. AFC Devices provide geolocation information through the AFC Device Responder Function. NRA Databases provide relevant Incumbent Licensing Information through the NRA Database Update Function.
AFC Device Responder Function	This function handles queries from AFC Devices and communicates either an error message to unauthorized or denied AFC Devices or a list of permissible frequencies and transmit power levels to validated AFC Devices. The Open AFC System will use the AFC System Frequency Availability Calculation Function to populate responses to AFC Device queries.

The Open AFC System enables individual AFC Operators to comply with NRA regulatory mandates through the combination of these five core functions. Individual AFC Operators may supplement these functions by integrating the Open AFC System into an AFC System that includes other hardware and software elements.



Note that the Open AFC System and AFC Devices will use the Wi-Fi Alliance AFC System to AFC Device Interface to communicate (see Wi-Fi Alliance, AFC Specification and Test Plans - https://www.wi-fi.org/downloads-registered-guest/AFC_Specifications_and_Test_Plans.zip/38132).

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