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DNAC BASED ANONYMOUS DFS (A-DFS) SERVICE

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ABSTRACT

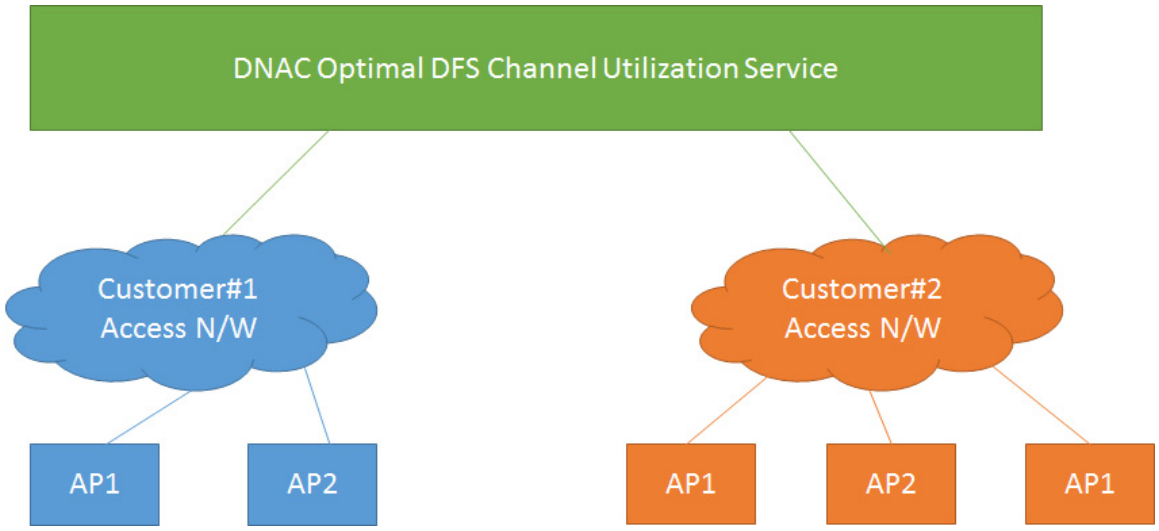
A service is provided to "anonymized" Dynamic Frequency Selection (DFS) data to provide an "A-DFS" Service. From every deployment that signs up for this service, DFS data is collected, e.g. channel information, dwell time, number of radars seen per unit time. This information is used to build a per channel radar statistics graph for different geographies (lat, long) ranges.

DETAILED DESCRIPTION

In a wireless local area network (WLAN), such as a Wi-Fi® wireless network, the number of wireless channels for providing service to clients are limited 4 (80 MHz) channels. Out of these, 2 are Dynamic Frequency Selection (DFS) channels, and if a radar is experienced on any DFS channel then it will potentially show up as a client outage (if the client gets disconnected in the process of channel change). Currently, if the AP moves from a busy channel (non-DFS) to a DFS channel there is a 60 sec regulatory wait interval – Call Admission Control (CAC) timeout. This will again cause an outage to the client. There is no way by which an access point currently knows if a DFS channel experiences or is likely to experience more radar.

Figure 1 below shows physically co-located (in the same vicinity) independent WLAN deployments sharing information through a Digital Network Architecture (DNA) Center (DNAC) service for better network performance.

Figure 1



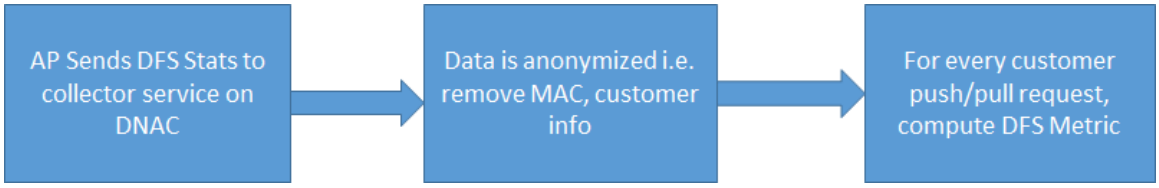
The A-DFS Service

A solution is presented herein that leverages the DNAC to provide a service that will provide "anonymized" DFS information, hence the term, "A-DFS" Service.

From every deployment that signs up for this service, DFS data is collected, e.g. channel information, dwell time, number of radars seen per unit time. This information is used to build a per channel radar statistics graph for different geographies (lat, long) ranges. A new metric is built inside the DNAC on a per channel basis: Radars detected/AP/HR.

This information is aggregated, anonymized and mapped to geolocation (information already present in DNAC) and exported to users of this service through an Application Programming Interface (API). See the example flow shown in Figure 2 below.

Figure 2



When a customer signs up for (buys) this service, the DNAC service will provide them data about DFS channels based on deployments from other customers.

For example, one customer in N. San Jose is seeing that channel 100 has been seeing radars 2pm - 2:30pm every week day. The Radio Resource Management (RRM) algorithm running on another customer setup, which is within 2 miles of that deployment, should not choose channel 100 at or around 2pm.

Multi-site deployment data is now available anonymized to the RRM algorithm on the controller. This will enable the RRM algorithm to make smarter decisions, resulting in fewer client outages, and happier network users. Also, since this data is anonymized, aggregated, and provided only to the controller, there is no further concern of privacy.

Network equipment vendors achieve improved network and client performance with fewer outage, better spectrum usage. Selling of DNAC licenses serves as another source of revenue for equipment vendors.

A-DFS is the first of its kind service related to sharing DFS data across customers by anonymizing the data. A unique metric is provided in computing DFS stats per area per unit time. This results in a new technique for visualization of DFS data through RF-Channel maps.

Example Implementation

AP component: Sends DFS stats periodically

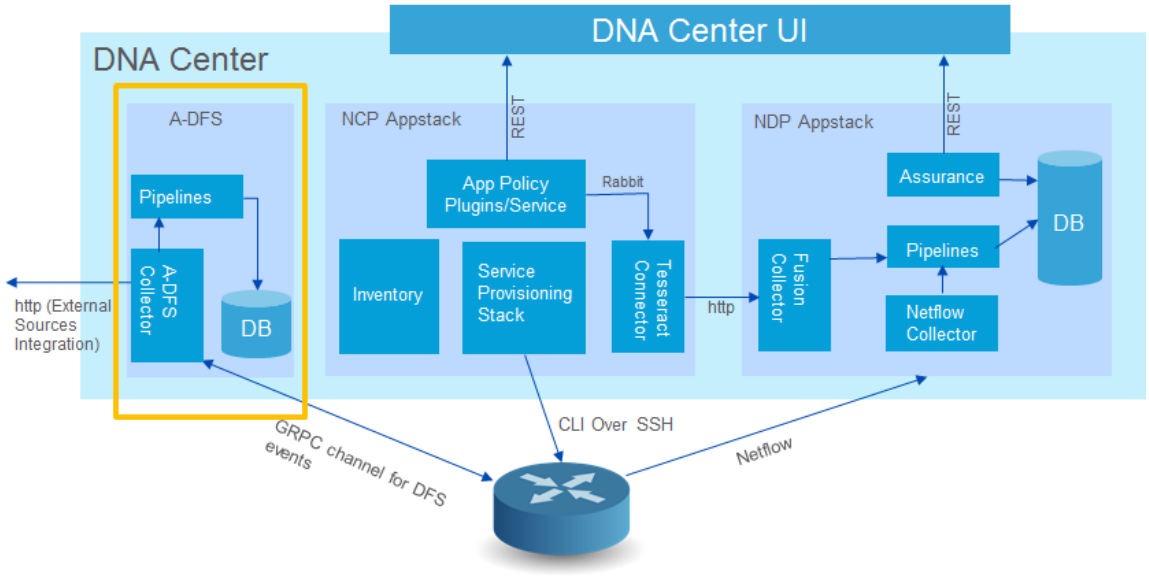
The format of this message may be:

```
// DFS State
message DfsState {
// Radio CAC state
uint32 CacState = 1;
// true if the radar was detected, false otherwise
bool RadarDetected = 2;
}
```

This information is aggregated using location information from a mobility services entity. Thus, using these statistics, DNAC will have the following information: (1) location of the deployment (APs), and (2) radar statistics.

Figure 3 below shows a block diagram of the DNAC component configured to implement the A-DFS solution.

Figure 3



A-DFS may hosted within DNAC as an independent application stack. There is a database to collect information from External DFS sources or DFS detection capable devices. Activation may be triggered through the "Provision->Services" function based on customer subscription.

Once the service is activated, DFS data is pushed from devices periodically (opt-in). The DFS metric will be pushed back to devices periodically. New detected events will be added to the database, so that reports with the new events will be displayed including their various attributes. When this data is received under DNAC, it will be anonymized by wiping out customer information such as MAC addresses, controller information, IP addresses etc.

Anonymized DFS (A-DFS) Schema

The following is an example of an A-DFS scheme.

Dep-Latitude	Dep-Longitude	Channel	Time (24hrs)	Radars/AP
37.4323 N	121.8996 W	100	22:05	3
40.7128 N	74.0060 W	149	01:50	2
**	**	**	**	**
**	**	**	**	**

The Radars/unit-AP is not consumed directly but normalized over time when a query is generated in the DNAC service, as explained below.

Metric for Geographic A-DFS Data

The following is an example of a metric that may be used:

$$Normalized\ A-DFS\_N = \bigvee APs\ in\ query\ radius\ on\ channel\ N\ \frac{\sum Radars}{\sum APs\ *\ \sum DetectionHrs}$$

Thus, when a query for a DFS statistic for a particular channel and a particular (lat, long, radius, channel, time interval) is raised, this metric is computed. This will indicate the number of radars detected on a particular channel over the last time interval.

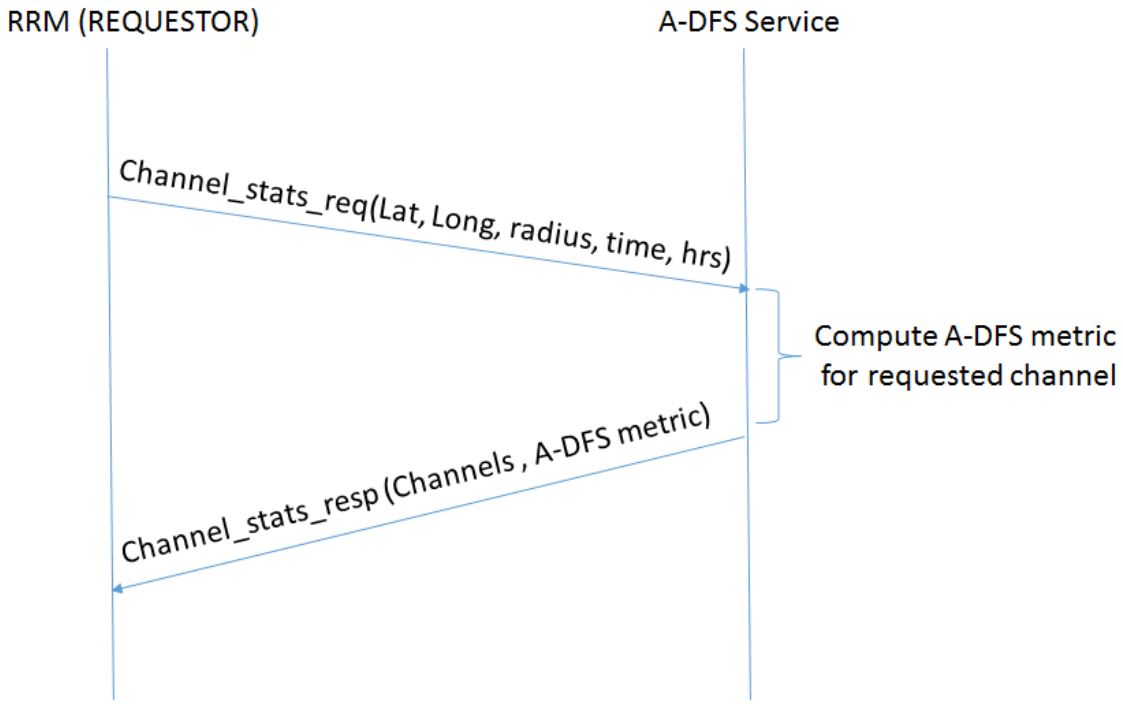
The smaller the DFS metric the better / more stable the channel.

How the A-DFS data and Metric are Queried

A-DFS will support both a push and a pull model under DNA-C. A pull model for getting data from the service is illustrated below in Figure 4. The push model is similar and uses a pub-sub approach.

Consumer of the service: This service is used by the Radio Resource Management (RRM) component running on the controller or DNAC (referred to as REQUESTOR). The use of this service in a deployment can also be enabled or disabled on the REQUESTOR (once the DNAC service subscription is in place).

Figure 5



The REQUSTOR queries for the channel_stats by specifying the channel, the location specs, query radius (Miles), time, and the window of time in which it wants the statistics to be computed. The window of time and query radius can be standardized or hard coded based on the RRM algorithm. However, these is shown for flexibility here. The A-DFS service will respond with the channel list and the computed A-DFS metric.

This information can be now used by the RRM algorithm independently in every deployment to pick a favorable DFS channel.

RF Channel Maps

Apart from feeding into the RRM mechanism on the REQUSTOR and making deployments more stable and efficient, the subscriber of the A-DFS service is also eligible to view this data from our unique RF channel maps user interface (UI).

Input: The user selects through a drop down: 1. DFS channel, 2. Location, 3. Viewing radius and Time.

Output: As shown below in Figure 6, the service computes the A-DFS metric as discussed above and plots it per deployment on a Maps API.

Figure 6

In summary, currently DFS channel selection is done independently per deployment. Locations which are geographically co-located benefit from leveraging the radar detection seen in the vicinity. An approach of combining intelligence across deployments is advantageous because: (1) each deployment independently comes up with smarter channel selection (2) the network equipment vendor wins because of a more stable customer deployments and revenue from selling licenses for a "differentiating" service.