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CREATING AVAILABLE BANDWIDTH HEATMAP FOR USER ASSIST TO RELOCATE BASED ON BANDWIDTH NEEDS

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ABSTRACT

A solution is presented herein for which an end-user of a wireless network does not know the channel utilization/interference conditions at a given location and also which location to go to meet their bandwidth needs. This solution provides a way to calculate the available bandwidth heatmap for a given floor map and a way for the user to visualize it using a mobile app. This solution also gives options to the user and provides a wayfinding solution to physically move to an area of better available bandwidth.

DETAILED DESCRIPTION

Reservation/admission control mechanisms are used to reserve wireless channel bandwidth based on the client Access Category and rate limiting is enforced based on the reservation. However, there is no way for the end user to know if a specific location has sufficient wireless (e.g., Wi-Fi® wireless network) bandwidth to accommodate bandwidth needs and which locations in a map will give user the desired bandwidth. There is no mechanism currently available to redirect the user to the physical location that satisfies their bandwidth needs.

A solution is presented herein by which a wireless network controller updates the channel utilization information of each access point (AP) radio to a management server entity and based on location of the APs on the floor, the management server entity generates a floor level available bandwidth heatmap. When the user requires a specific streaming application (for example, an WebEx® online conference with video streaming or a video streaming service), if the bandwidth limits are not met, then the user is given the heatmap information of the floor/building and presented with options on where to move to be able

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to serve the application. When the user chooses the desired location, then the application will provide a path to the location in the map.

With reference to Figure 1 below, the following is a description of the sequence of operations for this solution.

Figure 1
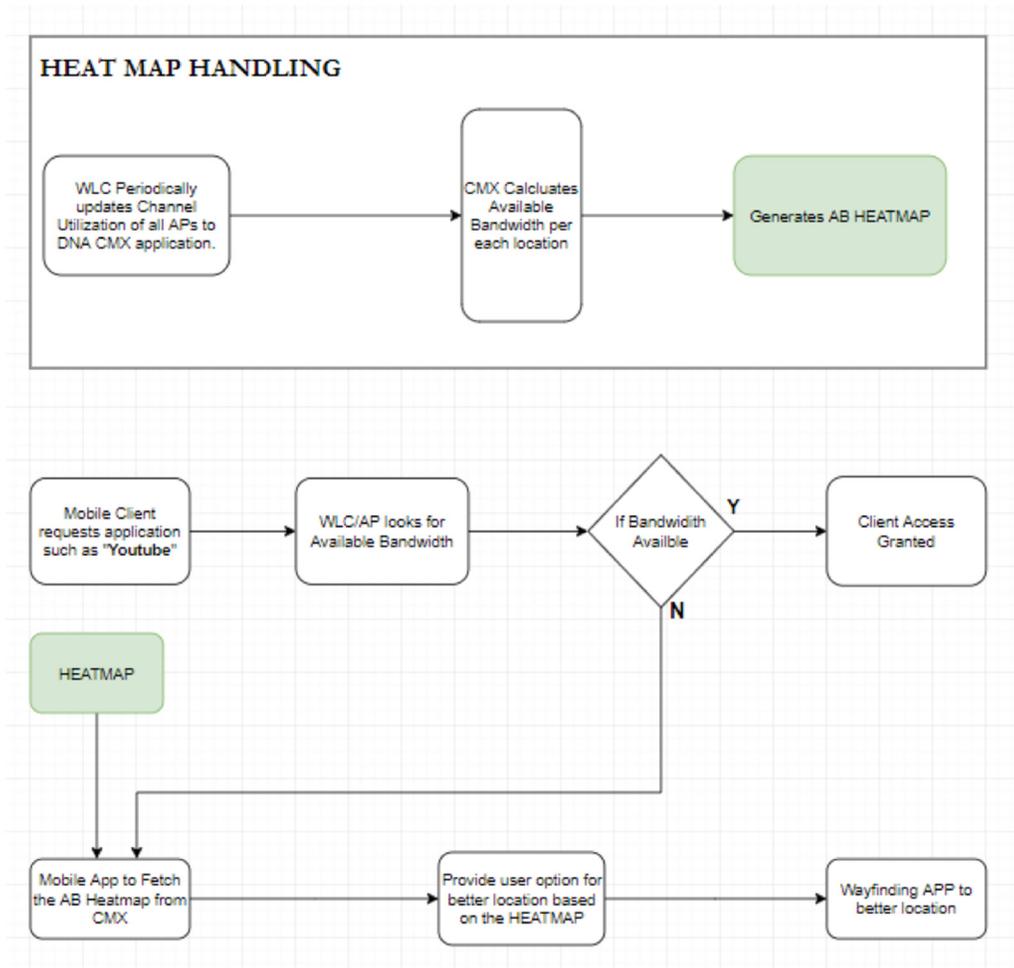
First, there is a periodic update of Channel Utilization (CU) information to a management entity. In Figure 1 and the description below, the management entity is referred to as the "CMX" which stands for Connected Mobile Experiences entity. The CU information of the AP radio is available at the wireless network controller (referred to as "WLC" in Figure 1) and updated on a periodic basis (such as every 3 mins) with AP reports.

The WLC updates the CMX entity on the CU value for each of these updates. There is an application running on the mobile device and it is referred to as a CMX application (app).

Next, the CMX entity calculates the heatmap of Available Bandwidth. With the Channel Utilization (CU) information on a per AP radio basis, the CMX entity calculate available bandwidth (AB) for each AP radio as: Available bandwidth = 100% - CU. This can be overlaid on the map (with the neighboring AP's AB information being averaged at any location on the map and also averaged across the 2.4GHz and 5GHz radio frequency spectrum). There may also be option for the user to see an overall averaged AB heatmap, a 5GHz network only AB heatmap or 2.4GHz network only (as a drop down selection in a user interface (UI) or a parameter option).

In the CMX mobile app, the AB heatmap can be made available. With this visual heatmap, the user will be notified about the network conditions before a call/streaming session is initiated and may change their location to an area with better AB values.

When the user tries to use a specific data/voice/video streaming application, the mobile device sends a Traffic Specification (TSPEC) with the bandwidth needs and the AP responds with a Call Admission Control (CAC) acceptance or rejection. If the request is rejected, then the mobile app will pull the AB heatmap for the floor/area and can give options to the user to move to a different location with a better AB value.

Integration of the AB heatmap to the CMX app will help the user with wayfinding to find a place with better AB value with turn by turn navigation on the same map.

With an IEEE 802.11v Basic Serviced Set (BSS) transition based on a mobile wireless client load, APs in a specific area are expected to be equally loaded to some extent. For example, 2 APs in a specific location is expected to be equally loaded to some extent. Even if they are unequally loaded, averaging is done for that area when calculating AB heatmap.

With the expansion of Outdoor APs and mesh networks, this solution can play an even more important role to find location pockets of good wireless network coverage and helps user plan accordingly.

One extension to this solution is for the wireless network controller to send Location-Based CAC (LB-CAC) parameters and thresholds to the CMX entity and the CMX entity can calculate heatmaps for voice/video/data separately and also calculate

whether the TSPEC will be accepted or rejected in a particular area. On mouse-over of the AP by the user on the heatmap, the medium time (MT) available for that AP radio can be displayed (MT is calculated based on the LB-CAC parameters and the voice/video threshold). MT available is the medium time available within a slot, and refers to the time available on the channel for any new traffic that needs to be added to the network. MT consumed is the time consumed by the existing traffic. MT available + MT consumed will be the total slot time. This will provide a quantitative indication to the user whether a voice call and/or a video streaming application will work even before the call is made.

Still another extension is to run predictive analytics (based on time of day/day of week) and provide the user with the potential AB values for a given date/time. For example, if the user is visiting a mall or a theme park, the user can plan their specific location within the coverage area for an important meeting.

In summary, a solution is presented herein for which an end-user of a wireless network does not know the channel utilization/interference conditions at a given location and also which location to go to meet their bandwidth needs. This solution provides a way to calculate the available bandwidth heatmap for a given floor map and a way for the user to visualize it using a mobile app. This solution also gives options to the user and provides a wayfinding solution to physically move to an area of better available bandwidth.

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