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Wi-Fi Rate Selection Using Machine Learning Models

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ABSTRACT

When a Wi-Fi device tries to connect to access points, it picks a channel, rate, and a particular access point (AP) out of a potentially large number of selections. Different selections result in different quality of user experiences, e.g., as measured by throughput and latency.

In many circumstances, the device has a past history of connecting to various access points in or near its current location. With user permission, this disclosure uses trained machine-learning models and the past history to select an optimal channel, rate, and access point. The selections made using this technique can result in superior throughput, latency, and can improve user experience.

KEYWORDS

- Wi-Fi
- access point selection
- context-based connection
- router selection
- quality of experience
- machine learning

BACKGROUND

When a Wi-Fi device tries to associate or re-associate to an access point (AP), it scans and potentially finds multiple basic service sets (BSS) with the same SSID. While establishing the connection, the device selects a variety of parameters, e.g., AP (or multiple APs with the same SSID, if over a large area), channel (e.g., 5 GHz vs. 2.4 GHz), rate, etc. Different selections yield different quality of user experience, e.g., as measured by throughput and latency.

DESCRIPTION

This disclosure provides techniques that make use of machine learning techniques to enable improved selection of Wi-Fi parameters such as AP, channel, rate, etc., given current user location and context, and in light of past history of connection with various access points. Information such as user location, context, past history, etc. is utilized for selection only upon express user consent. For users that do not provide such consent, the information is not accessed, and selection of AP is made without use of such factors, e.g., using conventional techniques.

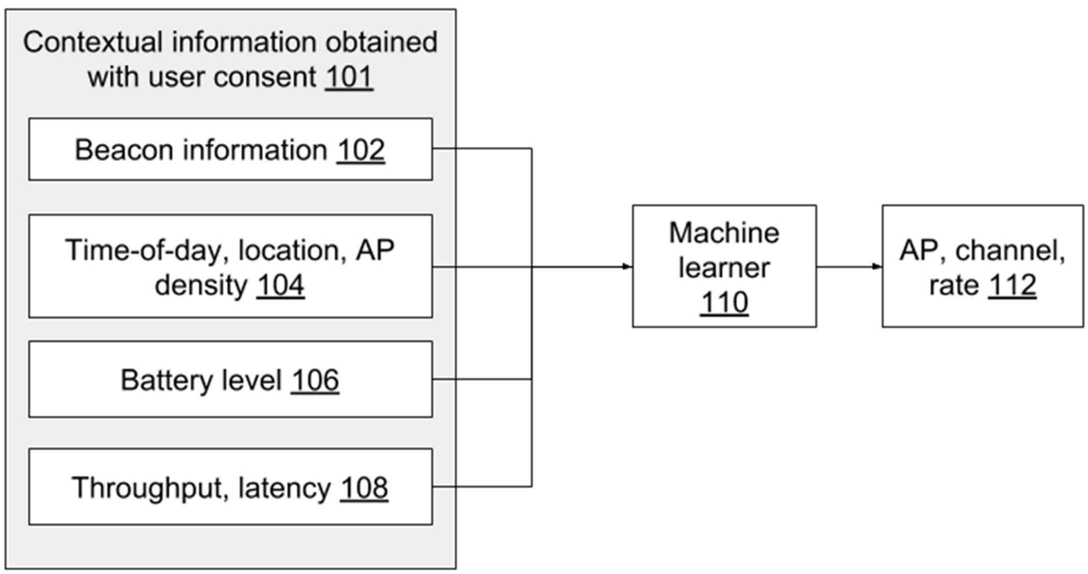

Fig. 1: Applying machine learning to select Wi-Fi parameters

Fig. 1 illustrates use of machine learning techniques to select optimal Wi-Fi parameters, per the techniques of this disclosure. A machine learner (110) is fed with contextual information obtained with user consent (101). Such information can include one or more user-permitted input features, e.g.,

- beacon information (102), e.g., signal strength, modulation-and-coding scheme, rate, channel state information, etc.;
- time-and-place features, such as time-of-day, location, AP density (104), etc.;

- device parameters, e.g., battery level (106), etc.;
- connectivity parameters, e.g., throughput, latency (108), etc.

A service in the device is used to measure input features including throughput, latency, etc. on a periodic basis. The machine learner is trained on the input features and maps these input features to Wi-Fi parameter selections, e.g., access point (AP), channel, rate (112), etc. The machine learner may be pre-trained, e.g., using training data. When permitted by a user of the Wi-Fi device, the machine learner can also improve Wi-Fi parameter selections as more samples of contextual information and parameter selections become available and are used as feedback.

The machine learner may be a multi-layer neural network, e.g., a long short-term memory (LSTM) neural network. Other types of models, e.g., recurrent neural networks, convolutional neural networks, support vector machines, random forests, boosted decision trees, etc., can also be used.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

When a Wi-Fi device tries to connect to access points, it picks a channel, rate, and a particular access point (AP) out of a potentially large number of selections. Different selections result in different quality of user experiences, e.g., as measured by throughput and latency.

In many circumstances, the device has a past history of connecting to various access points in or near its current location. With user permission, this disclosure uses trained machine-learning models and the past history to select an optimal channel, rate, and access point. The selections made using this technique can result in superior throughput, latency, and can improve user experience.