



### **Utilizing Location Analytics for Telesystem Managed WiFi**

With the rapid adoption of mobile devices, many organizations can now leverage data to better understand foot traffic patterns and behavior in a brick-and-mortar environment. This location information, based predominantly on 802.11 wireless and Bluetooth standards, can be used to engage users and optimize marketing strategies. For retail, this can help combat trends such as the erosion of in-store sales to online retailers, who for years have had access to similar data via the analytics produced by online tools (e.g., click-through conversion rates from online advertising).

Smartphones with WiFi can now be used as an indicator of customer presence thanks to a WiFi mechanism that is common across all such devices: probe requests. These 802.11 management frames are transmitted at regular intervals from WiFi devices. The frames contain information that can be used to identify presence, time spent, and repeat visits within range of a WiFi access point. These devices can be detected by WiFi access points irrespective of its WiFi association state meaning that even if a user does not connect his or her device to the wireless network, the device's presence can still be detected while the device is within range of the network and the device's WiFi antenna is turned on .

Since smartphones now have greater than 50% penetration across the general population, probe requests can be used to build and detect a statistically significant data set regarding the presence of WiFi enabled devices within range of a given access point. Telesystem wireless Access Points and cloud infrastructure gathers this data and presents it in aggregate on a web accessible dashboard. This is done through intuitive and customizable graphs that can be used to understand trends such as capture rate (passersby vs. visitors), user engagement (total time spent), and visitor loyalty (new vs. repeat visits). Telesystem is able to provide these analytics to all organizations by leveraging industry-leading cloud architecture. Additionally, APIs are capable of exporting raw data from the observed probe requests, which organizations can use to integrate directly with third-party data warehousing or analytics platforms. Not only can this facilitate a deeper integration with traditional customer relationship management (CRM) platforms, but, due to its real-time nature, it opens doors to next-generation customer engagement initiatives.

#### Location Data Collection

Wireless Access Points generate a presence signature from any WiFi-enabled device by detecting probe requests and 802.11 data frames, whether or not the device is associated to the network. WiFi devices typically emit a probe request at regular intervals based on the device state (see table below). Smartphones send probe requests to discover surrounding wireless networks, so that they can make the networks available to the user.

Device State	Probe Request Interval (smartphones)
Asleep (screen off)	About once a minute
Standby (screen on)	10-15 times per minute
Associated	Varies, could require user to manually search for networks

Probe request interval seen on smartphone OS vendors (iOS, Android, others) - varies greatly based on apps, device upgrades, and other factors.

Data frames received from all connected WiFi devices and probe requests detected from all devices seen within range (typically up to 100 feet or more) generate "seen device" events on WiFi Access Points. Triple-radio APs have a dedicated scanning radio that listens for probe requests 24x7 on all channels. Dual-radio APs lacking the scanning radio can hear probe requests when WiFi devices probe across all channels. Seen device information is uploaded through the secure management tunnel between the access point and the cloud controller.

Secure management tunnels are highly optimized for sending and receiving configuration statistics and high volumes of information, and the added overhead from seen device data is close to negligible; the total bandwidth consumed by the management tunnel remains around 1 kbit/s.

Access Points also detect the signal strength of data frames and probe requests, which can be used to estimate the physical position of the WiFi devices.



# Data Aggregation and Display

Once received by the cloud-based controller, presence signatures from all of the APs in a network are aggregated. After aggregation, data from each observed client device undergoes a series of computations to categorize it for later presentation. For example, retailers need to understand capture rate, which is the ratio of people passing by the store versus actually coming inside. To determine capture rate, analysis is performed on the signal strength of each client device, along with the time spent within that location (a high signal strength on its own may not indicate a visitor if they are simply passing by the storefront quickly).



There are a number of different client states that are created and stored in databases, computed using a variety of techniques.



# Location Analytics

While the above computations are run in real time to calculate the various client states, the online dashboard displays it via intuitive graphs that visualize capture rate, engagement, and loyalty. These graphs can be toggled between simple and complex views. The graphs may be configured to produce information over custom time ranges that may show hourly, daily, weekly, or custom ranges defined by the user.



## Value for Marketing and Business Intelligence Teams

The goal behind all of the data analytics and graphs presented is to provide a platform for both IT and non-IT departments to understand user presence. By understanding patterns such as foot traffic by time of day and how the capture rate varies across different sites, IT departments can gain a better understanding of network usage and trends, and non-IT departments, such as marketing and business intelligence teams, can gain insights and answer questions such as "Is my new marketing campaign at site A working based on the foot traffic numbers or do I need to staff more people at site B during peak hours?". Some of the different use-cases for which Location Analytics could be useful are highlighted below.

#### Use-Cases

- Detect total client visits
- Analyze and optimize window conversion
- Optimize staffing by time of day
- Analyze visitor dwell-time and repeat frequency
- · Compare across sites or take averages for sets of sites to understand below or above-average store foot traffic, dwell-time and repeat frequency
- Optimize and run A/B tests to see if changes in one variable affect outcome of measurable parameters (e.g. capture rate)
- · Analyze data and compare to external KPIs (e.g. average spend per site, average spend per user, average cost per store)
- Prepare network for weekly or seasonal fluctuations by optimizing policies
- · Correlation of location analytics data with traffic analysis and device fingerprinting data for 360-degree view of user presence, devices and online behavior



### Location Heatmaps

Part of Telesystem's Managed WiFi location capabilities include the ability to visualize where people are spending time inside a particular location over the course of the day (regardless of whether or not their devices are associated to the wireless network). This data is overlaid on a floor plan and can give network administrators and marketing/operations teams information on guest foot traffic flows within certain parts of a store or building. In order to attain the required level of location accuracy, the client probes should be heard by 3 or more APs to be overlaid on the floor plan.



Floorplans can be toggled for views on different floors, along with the ability to remove the APs from the display or display different metrics on the APs (e.g. model number, current client count, historic client count, etc). The heatmap page includes a "playback" function, making it possible to see how the client density changes throughout the course of the day.

The heatmaps are calculating using two metrics - (a) the number of devices were detected during the time period, and (b) how long those devices dwelled in the area. The heatmap will also plot the calculated location of clients within the wireless network.