

P-Tracer: Proximity Detection for Contact Tracing

Laxmi Thakare
Arista Networks
Pune, India

laxmi.thakare-ext@arista.com

Ruchi Dohare
Arista Networks
Navi Mumbai, India

ruchi.dohare@arista.com

Nadeem Akhtar
Arista Networks
Navi Mumbai, India

nadeem.akhtar@arista.com

Abstract— COVID-19 pandemic has impacted millions of people worldwide. To tackle the spread of disease, governments all over the world had to impose sudden lockdowns with strict restrictions and has resulted in stressing most of the enterprises on the financial fronts. As the governments all over the world are now relaxing the restrictions, businesses are re-opening gradually and employees are returning back to work. There is huge responsibility on the enterprises to stay vigilant when an employee tests positive for COVID-19. To target the issue, we have come up with a contact tracing solution, P-Tracer application which uses users wifi association data from Arista Networks' Cloud-Vision Wifi. This paper shortly presents the P-Tracer application working principle. We claim that the application will be useful in tracing the users association journey and detection of new hot zones and possible new cases.

Keywords— Contact tracing, COVID-19, P-Tracer, WiFi, Hotspot, Proximity Tracing, Work From Home, Social distancing

I. INTRODUCTION

The COVID-19 pandemic has significantly affected all aspects of human life. The highly contagious nature of coronavirus has led to enforcement of social distancing. In the early days of the pandemic, Work From Home (WFH) became the norm but due to socio-economic imperatives, workplaces are gradually reopening. In order to ensure health and safety of employees, social distancing is being enforced in the workplace[1]. In addition, whenever someone reports positive, extensive contact tracing[2] is required to identify co-workers who may have come in contact with the person of interest.

While Governments across the globe have invested in developing mobile apps to help in contact tracing, the challenge has been to enforce the use of such applications. In workplaces with existing wireless infrastructure, it is possible to detect the presence of employees at a particular location/time with the help of users WiFi activity logs[3], without forcing them to download any applications on phones or laptops.

With the aim of reducing COVID-related risk in the workplace by leveraging existing wireless infrastructure, Arista Networks[4] has developed the P-Tracer application with the following key objectives:

- Hot Zone Alerting: Identify areas that exceed allowed occupancy.
- Person of Interest Journey: Track the location history of person(s) of interest.

II. IMPLEMENTATION

The P-Tracer application makes use of existing WiFi association records to re-create the Association Journey of each user who got connected to the network over a given time period. For the purpose of the discussion which follows, we define the following terms[4]:

Person of Interest (PoI): User of a WiFi enabled device identified by one of the following:

- User name used for 802.1x authentication
- Device name
- Device MAC address

Proximal PoI: User of a WiFi-enabled device detected in the proximity of a PoI, identified by one of the following:

- User name used for 802.1x authentication
- Device name
- Device MAC address

Presence Hotspot: Area around an AP to which the device with logged in user of the PoI was associated with at the time under consideration.

High Presence Zone: Area around an AP with which more than "x" number of devices got associated. The P-Tracer application addresses two distinct use cases:

1. Generate a daily association history of employees and guests in the workplace.
2. Given a PoI and a time period, generate a multi-day association journey for the PoI.

The key challenge here is that WiFi association records pertain to devices, not humans. In order to identify the owner of the associated device, we relied on the username provided by the device owner while connecting to the WiFi network. This approach worked for company-issued devices such as laptops or personal devices such as phones which connect to the enterprise network using 802.1x authentication. While this method worked for employees, it could not capture details of guests or visitors. For this purpose, we used the details provided by the guests while registering for access to the Guest WiFi network.

For a given PoI and a time duration, the Association Journey was created as shown in Fig1.

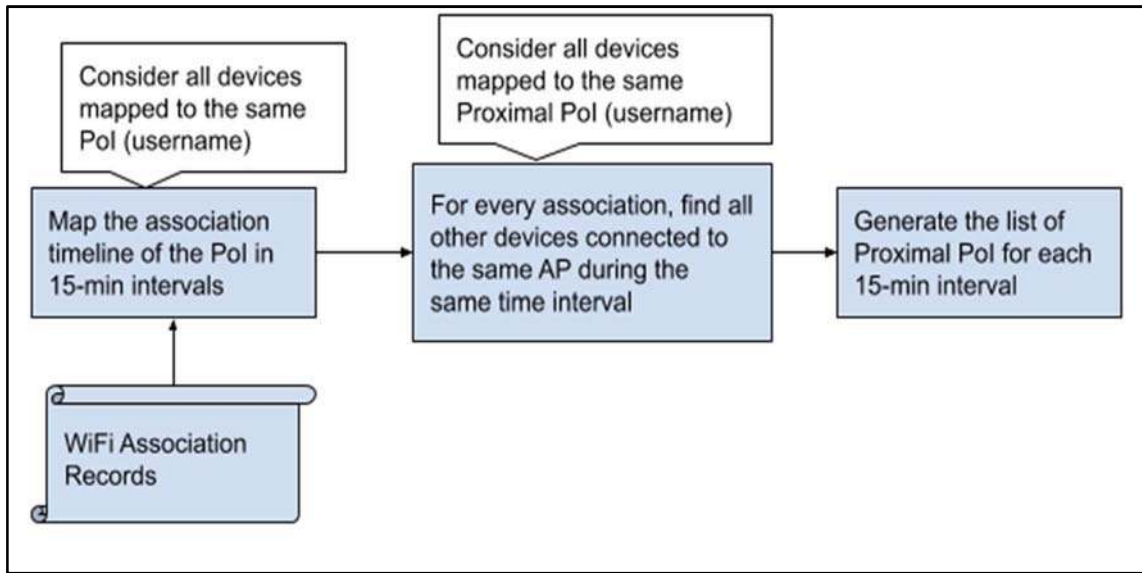


Fig. 1 Association Journey FlowChart

Table I shows sample entries in the Association Journey of a PoI, identified by the username ‘CL123’, mapped to the device with MAC address ‘AA:BB:CC:DD:EE:FF’.

Table I. PoI Association Report

Client MAC	Client Username	Date	Start Time	Association Duration (min)	AP Name	AP Location
AA:BB:CC:DD:EE:FF	CL123	mm-dd-yy	hh:mm	t1	AP123	/X/Y/Z

Table II. PoI Contact Mapping Report

Client MAC	Client Username	Date	Start Time	Proximal Clients List
AA:BB:CC:DD:EE:FF	CL123	mm-dd-yyyy	hh:mm	(FF:AA:BB:CC:DD:EE, CL456), (EE:BB:CC:DD:AA:FF, CL789)

Fig. 2 shows a graphical view of a PoI’s Association Journey over a 24-hour period. Each bar represents an association during a given 15-minute interval, with the height indicating the duration of association. From the WiFi association records, we also determined the number of users connected to each AP during each 15-minute interval.

Table II shows the entries containing the list of all the Proximal PoIs for each 15-min interval for a PoI, identified by the username ‘CL123’, mapped to the device with MAC address ‘AA:BB:CC:DD:EE:FF’.

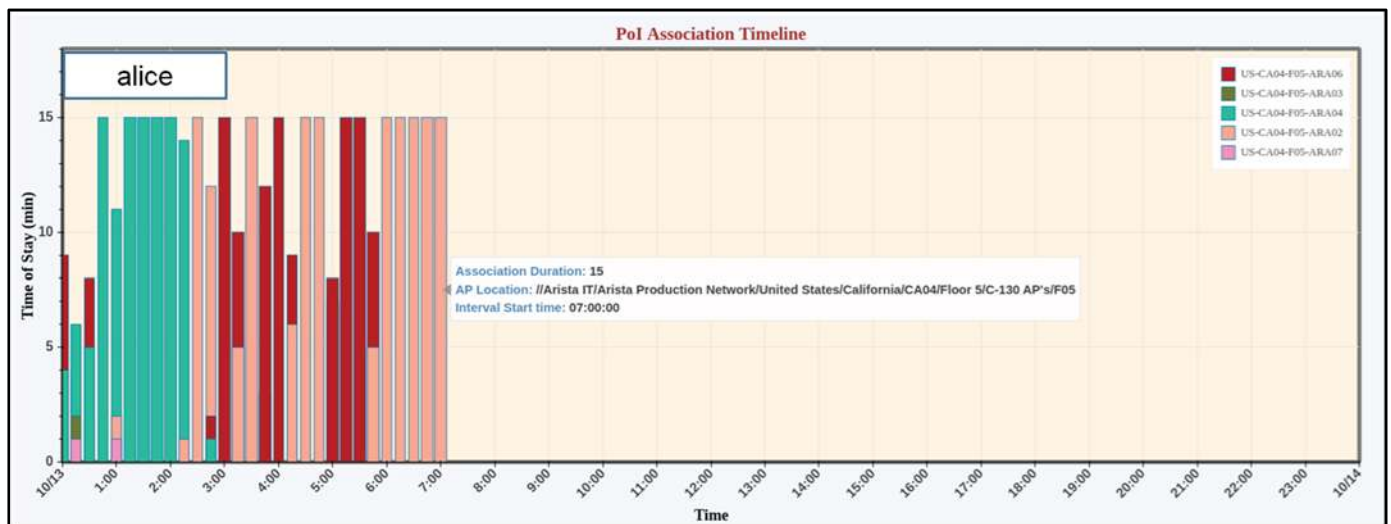


Fig. 2 PoI Association Timeline

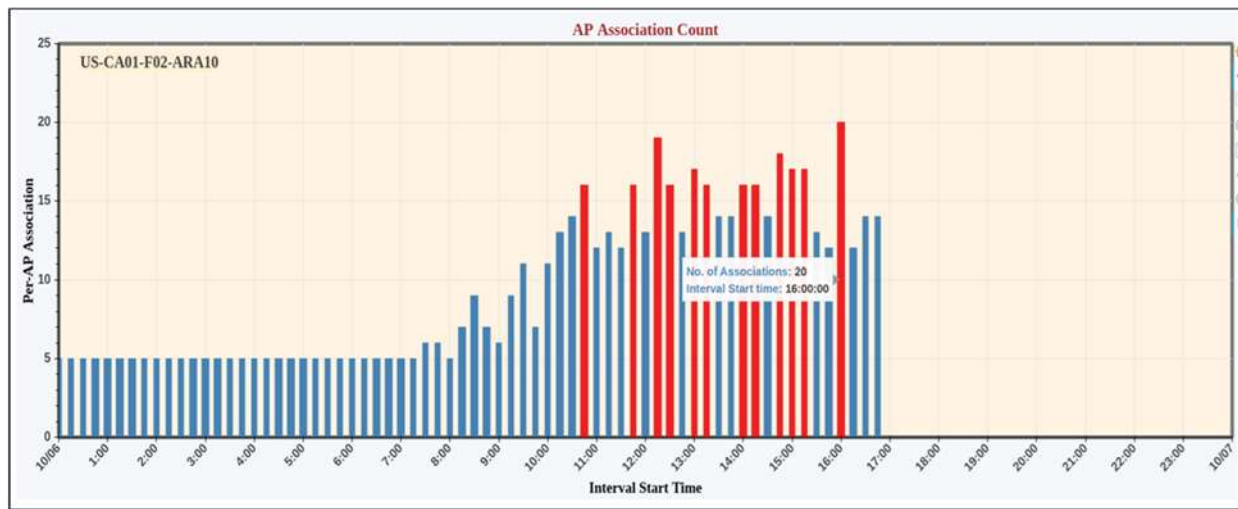


Fig.3 AP Association Count

Fig. 3 shows the number of users associated with a given AP over a 24-hour interval. The red bars indicate a High Presence Zone, i.e. cases where the user count exceeded the pre-defined threshold value.

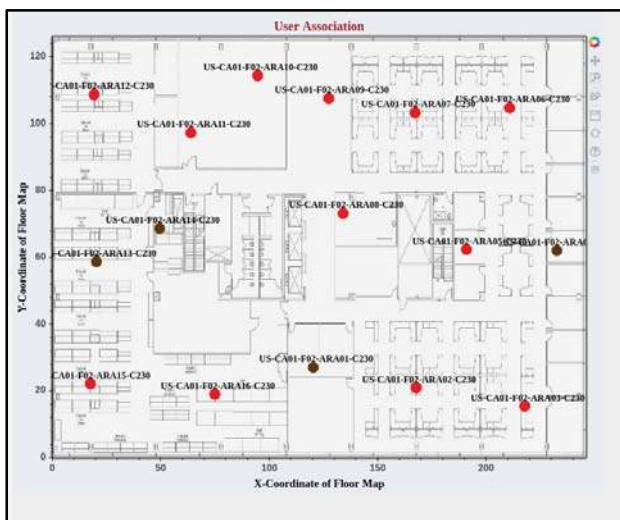


Fig.4 Hot Zone

Fig 4. shows hot zones on the location map of the organisation. Where red circles indicate location of APs with exceeded allowed occupancy these are referred to as high occupancy zones. Green Circles refers to AP locations with an under allowed occupancy threshold limits whereas brown circles on the location map show locations with no client associations.

Hot zones on the location map helps in identifying the areas where a large number of clients are getting connected to AP and getting in proximity with each other. This helps authorities to take timely actions to avoid overcrowding within the organisation.

In addition to the visual information, all the analytics are also available in CSV format so that it can be ingested by other systems and applications. For instance, the High Presence Zones data can be used by the Facility Management team to ensure that overcrowding does not take place in future.

Another challenge was to ensure data security and privacy[4]. This was addressed by making the application deployable on-prem, i.e. within the enterprise network. Thus, only authorized employees had access to the analytics generated by the application. Further, to obtain the WiFi Association Records, we use HTTPS-based REST APIs to connect with the Arista Wireless Manager and Arista Guest Manager, which can be located in the public cloud or inside the customer's network. Finally, the raw data and all analytics reports are automatically purged after 30 days to comply with the GDPR requirements.

The application itself is very lightweight with relatively modest storage and compute requirements. It can be deployed on any standard Linux server as a Docker image.

III. CONCLUSION

P-Tracer Application was developed with a vision to help authorities in monitoring and taking timely efforts to reduce the spread of COVID-19 within an organisation. It leverages existing network infrastructure and uses WiFi association records to generate association history of users and occupancy in different parts of a floor or a building. This information is made available in the form of CSV files as well as graphical reports via an interactive browser-based UI. P-Tracer application can assist in rapid contact tracing and to reduce the COVID-related risk in the workplace.

IV. REFERENCES

- [1] Mark Barnes, J.D., LL.M., and Paul E. Sax, "Challenges of "Return to Work" in an Ongoing Pandemic", The New England Journal of Medicine, DOI: 10.1056/NEJMsr2019953 Copyright © 2020 Massachusetts Medical Society.
- [2] World Health Organization, feature story., "Tracking COVID-19: Contact Tracing in the Digital Age", 9 September 2020, [Online]. Available: <https://www.who.int/news-room/feature-stories/detail/tracking-covid-19-contact-tracing-in-the-digital-age>.
- [3] Andrew Froehlich, "Wireless Technology Considerations for COVID-19 Contact Tracing". [Online], Available: <https://www.networkcomputing.com/wireless-infrastructure/wireless-technology-considerations-covid-19-contact-tracing>, Aug 20,2020
- [4] Arista Networks, "P-Tracer Application," Arista Networks Inc, 2019. [Online]. Available: <https://wifihelp.arista.com/post/p-tracer-application>.