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# DP-ACT: Decentralized Privacy- Preserving *Asymmetric* Digital Contact Tracing

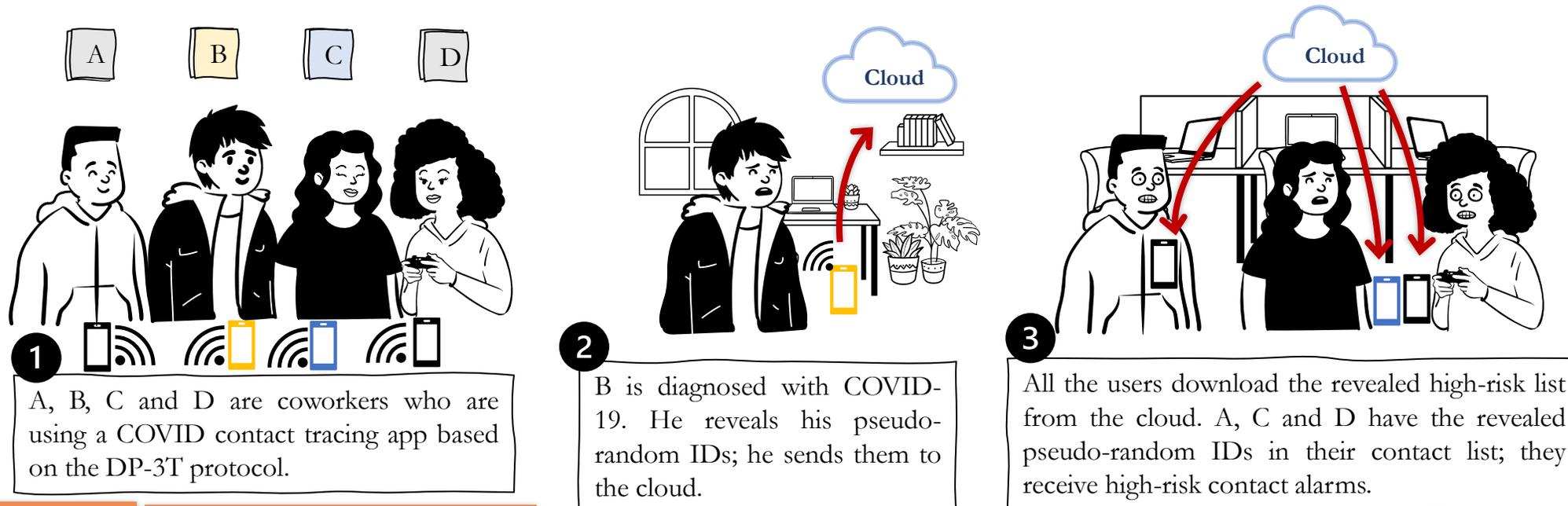
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# Introduction

- **Digital contact tracing** identifies high-risk contacts during pandemics.
- State-of-the-Art Protocol: Decentralized Privacy-Preserving Proximity Tracing (**DP-3T**)



Broadcasts Ephemeral Pseudo-Random IDs

Record

- Ephemeral Pseudo-Random IDs
- Time
- Exposure Measurement

Upload  $(i, seed_i) \cong$  Ephemeral Pseudo-Random IDs

# Motivation: Limited Adoption of Digital Contact Tracing

During the COVID-19 pandemic adoption of digital contract tracing was limited due to **privacy concerns**.

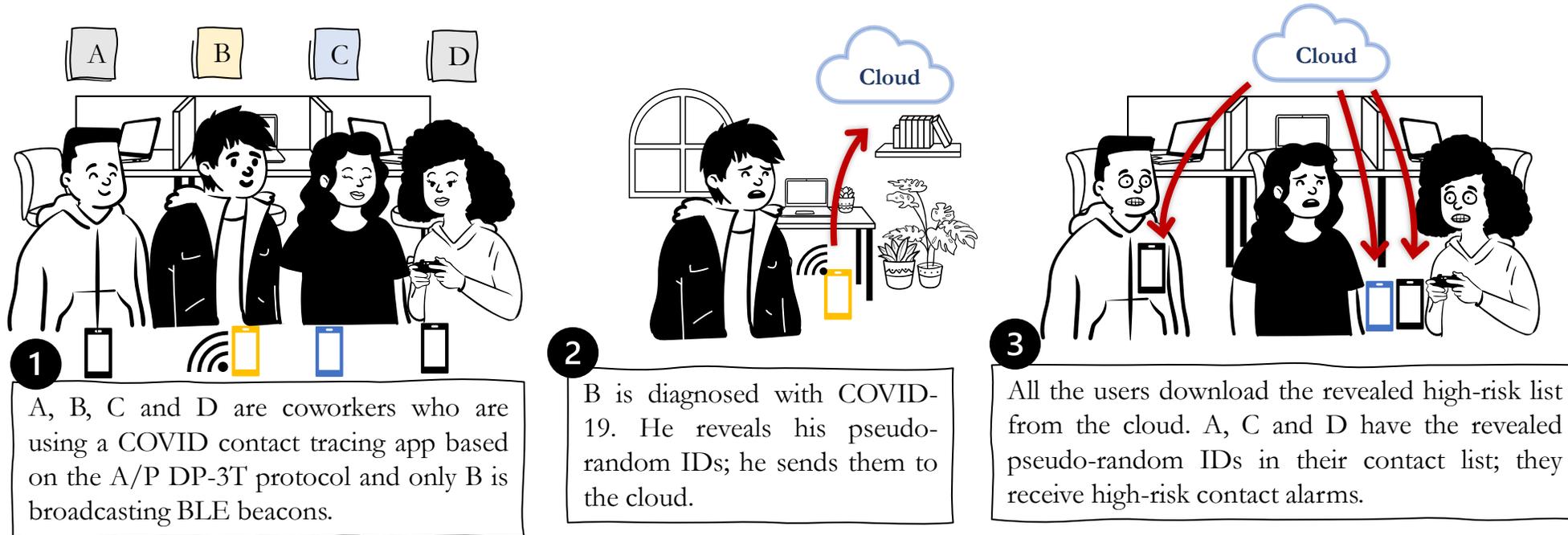


A, B, C and D are coworkers who are using a COVID contact tracing app based on the DP-3T protocol and only B is broadcasting BLE beacons.

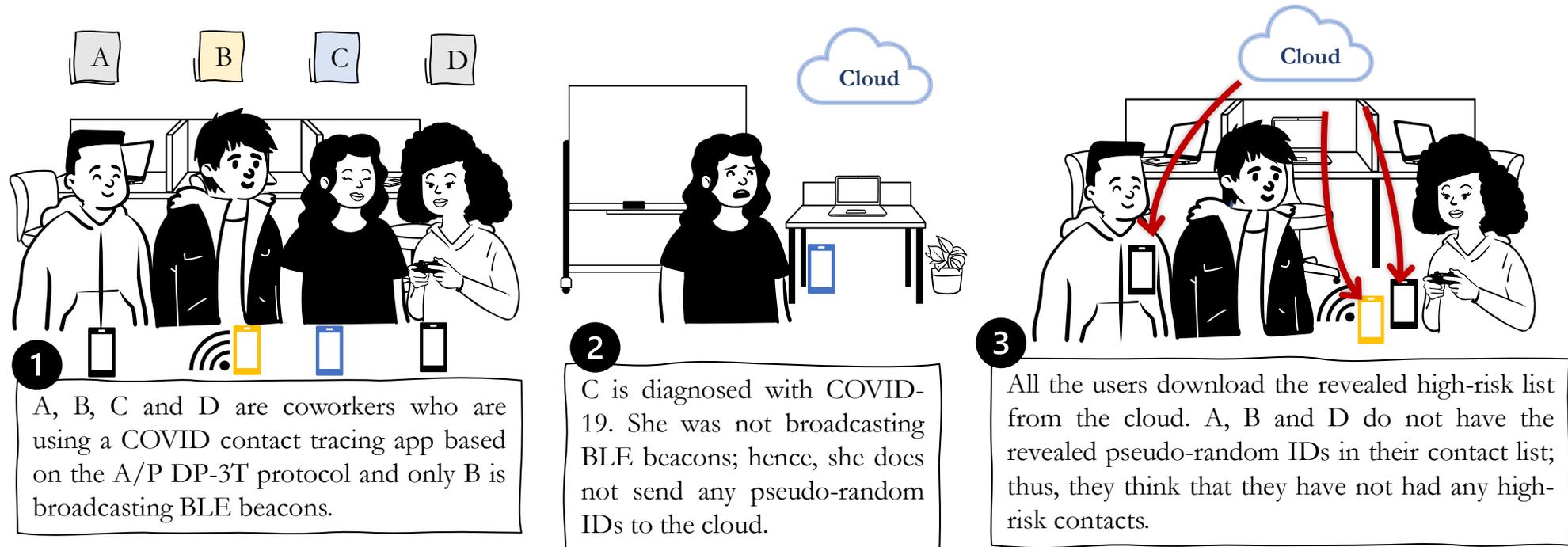
Our research question: ***Can the participation of users who never actively broadcast BLE beacons but passively listen to BLE beacons improve the precision of contact tracing?***

# Extension: Active/Passive DP-3T (A/P DP-3T)

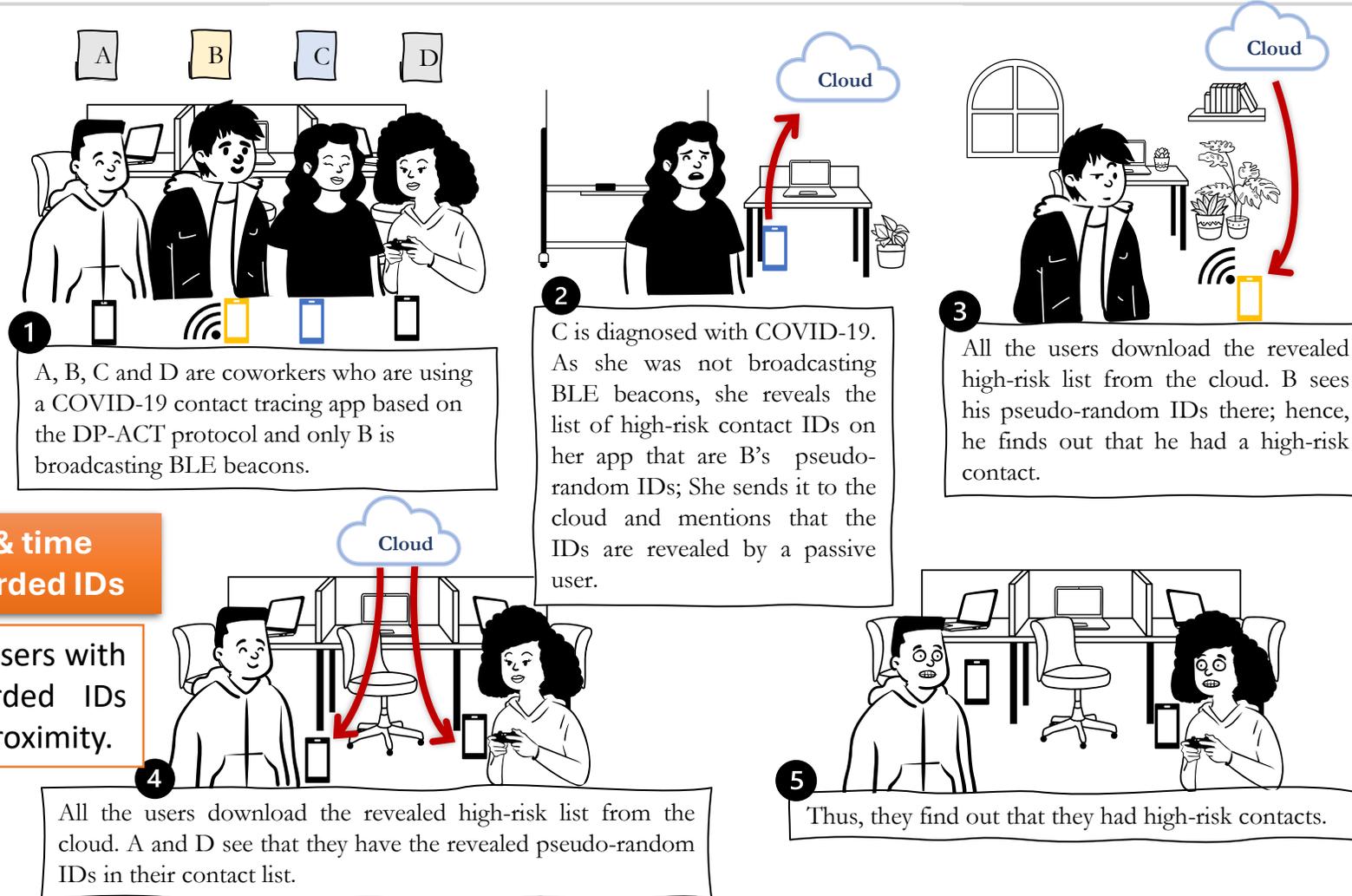
- **Active Users:** Broadcast BLE beacons, simultaneously record broadcasted IDs from others.
- **Passive Users:** Only record broadcasted IDs from other devices.



# Limitations of A/P DP-3T: Passive Users Do Not *Notify*



# Decentralized Privacy-Preserving *Asymmetric* Contact Tracing (DP-ACT)



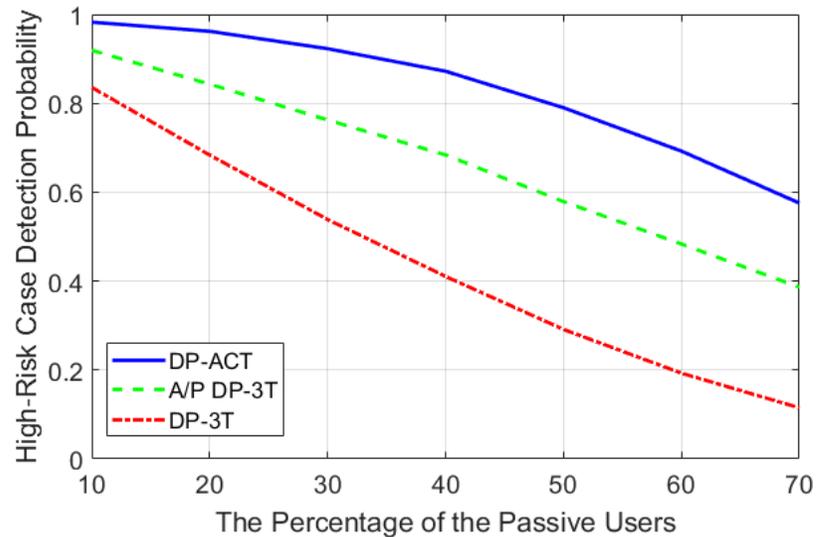
same place & time  
→ same recorded IDs

Key idea: passive users with overlapping recorded IDs indicate physical proximity.

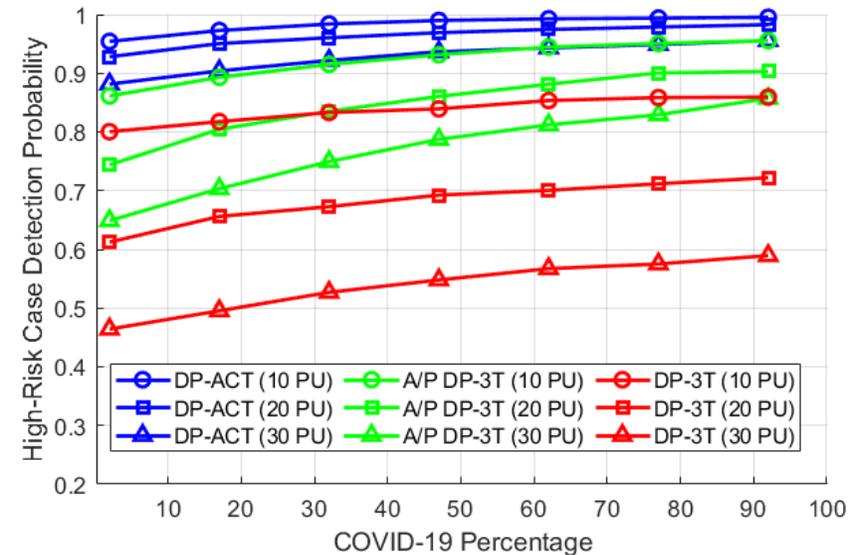
It is sufficient to have at least one active participant in each contact group in order to be able to detect all high-risk contacts.

# Evaluation: Face-to-Face Dataset [1]

- Dataset contains face-to-face interactions of individuals measured over 12 days in an office building.



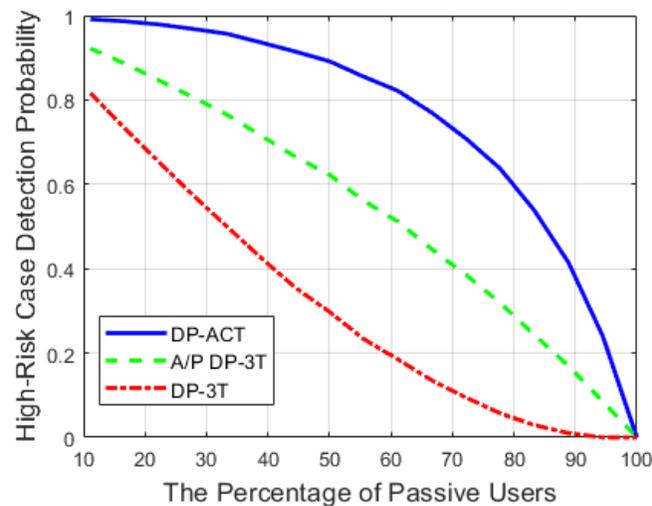
30% of users are diagnosed with COVID-19 and willing to notify others.



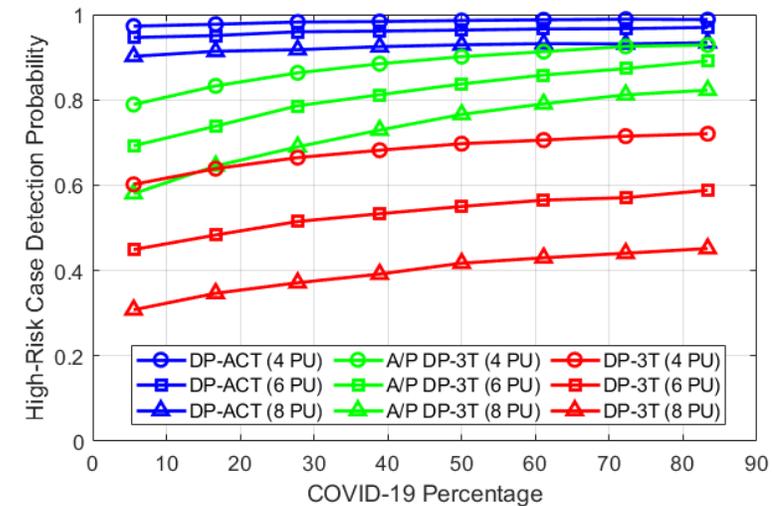
[1] Mathieu Génois and Alain Barrat. 2018. Can co-location be used as a proxy for face-to-face contacts? EPJ Data Science 7, 1 (2018).

# Evaluation: Real BLE dataset [2]

- Real-world BLE datasets collected considering five different scenarios: dining together, riding a train together, working in an open-space setting, waiting in line at the supermarket, and mingling in a club/bar.
- 20 users participated in these data collections.



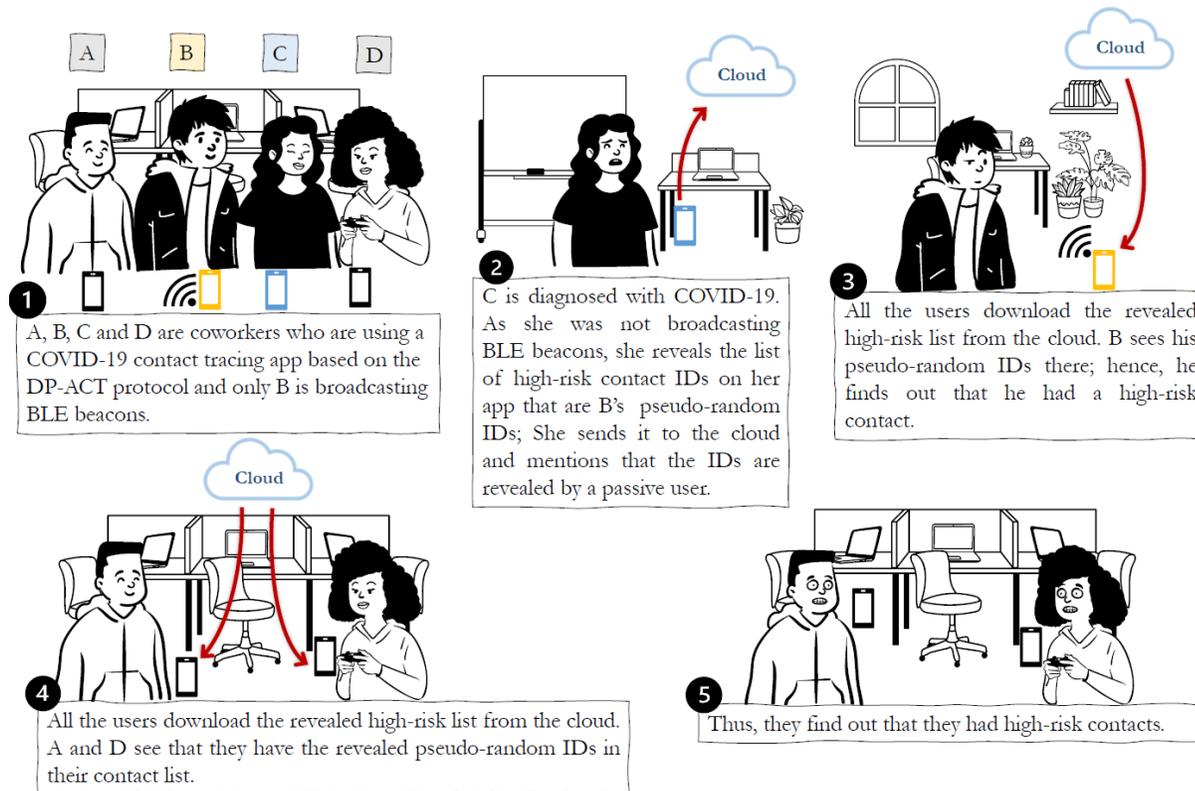
5 users are diagnosed with COVID-19.



[2] Mathias Payer and Daniele Antonioli. 2020. BLE measurements for GAEN/DP-3T contact tracing. <https://github.com/DP-3T/bt-measurements/tree/ba9f73962b35260e12e2c0a8a37af5c6195d22a8>.

# Conclusion: DP-ACT Significantly Improves the Precision of Digital Contact Tracing

Allowing conservative user who do not want to broadcast BLE beacons to participate in the Digital Automatic Contact Tracing can significantly improve high-risk contact identification.



Paper:  
<https://petsymposium.org/popets/2024/popets-2024-0019.pdf>



Code:  
<https://github.com/AzraSA/DP-ACT/tree/main>