

Overview of Digital Contact Tracing Technologies and Data in Mapping@Brown

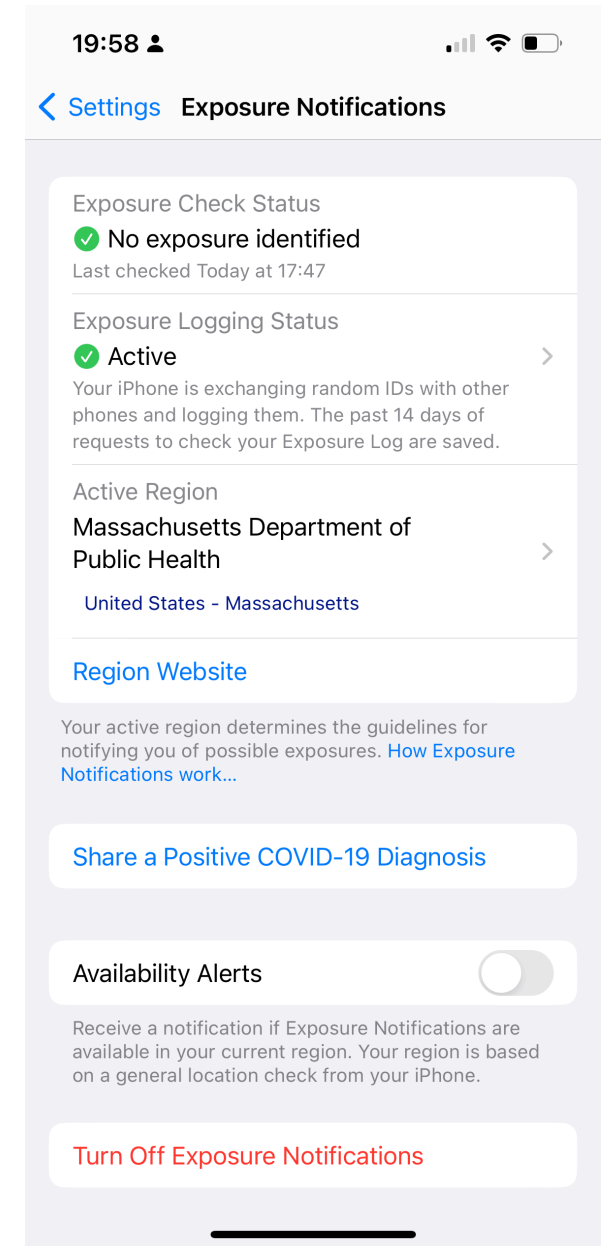
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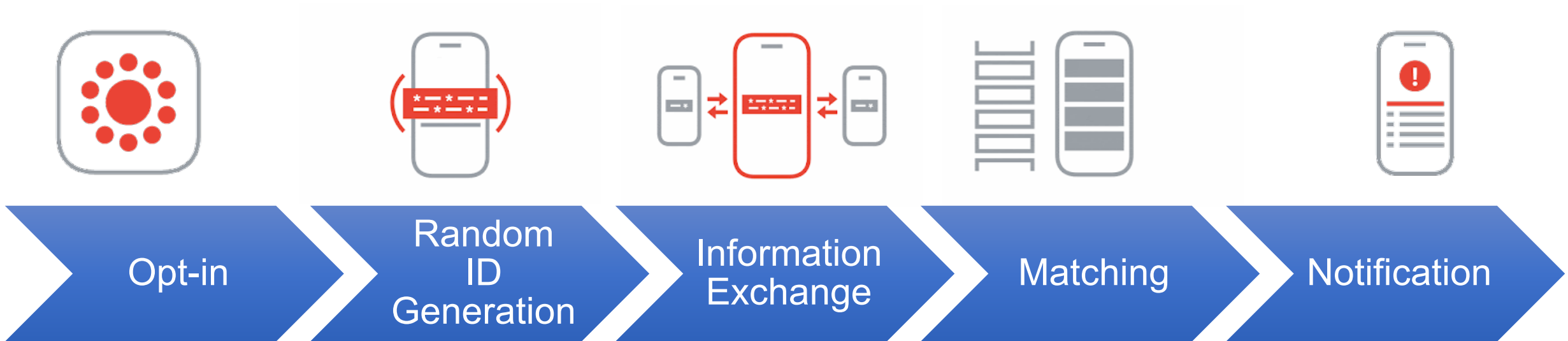
Google-Apple Exposure Notification (GAEN) System



- In April 2020, Apple and Google worked together to build a decentralized way of allowing individuals to know if they have come into contact with confirmed cases based on Bluetooth Low Energy (BLE) technology.
- Features:
 - Opt-in option
 - No location tracking
 - No identity sharing

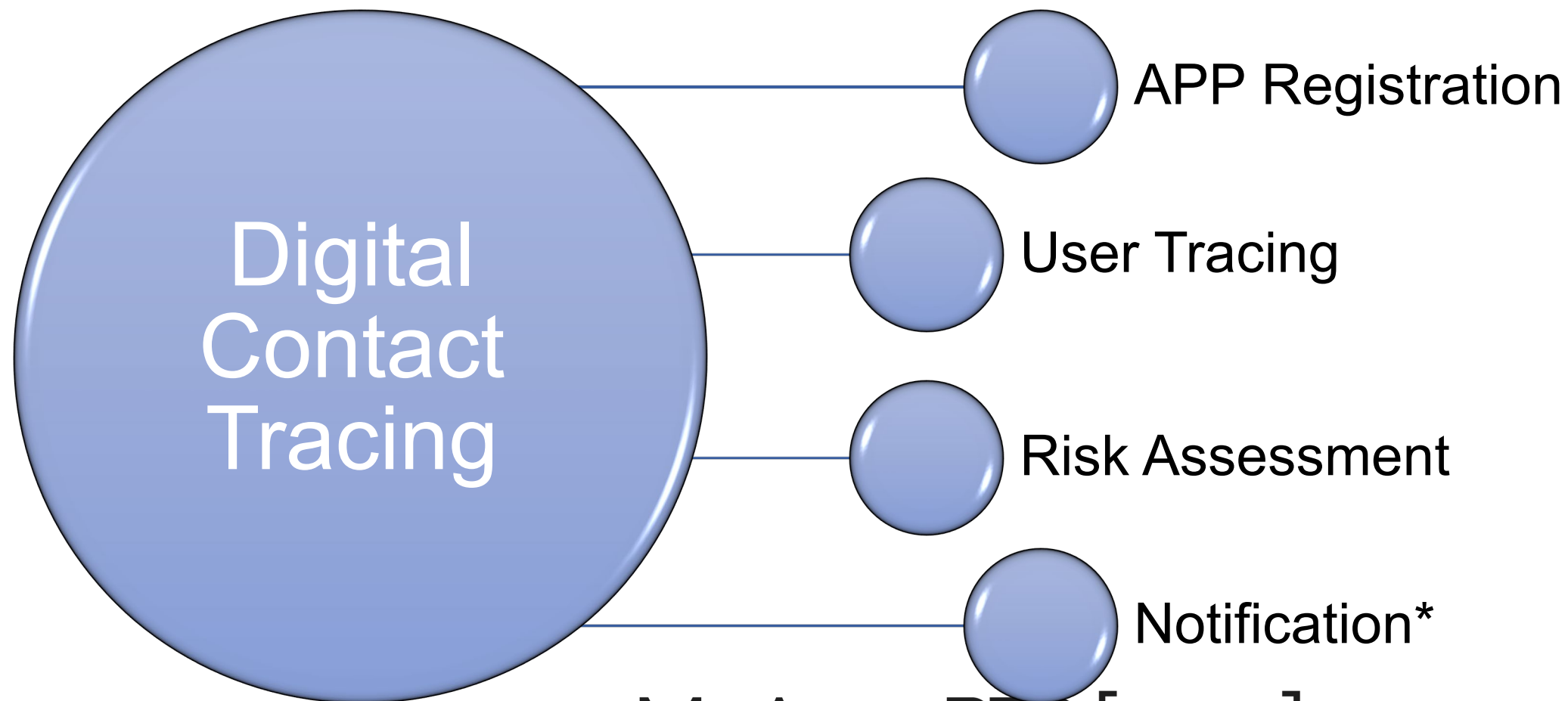


How GAEN System Works



Images Source: <https://www.google.com/covid19>

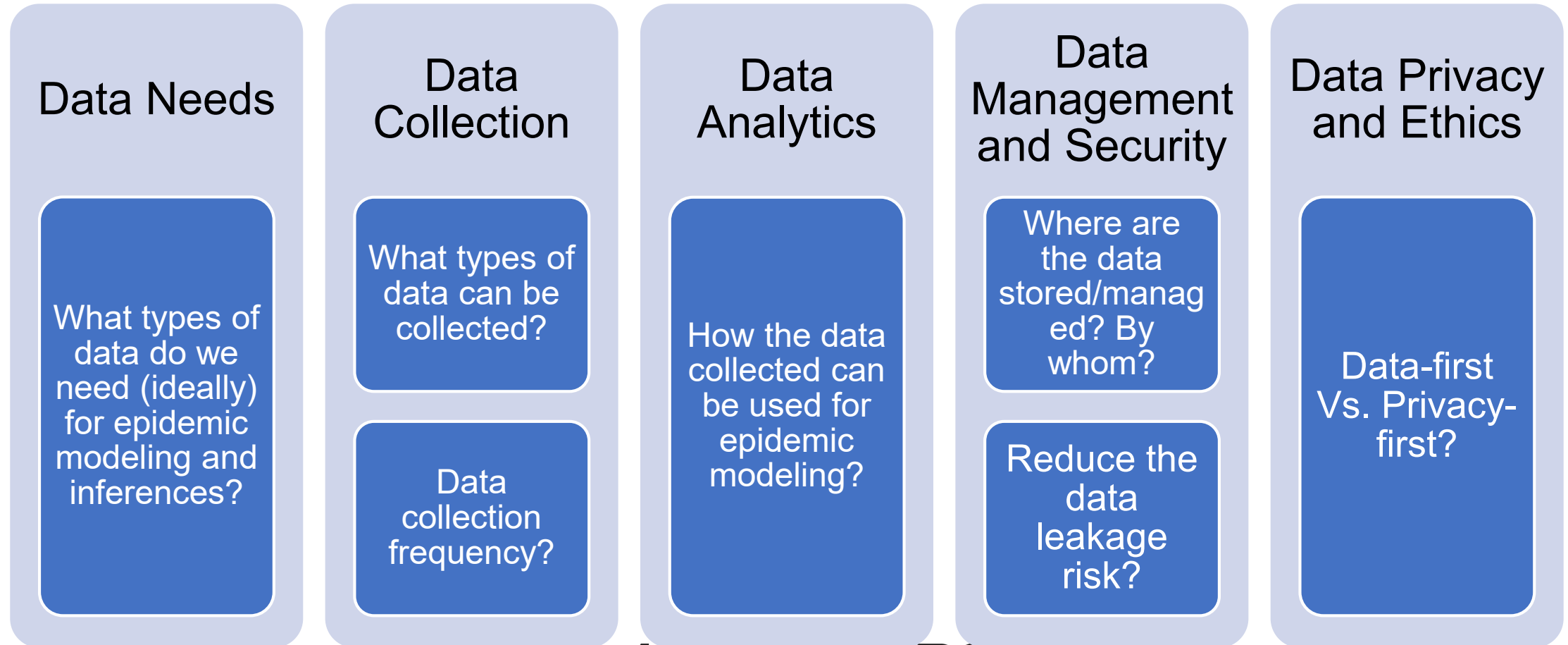
Components of Digital Tracing



Mapping@Brown

- The objective of Mapping@Brown is to measure and construct social networks at Brown University.
- Note that the core notification function in contact tracing Apps is NOT the focus of this pilot study.

Data



Data Produced in APP Registration Step

Demographic data	Details regarding behavior patterns	Phone Information	Other
<ul style="list-style-type: none">• Role• Age• Race• ...	<ul style="list-style-type: none">• How many people do you interact with on a daily basis?• The floor of your office?• How long do you stay at your office?	<ul style="list-style-type: none">• Phone #• Phone model• How do you use your phone? [leave it on the table? Put it in the pocket?]	<ul style="list-style-type: none">• ...

Data Produced in Tracing Step



Positioning data [absolute information]

Outdoor geolocation data
Indoor positioning data



Proximity data [relative information]

Distance between two communicating devices



Timestamp data

The moment when two devices "see" each other

The duration of two devices communicating with each other

Positioning & Proximity Detection Technologies



GPS



Bluetooth



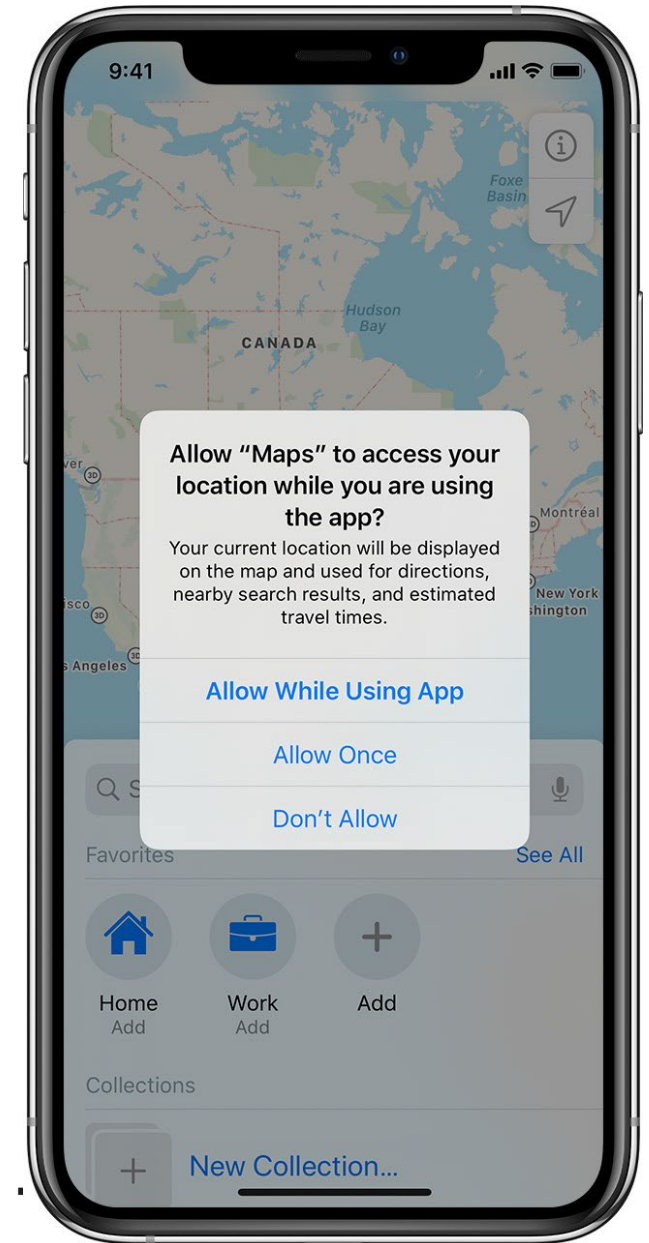
WI-FI



...

GPS: Positioning

- The GPS navigation system uses a network of satellites to locate the exact location of the device.
- Pros
 - Global coverage
 - Helpful in mapping hotspots of transmission
- Cons
 - Battery consumption
 - Bad performance in indoor settings
 - Low resolution for detecting face-to-face interactions
 - Privacy concerns



Bluetooth: Proximity Detection & Positioning

- Bluetooth Low Energy (BLE) is an energy-efficient, short-range variant of traditional Bluetooth.
- Pros
 - Low power consumption
 - Does not require explicit connections to transfer data between devices
 - Compatibility between different devices/OS
- Applications
 - Bluetooth for proximity detection
 - Bluetooth for indoor positioning



Bluetooth® Low Energy

Bluetooth: Proximity Detection

- Devices can be configured to transmit & scan signals at regular intervals.
- The idea is that the received signal strength (RSSI) provides a rough measure of the distance between the transmitter and receiver.
- Cons
 - The wireless signal is influenced from the operating environment (e.g., furniture, walls, people)
 - Accuracy of the distance approximation



Bluetooth: Positioning

- With the assistance of static Bluetooth beacons, Bluetooth devices can also achieve the indoor positioning goal.
- Requirement:
 - Floor plan map
 - Bluetooth Beacons

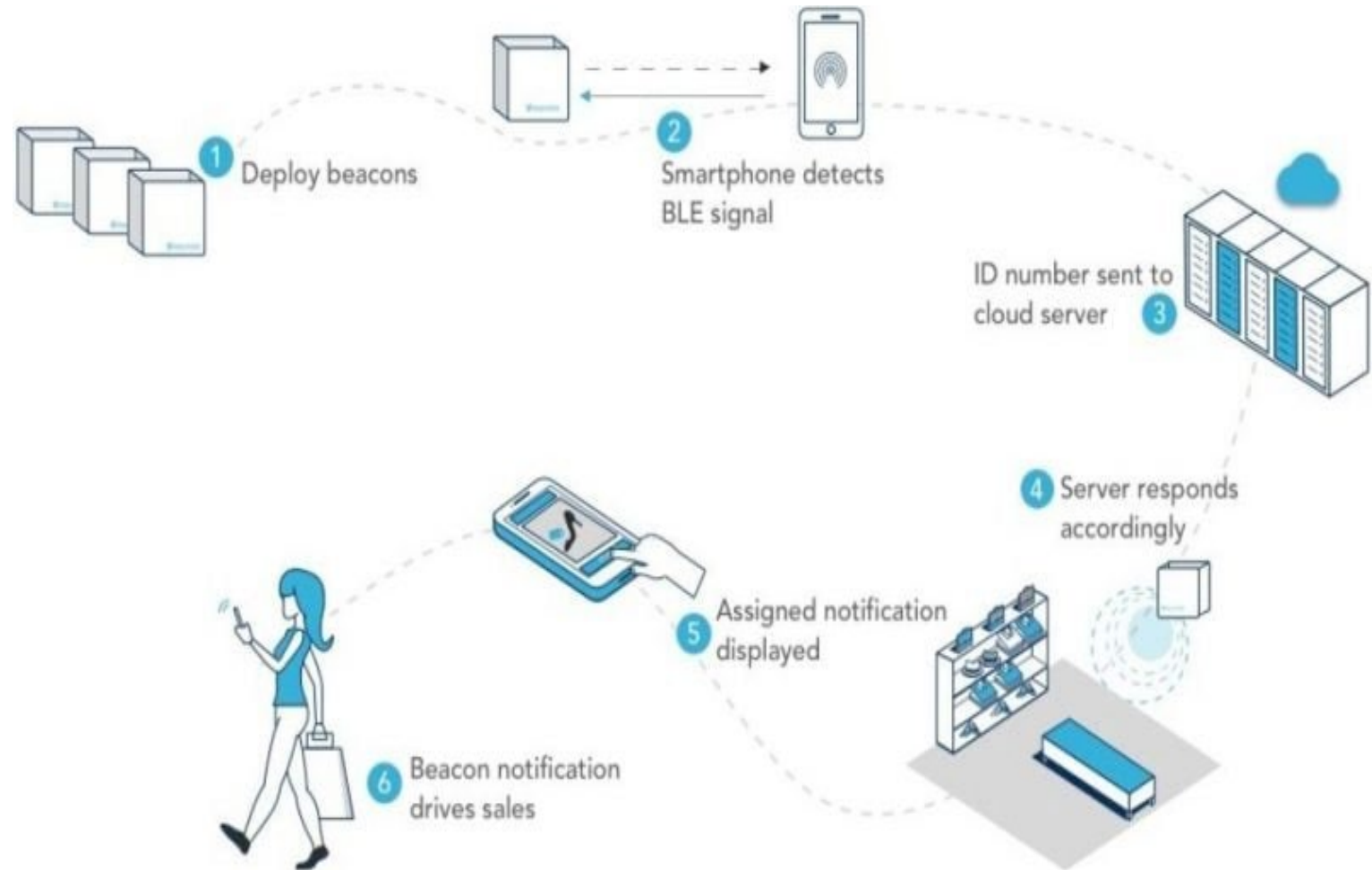


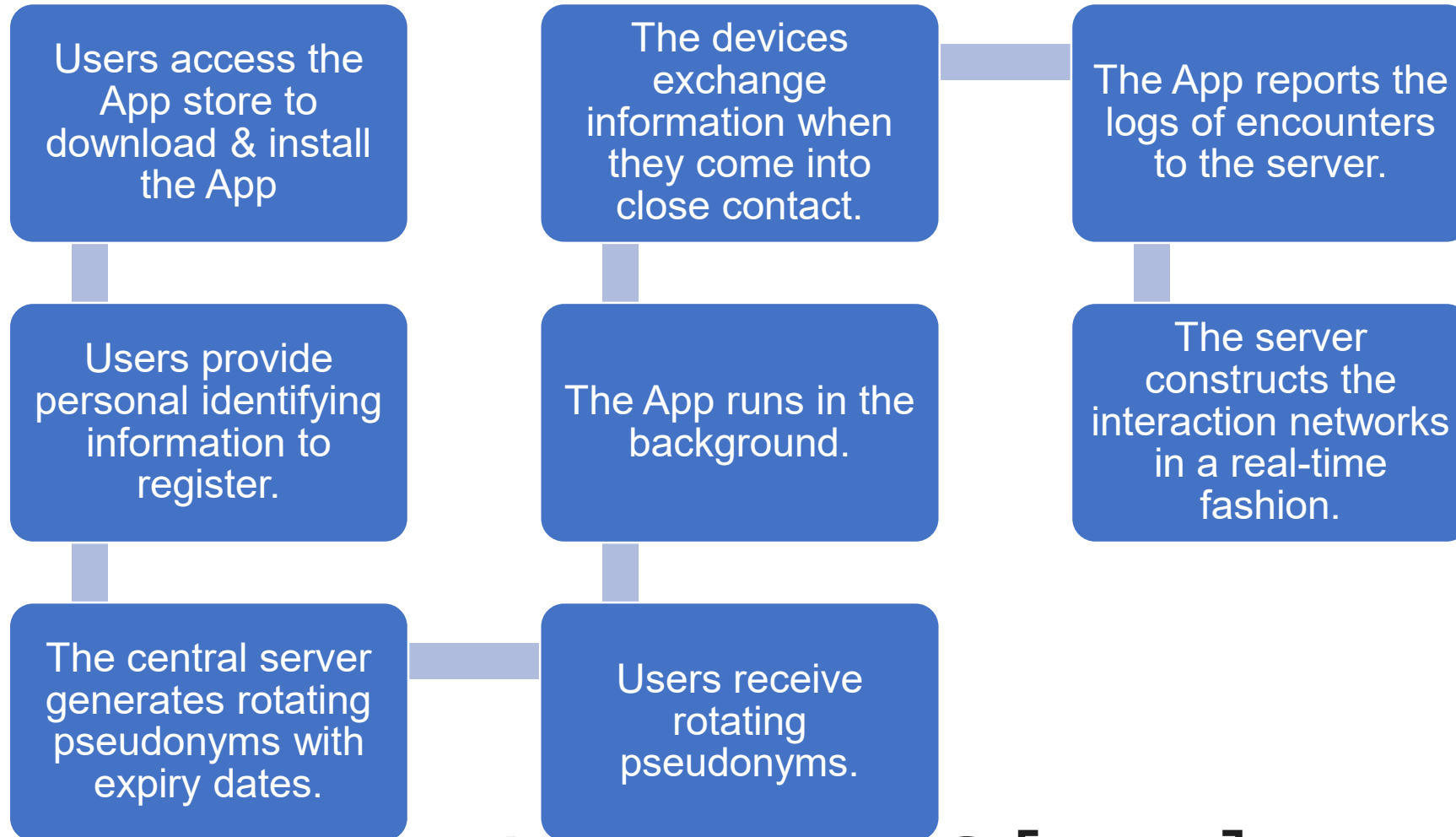
Image Source: <https://www.ac>

WI-FI: Positioning

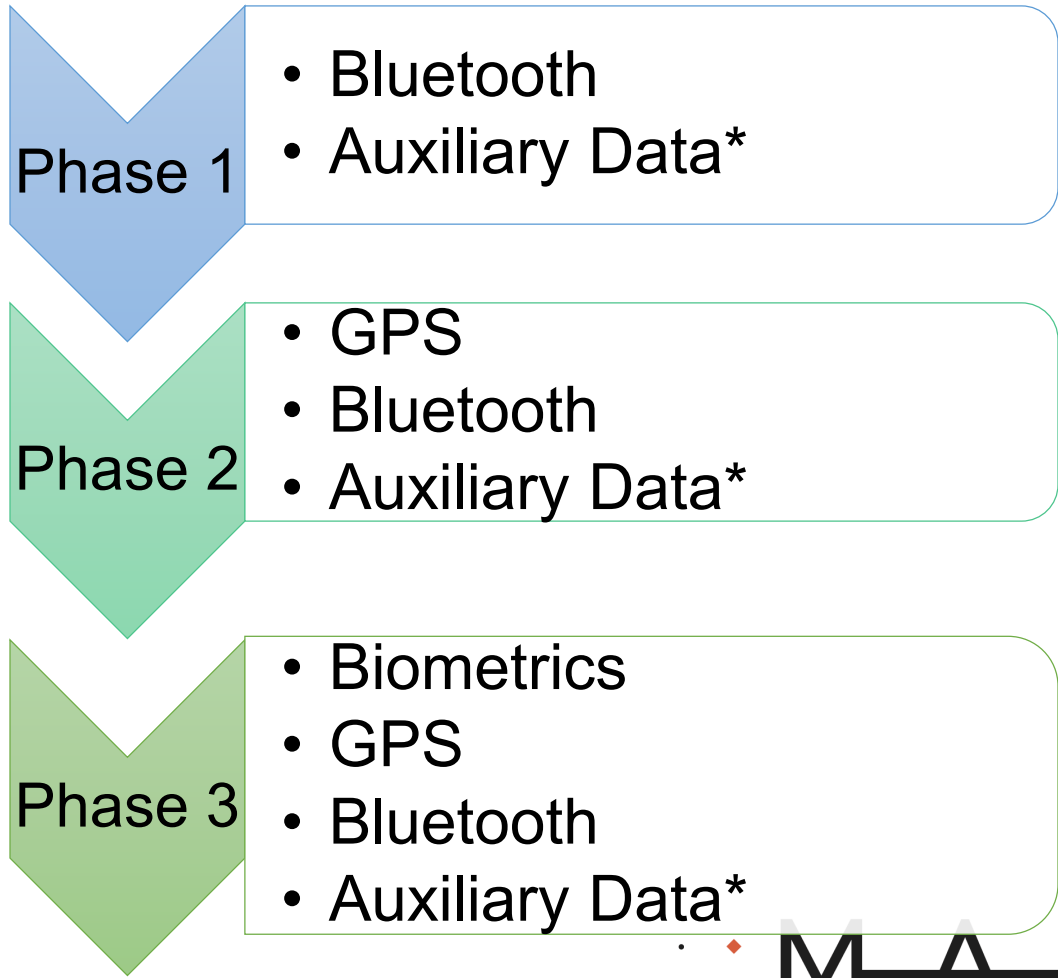
- WI-FI can also be used to determine devices' locations with the assistance of static WI-FI access points (WAP).
- Cons
 - It requires WI-FI infrastructure that may not be available everywhere, especially outdoors or in remote locations.



Data Collection Flow at Mapping@Brown



Expanding MAPPING@Brown



Auxiliary Data Sources:

- Sensors on the phone: WI-FI, gyroscope, accelerometer
- Brown's IT facility data (card swipes data, WI-FI access points log data)
- ...

Phase 3: Adding Biometrics

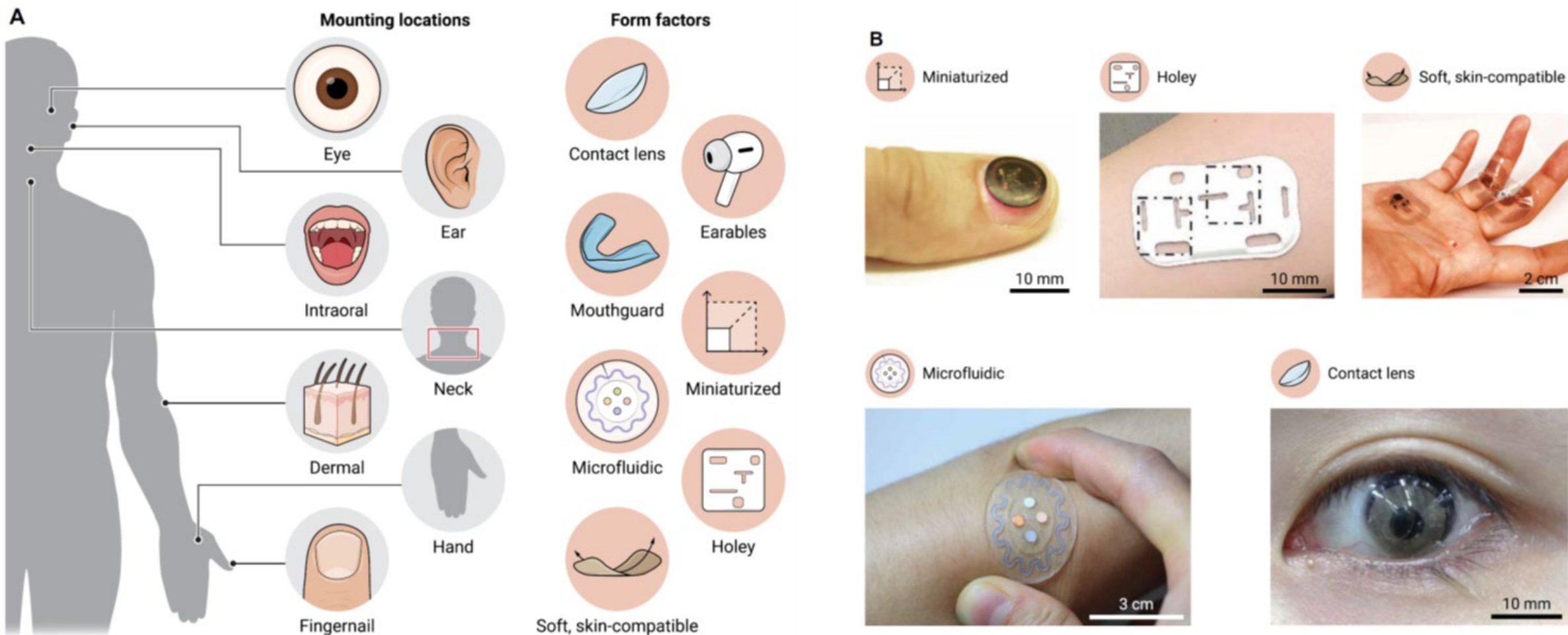
Wearable Sensors



- Sleep
- Activity
- Heart rate (variability)
- Blood oxygen

**'Wellness' devices
vs.
Medical devices**

Phase 3 (5-10 yrs+): Adding Biometrics



Challenges:

- App architecture and essential functions/utilities?
- APP adoption?
- Data management? (e.g., what data is stored at where and by whom? Who can access what data?)
- Security? (e.g., the server environment?)
- Privacy? (e.g., what data is produced and by whom? data-first Vs. privacy-first?)
- False positive/negative (e.g., the accuracy of proximity estimation?)
- ...

Privacy and Ethics in Pandemic Data Collection and Processing Websites



Workshop Website

<https://mapps-brown.github.io/workshop2023/>

The workshop materials can be found here. We will post materials to this website throughout the week.



ICERM Website

https://icerm.brown.edu/topical_workshops/tw-23-pep/

The daily agenda will be posted here, and ICERM will live stream the keynotes each day.