

Privacy-aware Data Acquisition and Sharing in OpenRoaming

Hideaki Goto Cityroam / Tohoku University

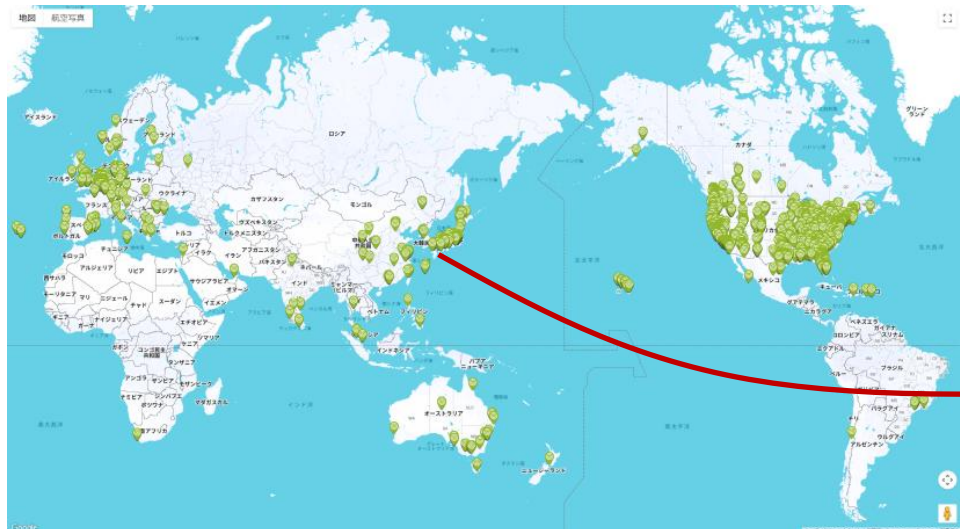


Part of this work is supported by JSPS KAKENHI Grant Number JP25K03103.

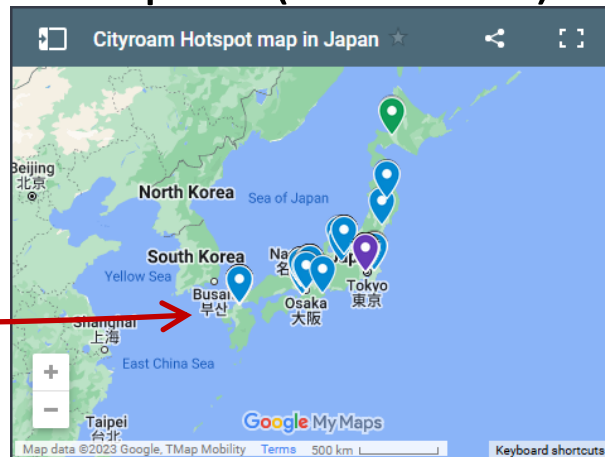
System development and trial are supported by the Commissioned research 23610
by National Institute of Information and Communications Technology (NICT).

Cityroam's rapid growth – why?

- Organized a Roaming Federation
 - **Community supports** (seminars, tech tests & discussions, etc.)
 - → **Wireless Identity Federation Association** (est. Apr. 2024)
- Affordable roaming platform with Simplified inter-connections (central hub).
 - IdP: eduroam, Cityroam Cloud IdP, operators in Japan, telcos/ISPs and cities overseas via  **OPENROAMING™**
WIRELESS BROADBAND ALLIANCE
- eduroam/OpenRoaming combined architecture
- Involvement of Municipal Wi-Fi (multi-vendor, multi-operator scheme)



90+ spots (Jan. 2023)

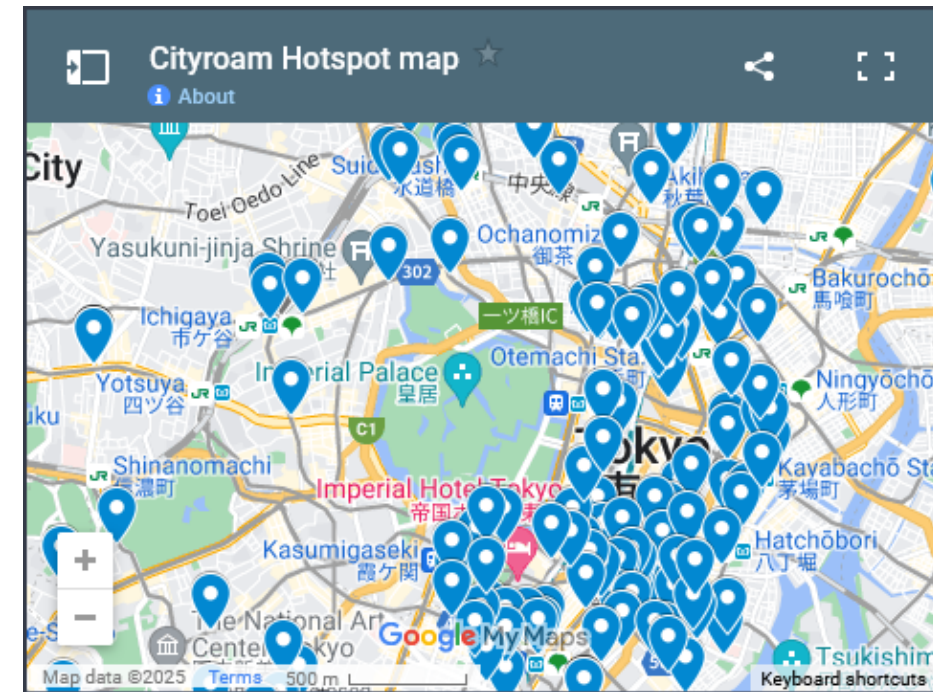


1000+ spots (Oct. 2025)



TOKYO FREE Wi-Fi supports OpenRoaming

- Released on Mar. 31, 2023
- Tokyo Metropolitan Government + KDDI / Wire & Wireless (Wi2)
- Enhanced security, safety, and usability. 😊



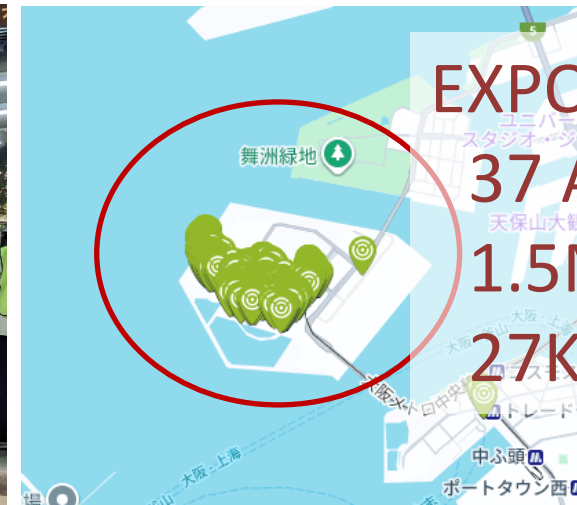
<https://wi-fi.metro.tokyo.lg.jp/en/>

Osaka Free Wi-Fi

- Oct. 10, 2024 –
- Initial deployment focuses on Public Transport. (for EXPO 2025)



<https://ofw-oer.com/>



EXPO -> Cityroam
37 AuthN / sec
1.5M AuthN / d
27K uniq. dev. / d

OpenRoaming adoption hurdles (application point of view)

- Many owners / sponsors expect user DATA.
 - Age group
 - Gender
 - Nationality
 - Language (browser setting)
 - Device/OS (for app development)
 - Wi-Fi usage location and staying time
 - Travel routes (e.g. shop-hopping in a mall, tourist sites), etc.
- Especially, municipalities want to know / do ...
 - Travel routes
 - Analysis of tourist sites
 - Analysis for disaster response / mitigation, and urban design



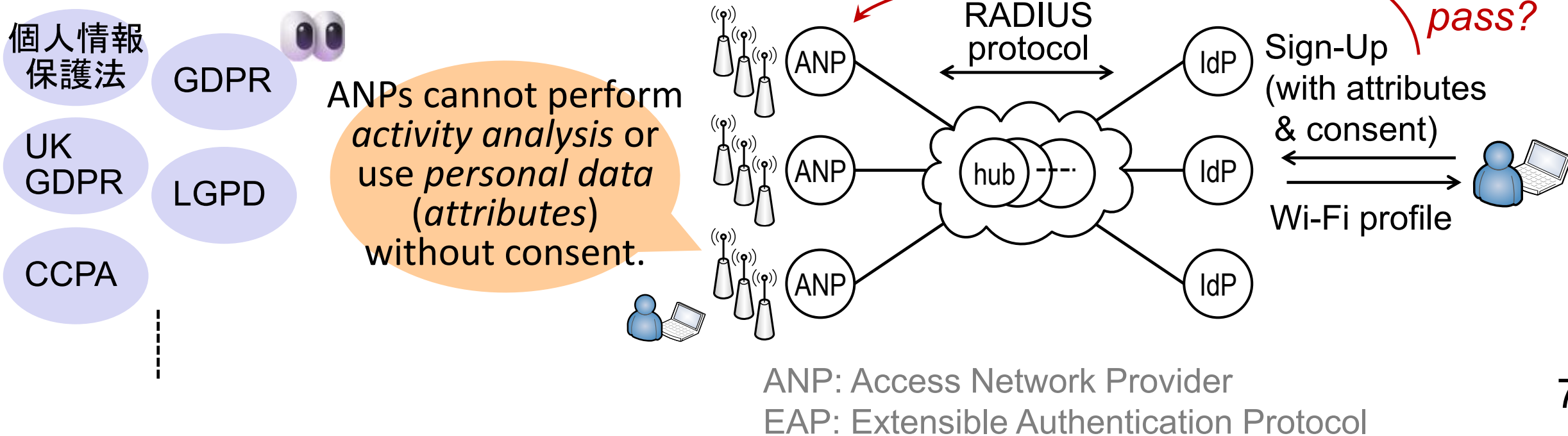
Important data
for business

What are missing?

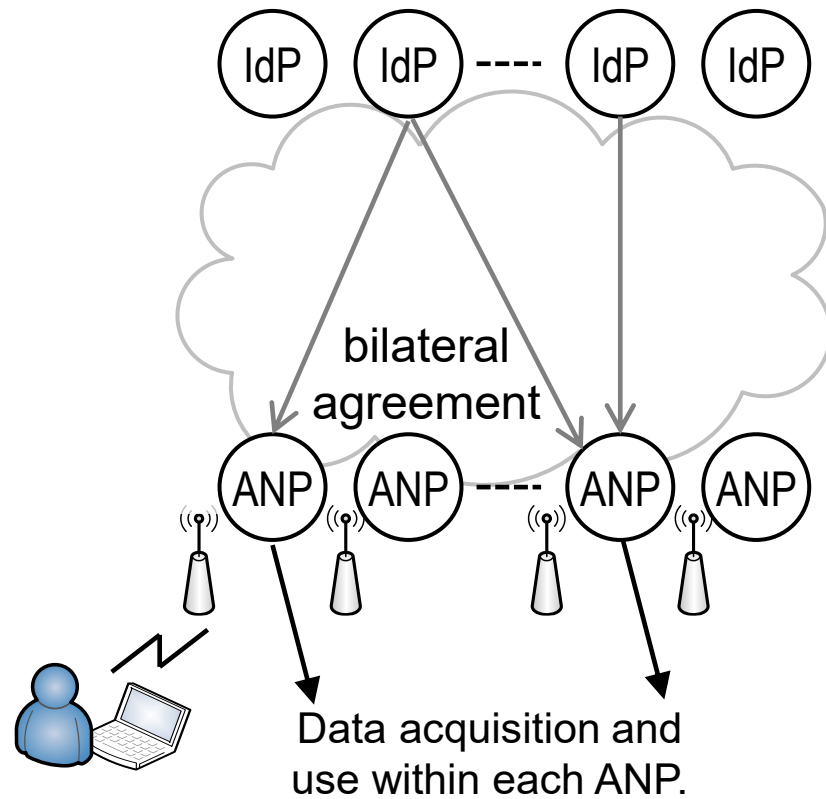
- Users' consent for data usage and activity analysis
- Privacy-aware data acquisition
- Privacy-aware, per-group data sharing

Challenges in user activity analysis and data usage

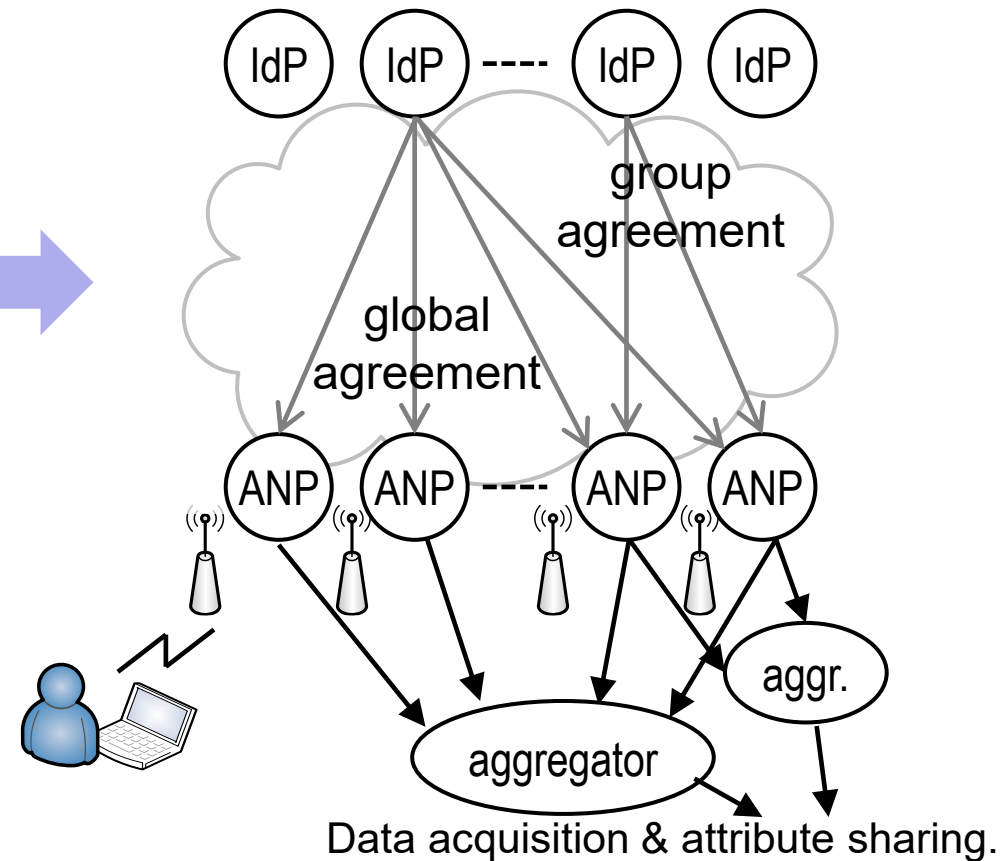
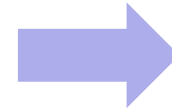
- IdP and ANP are separated in OpenRoaming.
- **ANPs cannot see “real user ID” or obtain user’s consent.**
 - Outer-Identity is anonymized, e.g. **anonymous@example.com**
Inner-Identity is protected by **EAP tunnel** between User Device - IdP.
 - EAP-TLS (with TLS 1.3) hides **the contents of Client Certificate**.
 - Ephemeral MAC addresses



Per-group data (attribute) sharing



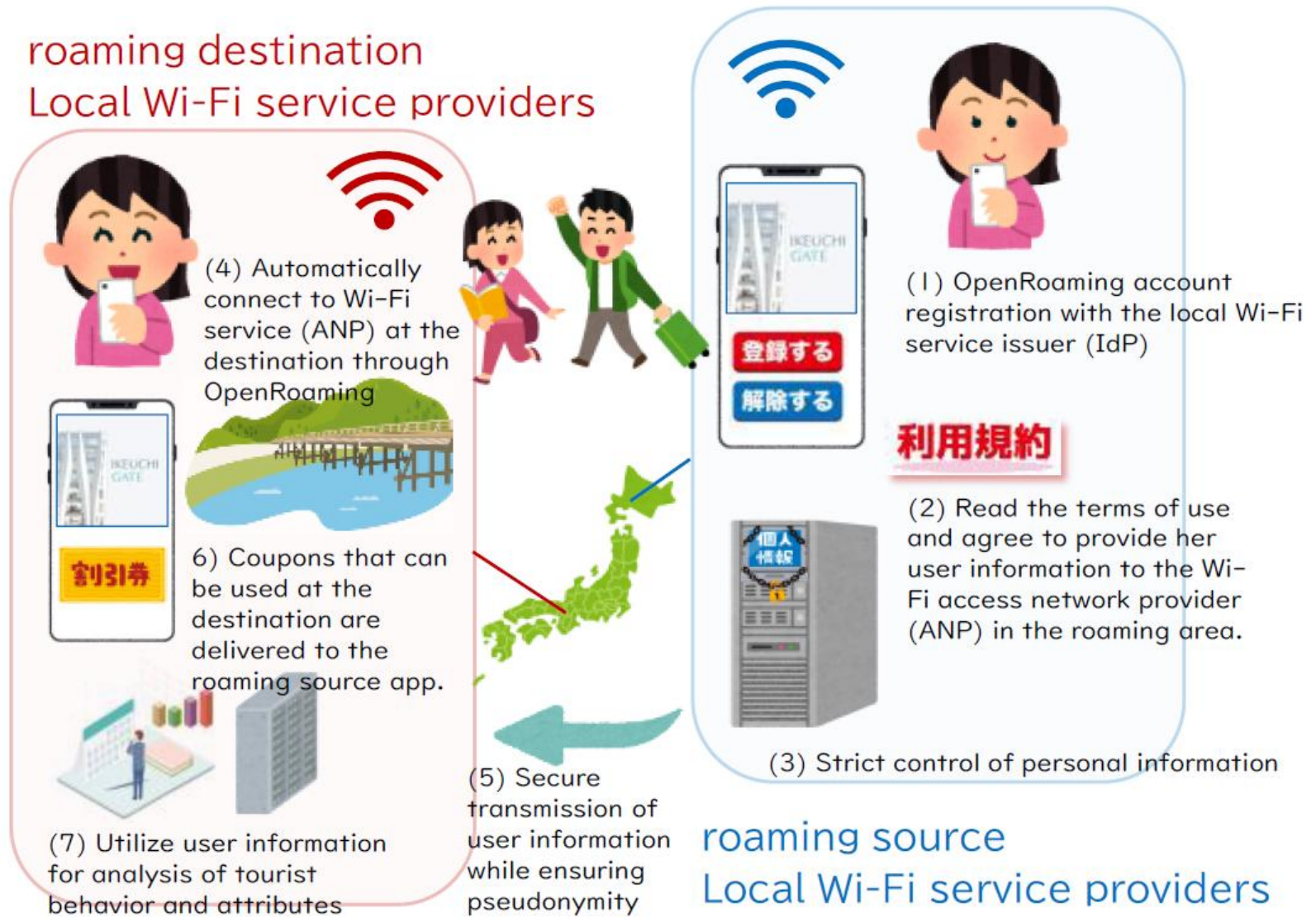
(a) Conventional roaming system based on bilateral agreements.



(b) Roaming system with global / per-group attribute sharing.

Use case 1: Regional tourism apps

Location Awareness
Location Privacy



Y. Okabe et al.,
IPSJ CDS43, 2025

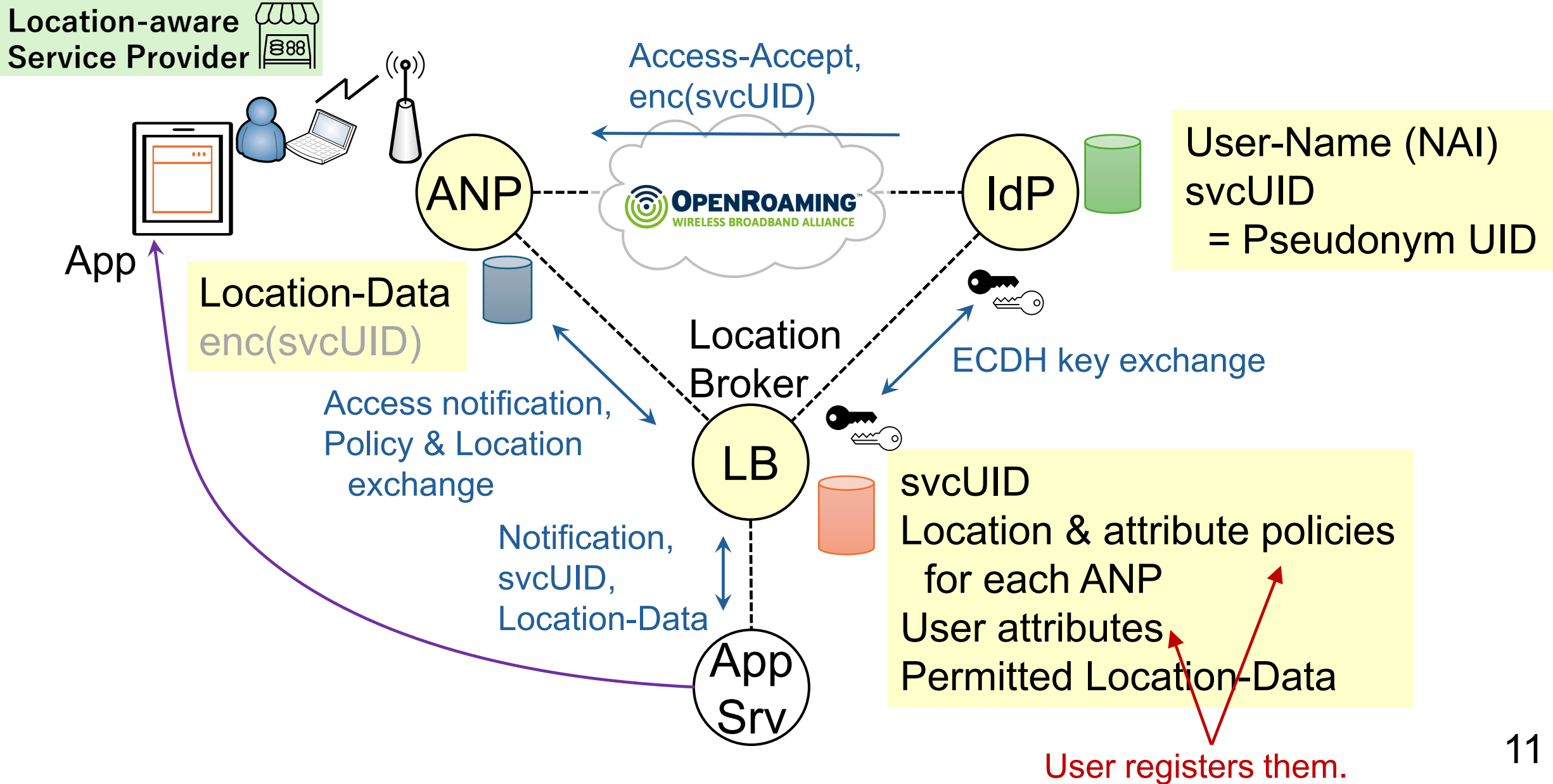
Commissioned research 23610 by National Institute of Information and Communications Technology (NICT), Japan (2024-2025)

Use case 2: User search and support under natural disasters

Location Awareness
Location Privacy



3-party privacy protection model for Location-Based Services (LBS)



Summary

- Privacy-aware Data Acquisition and Sharing will help developing various applications and new business models.
- Location-Based Services (LBS) require Location Privacy and User Attribute protections.
 - Basic architecture is ready for PoC.
 - We'll start trials of some LBS applications in 2025.
- We'll refine the architecture as well as the implementation for standardization in Cityroam.