# Implementing Encrypted Private Data Sharing between Personal Data Vaults

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Australian National University | Software Innovation Institute

# About Us

## Anushka Vidanage

### Research Fellow

Research Interests – Data Privacy, Personal Online Datastores, Privacy Preserving Record Linkage (PPRL), Distributed ML

## Team

Prof. Graham Williams

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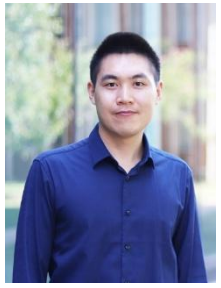
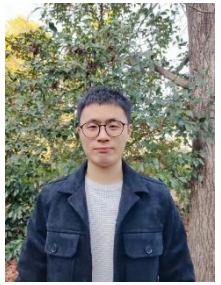


Dr Dawei Chen

Research Fellow

Yang Chen (Tony)

Software Engineer



Zheyuan Xu

Former Software Engineer

Ashley Tang

Former Software Engineer

- Software Innovation Institute (SII) - https://sii.anu.edu.au/
- Solidcommunity AU website - https://solidcommunity.au/

# What Motivated Us

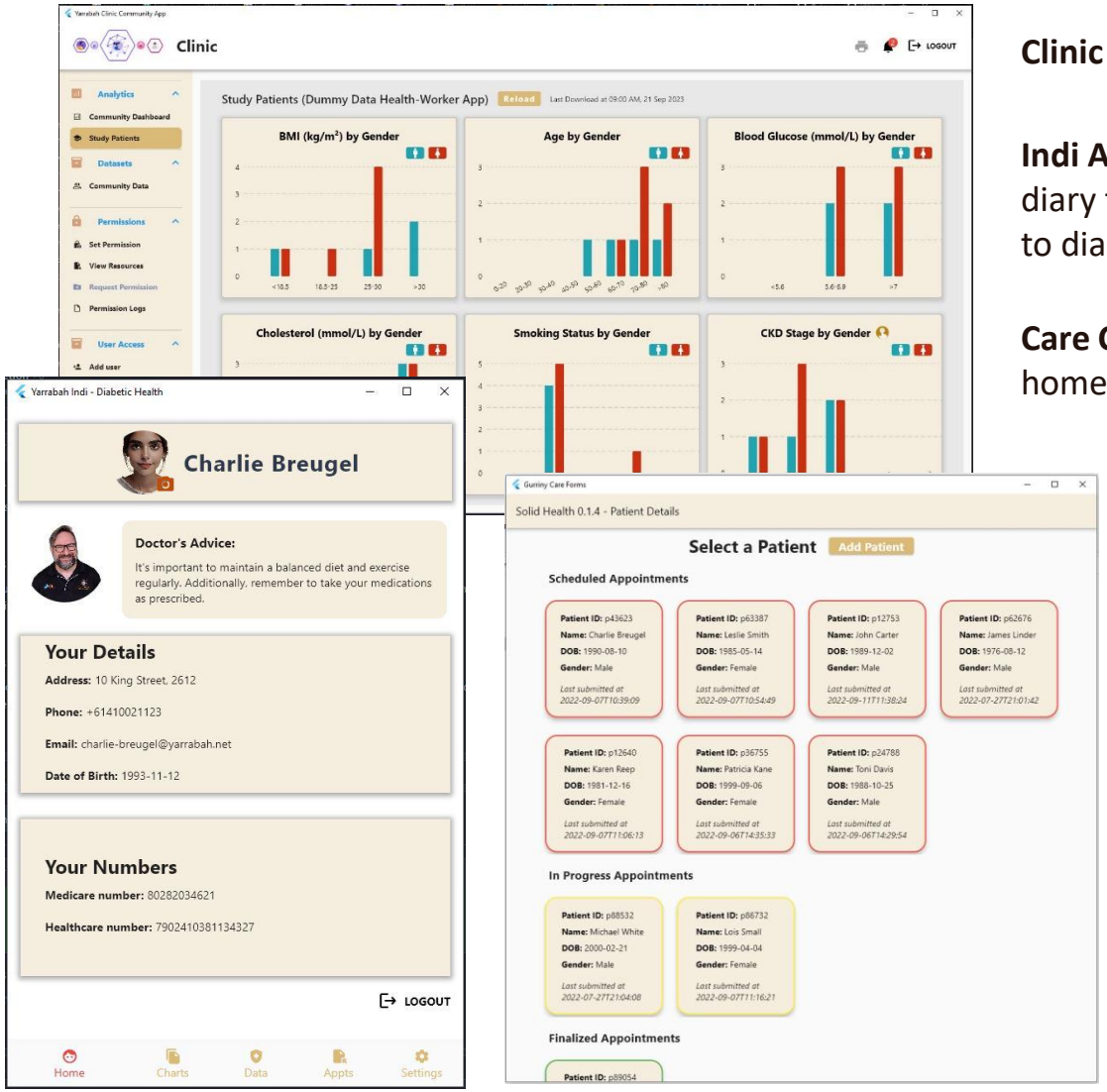
# Yarrabah

- Traditional country of the Gunggandji and Yidinji people. Mix of Traditional Owners and Historic Owners. Population of 4,500
- A project in collaboration with **Gurriny Yealamucka (Good Healing Water) health service** and Yarrabah leadership forum in Yarrabah
- Build a digital health platform to support integrated health care of Indigenous patients with diabetes using a person-centred data storage solution
  - We opted to use Solid Personal Online Datastores (PODs) to enable person centred solution



GURRINY YEALAMUCKA
HEALTH SERVICE ABORIGINAL CORPORATION

# Gurriny Indigenous Health Care




**Clinic App** to provide interface for doctors to analytics, insights, data for evaluation

**Indi App** to provide patients with diabetes info support tools from their GP, health diary to record well being, data access and control to support strength-based approach to diabetes management

**Care Coordination Team App** for patient record access and data collection during home care visits to patients

Challenge: Individuals must have control over their own medical and health data and be able to decide with who (doctors) they share their data

**It is important for individuals in the indigenous community to know that they can have complete security and privacy of their data, and particularly their data in the cloud at rest**

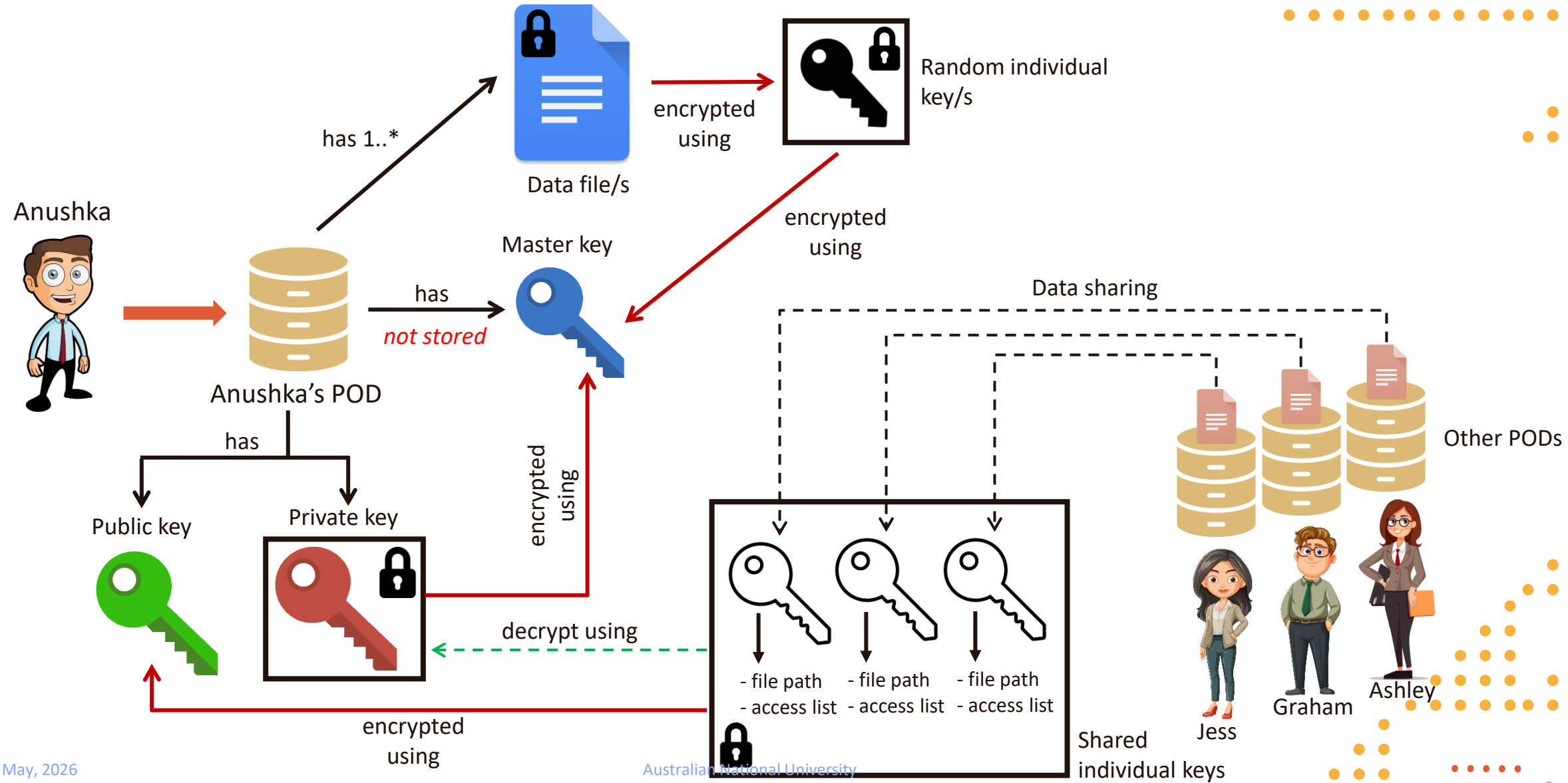
# Trust No One by Default

# Trust-No-One (TNO) environment

- **Zero trust security model**
- A privacy and a security architecture where a system does not automatically trust anyone or anything inside or outside its perimeters and instead must verify everything constantly - "never trust, always verify“

- *So, how do we ensure TNO environment in Solid PODs?*
  - *Data stored in PODs are encrypted by default*
  - *Encrypted data are only ever decrypted locally on device*
  - *The encryption keys are again encrypted using a master key*
  - *Encrypted data are shared with others using public-key infrastructure along with Access Control Lists (ACLs)*

# TNO Architecture in PODs



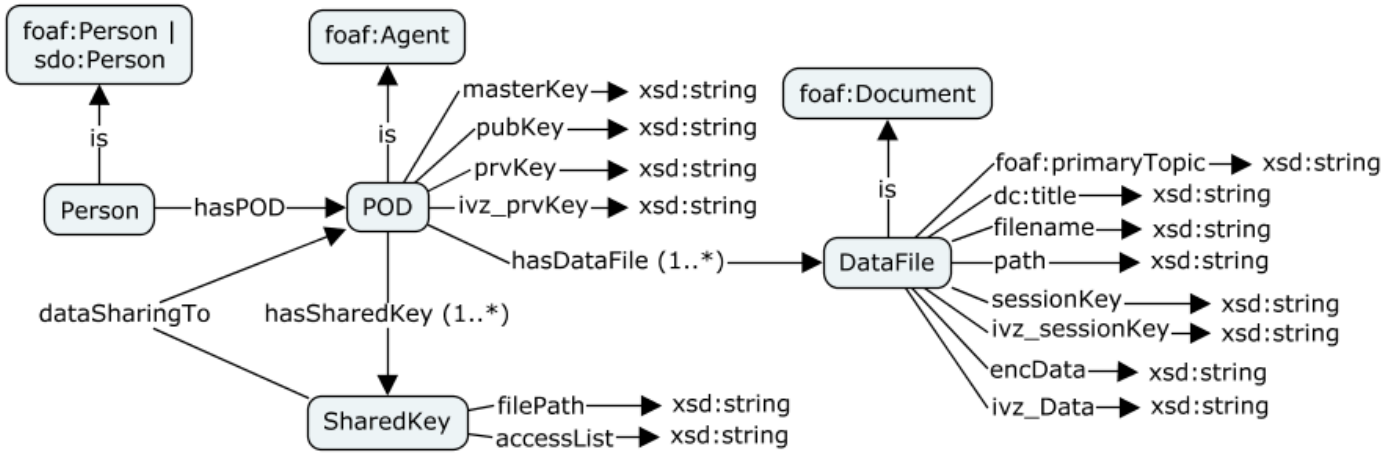
# Secure POD Data Model (SPDM)

- Data model that captures the concepts and their relations regarding the system's TNO security model with main classes: `Person`, `POD`, `DataFile`, `SharedKey`

```
** EXTERNAL ONTOLOGIES & VOCABULARIES **
- foaf: <http://xmlns.com/foaf/0.1/>
- dc   : <http://purl.org/dc/terms/>
- sdo  : <http://schema.org/>
```

- "pubKey": public key.
- "prvKey": private key.

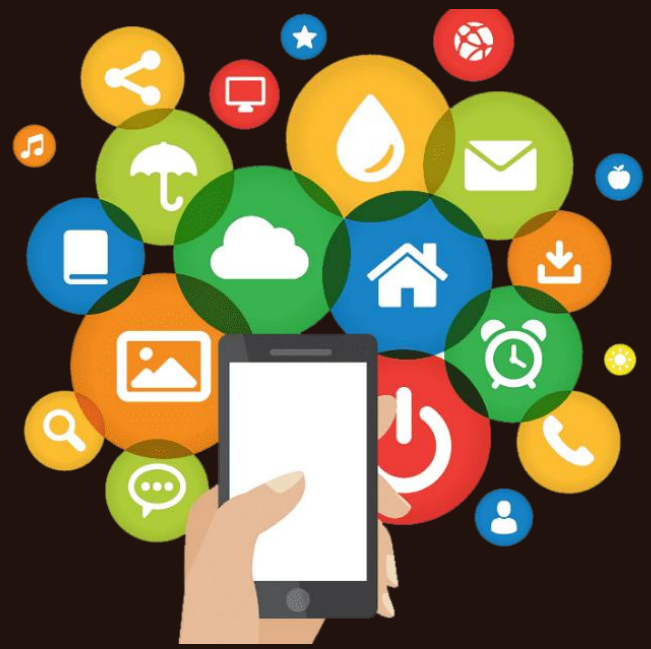
- "sessionKey": unique for each file (random symmetric key)
- "encData": encrypted data.
- "ivz_XXX": Initialisation vector value of the encryption algorithm for XXX.




**Sample resource structure of a POD**

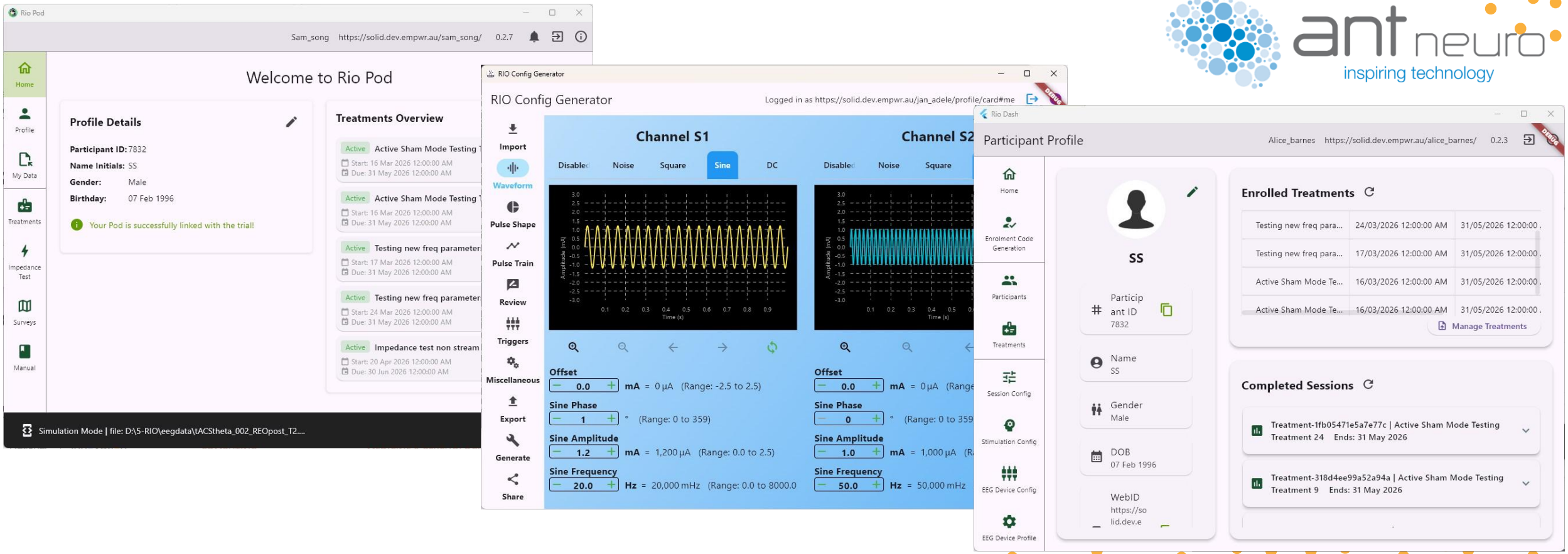
```
podname/
├── notepod/
│   ├── data/
│   │       myNote.ttl, myNote.ttl.acl
│   ├── encryption/
│   │       enc-keys.ttl, ind-keys.ttl
│   ├── logs/
│   │       permissions-log.ttl
│   ├── sharing/
│   │       public-key.ttl
│   └── shared/
│           shared-keys.ttl
└── profile/
    └── card.ttl
```

# Current Work at SII in Solid PODs



# Rio: Closed Loop Non-Invasive Brain Stimulation Treatment

- Collects and analyse EEG data of project participants through a series of treatment sessions incorporated with brain stimulation



# User Driven Privacy

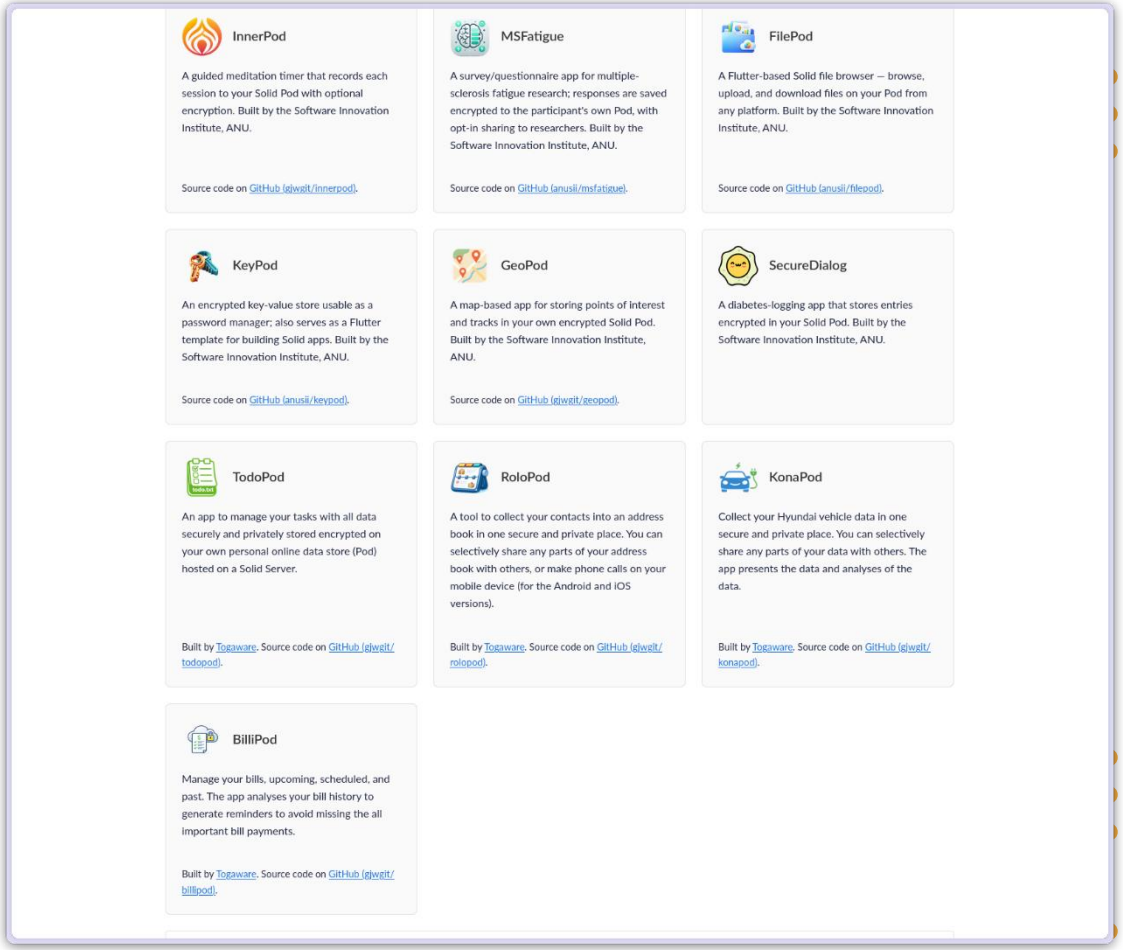
- Decentralised approaches such as PODs and federated learning shift privacy control to users, allowing them to decide how precisely their data is shared and in which amounts
- ***Can different privacy expectations from different users affect downstream machine learning (ML) performances?***
- Evaluated different data preparation methods (standard, granularity-based, and LLM-based imputation) against various data granularity to measure the performance changes. Tested with the following scenarios:
  - Anonymised training data
  - Anonymised inference data
  - Both anonymised
- **What we learned:** Effective learning under user-driven privacy does not require modifying ML models or reversing anonymisation. Instead, significant utility can be recovered by pre-processing anonymised data accordingly
  - Overall **specialisation** is the most robust and versatile strategy

Lange, L., Böttinger, A., Christen, V., Vidanage, A., Christen, P. and Rahm, E., 2026. Learning from Anonymized and Incomplete Tabular Data. *arXiv preprint arXiv:2602.01217*.

# The Ecosystem in Action

- Multiple Flutter/Dart based Solid packages for app development
  - `solidpod` (https://pub.dev/packages/solidpod)
  - `solidui` (https://github.com/anusii/solidui)
  - `solid-auth` (https://pub.dev/packages/solid_auth)
  - `rdflib` (https://pub.dev/packages/rdflib)

- Development of multiple apps based on Solid PODs
  - Apps listed on solidproject web page https://solidproject.org/apps
  - Also checkout our app directory at https://solidcommunity.au/#portfolio



# Thank you!

Appreciate your feedback!

Get in touch with us to know more about our work

Contact:
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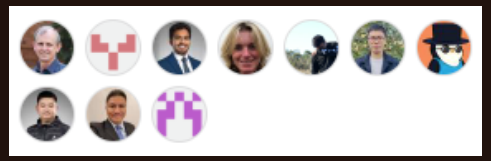
anushka.vidanage@anu.edu.au
SolidCommunity@togaware.com

Where to start:

https://github.com/anusii/solidui

ANU Solid team



Explore further:

- https://github.com/anusii/solidpod
- https://solidproject.au
- https://solidproject.org

Get involved:

- https://solidcommunity.au
- https://sii.anu.edu.au