A Solid-based Architecture for Decentralised Interoperable Location Data

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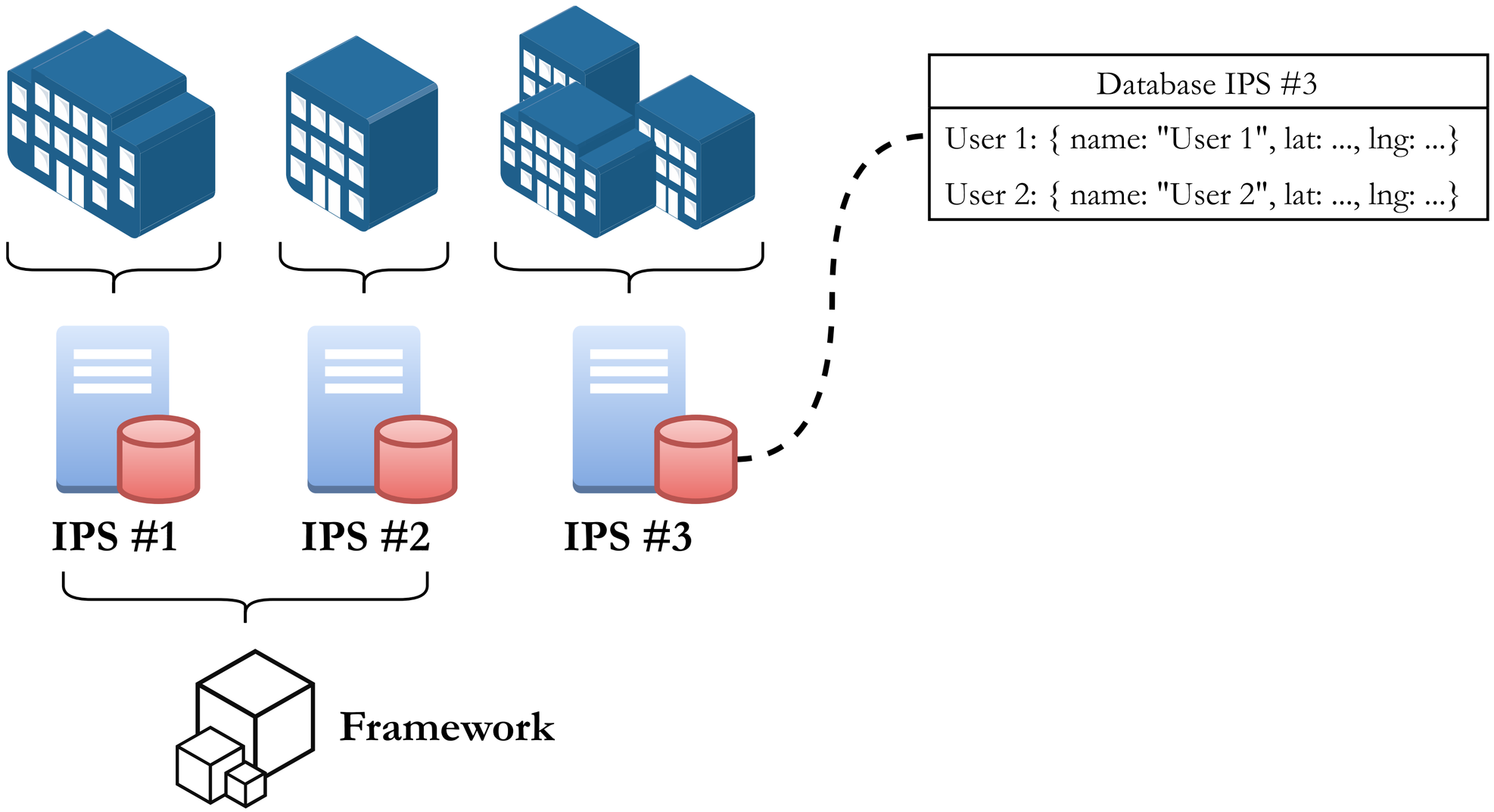
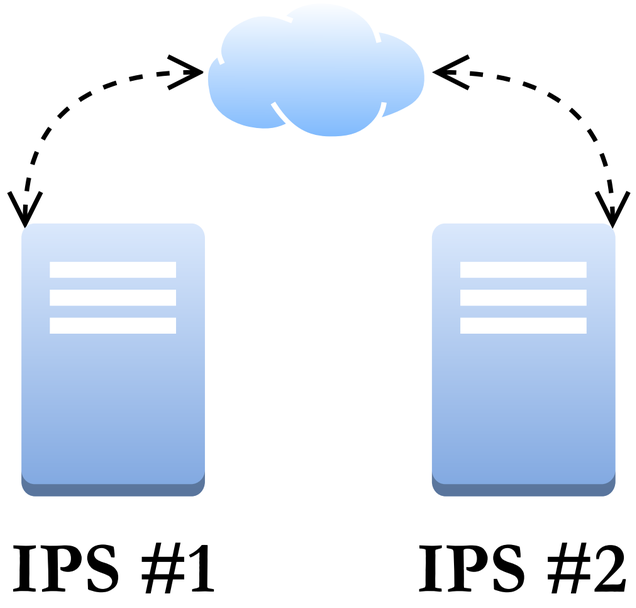
WEB & INFORMATION SYSTEMS ENGINEERING

Current Indoor Positioning Systems (IPS)

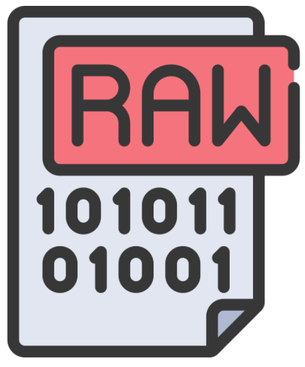


Problems With Current IPSs

1. Users not in **control** of their **data**
2. No **interoperability** between positioning **systems** and **applications**



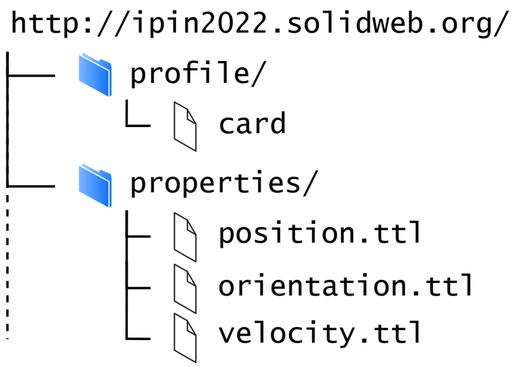
Accessibility

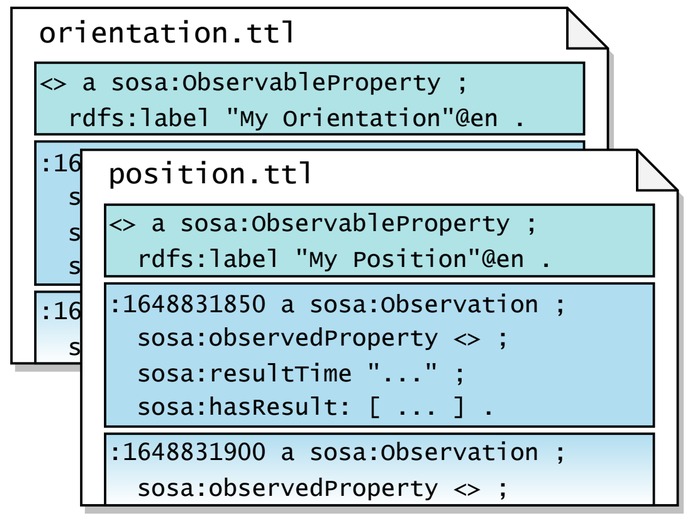


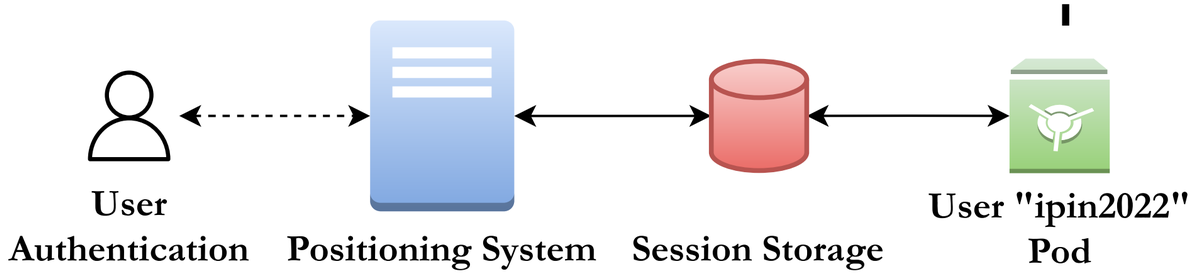
Readability

Understandability

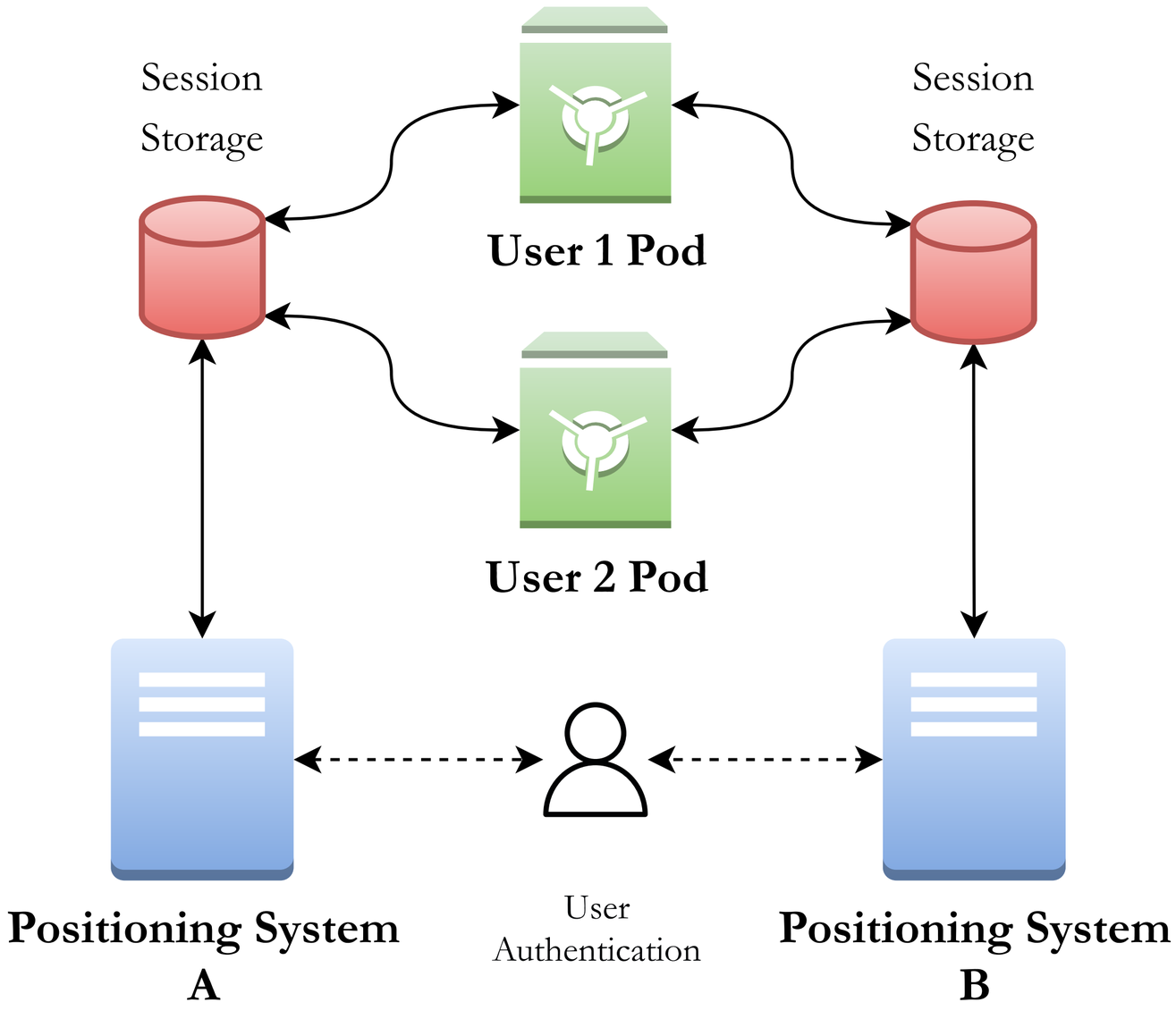
Decentralised Interoperable Architecture



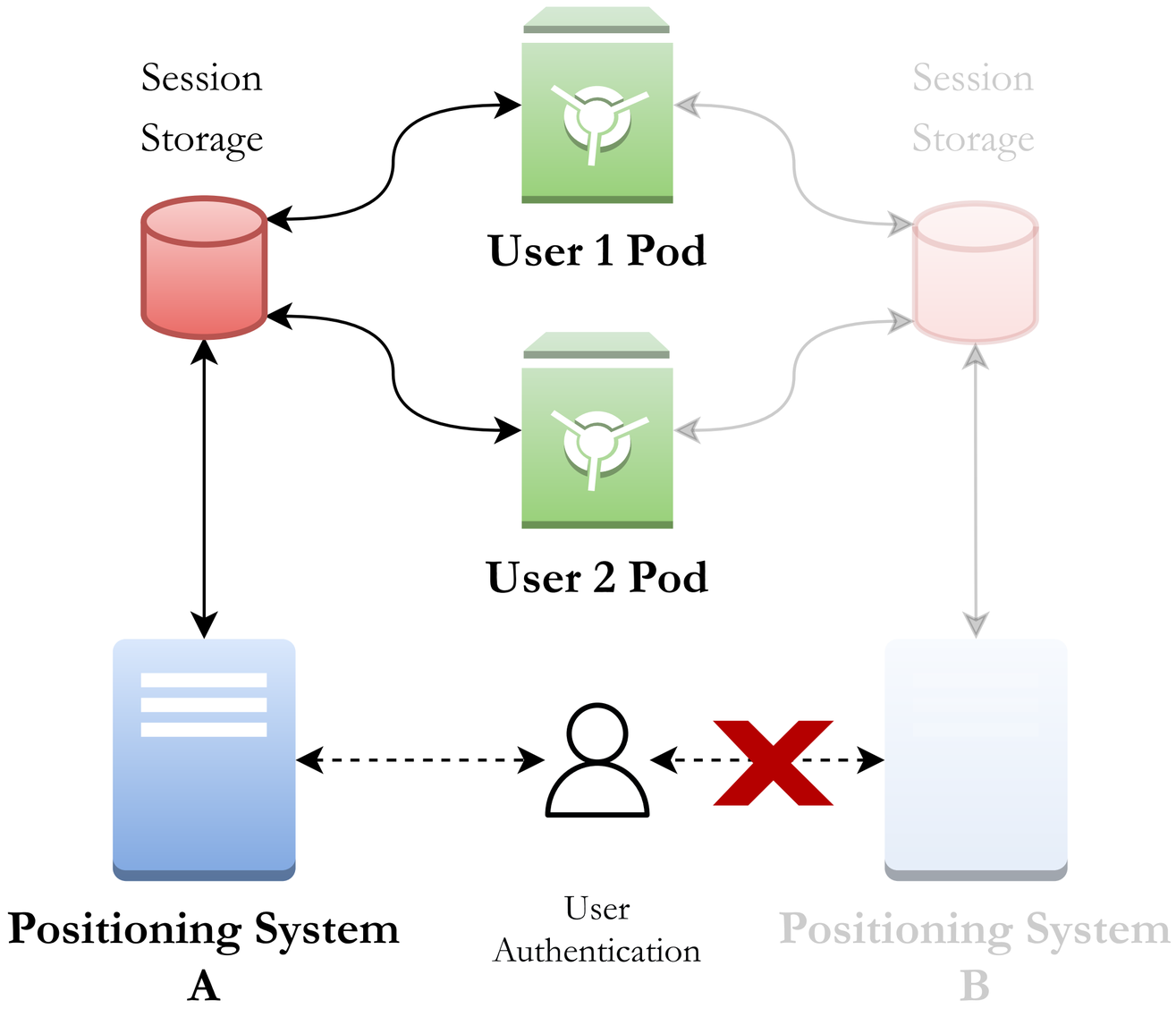




Decentralised Interoperable Architecture



Decentralised Interoperable Architecture



Vocabularies

Core vocabularies:

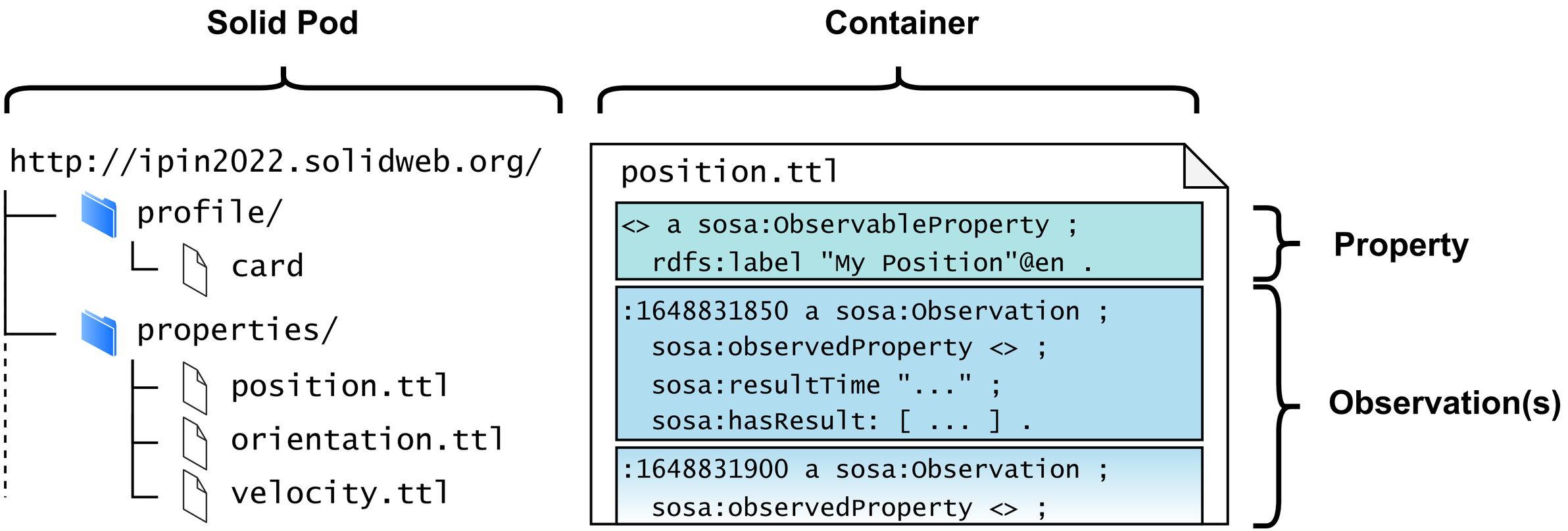
- SOSA
- SSN

Allignment vocabularies:

- GeoSPARQL
- QUDT
- SSN-Systems

See paper for more details ...

Properties and Observations

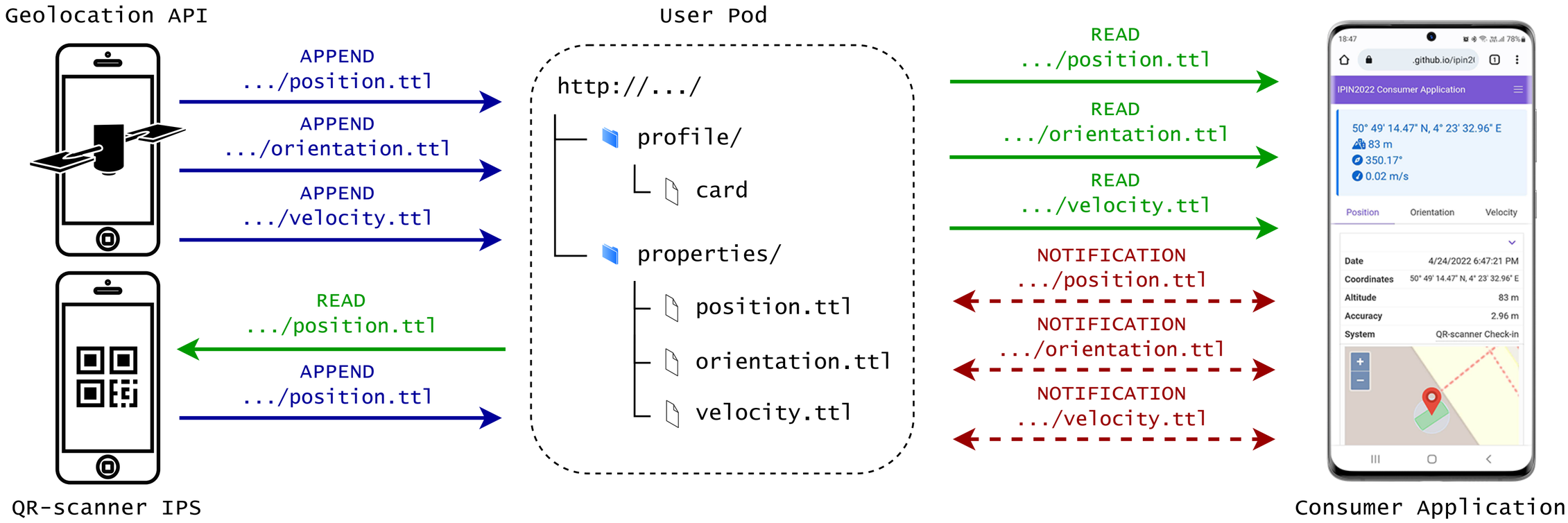


Properties and Observations

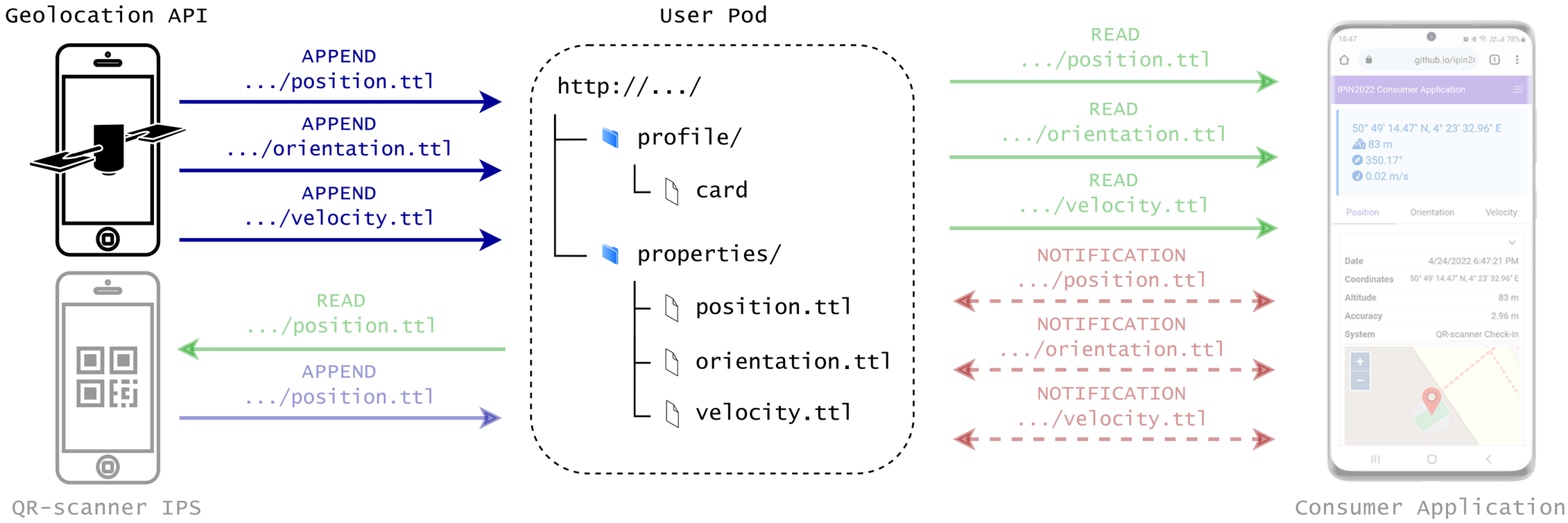
http://ipin2022.solidweb.org/properties/orientation.ttl

```
<>
    a sosa:ObservableProperty;
    rdfs:comment "Orientation of John Doe"@en;
    rdfs:label "Orientation"@en;
    ssn:isPropertyOf profile:me.
:1651065740981
    a sosa:Observation;
    sosa:hasFeatureOfInterest profile:me;
    sosa:hasResult [
            a qudt:QuantityValue;
            qudt:numericValue 108.11512756347656;
            qudt:unit unit:DEG;
        ];
    ssns:qualityOfObservation [
            a qudt:QuantityValue;
            qudt:numericValue 12;
            qudt:unit unit:DEG;
        ];
    sosa:observedProperty <>;
    sosa:resultTime "2022-04-27T13:22:20.981Z"^^xsd:dateTime;
    sosa:usedProcedure ipin:geolocationapi.
```

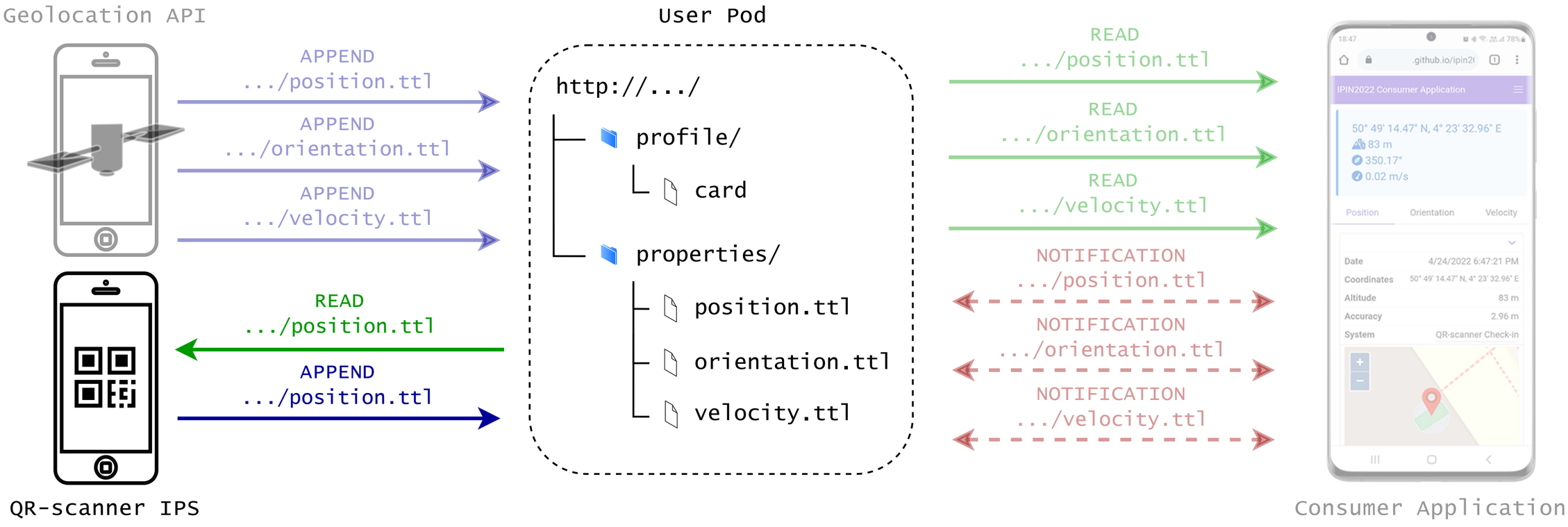
PoC Demonstrator



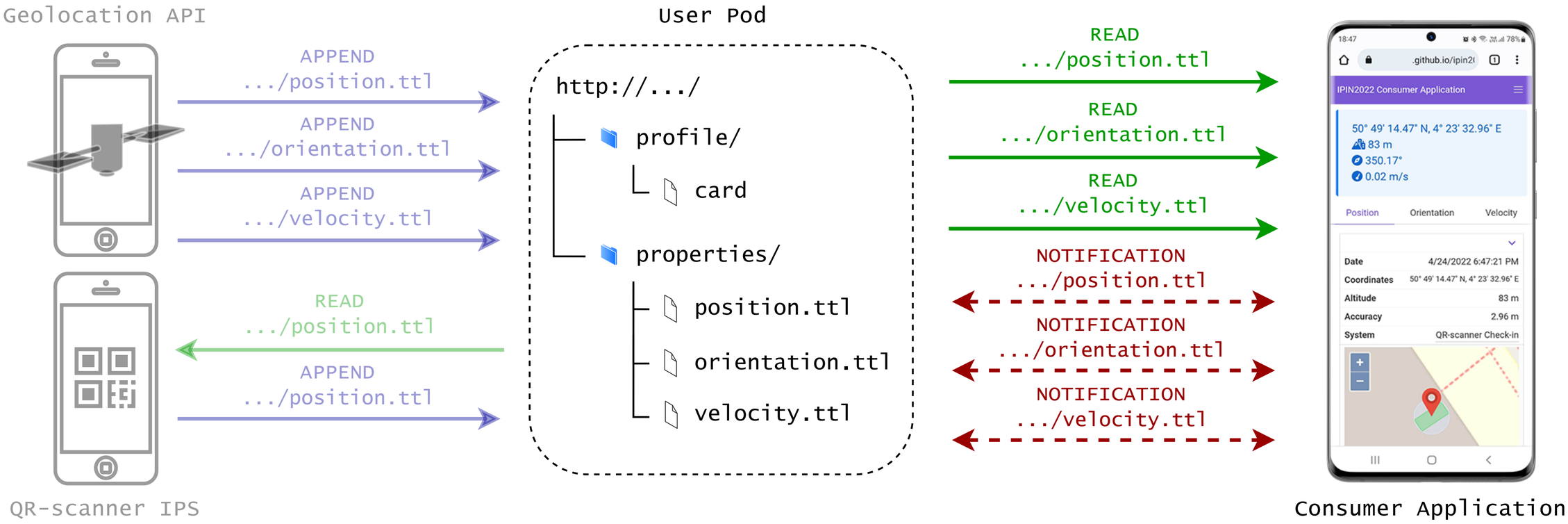
PoC Demonstrator



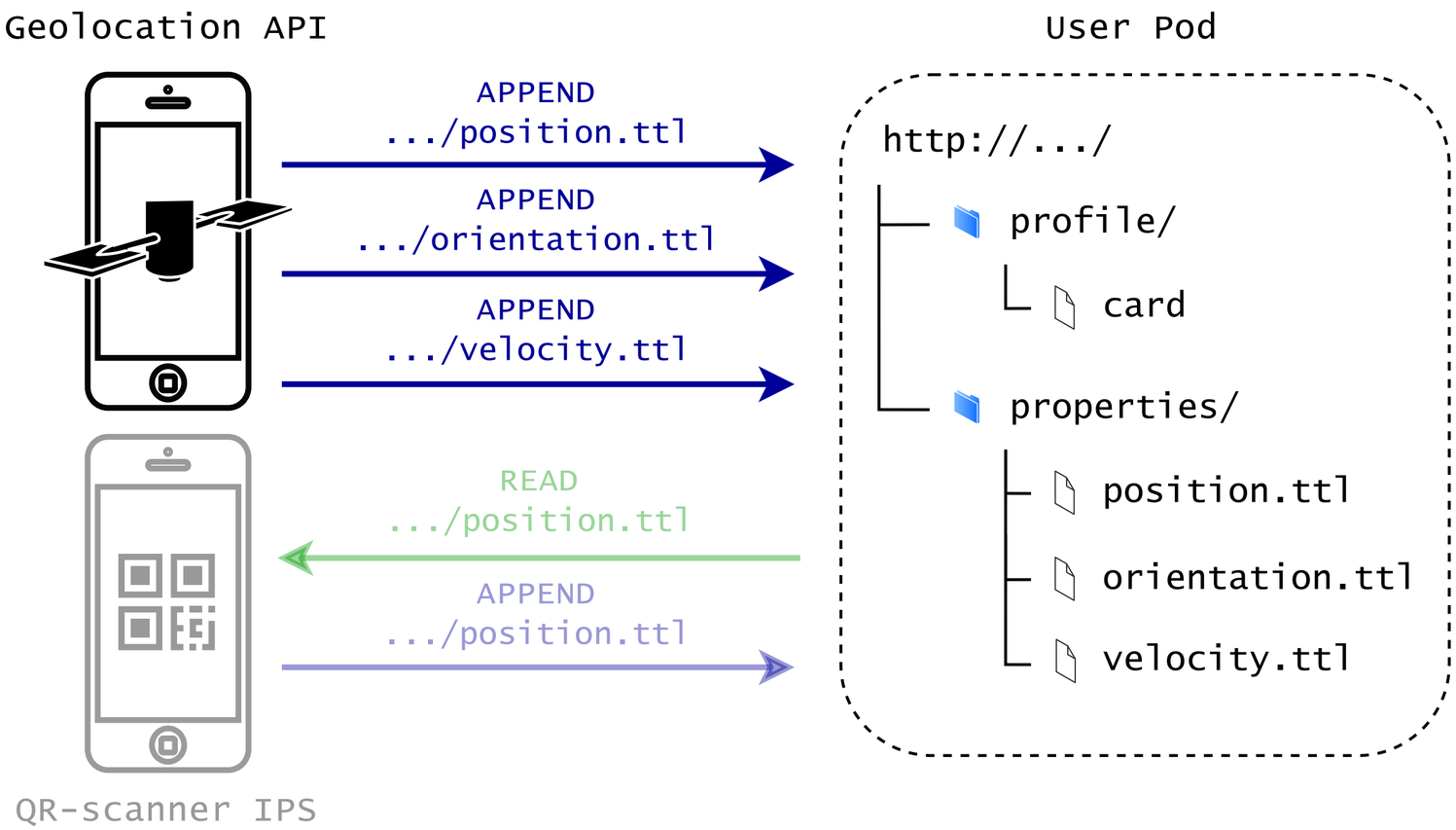
PoC Demonstrator



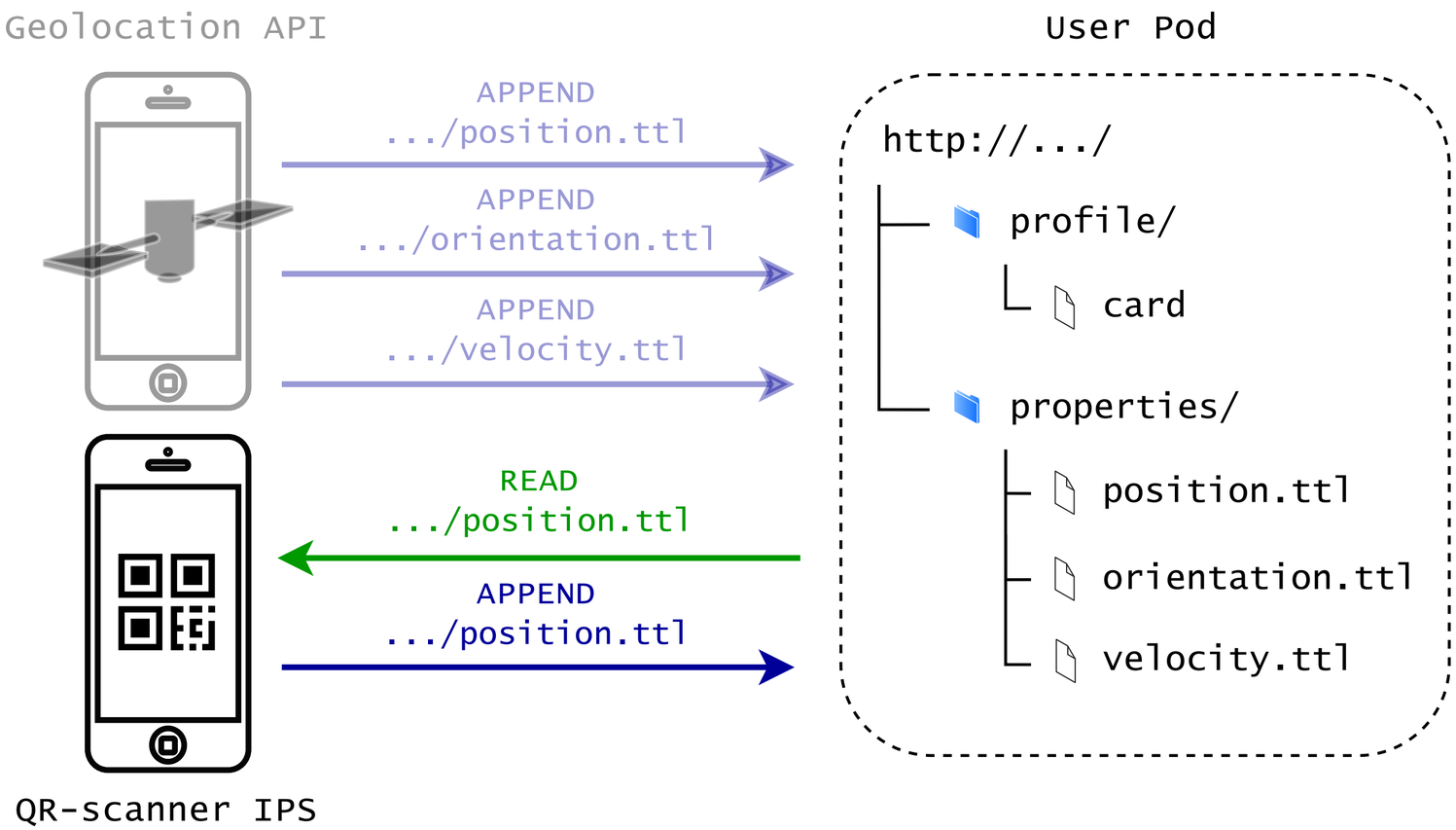
PoC Demonstrator



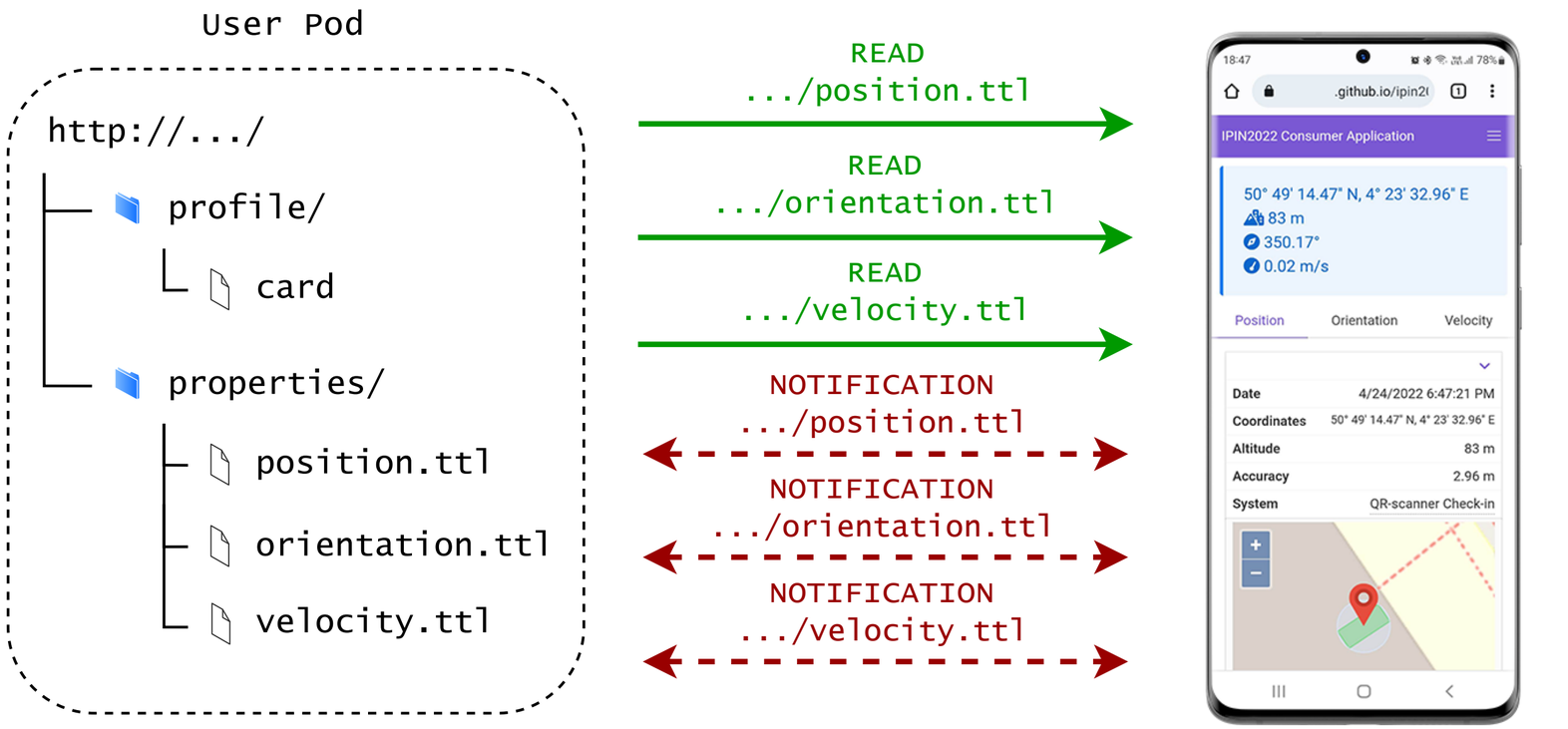
PoC Demonstrator



PoC Demonstrator

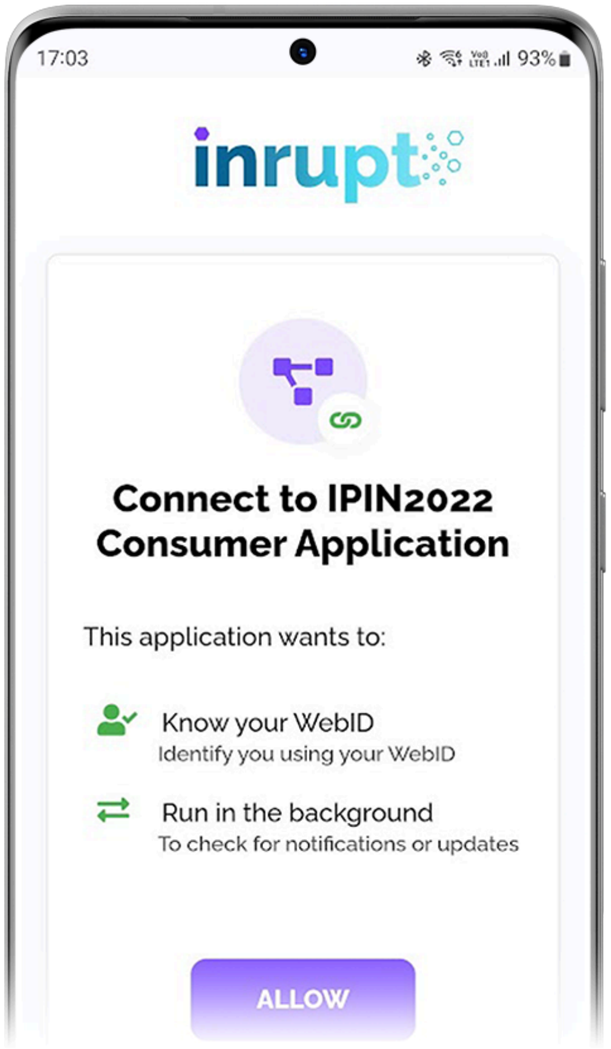


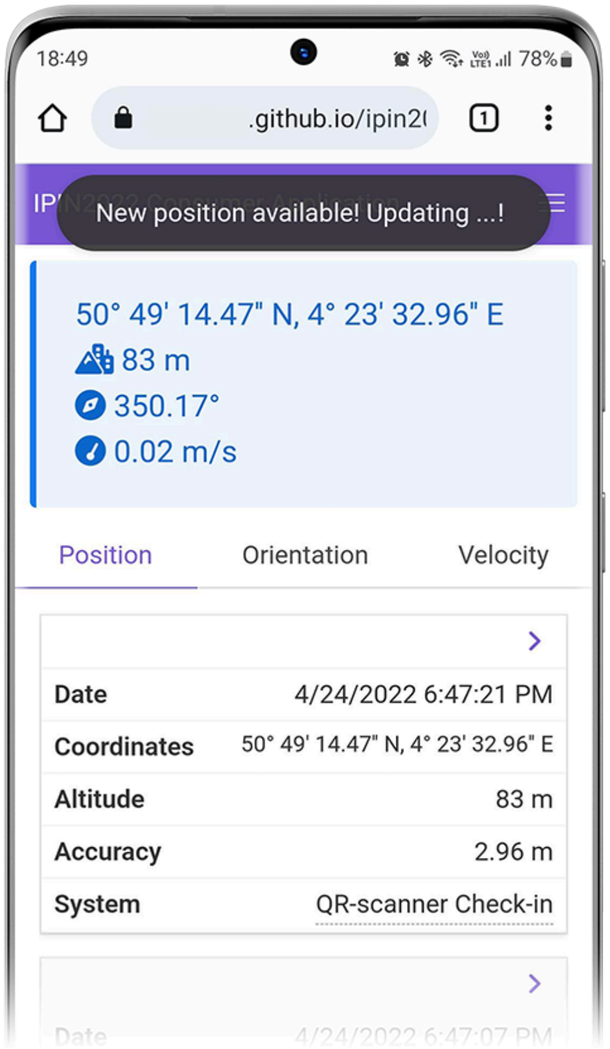
PoC Demonstrator

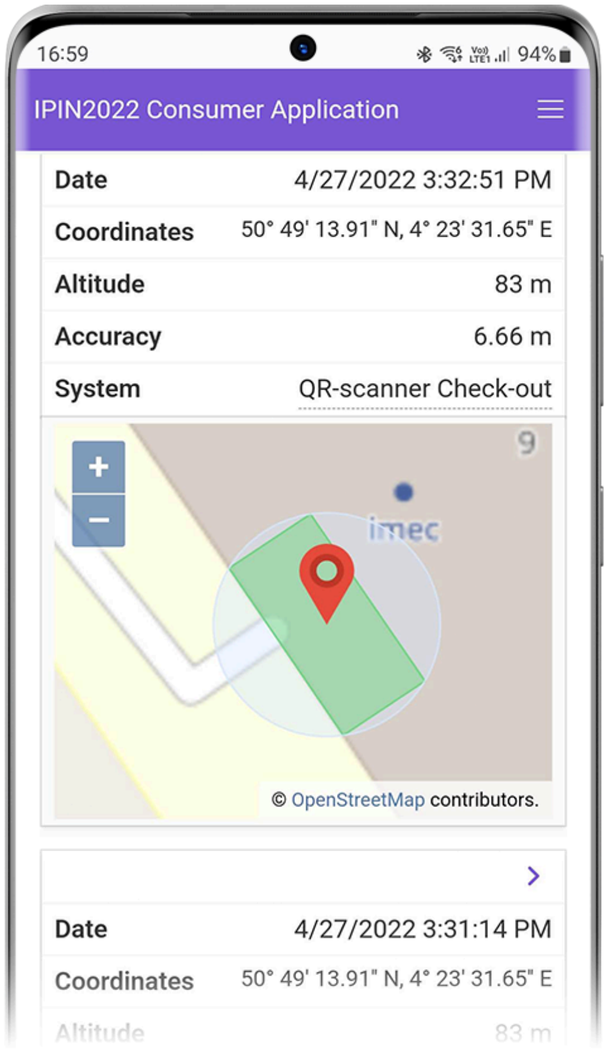


Consumer Application

PoC Demonstrator







PoC Demonstrator

http://.../properties/position.ttl

```
:1660049553011
      a sosa:Observation;
      sosa:hasFeatureOfInterest profile:me;
      sosa:hasResult
          [
              a geosparql:Geometry;
              geosparql:asWKT
                  "POINT Z(4.3922073 50.8206522 143.29)"^^geosparql:wktLiteral;
              geosparql:coordinateDimension 3;
              geosparql:dimension 3;
              geosparql:hasSpatialAccuracy
                  [
                      a qudt:QuantityValue;
                      qudt:numericValue 29.363000869750977;
                      qudt:unit unit:M
                  ];
              geosparql:spatialDimension 3
          ];
      sosa:observedProperty <>;
      sosa:resultTime "2022-08-09T12:52:33.011Z"^^xsd:dateTime;
      sosa:usedProcedure ipin:geolocationapi.
```

PoC Demonstrator

http://.../properties/position.ttl

```
:1660049449839
  a sosa:Observation;
  sosa:hasFeatureOfInterest profile:me;
  sosa:hasResult
          [
              a geosparql:Geometry;
              ipin:inDeployment ipin:deployment_pl9_3_58;
              geosparql:asWKT
                  "POINT Z(4.3922260 50.8204372 84.49)"^^geosparql:wktLiteral;
              geosparql:coordinateDimension 3;
              geosparql:dimension 3;
              geosparql:hasSpatialAccuracy
                      [
                          a qudt:QuantityValue;
                          qudt:numericValue 3.716614723104883;
                          qudt:unit unit:M
                      ];
              geosparql:spatialDimension 3
          ];
    sosa:observedProperty <>;
    sosa:resultTime "2022-08-09T12:50:49.839Z"^^xsd:dateTime;
    sosa:usedProcedure ipin:qrscanner_checkin.
```

PoC Demonstrator

http://.../properties/position.ttl

```
:1660049553011
      a sosa:Observation;
      sosa:hasFeatureOfInterest profile:me;
      sosa:hasResult
              [
                  a geosparql:Geometry;
                  geosparql:asWKT
                      "POINT Z(4.3922073 50.8206522 143.29)"^^geosparql:wktLiteral;
                  geosparql:coordinateDimension 3;
                  geosparql:dimension 3;
                  geosparql:hasSpatialAccuracy
                          [
                              a qudt:QuantityValue;
                              qudt:numericValue 29.363000869750977;
                              qudt:unit unit:M
                          ];
                  geosparql:spatialDimension 3
              ];
      sosa:observedProperty <>;
      sosa:resultTime "2022-08-09T12:52:33.011Z"^^xsd:dateTime;
      sosa:usedProcedure ipin:geolocationapi.
```

PoC Demonstrator

```
SELECT ?posGeoJSON ?datetime ?accuracy {
    ?profile a sosa:FeatureOfInterest ;
            ssn:hasProperty ?property .
    ?observation sosa:hasResult ?result ;
                sosa:observedProperty ?property ;
                sosa:resultTime ?datetime .
    ?result geosparql:hasSpatialAccuracy ?spatialAccuracy ;
            geosparql:asWKT ?posWKT .
    BIND(geof:asGeoJSON(?posWKT) AS ?posGeoJSON)
    ?spatialAccuracy qudt:numericValue ?value ;
                    qudt:unit ?unit .
    OPTIONAL { ?unit qudt:conversionMultiplier ?multiplier }
    OPTIONAL { ?unit qudt:conversionOffset ?offset }
    BIND(COALESCE(?multiplier, 1) as ?multiplier) # Default 1
    BIND(COALESCE(?offset, 0) as ?offset) # Default 0
    BIND(((?value * ?multiplier) + ?offset) AS ?accuracy)
} ORDER BY DESC(?datetime) LIMIT 20
```

Conclusion and Future Work

- Novel architecture for **decentralising** location **data**
  - **User** remains **in control** of their data
- **Interoperability** between systems and applications
  - **Handover** of tracking between systems
  - Single **navigation** application
  - High-level decision fusion
- **Vocabulary extensible** with additional semantics

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