Security in complex APIs

Considerations and Pitfalls

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2023.06.07

Level 0
All or Nothing

- A user can either access the service (and do anything) or not at all
  - Simple to solve with a reverse proxy

Level 1
Action Based

- Per action policies: C, R, U, D
  - Solvable with a reverse proxy: rights on
    - GET (read)
    - POST (create)
    - PUT/PATCH (update)
    - DELETE (delete)
  - BEWARE: Some API features break this:
    - Batch-processing allows read, update & delete with a POST

Level 2
Entity-Type Based

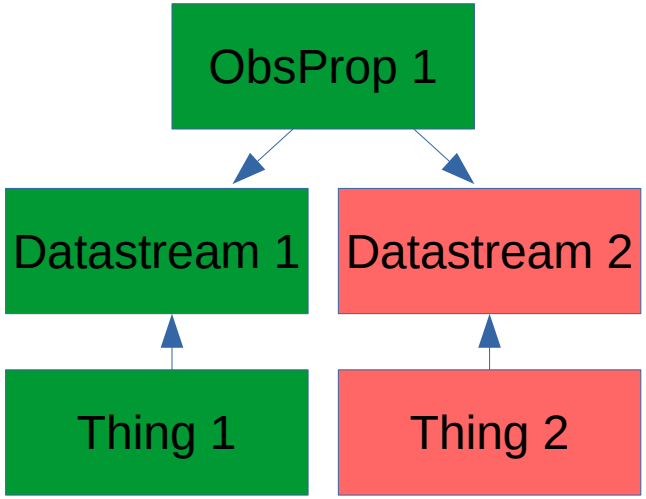
- Per action policies: C, R, U, D
  On a per-Type basis
  - Solvable with a reverse proxy: rights on
    - GET / POST / PUT / PATCH / DELETE
  - Based on the last section of the Path
    - /Observations
      /Datastreams(x)/Observations
      /FeaturesOfInterest(x)/Observations
  - BEWARE: Some API features break this:
    - Batch-processing allows read, update & delete with a POST to v1.1/$batch

Level 3
Entity Based

- CRUD-access based on individual entities or related entities
  - User S can create and read Observations for Datastreams of Thing-1, but nothing else
  - Can not be solved through a proxy, especially read restrictions due to indirect data leaking

Level 3: Read

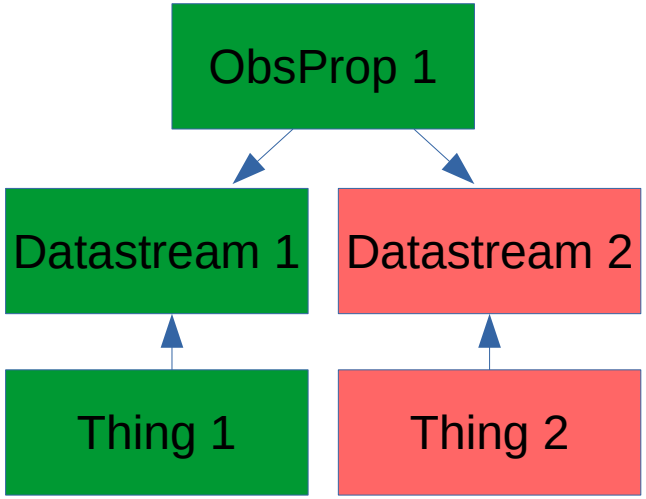
The Problem



- ProxyFail Example 1: expand
  1) User A can read:
     - Thing-1,
     - Datastreams of Thing-1 (DS-1),
     - ObservedProperties of these Datastreams (OP-1)
  2) User A executes query:
     ObservedProperties?$expand=Datastreams($select=name)
  3) Proxy will have a very hard time determining which of the embedded Datastreams should not be there

Level 3: Read

The Problem



- ProxyFail Example 2: filter
  1) User A can read:
     - Thing-1,
     - Datastreams of Thing-1 (DS-1),
     - ObservedProperties of these Datastreams (OP-1)
  2) User A executes query ObservedProperties?$filter=Datastreams/id gt 1
  3) Result is ObservedProperty 1, which User A is allowed to read, so proxy allows the result
  4) User A now knows there is at least 1 Datastream with an id greater than 1

Level 3: Read
Solutions

- Must be solved at a low (database) level
  - Per user group database views
  - Row-Level-Access in PostgreSQL
  - Query-modifications in the server
- This is not specific to STA
  - Relevant for any system that can filter across relations

Level 3: CUD

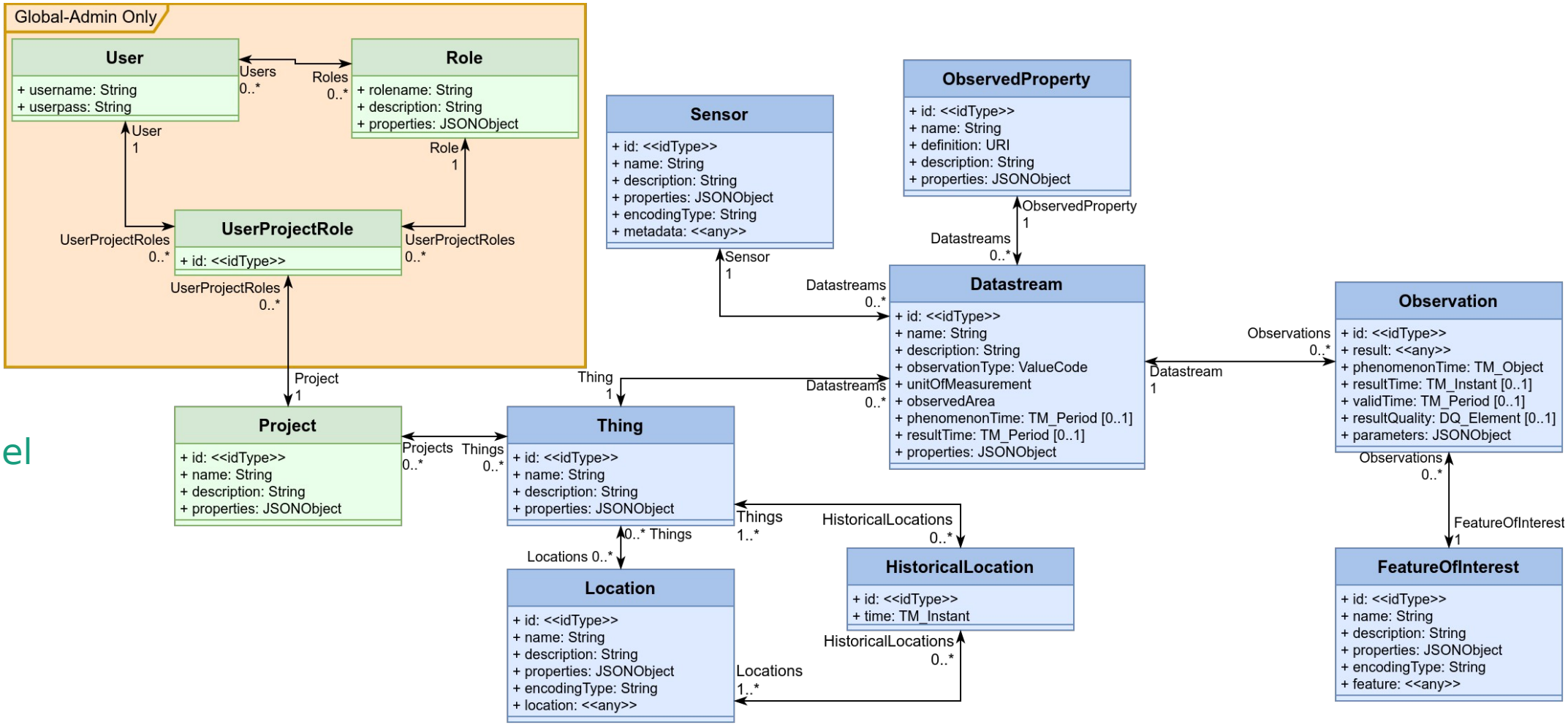
Many Questions

- Can a User
  - Create Entities of EntityType-X
    (new Observations)
  - Link new Entity-X to Entity-Y
    (new Observation in DS-1)
  - Update properties of Entity-X
    (Patch/Put Observation-1)
  - Change a link of Entity-X
    from Entity-Y1 to Entity-Y2
    (Move Observation-1 from DS-1 to DS-2)
  - Delete Entity-X

FROST-Server Implementation

A prototype

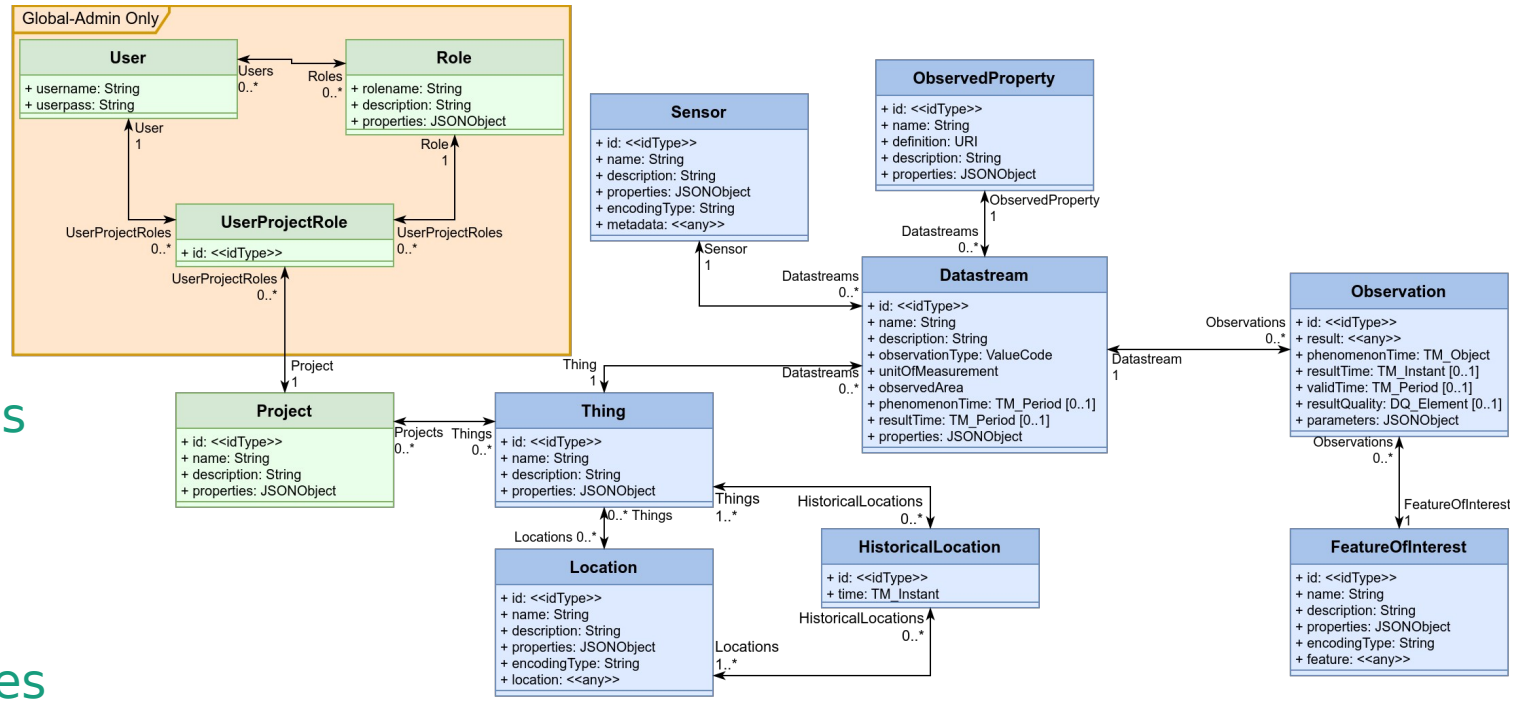
- Extended data model



FROST-Server Implementation

A prototype

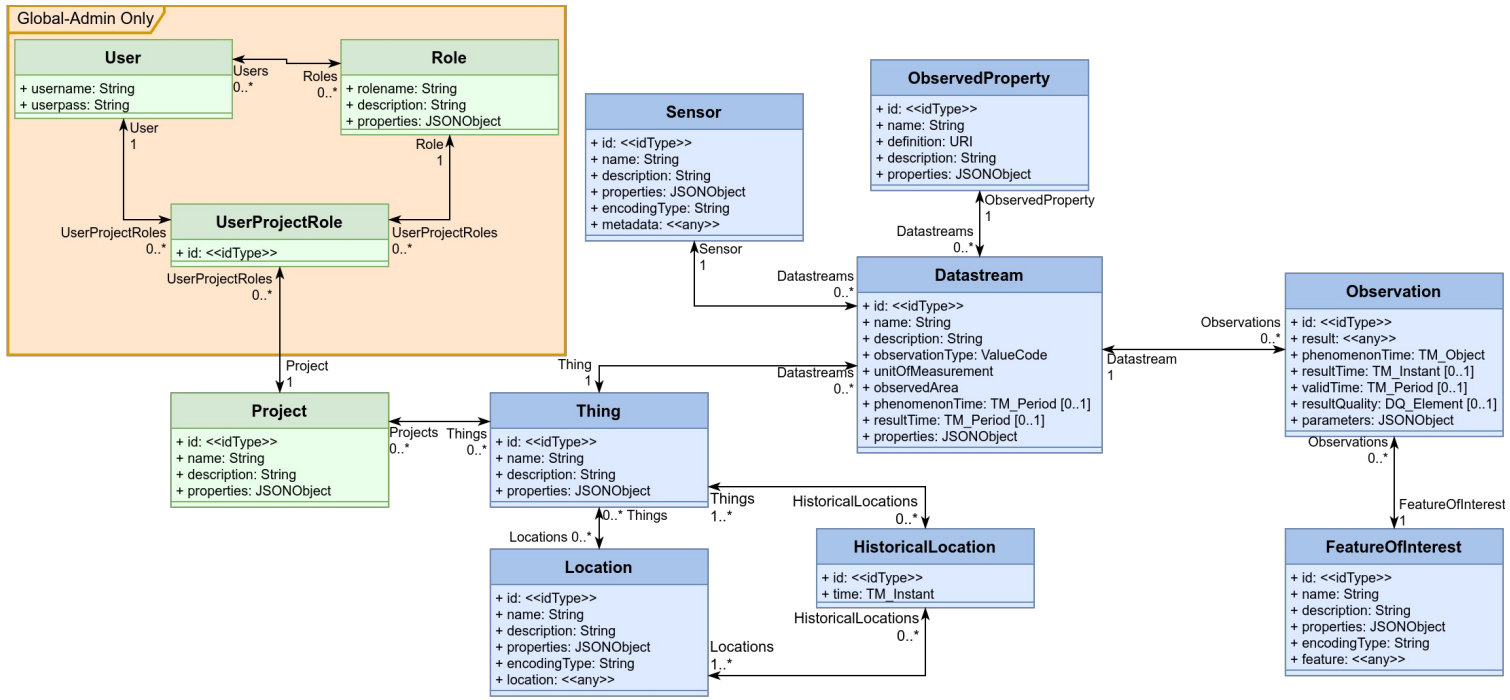
- Extended data model
- Two user-rights levels
  - Global
    - Users have 0..* (global)Roles
  - Project related
    - Things assigned to Projects
    - Users have 0..* (project)Roles in 0..* Projects



FROST-Server Implementation

A prototype

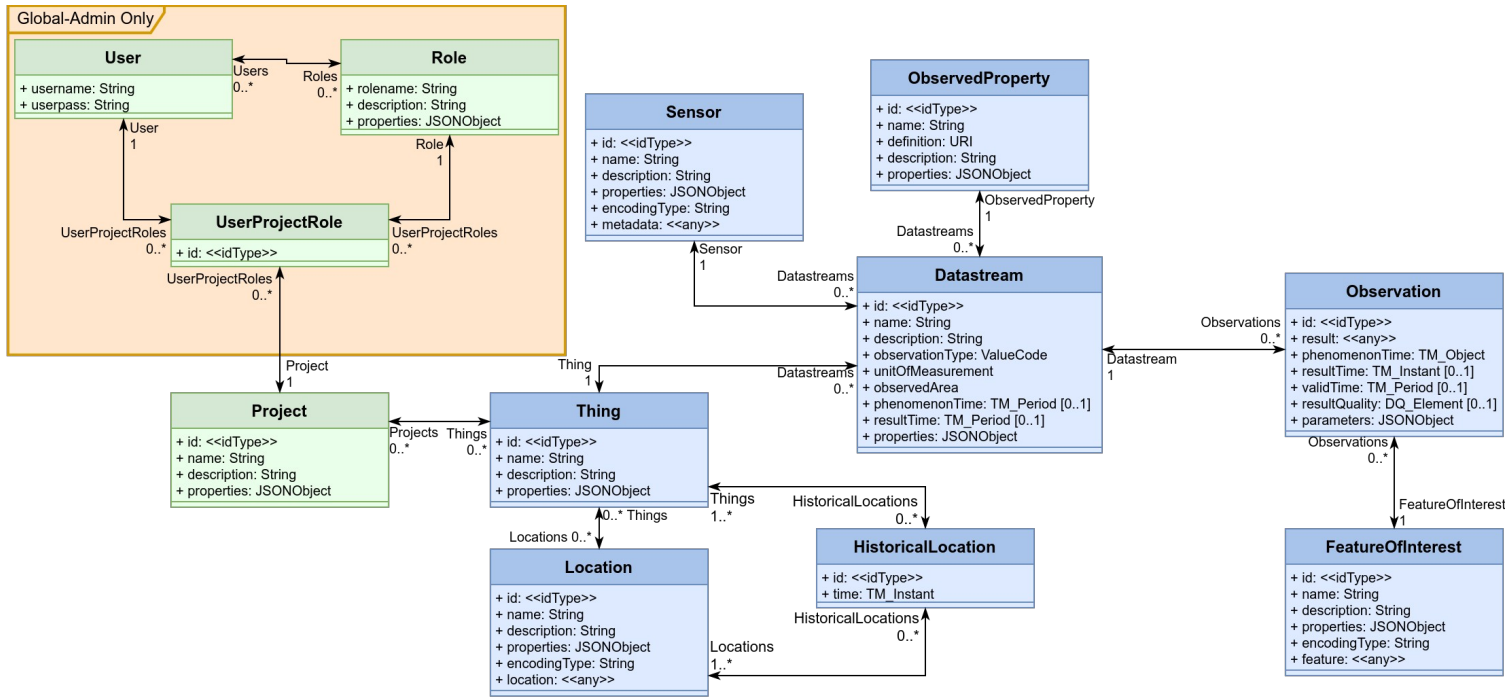
- Admin-Only EntityTypes
  - visible for global-admin users
  - do not exist for others
- Global Roles apply everywhere
  - Global Read can read all
  - Global Create can create all



FROST-Server Implementation

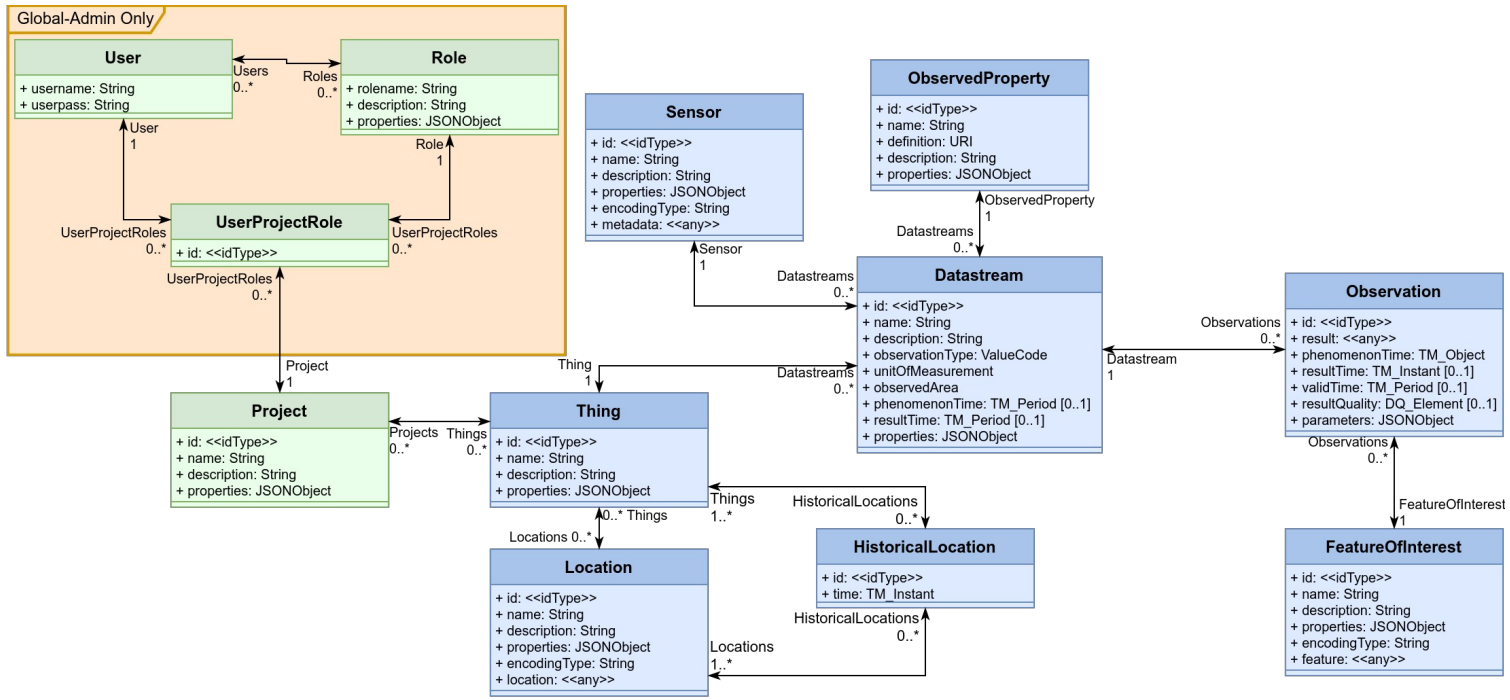
A prototype

- Project Roles for details
  - Users can read Observations in Datastreams of Things linked to a Project they have any role in.
  - User with Role obsCreate on ProjectX can create Observations in Datastreams of Things linked to ProjectX



FROST-Server Implementation

A prototype



- Read restrictions not yet applied to MQTT
- Data model and security rules configurable using JSON files
  - https://github.com/hylkevds/FROST-Server.Plugin.SecurityTest/

Questions?

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