# GEO CONTROL SYSTEM

Requirements document


## Abstract

This document describes the requirements for the GeoControl system, project developed in Software Engineering course, ay 2024-2025

## Contents

The rest of the document is based on the APIs delivered at the beginning of the project. In other words, this document results from a reverse documentation task (produce a requirement document starting from the APIs). Usually, the opposite happens (produce APIs, software design, and code from the requirement document). This choice was made to minimize ambiguities: asking the students to write a requirement document from just an informal description would produce a huge variety of results, quite difficult to evaluate by the teachers. On the other hand, starting from defined APIs should reduce the variability of the student requirement documents.

GeoControl can be developed in two versions: a simulated version (no actual connection with gateways and sensors) and a real one (with actual connection with gateways and sensors).

In the course, GeoControl will be implemented in a simulated version, since providing each group's hardware environment (sensors, gateways) would be too complicated. So, the document will describe the simulated version. For comparison, in the Appendix, the main differences with the real version are highlighted.

## Informal Description

GeoControl is a monitoring system designed to manage different kinds of sensors able to measure geological, meteorological, environmental, and other physical variables such as position, temperature, pressure, humidity, gas concentration, etc.

# Business model

*Value proposition*: provide a software platform to store and process measurements from various sensors (ex, humidity, temperature, pressure, position, etc.) in a physical environment.

*Customer segments*: Business-to-business. Geocontrol is aimed at private or public entities charged with installing and monitoring sensor networks. Examples include:

- Public agencies (ARPA, Unione Montana, and similar) monitoring meteorological status of specific areas
- Companies owning or managing large buildings, monitoring internal comfort (temperature, humidity, pollutant gases concentration)
- Public agencies monitoring seismic status of specific areas

*Revenue streams*: the product could be sold in several ways: yearly license fee, monthly fee, or fee per number of sensors. On top of that, other fees could be charged for support in training or overall configuration.

Comment

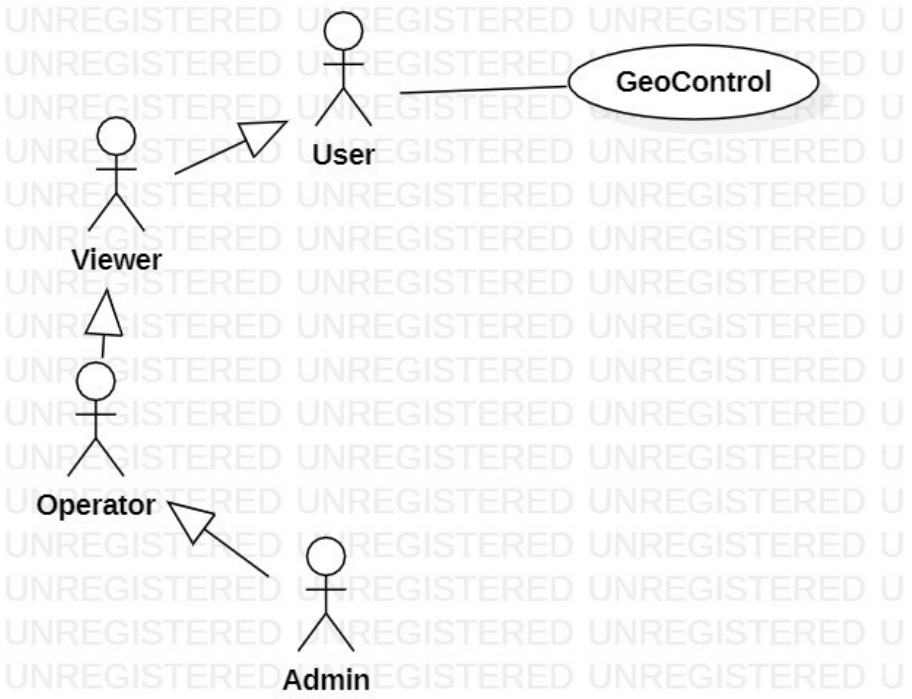
The best way to represent a business model is the Business Model Canvas (BMC) technique. Here we use a simplified version since the BMC was not part of the course program. The main point is that the product is B2B (no B2C) and sold in various ways, but not to simple individual customers (so there is no need to provide payment functions).

## Stakeholders

| Name | Description |
|---|---|
| | |
| Company X | Develops the Geocontrol systems, sells it and customizes it for different buyers (such as ARPA or Union Mountain Communities). Within Company X specific involved roles are owners of company, developer and technical roles, marketing roles. |
| Buyer | Private company or public agency (such as Union of Mountain Communities) which buys Geocontrol from Company X and operates it to collect and monitor measurements from the sensor network. |
| User | Employee of Buyer who actually uses the application. She can be Viewer, Operator or Admin. |
| Gateway, Sensors | Collects and redirects measurements from sensors. Changes in these hardware components (and especially their digital interface) could cause changes in Geocontrol |

**Commented [MM1]:** Ho tolto Arpa che non è mai citata in swagger

## Context Diagram




User is the generic user, who can specialize in Viewer (read-only access to measurements), Operator (setup of network gateways and sensors, force-write measurements), and Admin (user management). See the table of access rights below for details.

Comments:

There is no connection with the environment (no actor ‘Sensor’ or ‘Gateway’ in the context diagram). The GeoControl system (as defined by the APIs) is a purely software product (no hardware parts like gateways and sensors) that simulates the real system (in the APIs, the measurements from sensors are simulated via the endpoint Post Measurement).

Components of the Geocontrol system (front end, back end) appear in the system design and in the deployment diagram, not here.

Also, note that the context diagram shows the interaction between the system and actors during ‘operation’, not during ‘development’. Software developers, sensor vendors, and so on may be stakeholders but are not actors.

## Interfaces

| Actor | Physical interface | Logical interface |
|---|---|---|
| User | PC | REST API |
| Viewer | PC | REST API |
| Operator | PC | REST API |
| Administrator (Admin) | PC | REST API |

## Stories and personas

Context: regional environmental agency (public entity in charge of, among other tasks, monitoring the meteorologic and geologic state of the region). A sensor network has been put in place over the years, using sensors (ex temperature, humidity, pressure, position,..) from various vendors. Each vendor provides a different hardware and software platform to configure, monitor and read data from the sensors. In fact the network is not a homogeneous sensor network, but a loosely integrated sum of many networks.

Anna, Marco and Carla all work for the agency, in different offices.

Anna Rossi has a degree in physics and a master in meteorology. She works in the land monitoring department. Her job starts every dawn by validating the previous day's humidity, temperature, and rainfall figures. She wrangles three vendor dashboards, exports raw CSV files, harmonizes column names in Excel, and scans thousands of rows for anomalies. Crashes and mismatched date formats turn what should be a quick check into a half-hour ritual that still leaves her wondering whether she missed something. She wants one place where clean data appears immediately, and abnormal values are impossible to overlook.

Marco Bianchi has a degree in electronic engineering and works in the ICT unit of the agency. His task is to set up and monitor the sensor network for land monitoring. He installs LoRa gateways in remote mountain shelters, maps every sensor to its physical position, and runs traceability logs for audits. Today, he relies on a patchwork of manufacturer utilities and homemade scripts, none of which share authentication. Because he cannot rehearse deployments from the office, he often drives to a site twice—first to install, then again to fix configuration errors discovered only when real traffic starts flowing. Any downtime hurts the agency's reputation, so he prizes anything that lets him configure and test the full chain before leaving civilization.

Carla De Santis has a computer engineering degree, she also works in the agency's ICT unit. Her task is to manage the IT part of the sensor network, and notably monitor access rights to the data flowing from the sensor network. She must open separate spreadsheets and directories whenever staff join, change teams, or leave to create or disable accounts. Password resets arrive by email, and she has no quick way to see which accounts are still active. Keeping this manual inventory accurate steals hours weekly; she needs a single console that lets her add, list, and deactivate users in minutes.

Current ("as-is") stories

Anna starts at seven, pulls readings from three vendor sites, merges them in Excel and spends twenty minutes chasing a suspected humidity spike because date formats clash. By the time the morning bulletin is ready, half an hour is gone, and confidence is low.

A summer storm hits later; civil-protection officers phone for confirmation because no tool shows live rainfall across every station. Anna repeats the export-merge ritual under pressure.

Marco receives new gateways. IDs can be assigned only on-site, so he drives two hours, edits JSON over SSH, and discovers a typo back at base. A second journey is inevitable.

During another installation, an inclinometer reports null values. The only diagnostic option is a serial cable on a windy ridge; Marco sends raw strings, unsure whether the fault sits in the sensor, radio link, or database until he returns.

Carla compiles user lists from three sources every week to keep the access roster clean. She cross-checks names line by line and repeats the exercise after each resignation, losing half a day every time.

Future ("to-be") stories with GeoControl in place

Anna signs in as a viewer, and the dashboard immediately shows the last twenty-four hours for her network. One click isolates outliers; the other displays mean and standard deviation. She finishes in five minutes. When heavy rain arrives, she repeats the query and forwards the live chart without opening Excel.

Marco authenticates as an operator, defines a new network, adds gateways and sensors in the simulator, and injects a synthetic temperature reading. A quick statistics call confirms the data path works, so he leaves for the mountains confident that no configuration typo will haunt him. When one pressure sensor comes up blank, the value instantly confirms a hardware fault, which he replaces on-site.

Carla logs in as admin, lists all users, filters by "last login more than ninety days ago," and deactivates four dormant accounts in under two minutes. She then creates an account for a new hire with a single form and no spreadsheet juggling. Her weekly roster check now takes minutes instead of hours.

Comment:

Since this project is a B2B case (much more limited number of users versus a B2C case), there are not many personas; in fact, personas match up with actors.

## Functional Requirements

| ID | FR |
|---|---|
| FR1 | **Authentication** |
| FR1.1 | Authenticate user |
| FR2 | **Manage users** |
| FR2.1 | Retrieve all users |
| FR2.2 | Create a new user |

| | |
|---|---|
| FR2.3 | Retrieve a specific user |
| FR2.4 | Delete a specific user |
| FR3 | **Manage networks** |
| FR3.1 | Retrieve all networks |
| FR3.2 | Create a new network |
| FR3.3 | Retrieve a specific network |
| FR3.4 | Update a network |
| FR3.5 | Delete a specific network |
| FR4 | **Manage gateways** |
| FR4.1 | Retrieve all gateways of a network |
| FR4.2 | Create a new gateway for a network |
| FR4.3 | Retrieve a specific gateway |
| FR4.4 | Update a gateway |
| FR4.5 | Delete a specific gateway |
| FR5 | **Manage sensors** |
| FR5.1 | Retrieve all sensors of a gateway |
| FR5.2 | Create a new sensor for a gateway |
| FR5.3 | Retrieve a specific sensor |
| FR5.4 | Update a sensor |
| FR5.5 | Delete a specific sensor |
| FR6 | **Manage measurements** |
| FR6.1 | Retrieve measurements for a set of sensors of a specific network |
| FR6.2 | Retrieve statistics for a set of sensors of a specific network |
| FR6.3 | Retrieve outliers for a set of sensors of a specific network |
| FR6.4 | Store measurements for a specific sensor |
| FR6.5 | Retrieve measurements for a specific sensor |
| FR6.6 | Retrieve statistics for a specific sensor |
| FR6.7 | Retrieve outliers for a specific sensor |

Comment: FRs are 1:1 with the APIs. This is mainly because APIs were given. In a real-life case, the APIs would follow the definition of requirements, so a 1:1 match would be less likely.

The access rights (which actor should be authorized to use which functions) are better represented in a separate table (and not in the FR) for two reasons. They can change over time and are orthogonal to the list of functions.

## Non-Functional Requirements

| Id | Type | Description | Refers to FR |
|---|---|---|---|
| NFR1 | Security | Only authorized users can access functions | All |
| NFR2 | Reliability | Max 6 measurements per sensor per year lost | FR6.4 |
| NFR3 | Localization | Dates and times must be expressed in UTC in milliseconds | FR6 |
| NFR4 | Efficiency | All functions should respond in < 0.5sec | All |

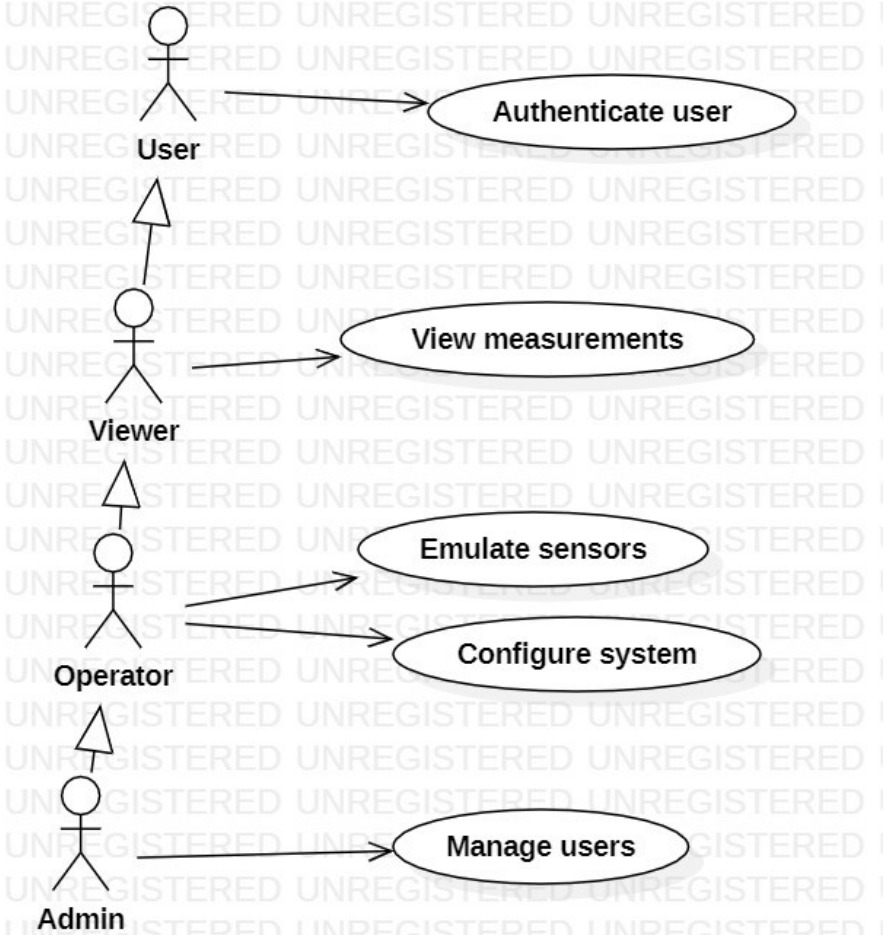
## Access Rights

| ID | FR | Admin | Operator | Viewer | Unlogged user |
|---|---|---|---|---|---|
| FR1 | **Authentication** | ✅ | ✅ | ✅ | ✅ |
| FR1.1 | Authenticate user | ✅ | ✅ | ✅ | ✅ |
| FR2 | **Manage users** | ✅ | ❌ | ❌ | ❌ |
| FR2.1 | Retrieve all users | ✅ | ❌ | ❌ | ❌ |
| FR2.2 | Create a new user | ✅ | ❌ | ❌ | ❌ |
| FR2.3 | Retrieve a specific user | ✅ | ❌ | ❌ | ❌ |
| FR2.4 | Delete a specific user | ✅ | ❌ | ❌ | ❌ |
| FR3 | **Manage networks** | ✅ | ✅ | ❌ | ❌ |
| FR3.1 | Retrieve all networks | ✅ | ✅ | ✅ | ❌ |
| FR3.2 | Create a new network | ✅ | ✅ | | ❌ |
| FR3.3 | Retrieve a specific network | ✅ | ✅ | ✅ | ❌ |
| FR3.4 | Update a network | ✅ | ✅ | ❌ | ❌ |
| FR3.5 | Delete a specific network | ✅ | ✅ | ❌ | ❌ |
| FR4 | **Manage gateways** | ✅ | ✅ | ❌ | ❌ |
| FR4.1 | Retrieve all gateways of a network | ✅ | ✅ | ✅ | ❌ |
| FR4.2 | Create a new gateway for a network | ✅ | ✅ | ❌ | ❌ |
| FR4.3 | Retrieve a specific gateway | ✅ | ✅ | ✅ | ❌ |
| FR4.4 | Update a gateway | ✅ | ✅ | ❌ | ❌ |
| FR4.5 | Delete a specific gateway | ✅ | ✅ | ❌ | ❌ |
| FR5 | **Manage sensors** | ✅ | ✅ | ❌ | ❌ |
| FR5.1 | Retrieve all sensors of a gateway | ✅ | ✅ | ✅ | ❌ |
| FR5.2 | Create a new sensor for a gateway | ✅ | ✅ | ❌ | ❌ |
| FR5.3 | Retrieve a specific sensor | ✅ | ✅ | ✅ | ❌ |
| FR5.4 | Update a sensor | ✅ | ✅ | ❌ | ❌ |
| FR5.5 | Delete a specific sensor | ✅ | ✅ | ❌ | ❌ |
| FR6 | **Manage measurements** | ✅ | ✅ | ✅ | ❌ |
| FR6.1 | Retrieve measurements for a | ✅ | ✅ | ✅ | ❌ |

| | | | | | |
|---|---|---|---|---|---|
| | set of sensors of a specific network | | | | |
| FR6.2 | Retrieve statistics for a set of sensors of a specific network | ✅ | ✅ | ✅ | ❌ |
| FR6.3 | Retrieve outliers for a set of sensors of a specific network | ✅ | ✅ | ✅ | ❌ |
| FR6.4 | Store measurements for a specific sensor | ✅ | ✅ | ❌ | ❌ |
| FR6.5 | Retrieve measurements for a specific sensor | ✅ | ✅ | ✅ | ❌ |
| FR6.6 | Retrieve statistics for a specific sensor | ✅ | ✅ | ✅ | ❌ |
| FR6.7 | Retrieve outliers for a specific sensor | ✅ | ✅ | ✅ | ❌ |

Comment: This table was missing from the template document due to a mistake. However, the table is essential. Adding access rights to the list of FR (ex, FR2.1 would be written as 'Administrator retrieves all users') is a much less clear option; it clutters the list of FRs and complicates maintenance of the document (access rights typically change over time, faster than FRs)

## Use Case Diagram




Comment: UC should be high-level, nearly all of the solutions proposed by the teams equate UC with functions. Since most functions are low-level (e.g., create user), the result is a large number of low-level UCs. This cannot scale up in larger projects (in fact, the UCD proposed by the teams contains dozens and dozens of UCs; in a larger project, it would contain hundreds of UCs). We have accepted this approach, but please note that UCs should be higher-level, focusing on the value added for actors (as in the proposed UCD). Notice also that the UCs we propose are closer to stories.

Remark also, in the following use cases, the mapping UC – FR: in most cases, a UC maps to many FRs

## Use Cases

## UC Authenticate user

| | |
|---|---|
| Actors involved | User |
| Pre condition | |
| Post condition | |
| Nominal scenarios | -sign in (user has account) |
| Variants | |
| Exceptions | -sign in, password wrong<br>-sign in, username wrong or not existing |

### Scenario sign in

| | |
|---|---|
| Precondition | User has account |
| Postcondition | User is authenticated and authorized with role (admin or operator or viewer) |
| Steps | |
| 1 | System prompts for credentials |
| 2 | Unlogged user enters user name and password |
| 3 | System looks for username, finds it, looks for stored password, passwords match |
| 4 | System notifies sign in successful |

### Scenario sign in pwd wrong

| | |
|---|---|
| Precondition | User has account |
| Postcondition | User not authenticated |
| Steps | |
| 1 | System prompts for credentials |
| 2 | Unlogged user enters user name and password |
| 3 | System looks for username, finds it, looks for stored password, passwords does not match |
| 4 | System notifies sign in failed |

### Scenario sign in username wrong

| | |
|---|---|
| Precondition | User has account |
| Postcondition | User not authenticated |
| Steps | |
| 1 | System prompts for credentials |
| 2 | Unlogged user enters user name and password |
| 3 | System looks for username, does not finds it |
| 4 | System notifies sign in failed |

## UC Manage users

| | |
|---|---|
| Actors involved | Admin |
| Pre condition | User successfully logged in as Admin |
| Post condition | |
| Nominal scenarios | -Create a new user (FR2.2)<br>-Delete a specific user (FR 2.4) |
| Variants | -Modify characteristics of a specific user (FR2.3 FR2.4 FR2.2) |
| Exceptions | -Create a new user, user already exists (FR2.2)<br>-Delete user, user not found |

### Scenario create user

| | |
|---|---|
| Precondition | User successfully logged in as Admin |
| Postcondition | User X created |
| Steps | |
| 1 | System prompts Admin options |
| 2 | Admin selects new user creation |
| 3 | System prompts new user creation |
| 4 | Admin enters username X and password |
| 5 | System checks username X is available, and password is acceptable, stores them |
| 6 | System notifies user creation successful |

### Scenario create user, username wrong

| | |
|---|---|
| Precondition | User successfully logged in as Admin |
| Postcondition | User X not created |
| Steps | |
| 1 | System prompts Admin options |
| 2 | Admin selects new user creation |
| 3 | System prompts new user creation |
| 4 | Admin enters username X and password |
| 5 | System checks username X is not available |
| 6 | System notifies user creation failed |

### Scenario delete user

| | |
|---|---|
| Precondition | User successfully logged in as Admin |
| Postcondition | User X deleted |
| Steps | |

| | |
|---|---|
| 1 | System prompts Admin options |
| 2 | Admin selects delete user |
| 3 | System prompts user search |
| 4 | Admin enters username X |
| 5 | System checks username X, finds it, deletes it |
| 6 | System notifies user deletion successful |

### Scenario delete user, user not found

| | |
|---|---|
| Precondition | User successfully logged in as Admin |
| Postcondition | Nope |
| Steps | |
| 1 | System prompts Admin options |
| 2 | Admin selects delete user |
| 3 | System prompts user search |
| 4 | Admin enters username X |
| 5 | System checks username X, does not find it |
| 6 | System notifies user deletion failed |

## UC Configure system

| | |
|---|---|
| Actors involved | Operator, Administrator |
| Pre condition | -User successfully logged in as operator |
| Post condition | |
| Nominal scenarios | -create a network, create a gateway, create a sensor<br>-create a gateway, create a sensor, attach to existing network<br>-create a sensor, attach to existing network and gateway |
| Variants | |
| Exceptions | -network not found<br>-gateway not found<br>-sensor already exists |

### Scenario configure network gateway sensor

| | |
|---|---|
| Precondition | User  successfully logged in as operator or admin |
| Postcondition | Network N created, gateway G created and attached to N, sensor S created and attached to G |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Network creation |
| 3 | System prompts network creation form |

| | |
|---|---|
| 4 | Operator enters Network N attributes |
| 5 | System creates Network N |
| 6 | System prompts Operator options |
| 7 | Operator selects Gateway creation |
| 8 | System prompts Gateway creation form |
| 9 | Operator enters Gateway G attributes, and N id |
| 10 | System creates Gateway G, attached to N |
| 11 | System prompts Operator options |
| 12 | Operator selects Sensor creation |
| 13 | System prompts Sensor creation form |
| 14 | Operator enters Sensor S attributes, G id |
| 15 | System creates Sensor S attached to G |

### Scenario create network, exception

| | |
|---|---|
| Precondition | User successfully logged in as operator or admin |
| Postcondition | Network not created |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Network creation |
| 3 | System prompts network creation form |
| 4 | Operator enters Network N attributes |
| 5 | System checks N, N already exists |
| 6 | System notifies network creation failed |

### Scenario configure gateway sensor

| | |
|---|---|
| Precondition | User successfully logged in as operator or admin |
| Postcondition | Gateway G created and attached to N, sensor S created and attached to G |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Gateway creation |
| 3 | System prompts Gateway creation form |
| 4 | Operator enters Gateway G attributes, and N id |
| 5 | System creates Gateway G, attached to N |
| 6 | System prompts Operator options |
| 7 | Operator selects Sensor creation |
| 8 | System prompts Sensor creation form |
| 9 | Operator enters Sensor S attributes, G id |
| 10 | System creates Sensor S attached to G |

### Scenario create gateway exception1

| Precondition | User successfully logged in as operator or admin |
|---|---|
| Postcondition | Gateway G not created |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Gateway creation |
| 3 | System prompts Gateway creation form |
| 4 | Operator enters Gateway G attributes, and N id |
| 5 | System checks G, G already exists |
| 6 | System notifies gateway creation failed |

### Scenario create gateway exception2

| Precondition | User successfully logged in as operator or admin |
|---|---|
| Postcondition | Gateway G not created |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Gateway creation |
| 3 | System prompts Gateway creation form |
| 4 | Operator enters Gateway G attributes, and N id |
| 5 | System checks N, N does not exists |
| 6 | System notifies gateway creation failed |

### Scenario create sensor

| Precondition | User successfully logged in as operator or admin |
|---|---|
| Postcondition | Sensor S created and attached to G |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Sensor creation |
| 3 | System prompts Sensor creation form |
| 4 | Operator enters Sensor S attributes, G id |
| 5 | System creates Sensor S attached to G |

### Scenario create sensor exception1

| Precondition | User successfully logged in as operator or admin |
|---|---|
| Postcondition | Sensor not created |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Sensor creation |
| 3 | System prompts Sensor creation form |
| 4 | Operator enters Sensor S attributes, G id |

| | |
|---|---|
| 5 | System checks S, S exists already |
| 6 | System notifies sensor creation failed |

### Scenario create sensor exception2

| | |
|---|---|
| Precondition | User successfully logged in as operator or admin |
| Postcondition | Sensor not created |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects Sensor creation |
| 3 | System prompts Sensor creation form |
| 4 | Operator enters Sensor S attributes, G id |
| 5 | System checks G, G does not exist |
| 6 | System notifies sensor creation failed |

## UC Emulate sensors

| | |
|---|---|
| Actors involved | Operator |
| Pre condition | -User successfully logged in as operator<br>-System configured (at least a sensor attached to a gateway, attached to a network has been defined) |
| Post condition | |
| Nominal scenarios | -Operator forces measurements for a certain sensor (FR 6.4) |
| Variants | |
| Exceptions | -sensor not found |

### Scenario store measurement for a sensor

| | |
|---|---|
| Precondition | User successfully logged in as operator |
| Postcondition | Value for sensor S updated |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects store measurement option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date, value |
| 5 | System checks S, S exists |
| 6 | System stores measurements of S |

### Scenario store measurement for a sensor - exception

| | |
|---|---|
| Precondition | User successfully logged in as operator |

| | |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Operator options |
| 2 | Operator selects store measurement option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date, value |
| 5 | System checks S, S does not exist |
| 6 | System notifies S does not exist |

## UC View measurements

| | |
|---|---|
| Actors involved | Viewer |
| Pre condition | -User successfully logged in as viewer<br>-System configured (at least a sensor attached to a gateway, attached to a network has been defined) |
| Post condition | - |
| Nominal scenarios | -Viewer retrieves measurements for a certain sensor (FR 6.5)<br>-Viewer retrieves outliers for a certain sensor (FR6.7)<br>-Viewer retrieves statistics for a certain sensor (FR6.6) |
| Variants | -Viewer retrieves measurements for all sensors of a certain network (FR6.1)<br>-Viewer retrieves outliers for all sensors of a certain network (FR6.3)<br>-Viewer retrieves statistics for all sensors of a certain network (FR6.2) |
| Exceptions | -sensor not found<br>-network not found |

### Scenario view measurements of a sensor

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view measurement option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date range |
| 5 | System checks S, S exists |
| 6 | System shows measurements of S |

### Scenario view measurements of a sensor, exception

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |

| | |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view measurement option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date range |
| 5 | System checks S, S does not exist |
| 6 | System notifies exception |

### Scenario view outliers of a sensor

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view outliers option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date range |
| 5 | System checks S, S exists |
| 6 | System shows outliers of S |

### Scenario view statistics of a sensor

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view statistics option |
| 3 | System prompts Sensor id |
| 4 | Operator enters Sensor S id, date range |
| 5 | System checks S, S exists |
| 6 | System shows statistics of S |

### Scenario view measurements of a network

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view measurements of a network option |
| 3 | System prompts Network id |
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, N exists |
| 6 | System shows measurements of all sensors of N |

### Scenario view measurements of a network, exception

| Precondition | User successfully logged in as viewer (or operator or admin) |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view measurements of a network option |
| 3 | System prompts Network id |
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, N does not exist |
| 6 | System notifies exception |

### Scenario view outliers of a network

| Precondition | User successfully logged in as viewer (or operator or admin) |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view outliers of a network option |
| 3 | System prompts Network id |
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, N exists |
| 6 | System shows outliers of all sensors of N |

### Scenario view outliers of a network, exception

| Precondition | User successfully logged in as viewer (or operator or admin) |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view outliers of a network option |
| 3 | System prompts Network id |
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, does not N exist |
| 6 | System notifies exception |

### Scenario view statistics of a network

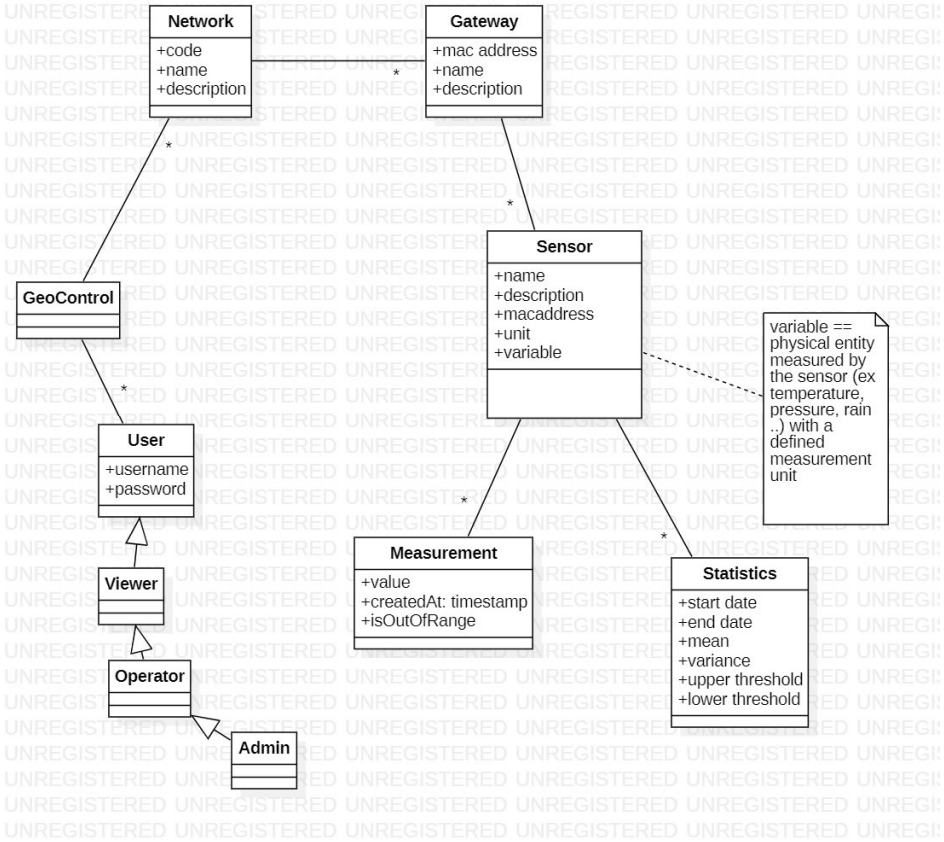
| Precondition | User successfully logged in as viewer (or operator or admin) |
|---|---|
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view statistics of a network option |
| 3 | System prompts Network id |

| | |
|---|---|
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, N exists |
| 6 | System shows statistics of all sensors of N |

### Scenario view statistics of a network, exception

| | |
|---|---|
| Precondition | User successfully logged in as viewer (or operator or admin) |
| Postcondition | |
| Steps | |
| 1 | System prompts Viewer options |
| 2 | Viewer selects view statistics of a network option |
| 3 | System prompts Network id |
| 4 | Operator enters Network N id, date range |
| 5 | System checks N, does not N exist |
| 6 | System notifies exception |

## Glossary




Comments:

A separate class should not represent outliers; an outlier is a measurement, so it is represented by a Boolean field 'isOutOfRange'.

Viewer, Operator, and Admin could also be represented by a 'type' attribute in class User.

The relationship between Network and Gateway is 1 to many (and so gateway to Sensor). The latter represents a physical topology and is clearly 1 to many. The former represents a logical organization (Network is a logical concept, not physical), so it could be possible to consider a gateway (and its sensors) belonging to more than one Network. This should be discussed with the stakeholders.

## System Design

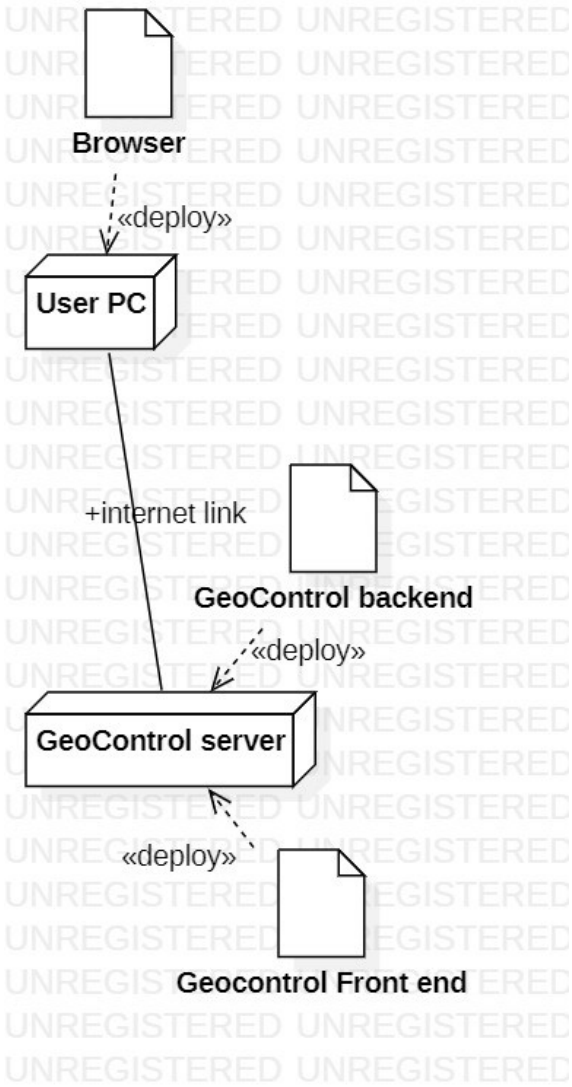
The system is composed of

- Geo Control back end
    - Geo Control Database

Comment: The system design shows the components of the Geocontrol system and should be read in parallel with the context diagram. The main information shown by both is that the hardware part (sensors, gateways, servers running front end, back end, and database) is ‘not’ part of the system. This is important for contractual reasons (the customer needs to know what he pays for, what is included in the contract, referring to the product, and what is not included). Normally, the requirement document is a technical annex to the contract signed between the vendor and the customer. The contract contains the legal wording, commercial information (pricing, delivery dates, penalties), and the technical annex, which is the more technical part of the contract.

A GUI is needed for a simpler use of GeoControl, which could be implemented via a front-end component. The front end is not part of the product either, but it appears in the Deployment diagram.

## Deployment Diagram



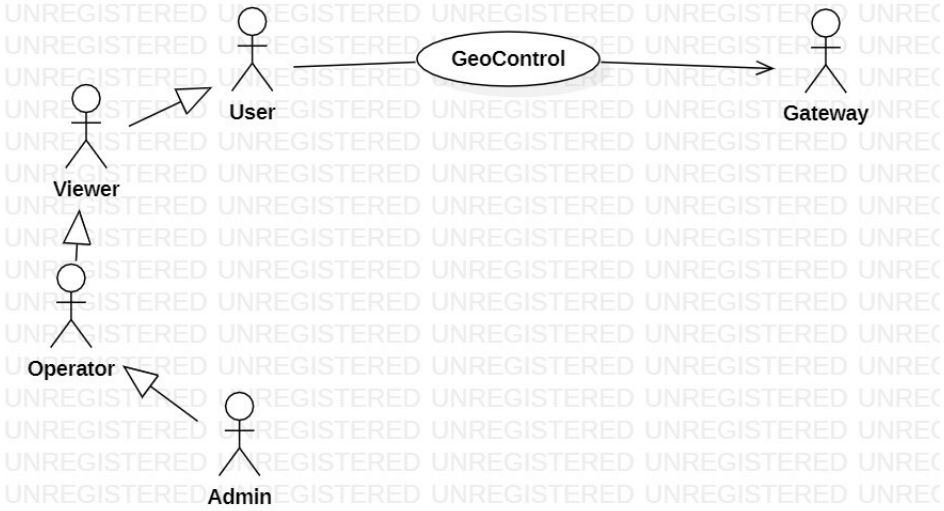

Comment

The DD shows the hardware/software architecture of the simulated Geocontrol. In particular, the GeoControl server (not part of the system) must appear here.

# APPENDIX

Here we present a possible real (not simulated) version of GeoControl.

## Context diagram




Comment

This Context diagram assumes that the product is purely a software product (APIs and their implementation), so the hardware part (sensors and gateways) is outside. Gateways are connected to sensors, but this cannot be represented here (but appears in the Deployment diagram).

Other options are possible (ex, gateways and sensors could be part of the system). The important point is that the Context diagram and system design must be consistent.

## FR

The FRs should be enriched with functions to read and possibly process measurements from the gateways.

## NFR

No changes here.

## UCD and UCs

At least a UC should be added to manage the reading, processing, and storage of measurements.

## Glossary

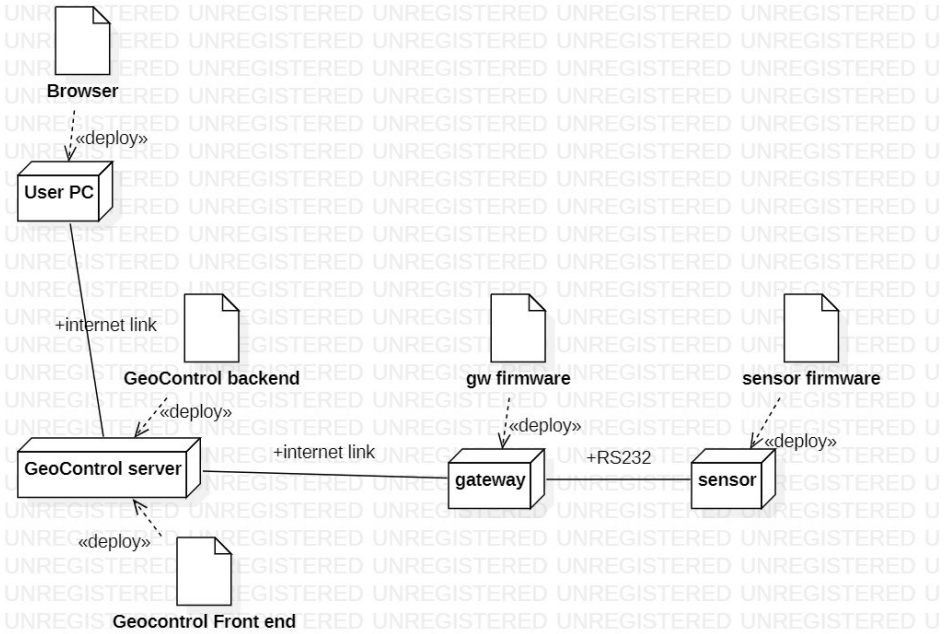
No changes here

## System design

No changes here, considering GeoControl as a purely software product.

As said above in the comments about the context diagram, another option could include in the system both gateways and sensors. In this case the system design should list them too.

## Deployment diagram




The DD shows the complete picture of all hardware and software components needed to run the system, without considering the boundary in/out (as in context diagram and system design). So here, the sensor, gateway, servers, and browser appear, even if they are not part of the system.