

# Global Earth Observation System of Systems Architecture Development Using a System Specification in Terms of Viewpoints

Lawrence McGovern, DSc  
International Consortium of System Engineers  
[Lawrence.McGovern@NGC.com/](mailto:Lawrence.McGovern@NGC.com/)  
[Lawrence.McGovern@incose.com/](mailto:Lawrence.McGovern@incose.com/)





## Agenda

- Background
- Introduction
- Overview of Use of UML for Open Distributed Processing (ODP) System Specifications
- RM\_ODP Viewpoint Specifications
- RM\_ODP Languages
- Overview of UML Concepts
- GEOSS Enterprise View Example
- Summary
- Questions?



## Background

- Global Earth Observation System of Systems (GEOSS) will provide the overall conceptual and organizational framework to build towards integrated Global Earth observations that meet user needs
- GEOSS will be a “system of systems” made up of existing and future Earth observation systems, that supplement but do not supplant their own mandates and governance arrangements.
- It will provide the institutional mechanisms for ensuring the necessary level of coordination, strengthening and supplementation of existing global Earth observation systems
- Reinforcing and supporting them in carrying out their mandates.



## Background

- **ISO/IEC 19793:2006** International Standard defines use of the Unified Modeling Language (UML 2.0 Superstructure Specification, OMG document formal/01-020-08) for expressing system specifications in terms of
- Viewpoint specifications defined by the Reference Model of Open Distributed Processing (RM-ODP, ITU-T Rec.9 X.901 to X.904 | ISO/IEC 10746 Parts 1 to 4) and the Enterprise Language (ITU-T Rec. X.911 | ISO/IEC 1541)



## Introduction

- Reference Model of Open Distributed Processing (RM-ODP) ISO/IEC 10746
  - Coordinating Framework for standardization of ODP
  - RM-ODP depicts an architecture that supports
    - Distribution, inter-working, and portability integration



## Presentation Constraints

- Due to time allowed for presentation of one hour
  - Coverage of subject matter limited to descriptions and one example of the RM-ODP structure and framework provided by ISO/IEC 19793:2007
  - Example will cover Enterprise Specification and View using UML for one GEOSS scenario.



## Unified Modeling Language

- Unified Modeling Language is used to specify and document the artifacts of the systems
- Can be applied to all major object and component methods
- RM-ODP ISO/IEC 10746 computational and engineering language uses UML 2.0 as its baseline



## Unified Modeling Language

- Overview and Motivation
  - Five viewpoints, called enterprise, information, computational, engineering and technology serve as basis for specification of ODP systems
  - RMP-ODP does not prescribe a notation or model developed methodology
  - RMP-ODP documents provide the framework for ODP specifications using UML



## View Point Specifications

- **Enterprise Specification** - Specifies the roles played by an IT system in its organizational environment
- **Information Specification** - Specifies system behavior to meet its objectives abstracted from implementation
- **Computational Specification** - Specifies computational structure in terms of units of functionality and distribution and their interactions
- **Engineering Specification** - Specifies the mechanisms and services to provide the distribution transparencies and meet Quality of Service (QoS) constraints required by the system
- **Technology Specification** - Specifies the hardware and software pieces from which the system is built.

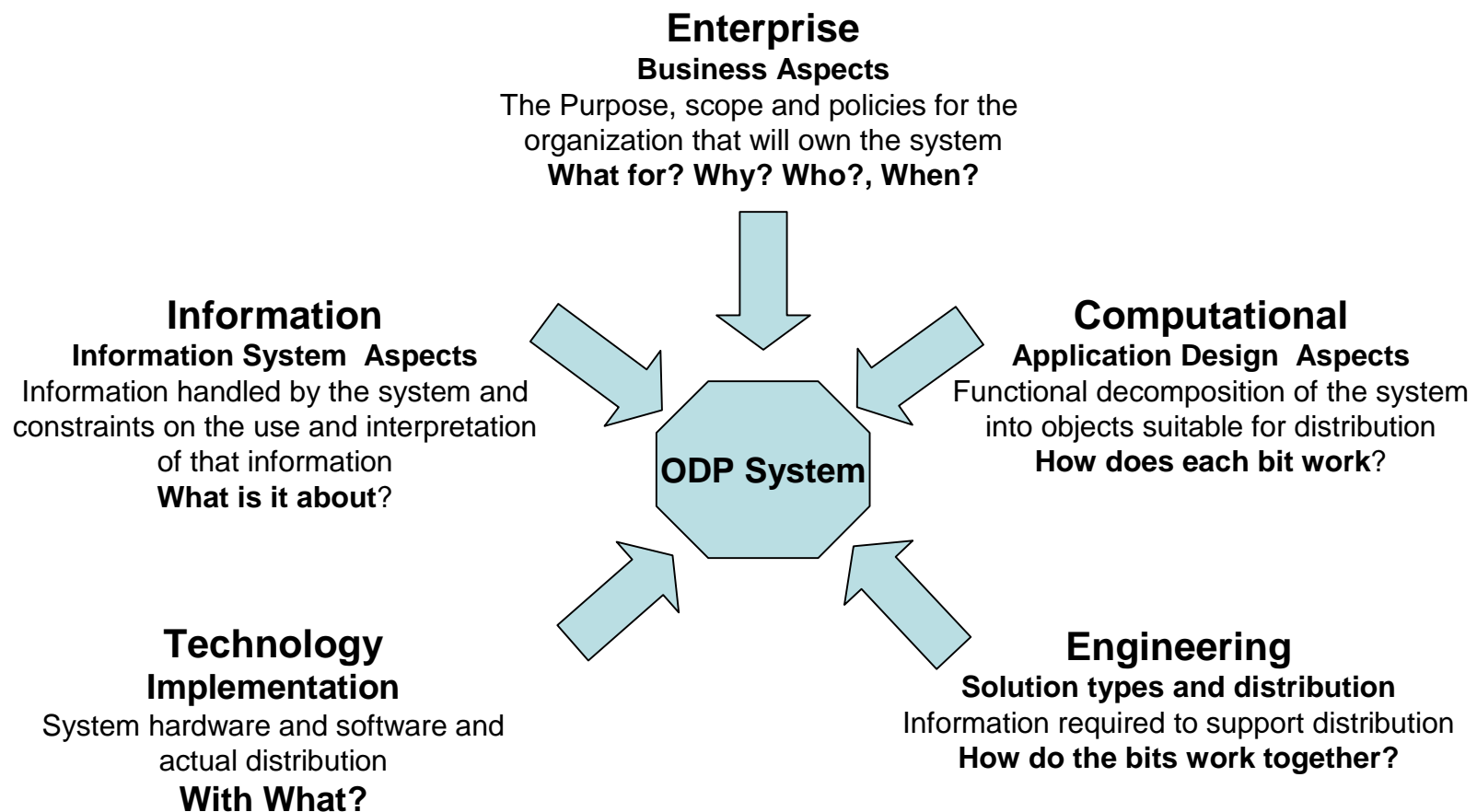


## UML Profiles to be used for ODP

- **Enterprise viewpoint** -concerned with the purpose, scope and policies governing the activities of the specified system within the organization of which it is a part
- **Information Viewpoint** -concerned with the kinds of information handled by the system and constraints on the use and interpretation of that information;
- **Computational Viewpoint** -concerned with the functional decomposition of the system into a set of objects that interact at interfaces – enabling system distribution;
- **Engineering Viewpoint** - concerned with the infrastructure required to support system distribution;
- **Technology Viewpoint** - concerned with the choice of technology to support system distribution.



# Viewpoint Specifications





## Viewpoint Language

- Each viewpoint is associated with a viewpoint language
  - Enterprise Language
    - Modeled by one or more enterprise objects
    - Models ODP system in context of business or organization in which it operates
    - Model has one or more enterprise objects within communities of enterprise objects that model its environment
    - Roles are used to model users, owners and providers of information



## Information Language

- Defines concept for the specification of the meaning of information that is stored inside, and manipulated by an ODP system
- ODP system is modeled in an information specification in terms of
  - Information Objects and relationships and behavior
  - Basic information elements modeled as atomic information objects
  - Complex information modeled as composite information objects



## Computational Language

- Decomposes system into Computational objects that perform individual functions and interface at interfaces.
- computational language includes
  - Form of interface an object can have
  - Ways interfaces can be bound and forms on interaction that can take place at them
  - Actions an object can perform such as creating new objects and interfaces and establishment of bindings
- Ensures consistency between different engineering and technology specifications



## Engineering Language

- Concerned with how objects interact
- Supports interactions between computational objects
- Defines mechanisms and functions required to support distributed interaction between objects in an ODP system

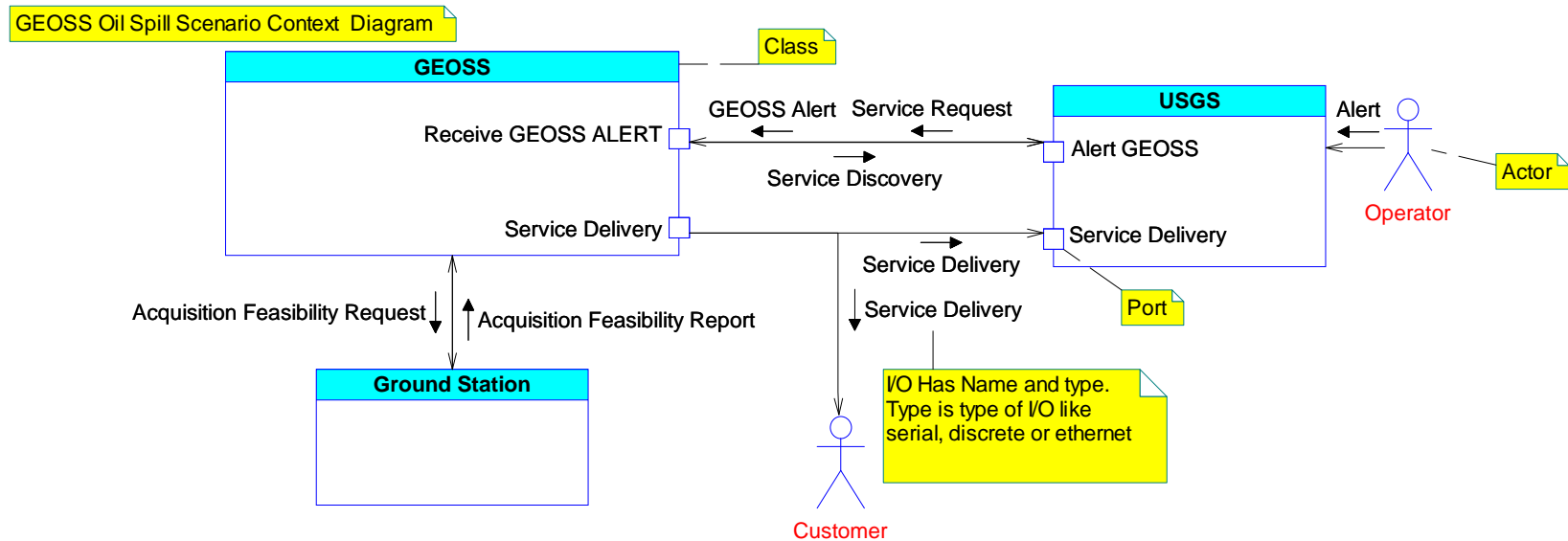


## Technology Language

- Provides a link between the set of viewpoint specifications and the real ODP system implementation
- Lists the standards used to provide the necessary basic operations in the other viewpoint specifications
- Objective of the Technology specification is to provide extra information needed for implementation and testing
- Technology specification selects standard solutions for basic components and communication mechanisms

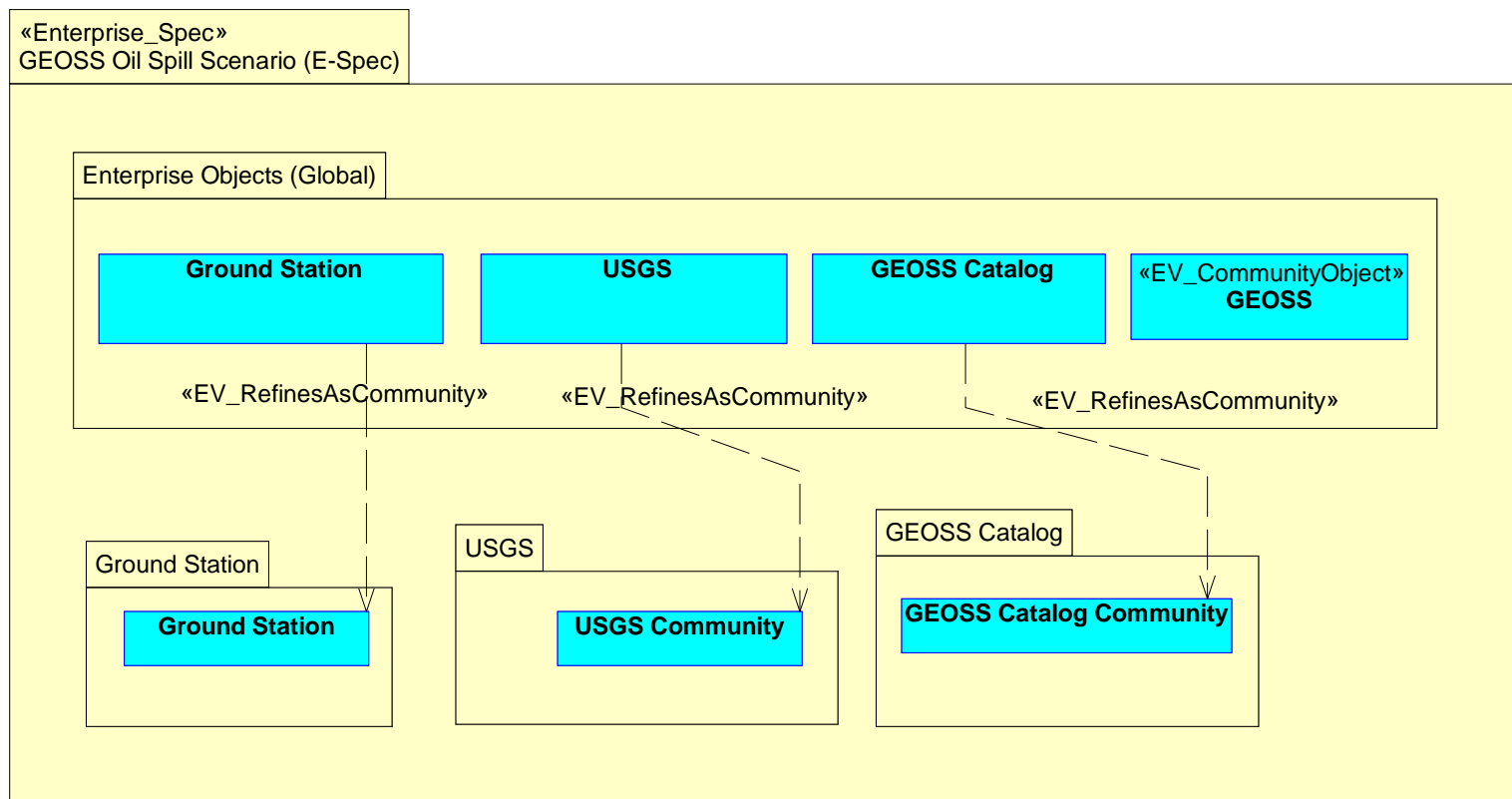


# Oil Spill Scenario Context Diagram



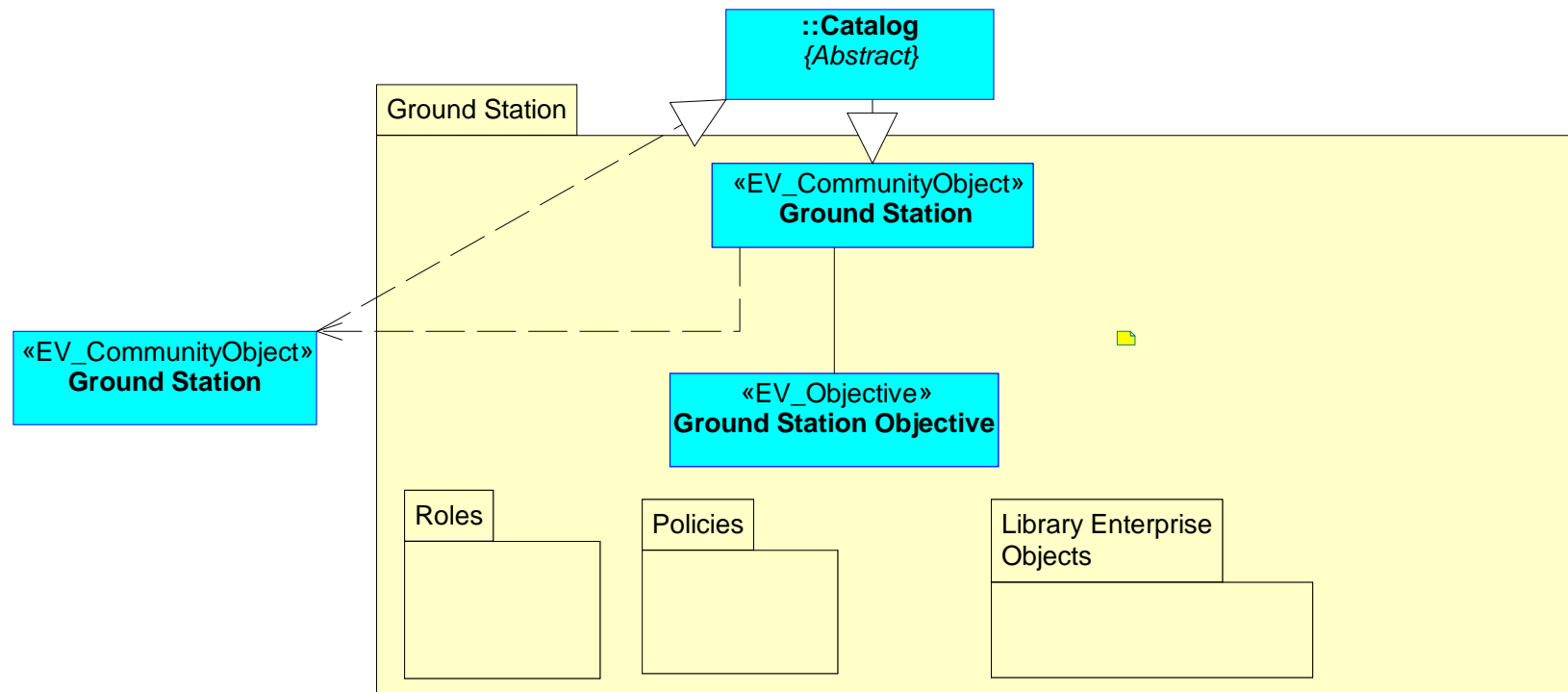


# GEOSS Oil Spill Scenario Enterprise Specification



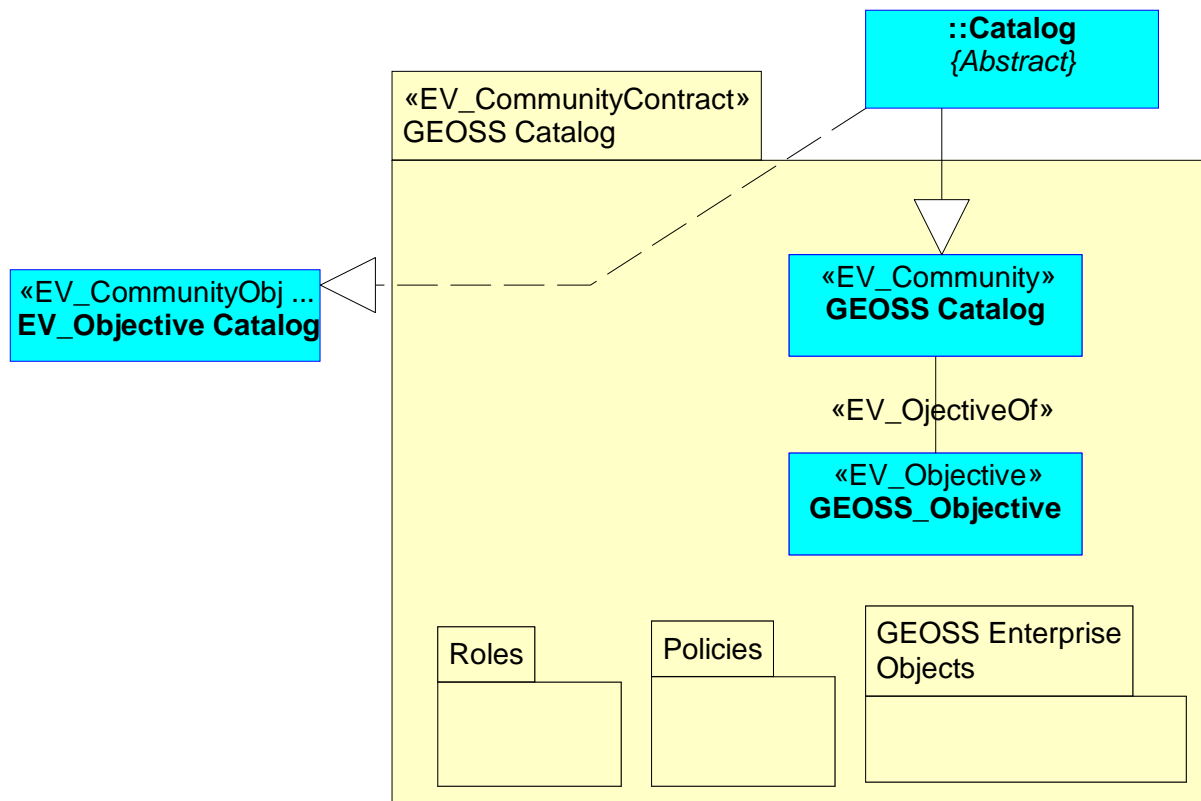


# UML Specification of Ground Station Community





# UML Specification GEOSS Catalog Community

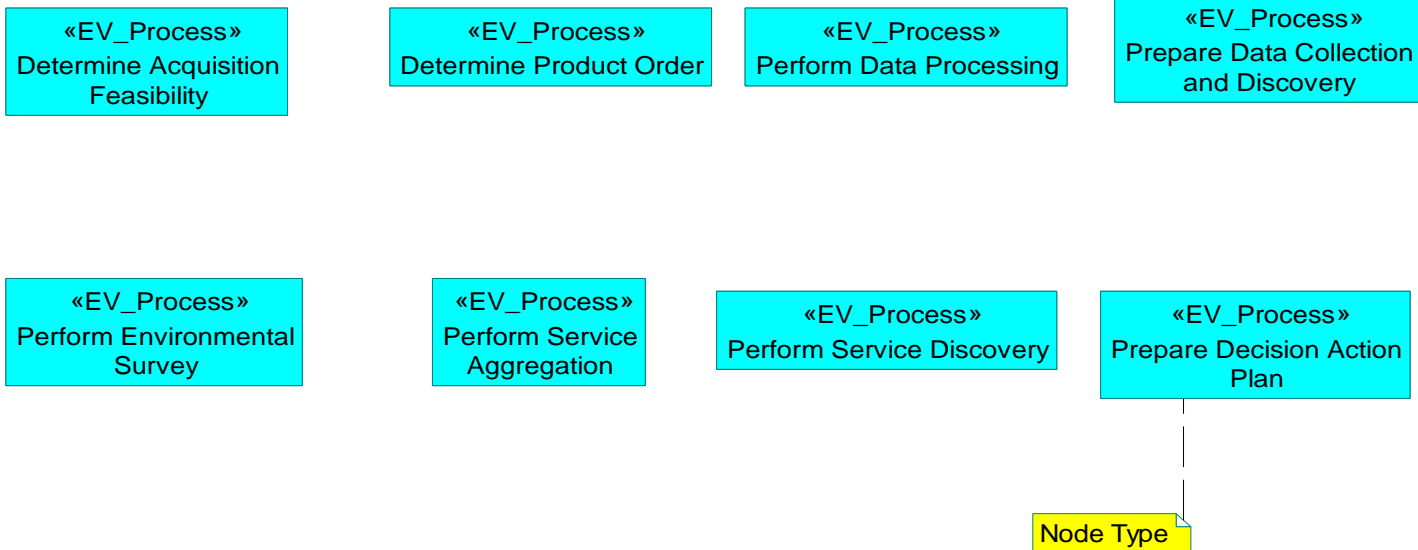




# GEOSS Catalog Processes Activity Diagram

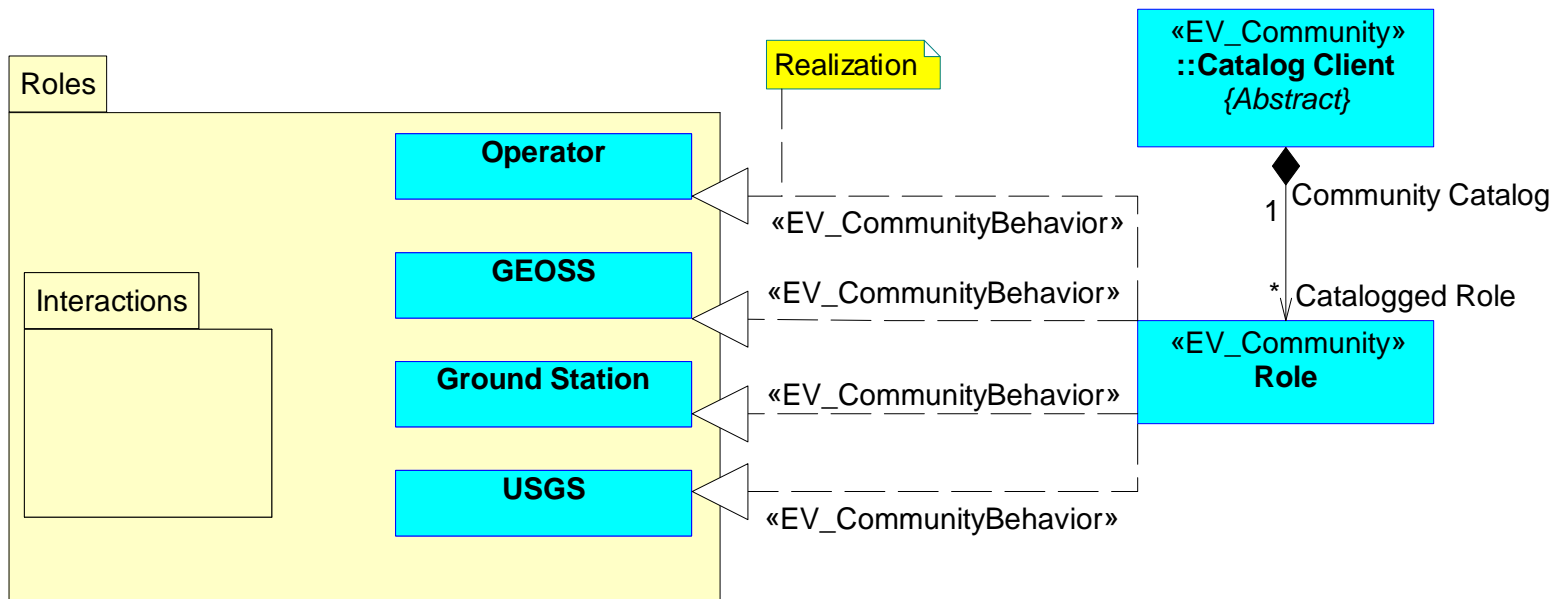
«EV\_Community»  
GEOSS Clearinghouse

GEOSS Catalog Processes AD



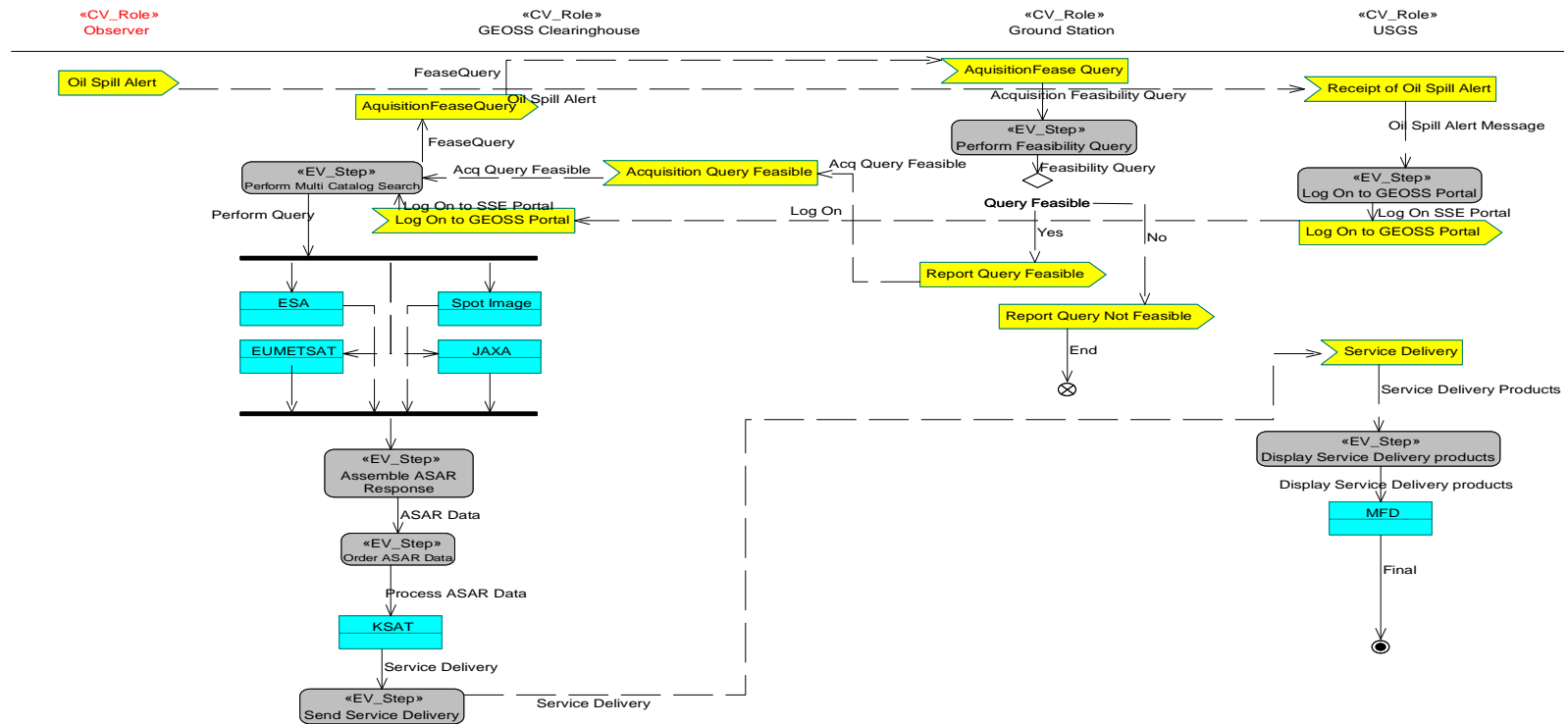


GEOSS Catalog Client Community Roles



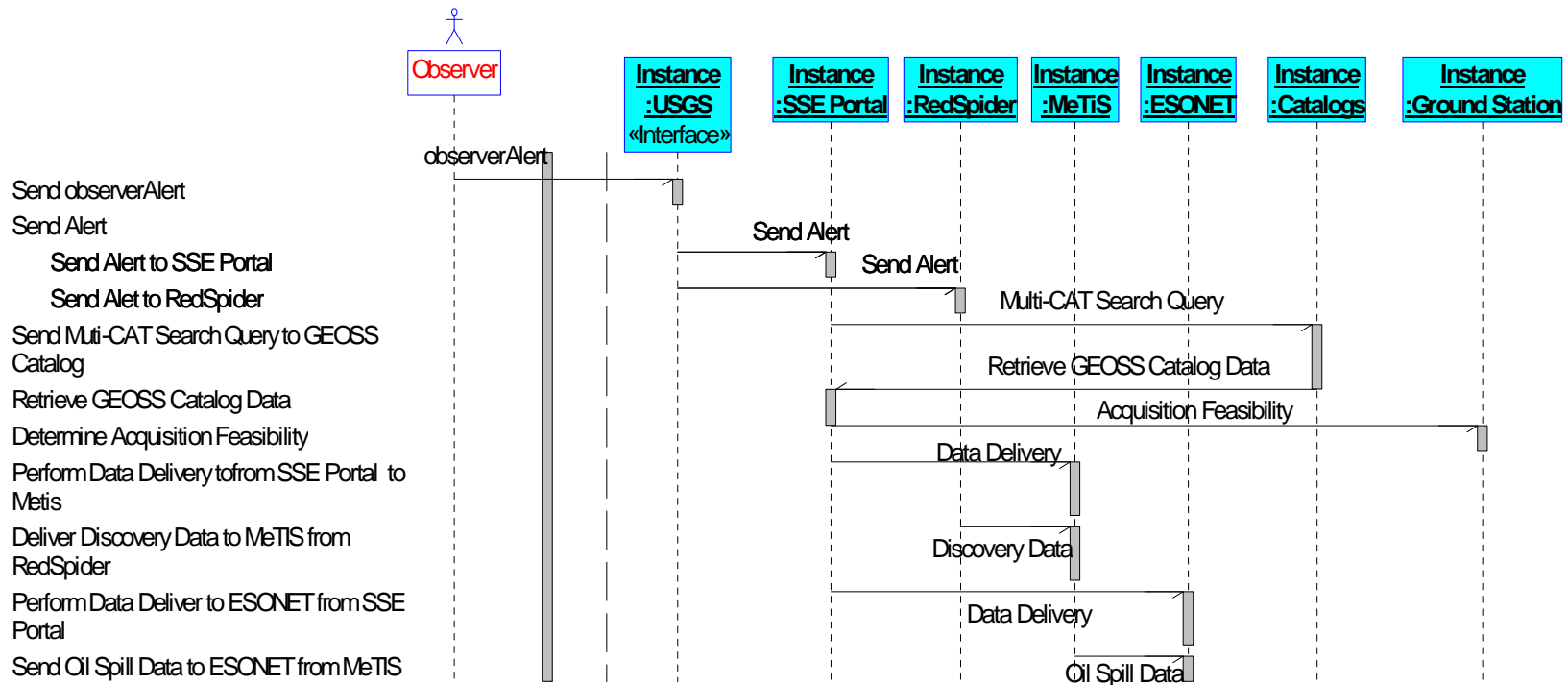


# GEOSS Oil Spill Action Plan Activity Diagram



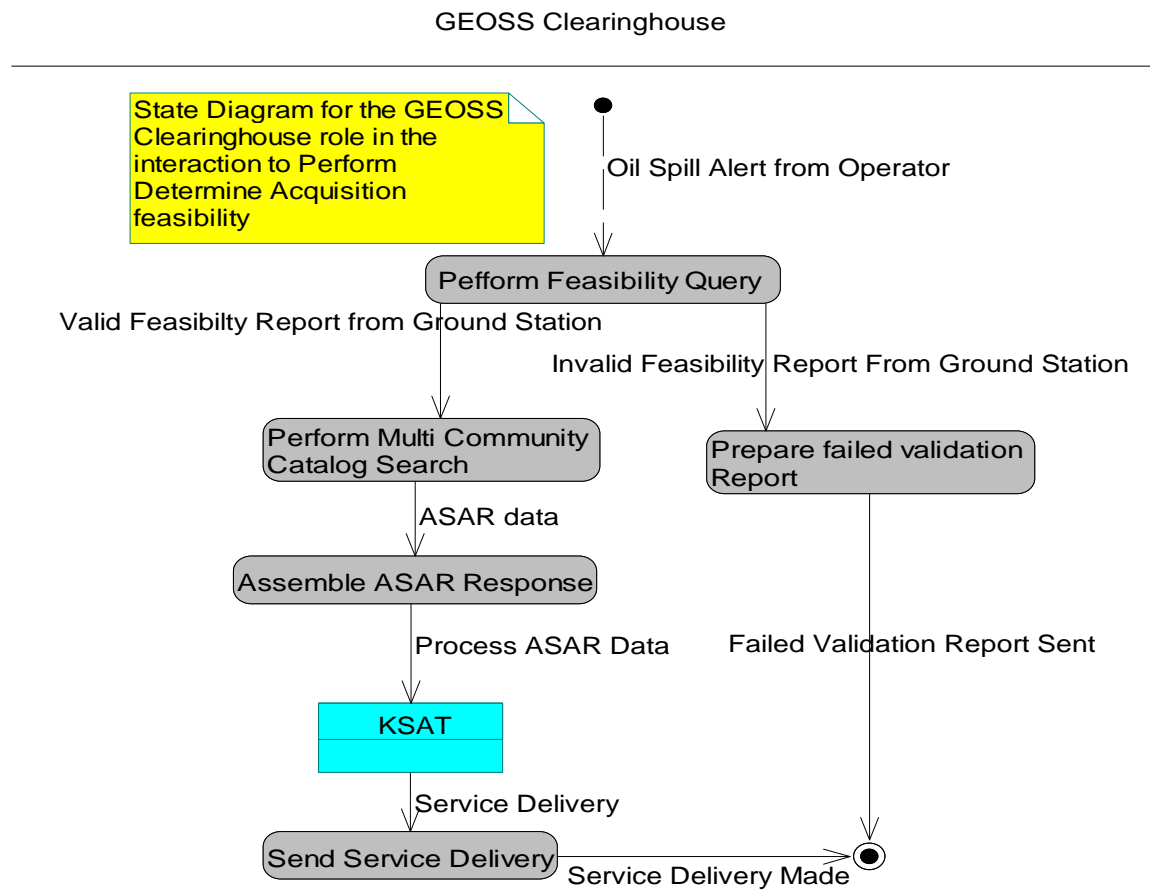


# GEOSS Oil Spill Action Plan Iteration Diagram (UML Sequence Diagram)





# GEOSS Clearing House State Diagram





**Questions?**