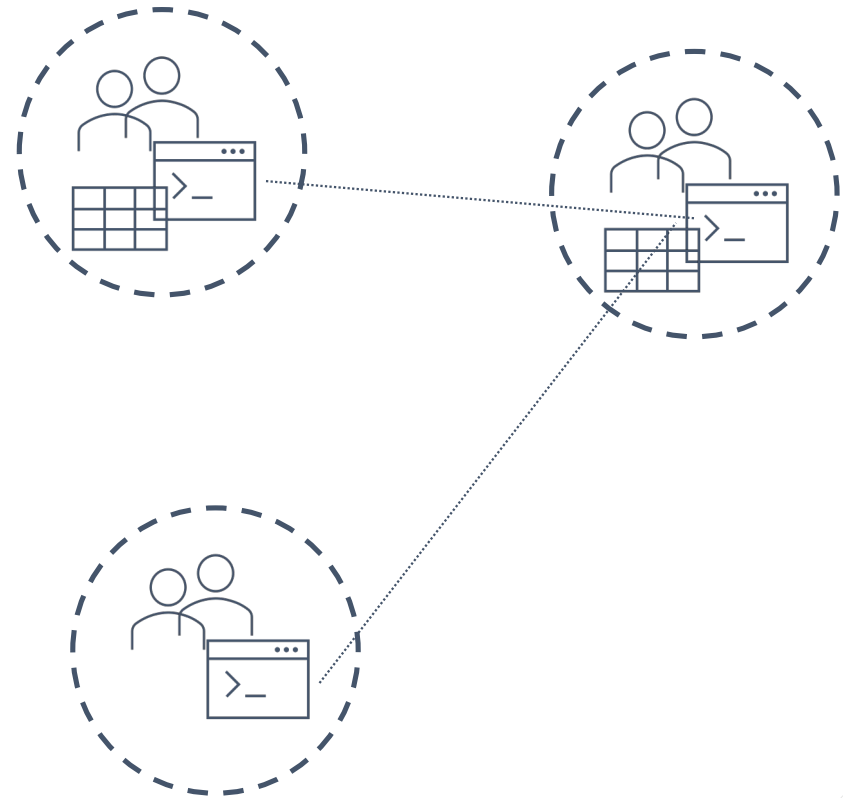


UNIVERSITY OF OSLO

IN5090

Health Data and
Decision making

Interoperability



Interoperability: The ability to communicate and exchange information across contexts and organizational boundaries



Organization



System



Users



Data





Organization



System



Users



Data



PatientID	SmokingStatus
P123	Current
P124	Never
P125	Former



Organization



System

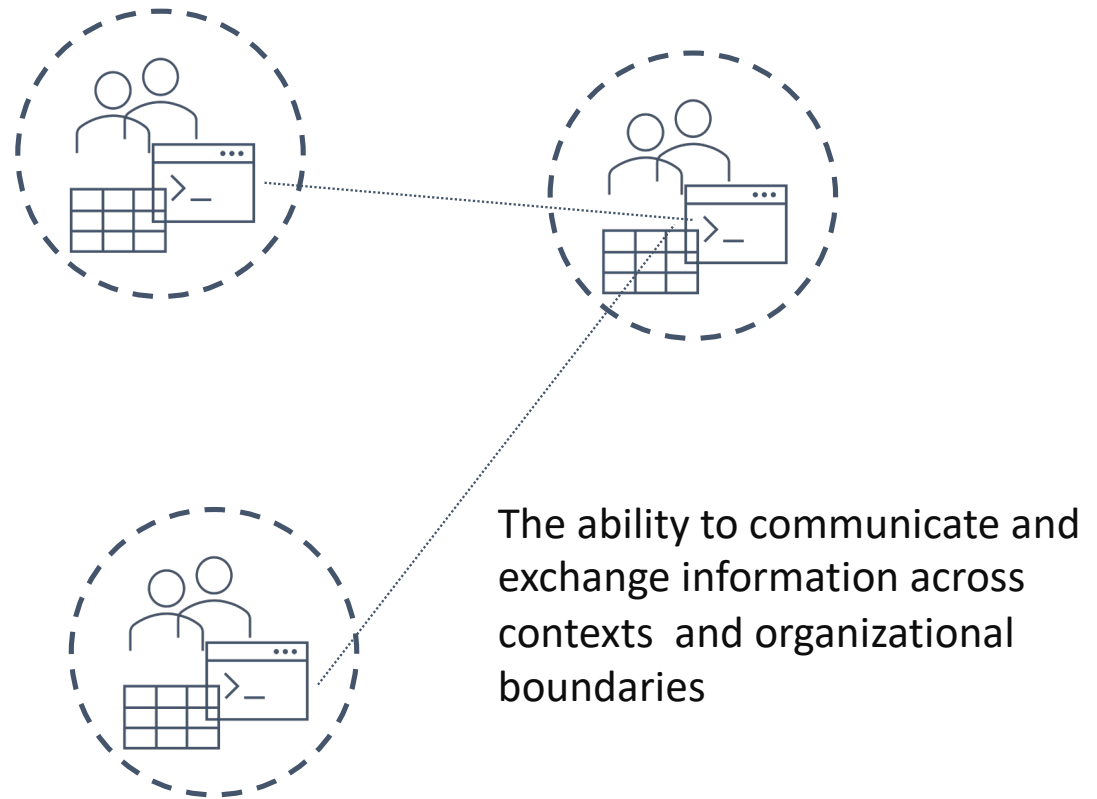
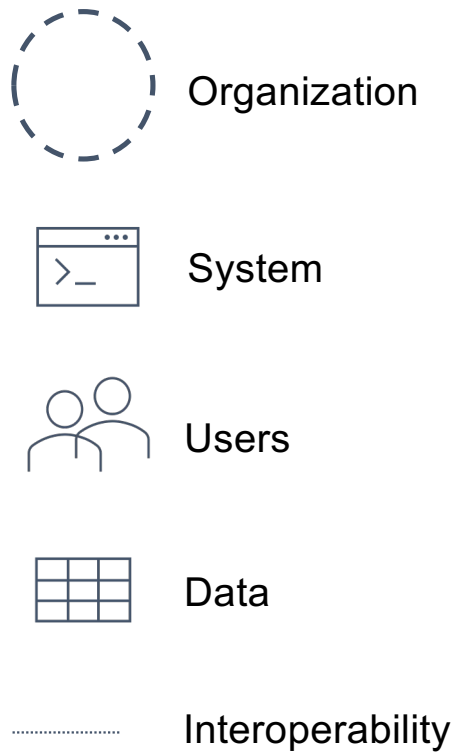


Users



Data







Organization



System

PatientID	SNOMED_Code	SNOMED_Description
P123	449868002	Current every day smoker
P124	266919005	Never smoked tobacco
P125	8517006	Ex-smoker



Data

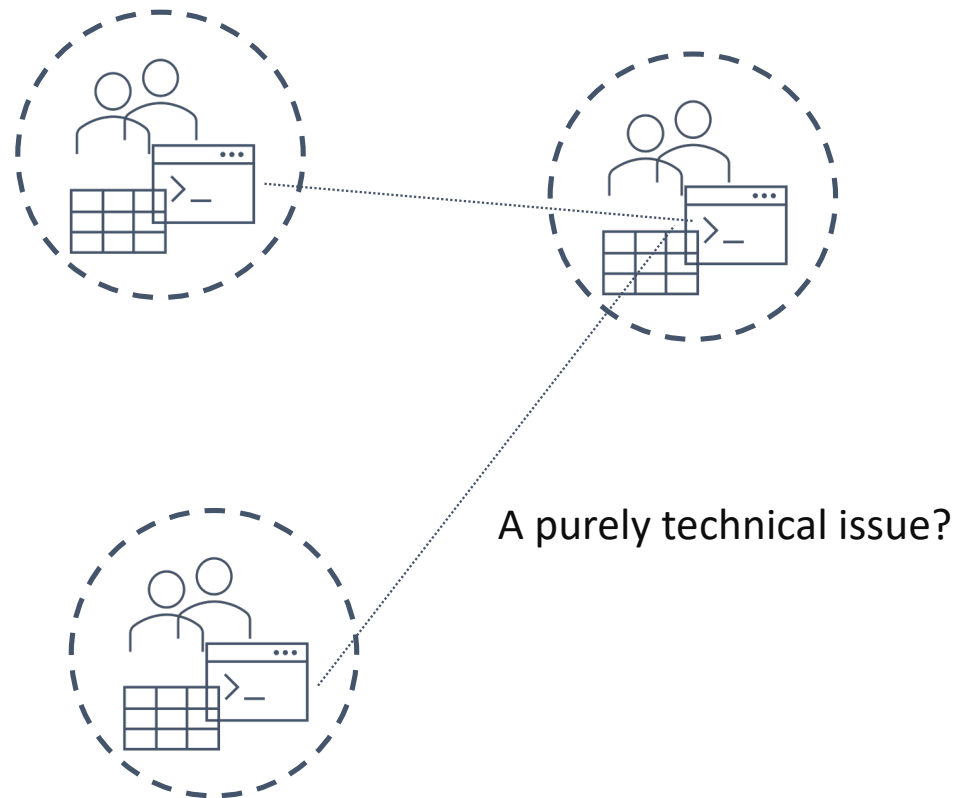
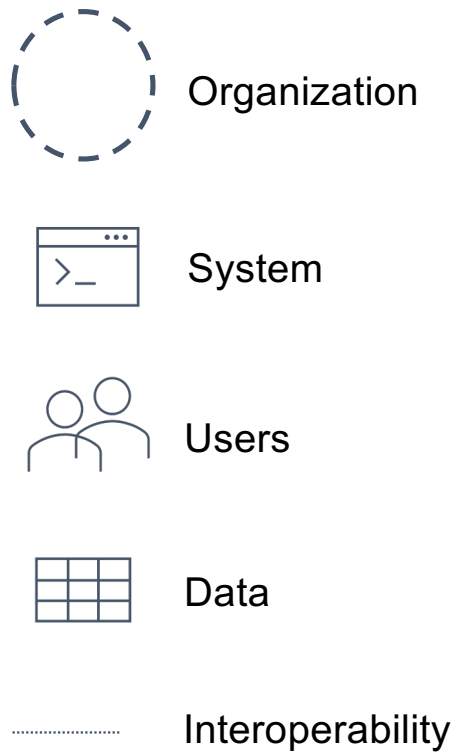


Interoperability



PatientID	SmokingStatus	PacksPerDay	YearsSmoked	QuitDate
P123	Current	1.5	10	-
P124	Never	-	-	-
P125	Former	2	15	2020-06-15

PatientID	SmokingStatus
P123	Current
P124	Never
P125	Former





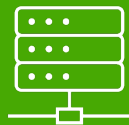
Legal interoperability



Organisational interoperability

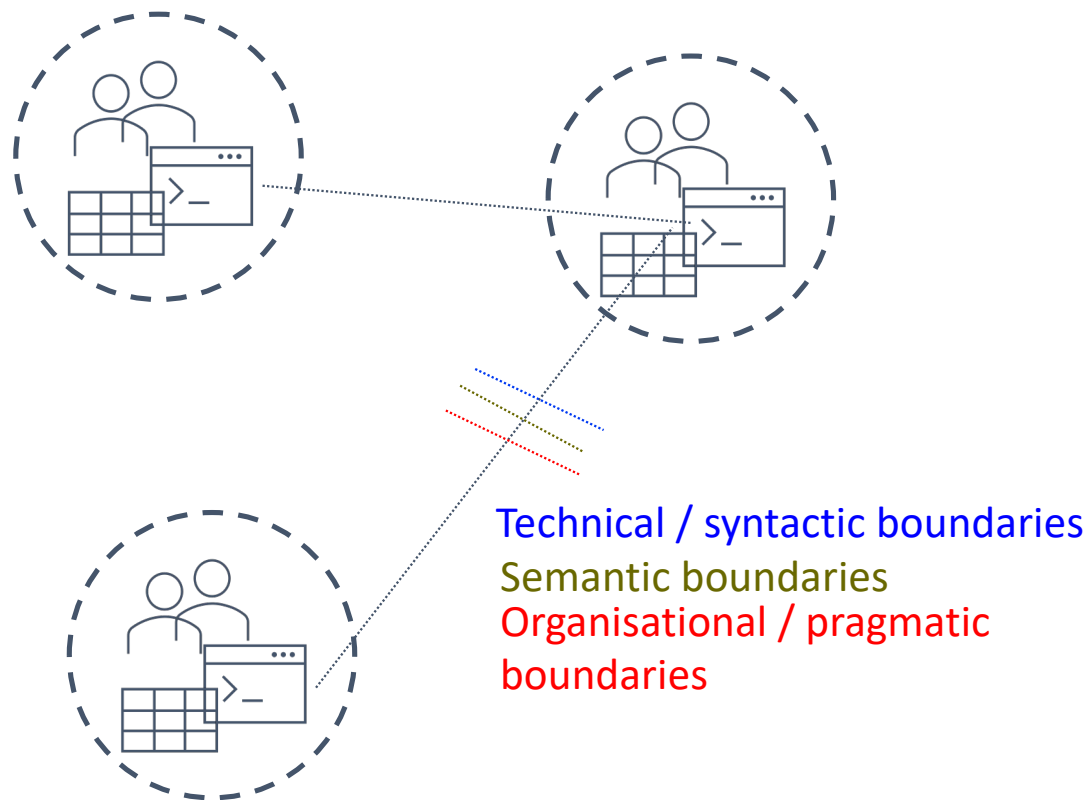
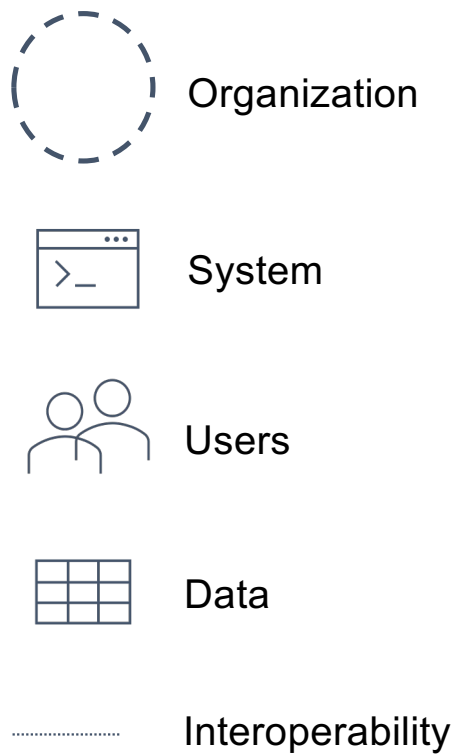


Semantic interoperability



Technical interoperability

EUs Interoperability Framework



Interoperability across boundaries

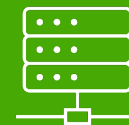
- Pragmatic / Organizational boundaries: Differences in goals or approaches to a problem between groups.
- Semantic boundaries: Differences in concepts and their meaning between groups.
- Syntactic / Technical boundaries: Differences in format, terminology, and language used by different groups.



Organisational interoperability



Semantic interoperability

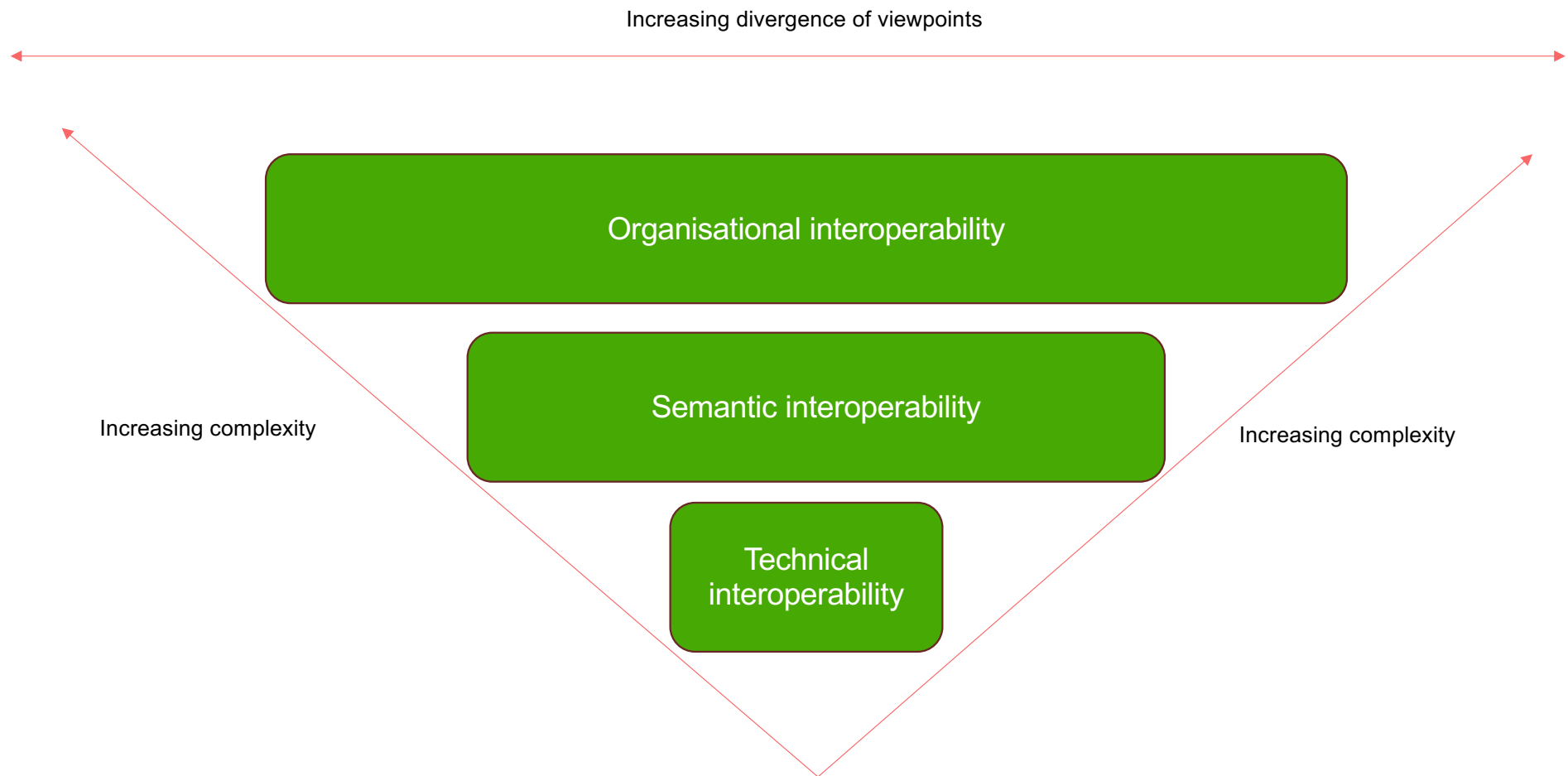


Technical interoperability

Discuss

- What does the technical, semantic and organizational boundaries entail for interoperability? Explain and exemplify

- Organizational (pragmatic) boundaries: Differences in goals or approaches to a problem between groups.
- Semantic boundaries: Differences in concepts and their meaning between groups.
- Technical (syntactic) boundaries: Differences in format, terminology, and language used by different groups.



Two approaches to interoperability:

- Architecture: The structure of systems and how they relate and connect to each other
- Standards: Agreed-upon set of rules that defines what data means and how it should be structured and formatted

Standards ensure systems speak the same language, while architecture ensures they can have the conversation in the first place

Organisational interoperability

Semantic interoperability

Technical interoperability

Architecture

The structure of systems and how they relate and connect to each other



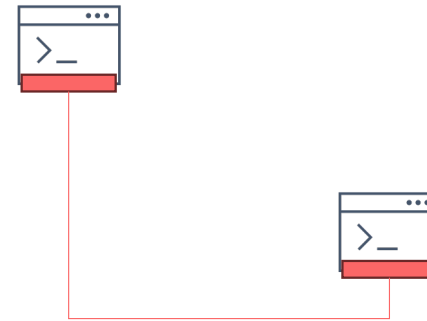
System



Application Programming Interface (API)

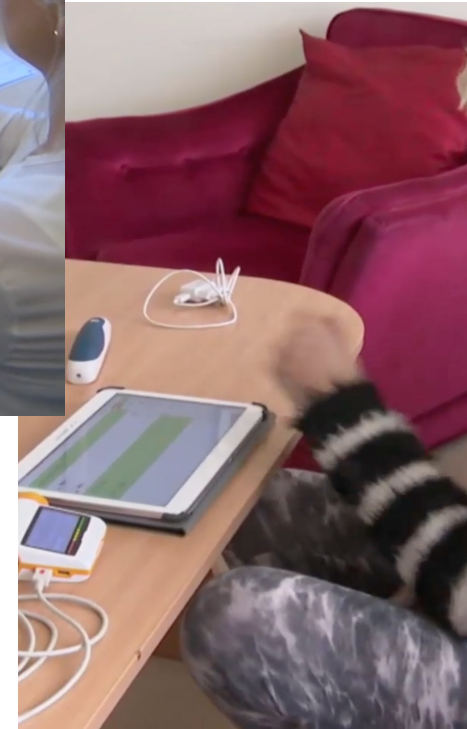
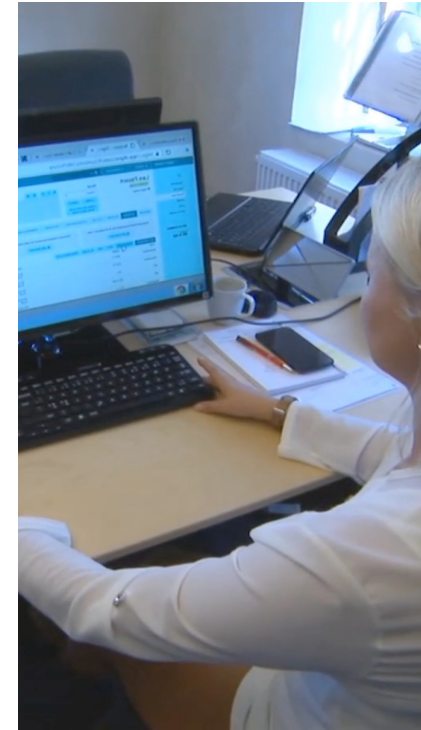


Connection



Example case: connected care (velferdsteknologi)

- New health services providing care digitally for patients staying at home
- Innovation both in local healthcare services and among private companies and startups
- New practices of generating data, combining data, interpreting data
- Understanding the potential of tracking what has not been tracked before





System



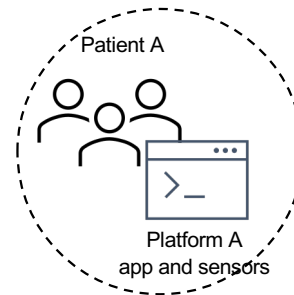
Application Programming Interface (API)



Connection



Organization





System



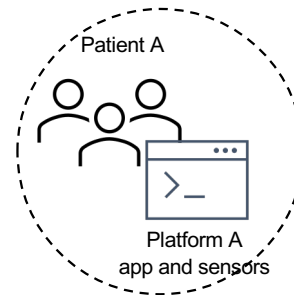
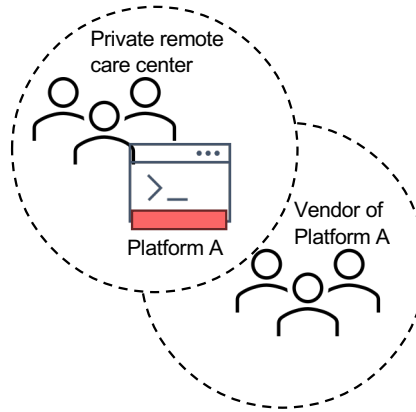
Application Programming Interface (API)

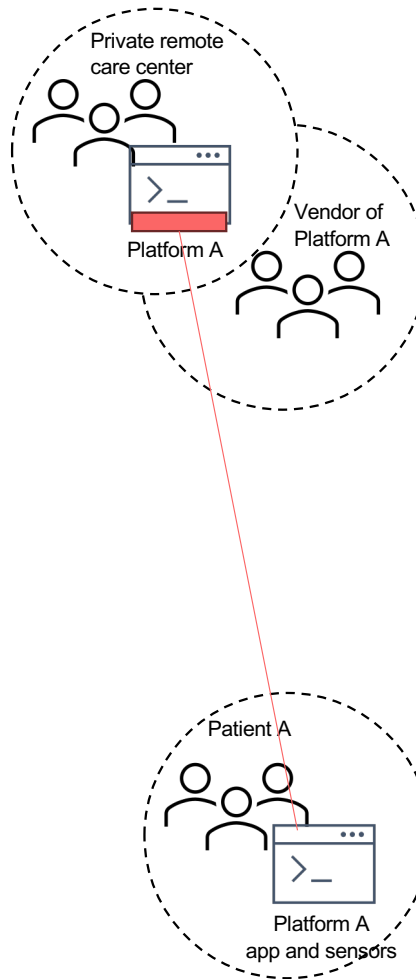
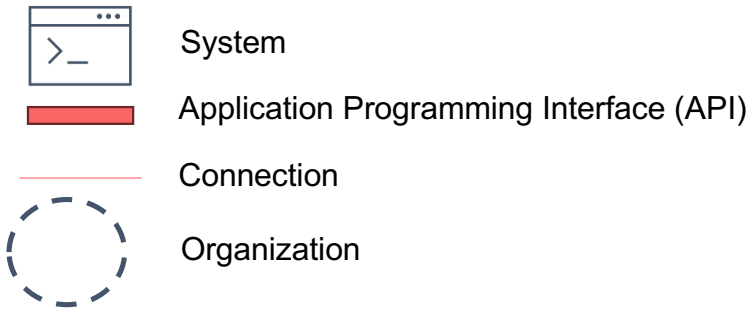


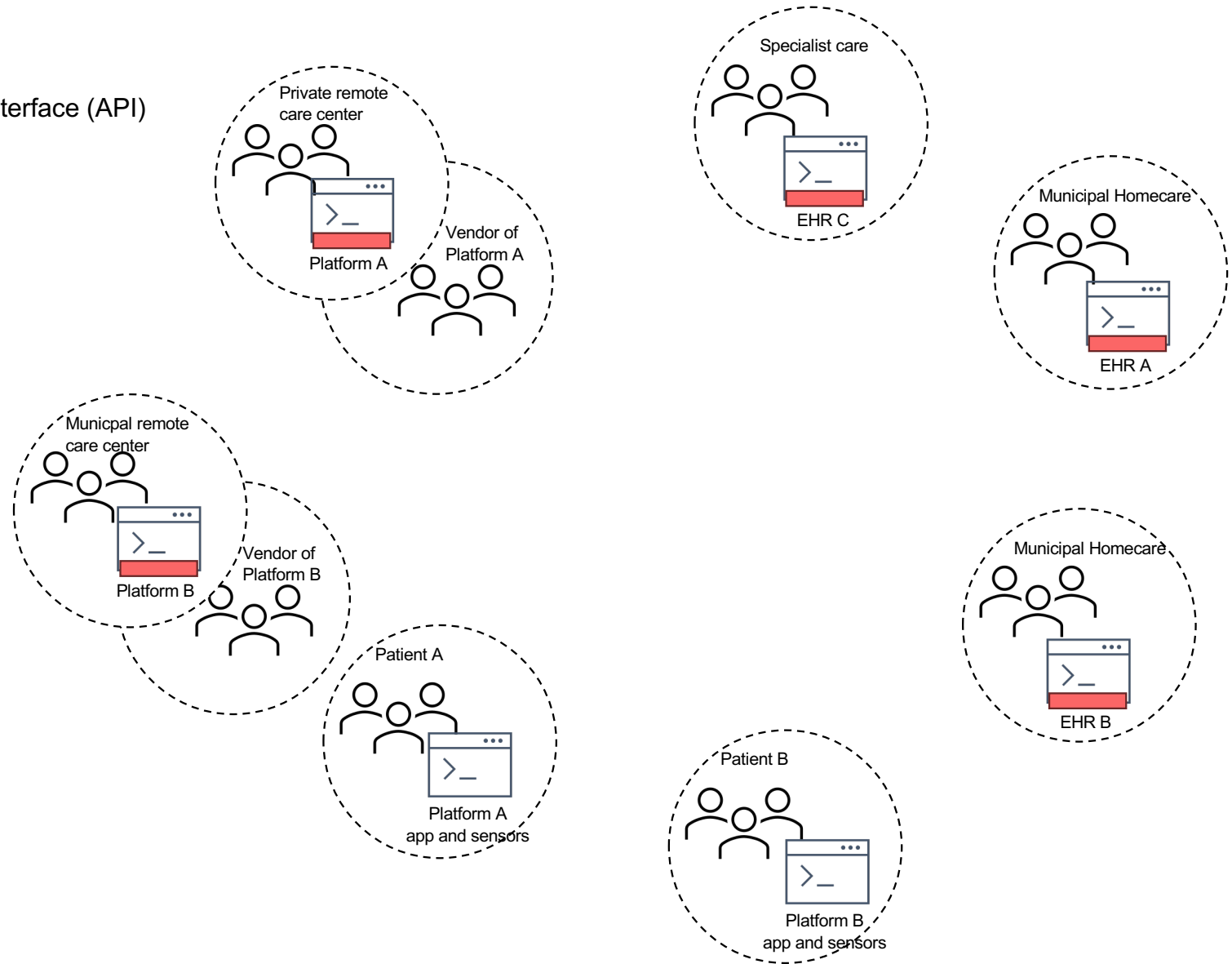
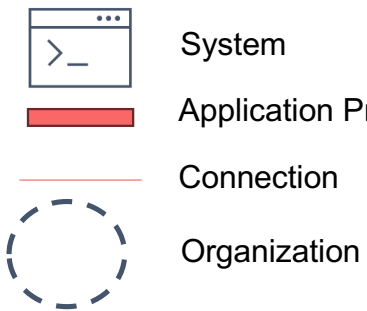
Connection

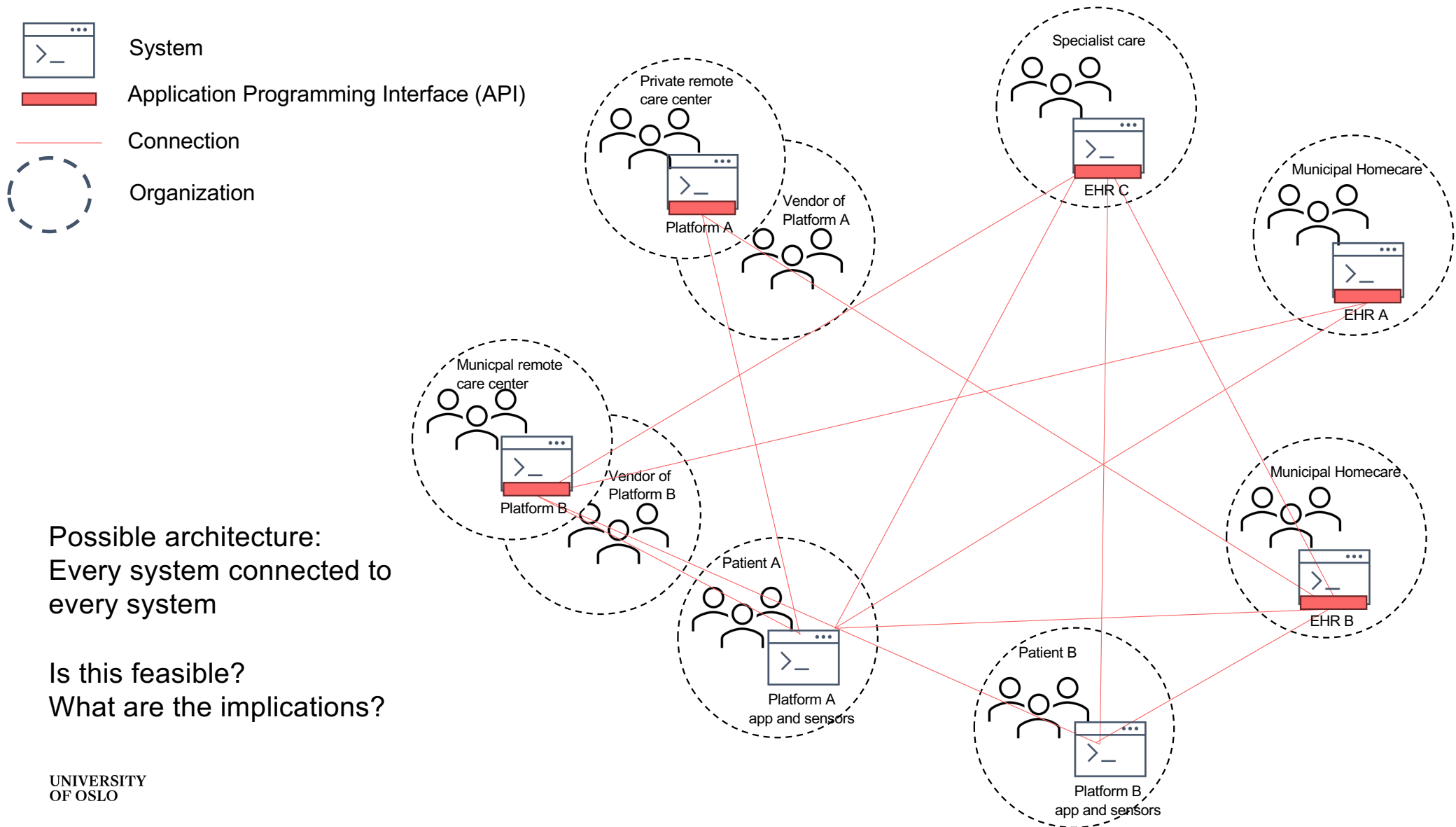


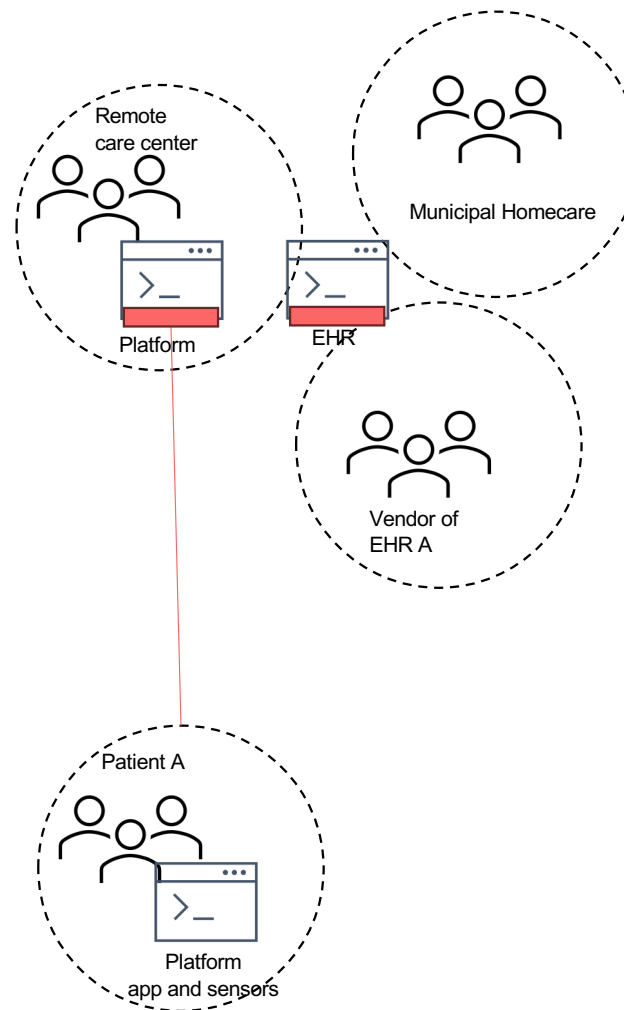
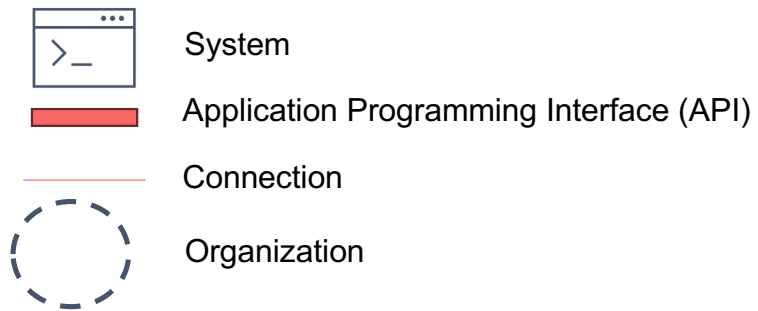
Organization





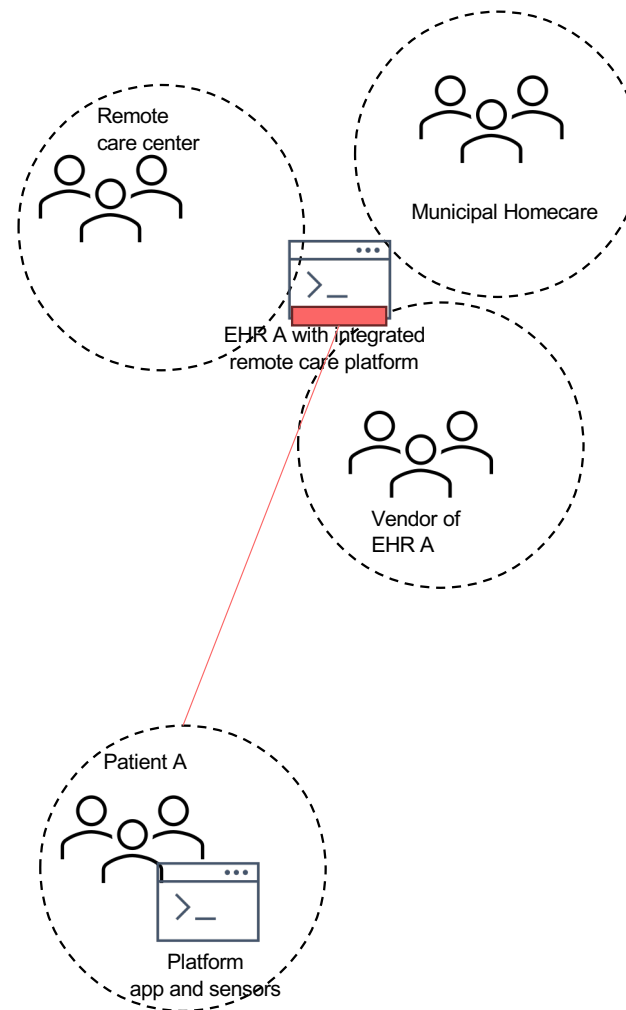
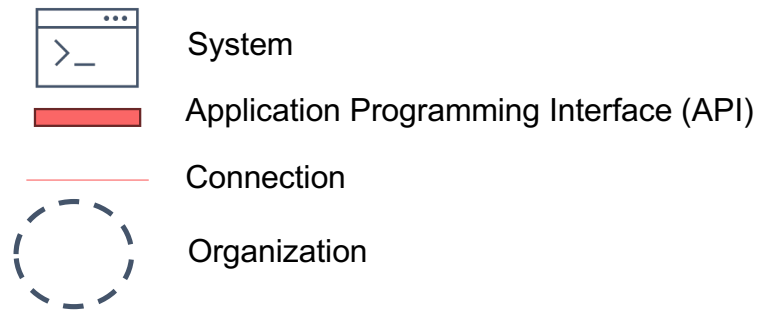






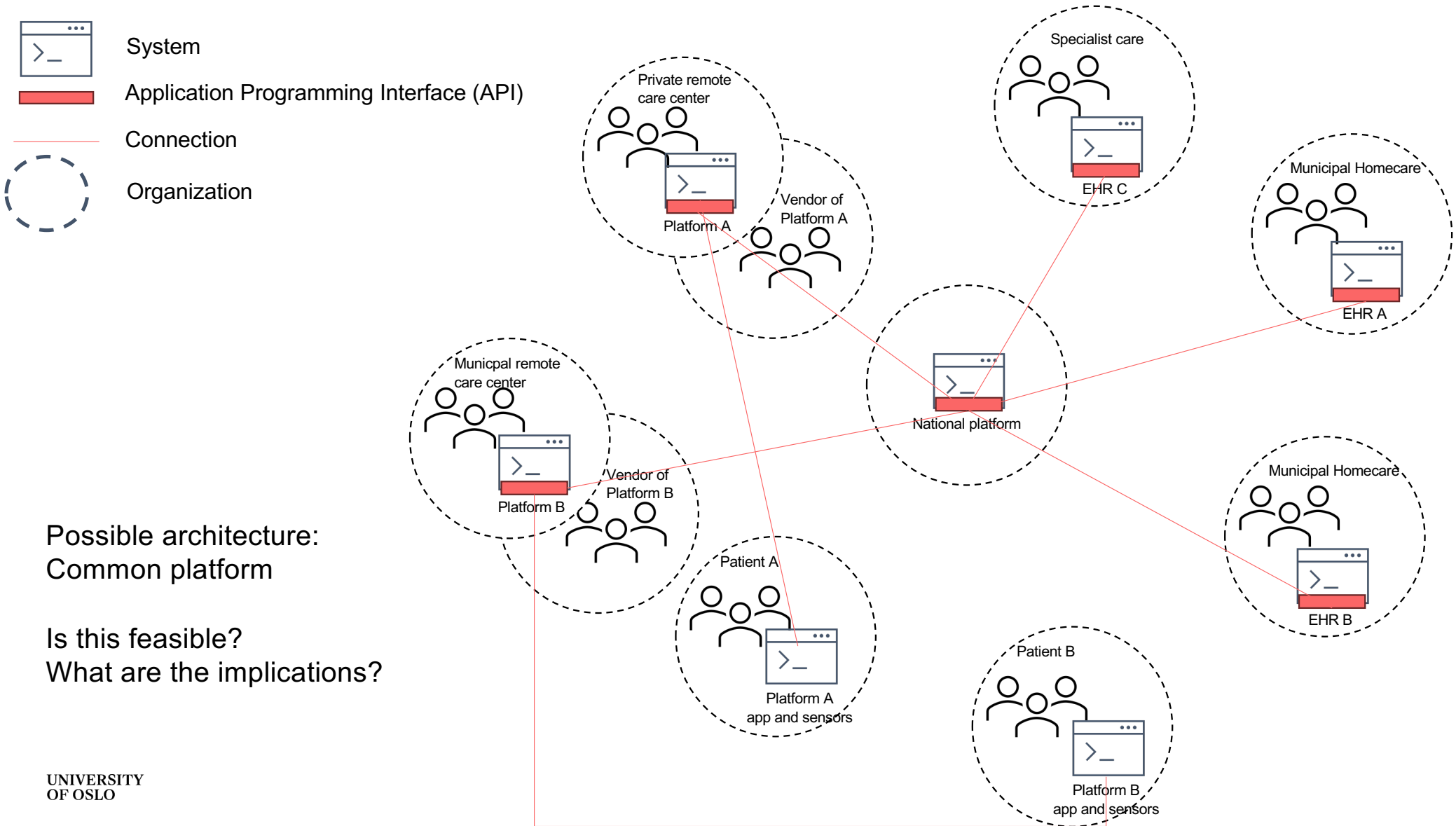
Possible Architecture:
 Separate and non-
 interoperable EHR and
 Remote care platform

Is this feasible?
 What are the implications?



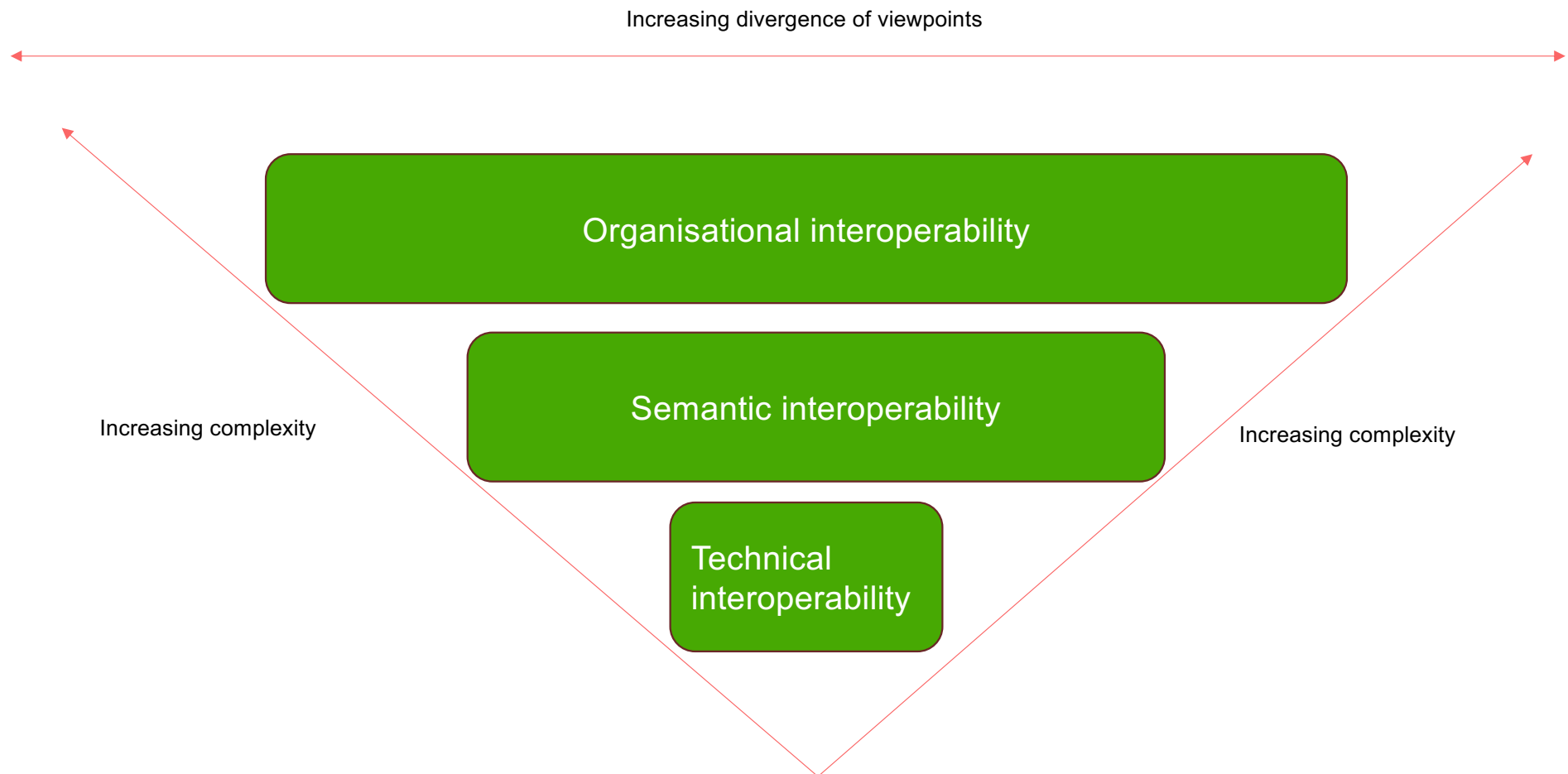
Possible architecture:
 Integration between EHR
 and remote care solution

Is this feasible?
 What are the implications?



Possible architecture:
Common platform

Is this feasible?
What are the implications?



Standards

- Standards: Agreed-upon set of rules that defines what data means and how it should be structured and formatted

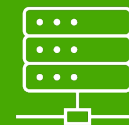
Standards ensure systems speak the same language, while architecture ensures they can have the conversation in the first place



Organisational interoperability



Semantic interoperability



Technical interoperability

Interoperability across boundaries

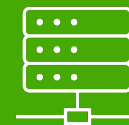
- Organizational boundaries: Differences in goals or approaches to a problem between groups.
- Semantic boundaries: Differences in concepts and their meaning between groups.
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Organisational interoperability



Semantic interoperability



Technical interoperability

Standards

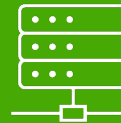
- Technical standard
- Semantic standards
- (Organizational standards)



Organisational interoperability



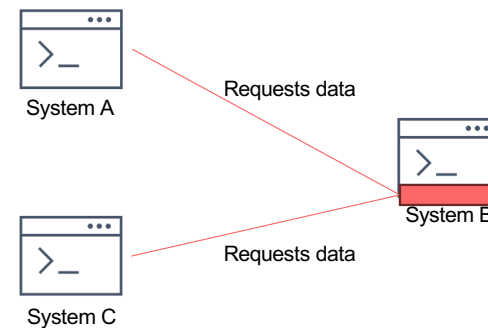
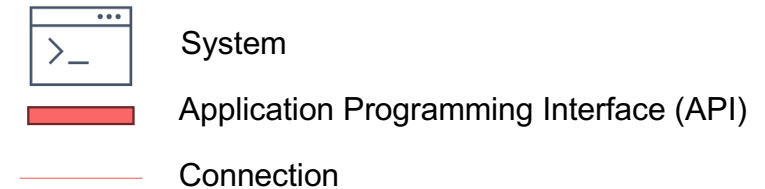
Semantic interoperability



Technical interoperability

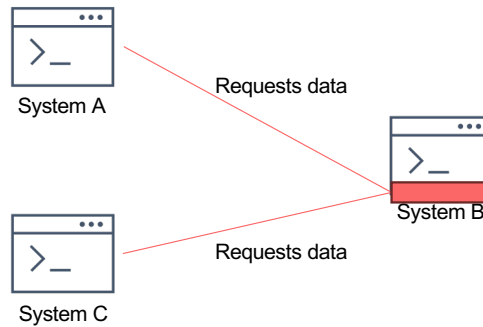
Technical standards

- (Most) Systems can only accept and process values that are formatted in a predefined way
- Many technical standards in the health domain
- HL-7 FHIR recommended for intersystem communication



Request

```
{
  "resourceType": "Observation",
  "id": "blood-pressure",
  "status": "final",
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "85354-9"
      }
    ]
  },
  "component": [
    {
      "code": {
        "coding": [
          {
            "system": "http://loinc.org",
            "code": "8462-4",
            "display": "Systolic blood pressure"
          }
        ]
      },
      "valueQuantity": {
        "value": 120,
        "unit": "mmHg",
        "system": "http://unitsofmeasure.org",
        "code": "mm[Hg]"
      }
    },
    {
      "code": {
        "coding": [
          {
            "system": "http://loinc.org",
            "code": "8480-6",
            "display": "Diastolic blood pressure"
          }
        ]
      },
      "valueQuantity": {
        "value": 80,
        "unit": "mmHg",
        "system": "http://unitsofmeasure.org",
        "code": "mm[Hg]"
      }
    }
  ]
}
```



Code running on System B

```
@app.route('/blood-pressure', methods=['POST'])
def receive_blood_pressure_observation():
    observation = request.json

    systolic_value = None
    diastolic_value = None

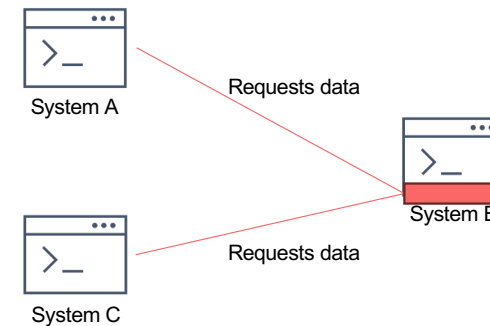
    for component in observation.get('component', []):
        if component['code']['coding'][0]['code'] == '8462-4':
            systolic_value = component['valueQuantity']['value']
        elif component['code']['coding'][0]['code'] == '8480-6':
            diastolic_value = component['valueQuantity']['value']

    process_blood_pressure(systolic_value, diastolic_value)

    return jsonify({"message": "Blood pressure observation received",
                    "systolic": systolic_value,
                    "diastolic": diastolic_value}), 200
```

Semantic standards

- Ensuring that data has the same meaning across contexts
- Many different semantic standards that cover different domains
- “Standards for data and indicators, data dictionaries and metadata; for example, on procedures for calculating indicators, health facility lists, and coding schemes like ICD10.” (Braa and Sahay 2012)



Example: Snomed CT

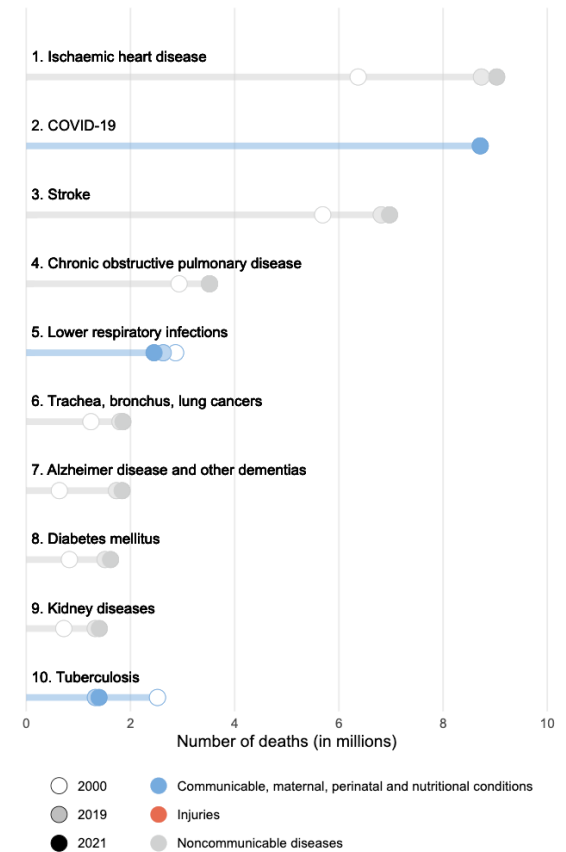
- Consistent terminology across contexts
- “If one doctor enters 'high blood pressure' into the system while another enters 'hypertension,' today's systems may not necessarily capture that these are the same condition. When both are linked to the same code in SNOMED CT, this problem is solved. “

<https://www.dagensmedisin.no/en-innbygger-en-journal-helseplattformen/banebrytende-arbeid-for-felles-klinisk-sprak/254627>

Example: ICD 11

- International Classification of Diseases (ICD)
- A standardized system to classify and code all health conditions and related factors that affect human health
- Builds on developments within epidemiology:
 - 16th century "bills of mortality", Florence Nightingale and the collection of disease and death statistics in the mid 19th century, Bertillon Classification of Causes of Death in late 19th century.
- WHO from 1940s
- Allows us to track
 - What makes people sick (morbidity)
 - What causes death (mortality)
 - How these patterns change over time

Leading causes of death in 2021 globally



Example: Snomed CT

- Each concept is assigned a unique Concept ID, which is a numeric code
- Alongside the Concept ID, there are human-readable terms that describe the concept. For example:
 - Concept ID: 44054006
 - Fully Specified Name: Pneumonia (disorder)
 - Synonyms: Pulmonary infection, Lung infection
- Also defines relationships between concepts to express things like hierarchy (a concept is a type of another concept), causation (a disease is caused by an organism), or attribute (a procedure targets a body structure).

SNOMED CT Concept for Pneumonia

•**Concept ID:** 44054006

•**Fully Specified Name:** Pneumonia (disorder)

•**Synonyms:** Includes terms such as "Pulmonary infection" and "Lung infection."

•**Definition:** Described as an infectious process affecting the lungs, typically caused by bacteria, viruses, or fungi.

Relationships with Other Concepts:

1. Is a Type Of:

1. **Concept ID:** 19829001
2. **Name:** Respiratory tract infection (disorder)
3. Pneumonia is categorized under respiratory tract infections.

2. Associated Morphology (Characteristic or Nature of the Disorder):

1. **Concept ID:** 41553000
2. **Name:** Inflammation (morphologic abnormality)
3. The inflammation associated with pneumonia is captured by linking to the concept of inflammation.

3. Finding Site (Location of the Disorder):

1. **Concept ID:** 39607008
2. **Name:** Lung structure (body structure)
3. The site of the infection, in the case of pneumonia, is the lungs.

But there are diverging perspectives on standardized terminology

<https://tidsskriftet.no/2022/03/leder/fagspraket-ingen-leger-har-hort-om>

“Good healthcare is based on knowledge and experience, not simplified models. It requires a medical terminology that allows doctors and other healthcare personnel to document the nuances and degrees of uncertainty they deem necessary for professionally sound practice. This is essential for conducting professionally sound practice. A professional language evolves in step with the field, without needing approval from a company or agency.”

