CSD&MAsia 2016

2nd Asia-Pacific Conference

« Complex Systems Design & Management »

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Ontology for Weather Observation System

Yuki ONOZUKA, Keio University, Japan

Event created and organized by

CESAMES

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Summary

- Develop ontology for weather observation system by focusing on viewpoint
- Visualize the viewpoint and the relationship between viewpoints, which cultivates common understanding and shows system resilience

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Outline

1 Background

2 Ontology

3 Apply Ontology to Weather Observation System

4 Conclusion

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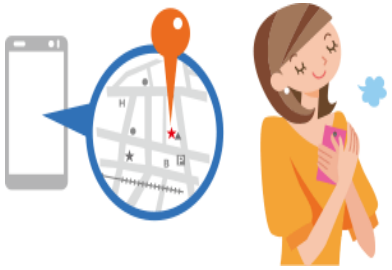
1 Background

1 Background

Depend on Space System

Weather Forecast Service



GPS Service

Several threads to Space System

Armament

Malfunction

1 Background

Depend on Space System

Need to prepare counterplan for these threats.
Japanese government announced to
enhance resilience of the whole space system.

Armament

Malfunction

1 Background

Resilience

- The ability of an architecture to support the functions necessary for mission success in spite of hostile action or adverse condition [DOD, 2011]

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Resilience

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Resilience

- **Avoidance**
- **Robustness**
- **Recovery**
- **Reconstitution**

1 Background

Before “Enhance Resilience”...
Need to “Evaluate Resilience”

In order to evaluate resilience, common understanding is required because several stakeholders are involved in space system.

Ontology

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2 Ontology

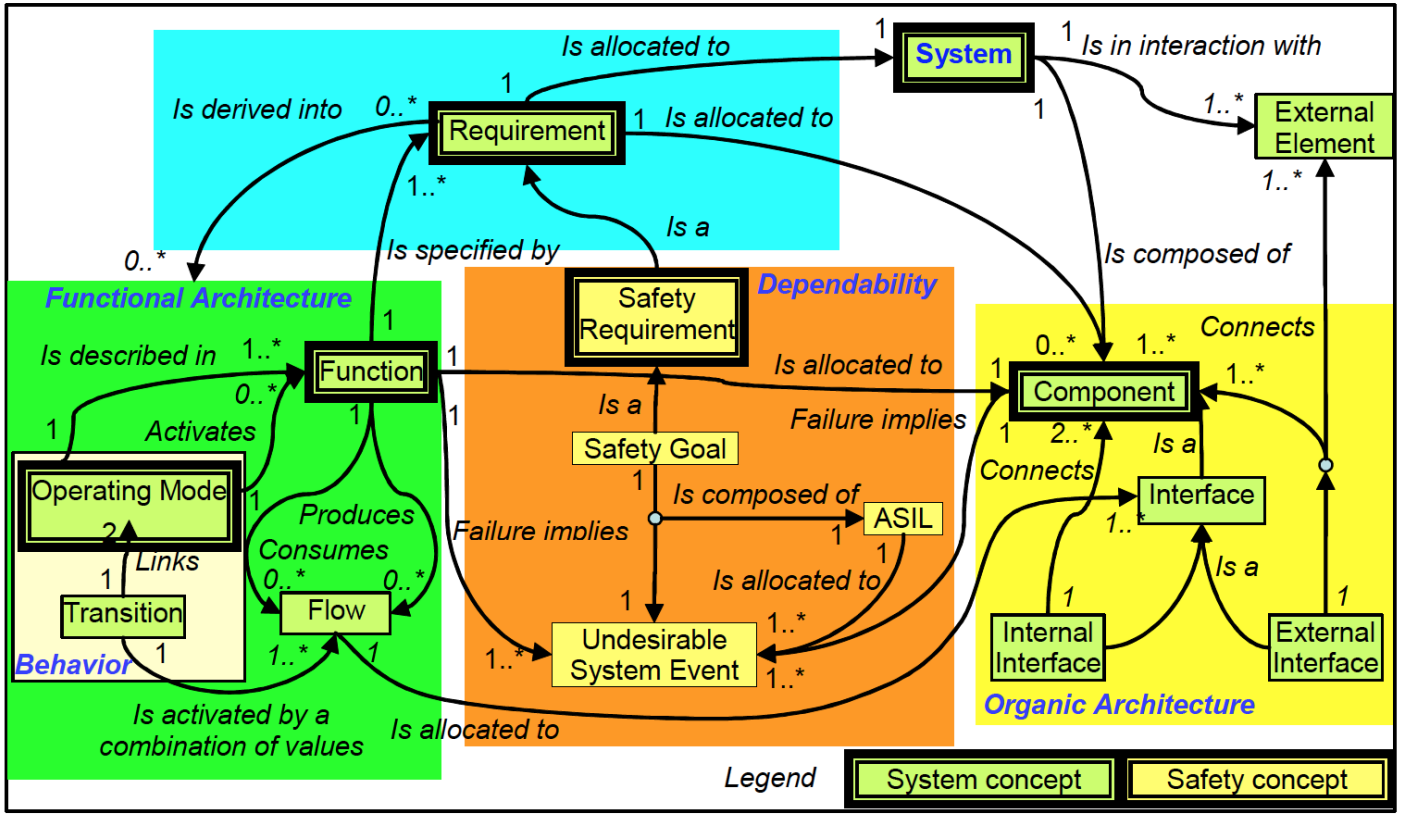
2 Ontology

Ontology

- identifies and defines concepts and terms [Holt et al., 2013]
- is formal description of classes and relationships between these concepts [Soung, 2013]

2 Ontology

Example: Automobile company RENAULT [Hugo et al., 2012]



- Develop Common understanding between organizations

2 Ontology

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2 Ontology

How can we view system?

ISO/IEC 42010

2 Ontology

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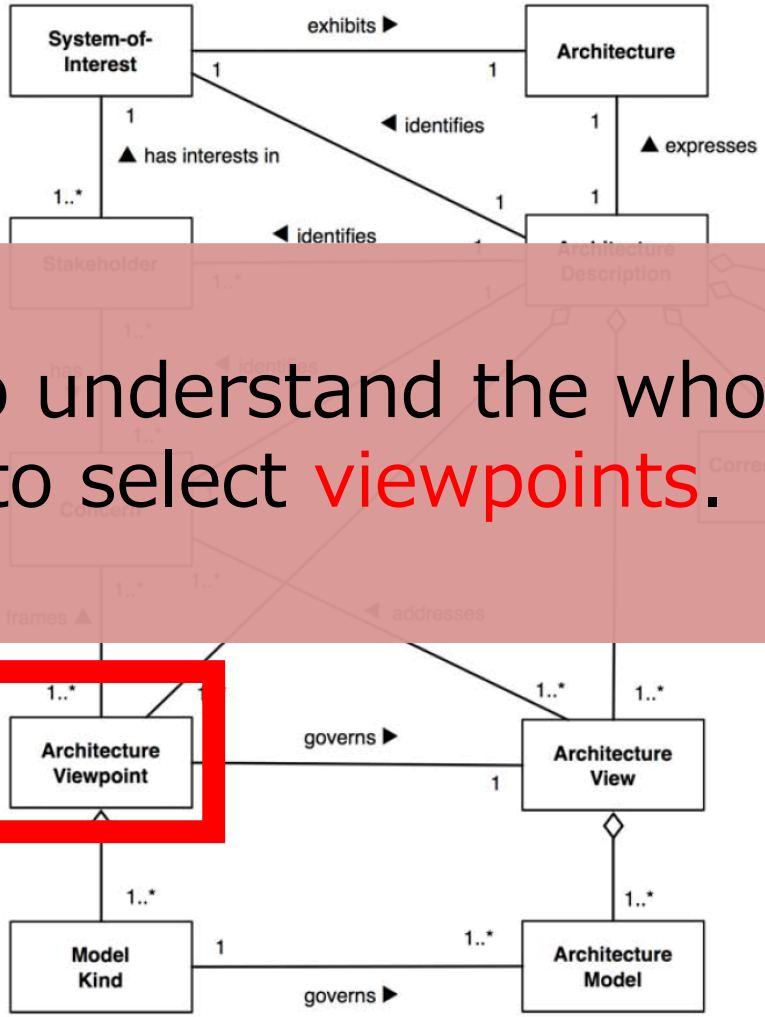
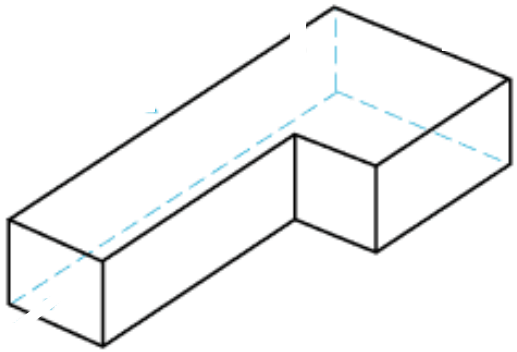


When we try to understand the whole system, it is important to select viewpoints.

ISO/IEC 42010

2 Ontology

Example;
What kinds of viewpoints do we need to see the L-Block?

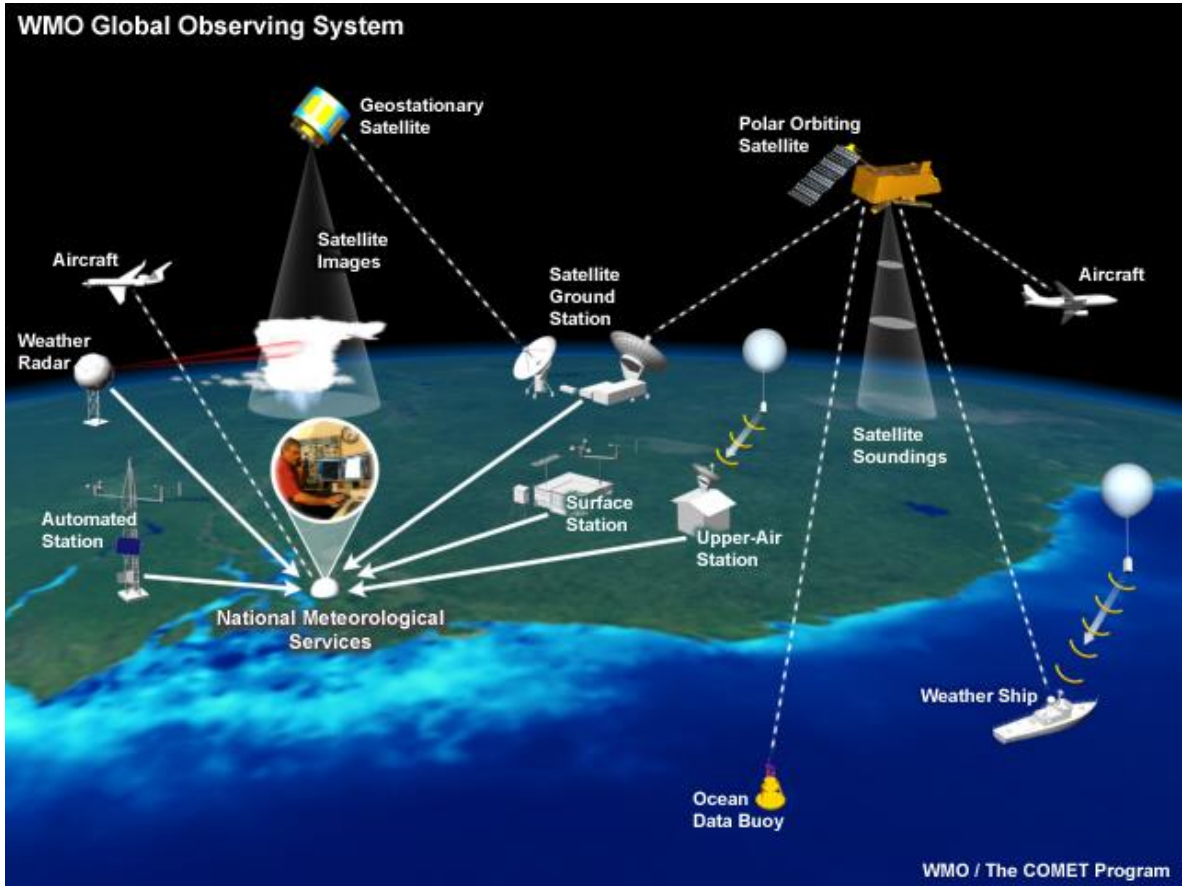


http://metal.brightcookie.com/2_draw/draw_t3/htm/draw3_2_6.html

Top Viewpoint	**Right Viewpoint**	**Front Viewpoint**
Bottom Viewpoint	**Left Viewpoint**	**Rear Viewpoint**

2 Ontology

What kinds of viewpoints do we need to understand the whole weather observation system?



http://www.goes-r.gov/users/comet/tropical/textbook_2nd_edition/print_9.htm

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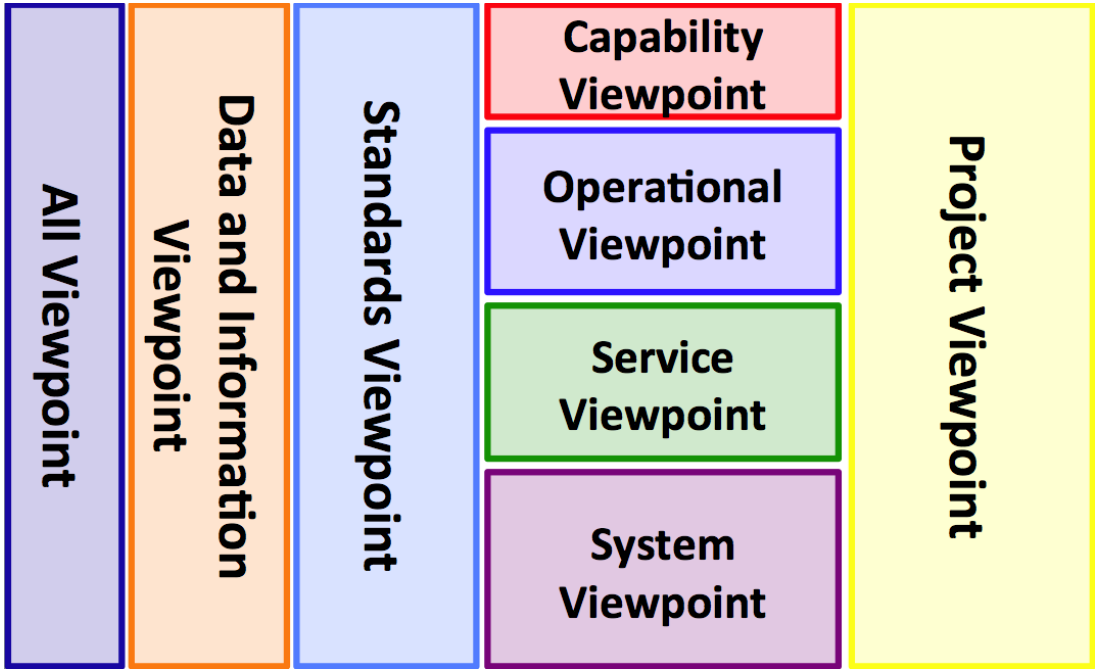
2 Ontology

Viewpoints

DODAF 2.0 ➡

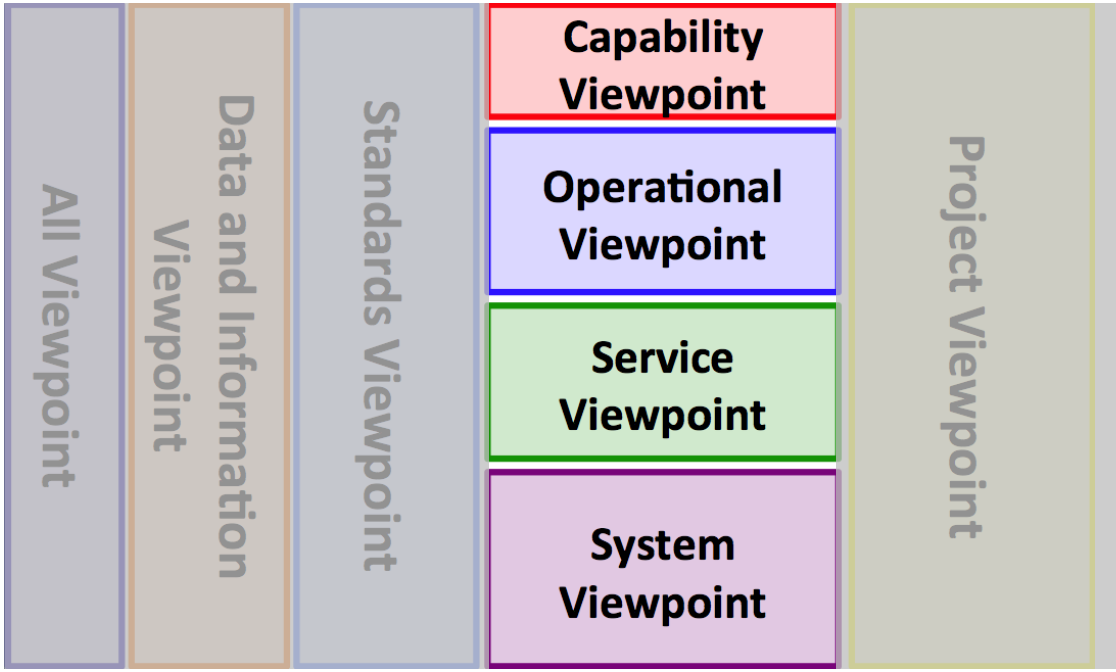


ISO 15288
IEEE 1220 ➡ **Functional Viewpoint**, **Physical Viewpoint**

2 Ontology

Viewpoints

DODAF 2.0 ➡



ISO 15288
IEEE 1220 ➡ **Functional Viewpoint**, **Physical Viewpoint**

Ontology

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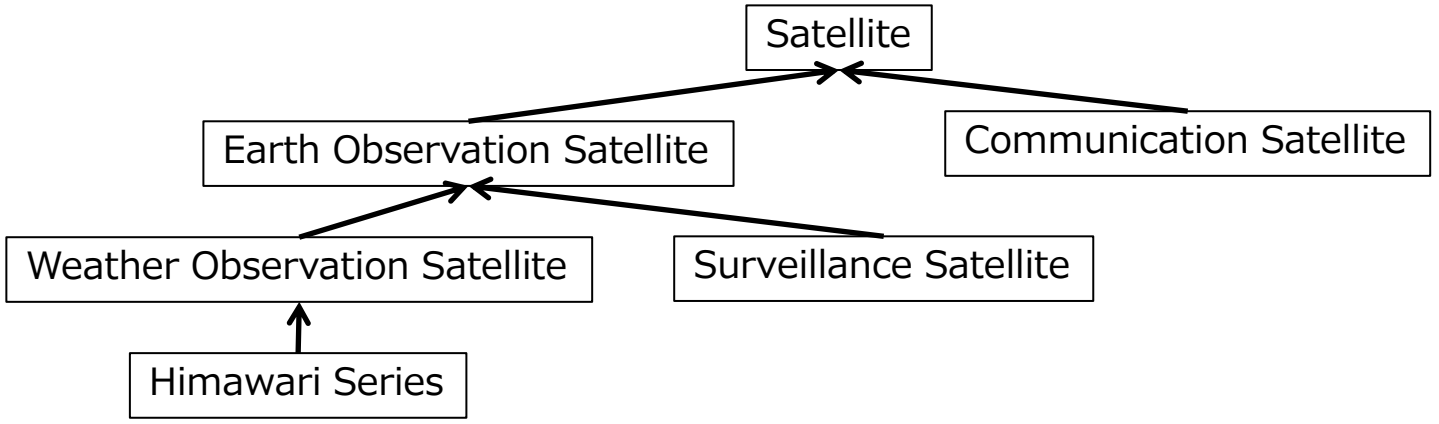
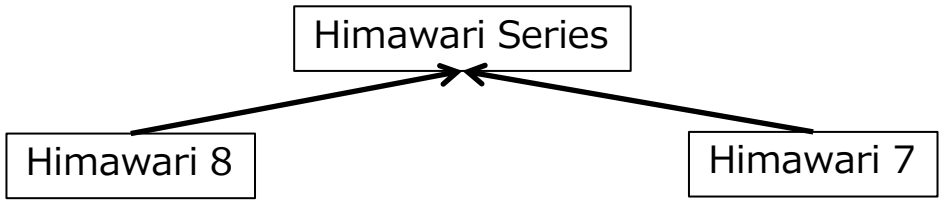
2 Ontology

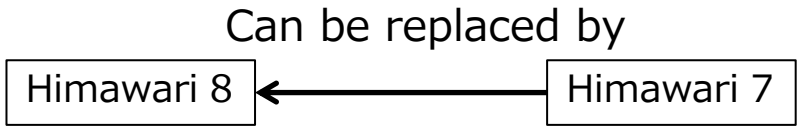
(A) Class Relationship



(B) Class-Instance Relationship

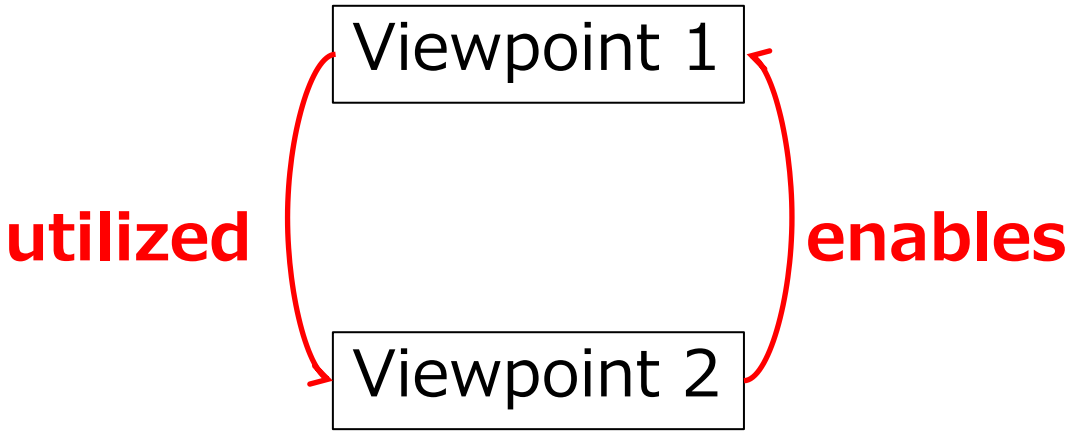


(C) Attribute Relationship

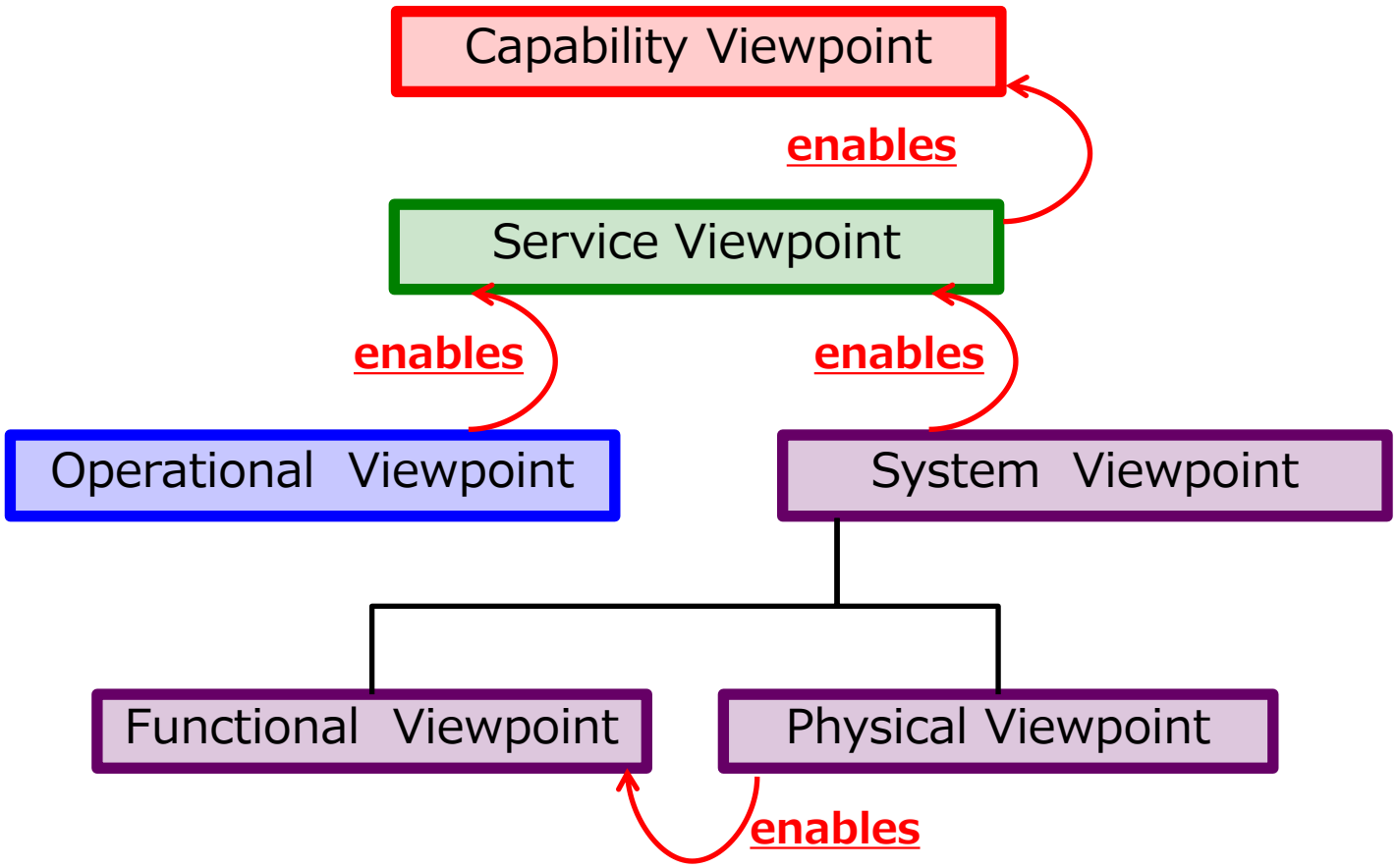


2 Ontology

Enabler Framework [Shirasaka, 2012]



2 Ontology



3 Apply Ontology to WOS

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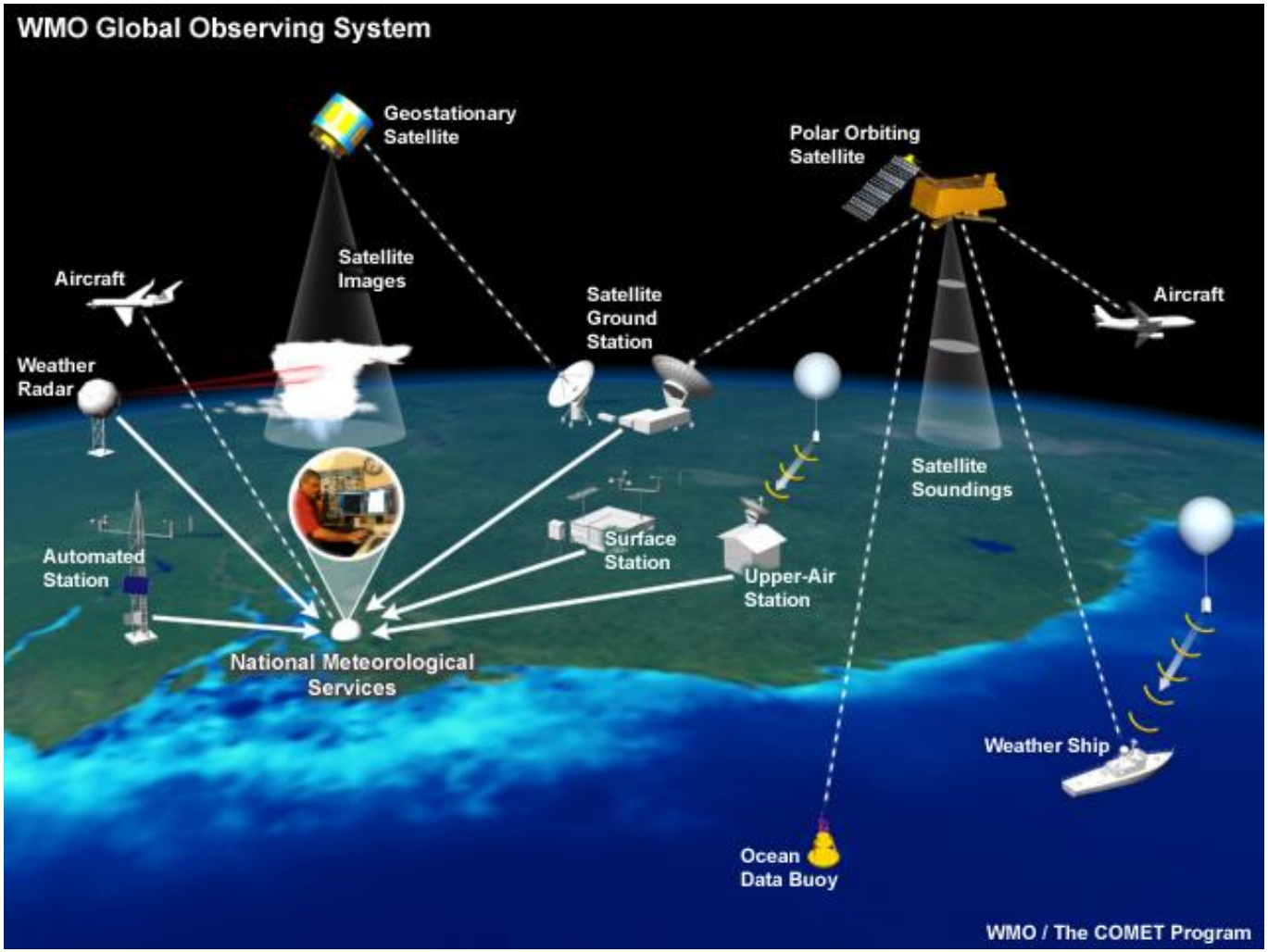

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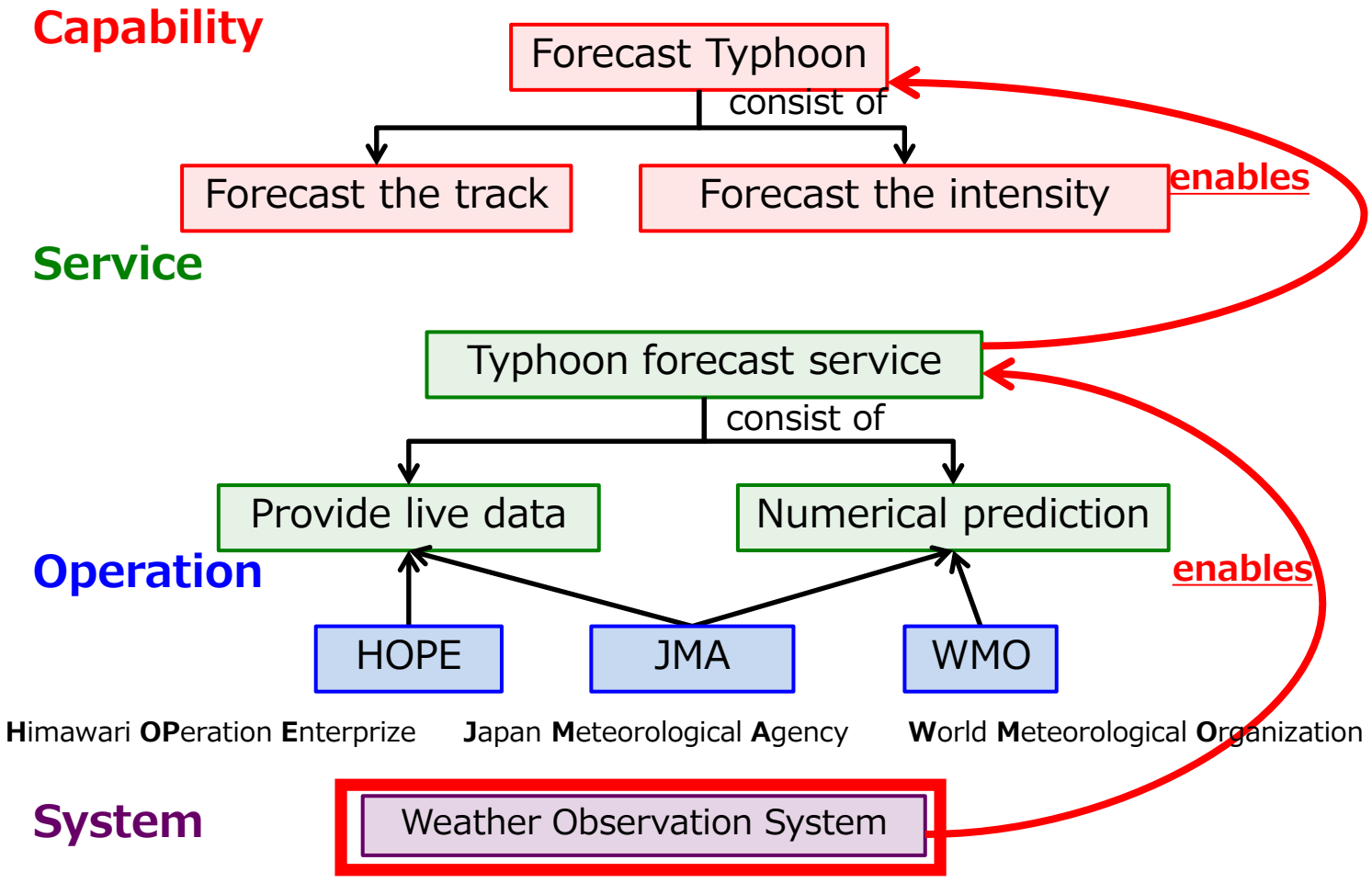

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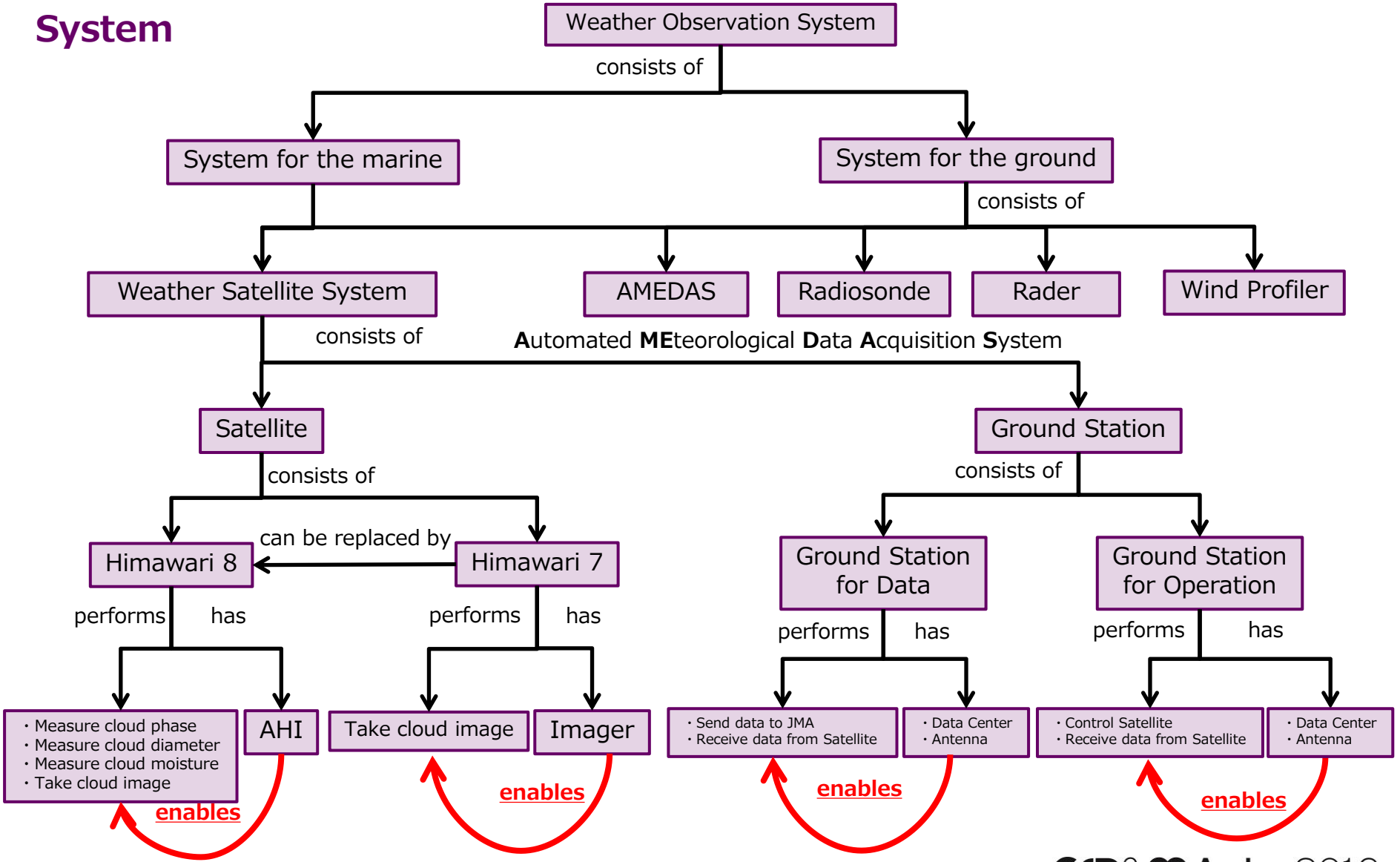
3 Apply Ontology to WOS

System



Advanced **H**imawari **I**mager

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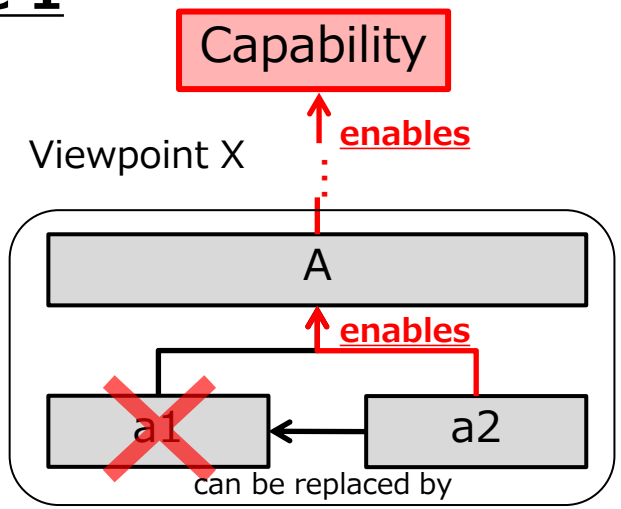
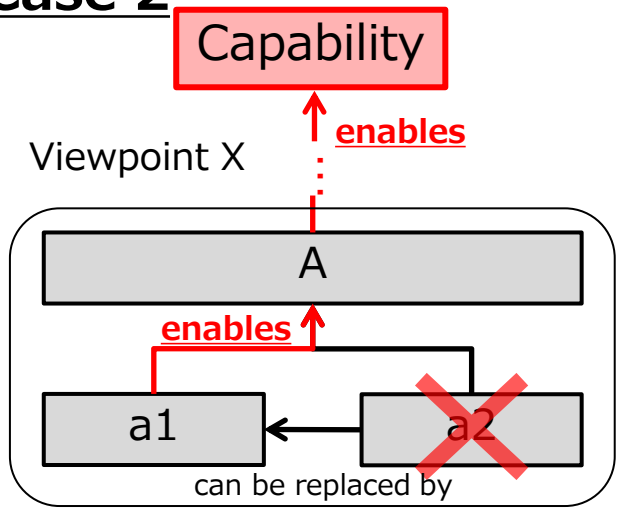
3 Apply Ontology to WOS

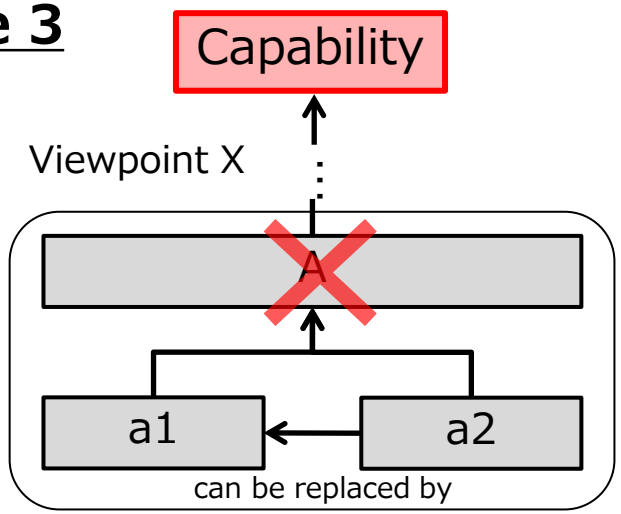
Case 1



Case 2



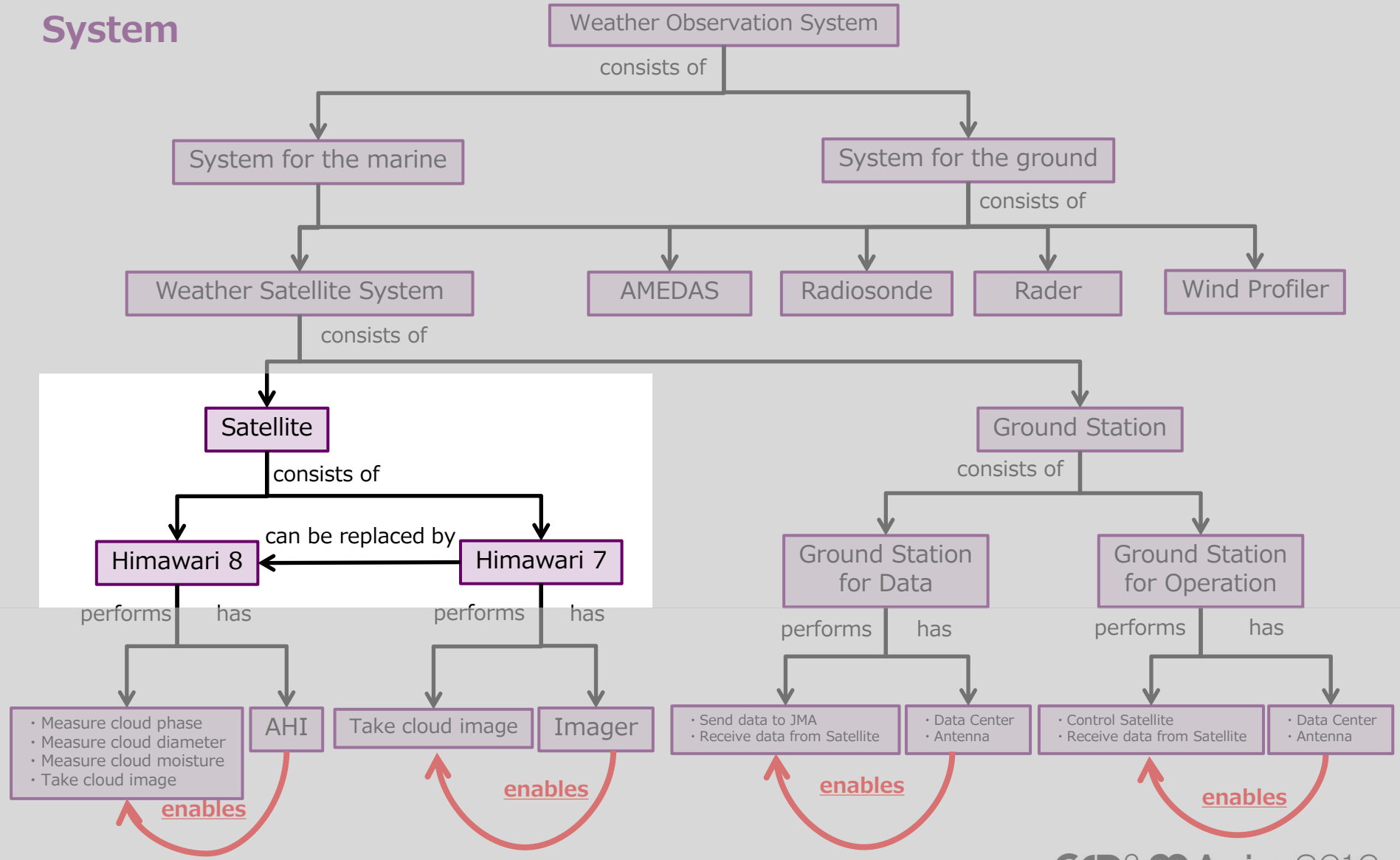
Case 3



Assumption

- A composes from a1 and a2
- Performance of a1 is better than that of a2
- 1 entity lost

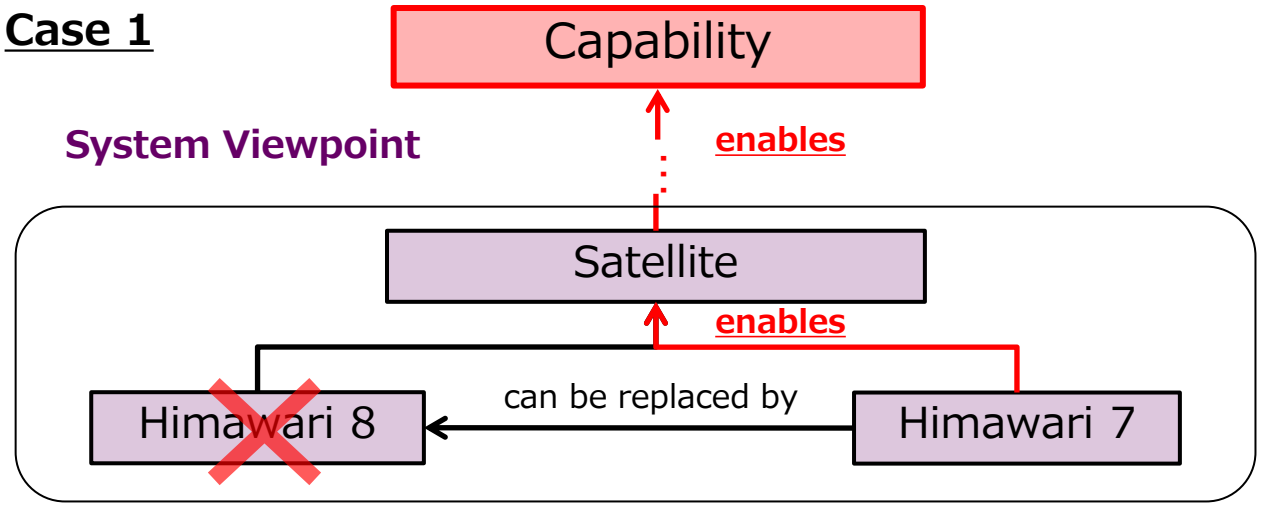
3 Apply Ontology to WOS



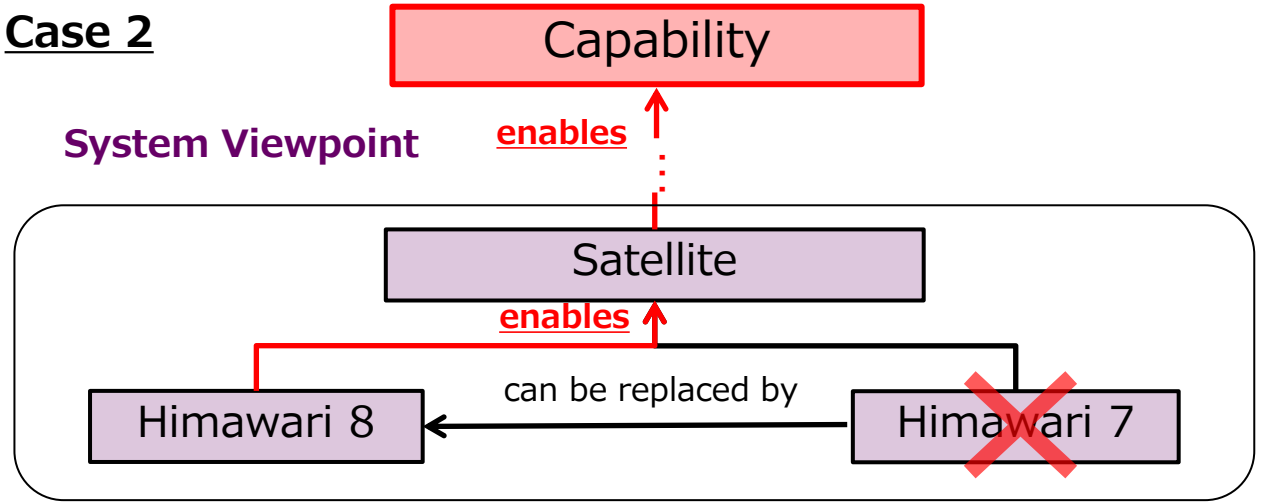
3 Apply Ontology to WOS

※ The performance of Himawari 8 is better than that of Himawari 7

Case 1

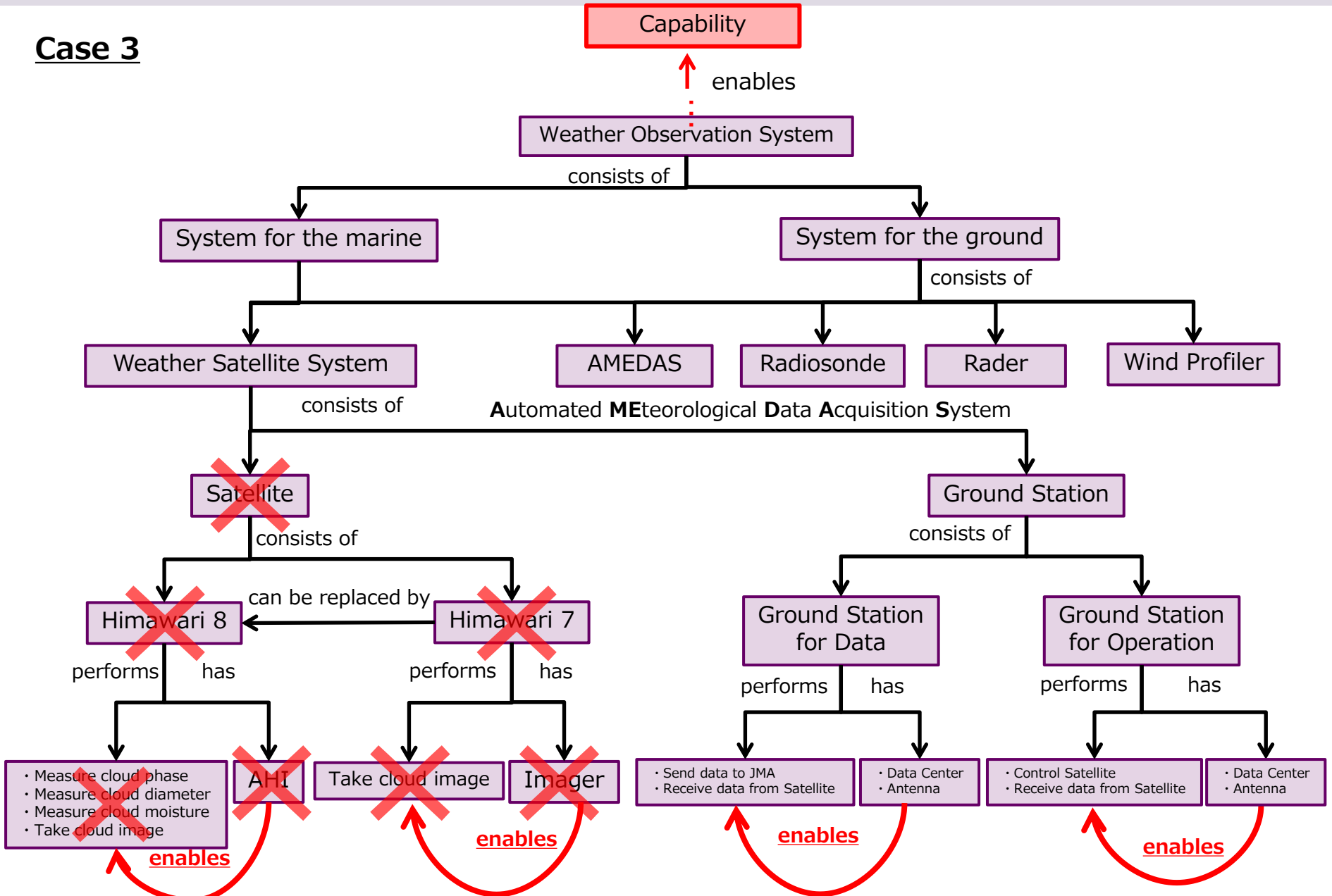


Case 2



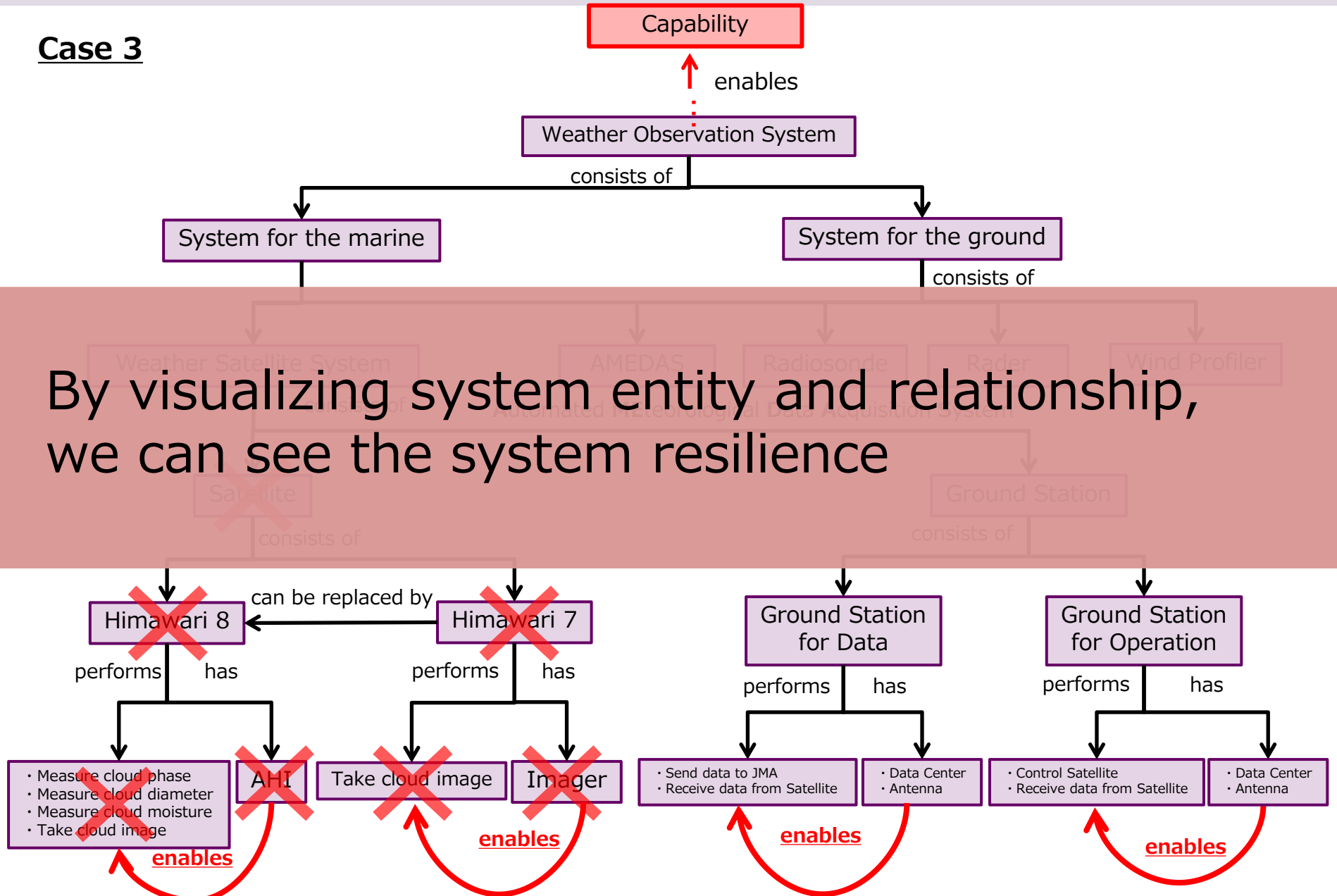
Apply Ontology to WOS

Case 3



Apply Ontology to WOS

Case 3



By visualizing system entity and relationship, we can see the system resilience

4 Conclusion

4 Conclusion

- Develop ontology for weather observation system by focusing on viewpoint
- Visualize the viewpoint and the relationship between viewpoints, which cultivates common understanding
- By applying the ontology to WOS, it helps to understand the system resilience

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Thank you for your kind attention

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