Front page

INF5150 - Unassailable IT-systems

Final exam
Monday 28. November 2016

Length: 14:30 - 18:30 (4 hours)

All printed and written exam resources are allowed.

This exam set is only available in English. You may choose to answer this exam in Norwegian or English.

The course teacher will come to the exam venue some time after the exam has begun.

Please read the whole exam set before attempting to answer any questions.

Good luck!

Background question 1 Modeling

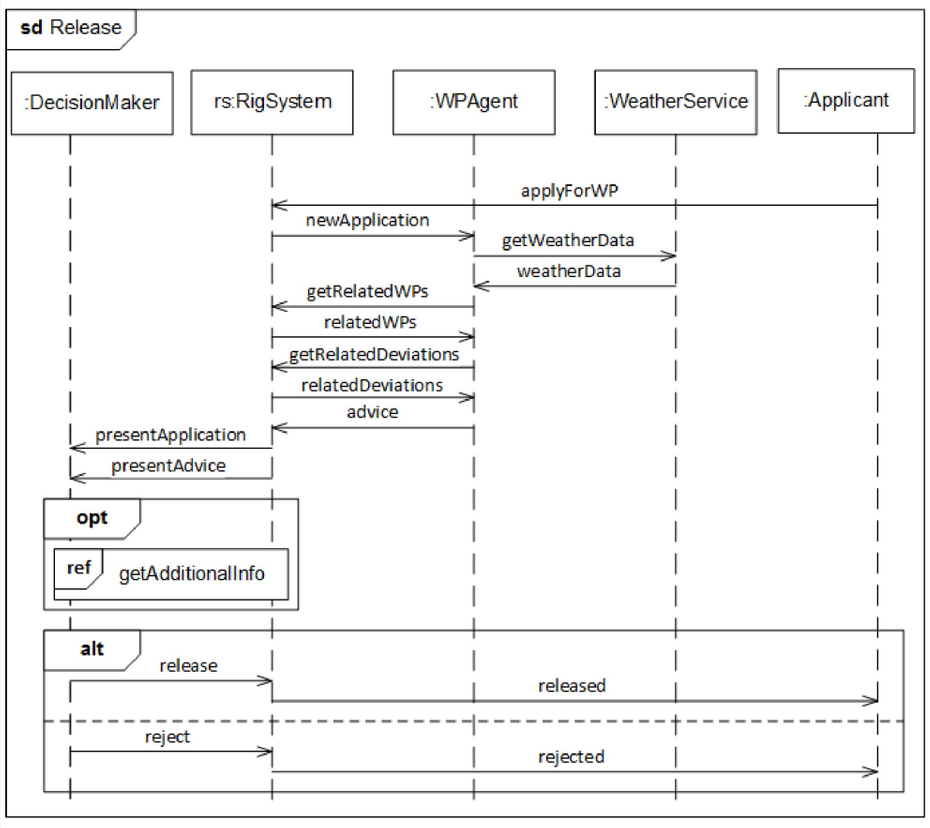

Fig 1

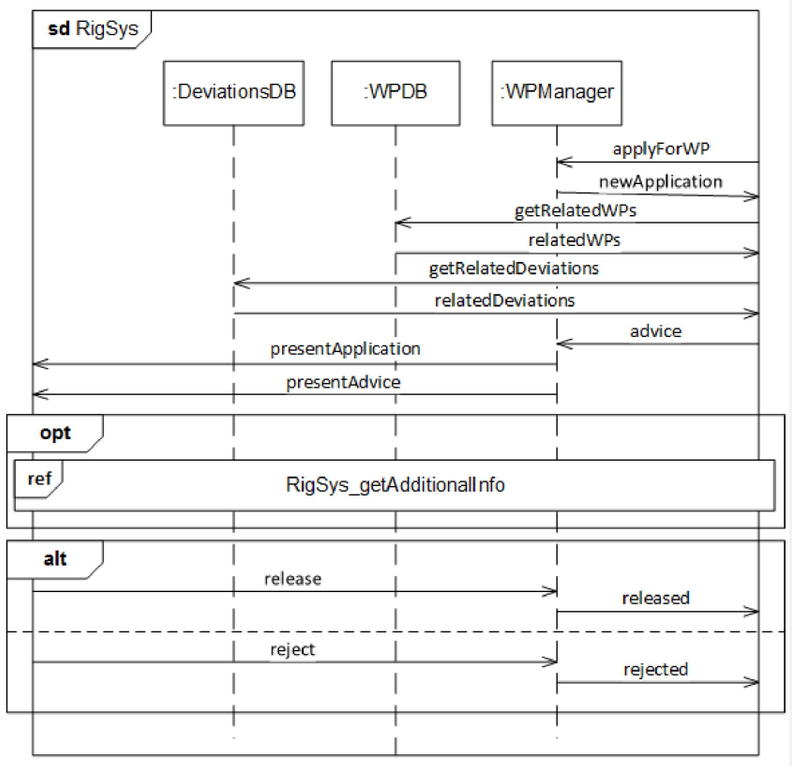

Fig 2

Accidents on oil and gas rigs can have large consequences in terms of loss of life, damage to the environment and economic loss. Non-routine work that takes place on a rig, such as welding or replacement of defect gas detectors, may increase the risk. Therefore, all work except daily routine tasks requires a work permit (WP). This allows decision makers to obtain an overview of all the different types of work that is planned and ongoing on all locations on the rig at all times, to oversee all extra safety measures related to the work, and to reject or stop work if necessary.

Every 12th hour, a WP meeting is held on the rig to decide which work permits to release for the next shift. When deciding whether to release (accept) or reject a WP, the decision makers need to take a number of safety considerations into account, including potential conflicts or interference with other work, the current state of safety barriers and the weather. This is very challenging, as the number of applications can be very high, meaning that only a few minutes or even less are available for each decision.

The rig operator wishes to introduce decision support in the form of an automated smart agent that collects relevant information for each WP application and provides advice to the human decision makers. The advice will be either a warning that the agent has detected something that might indicate that the WP should be rejected, accompanied by an explanation, or simply an empty message. Human decision makers will still be fully responsible for the final decision.

The sequence diagram Release in Fig 1 models the WP application process with the new solution.

After the Applicant has registered a new application, this information is forwarded to WPAgent, as represented by the newApplication message. WPAgent then collects the information it needs from the WeatherService and the (internal components of) the RigSystem, as represented by the next six messages going from and to WPAgent. After collecting this information, the WPAgent produces its advice (a purely internal process that is not shown) and sends it to RigSystem, which then presents the application and the advice from WPAgent to DecisionMaker.

The sequence diagram RigSys in Fig 2 shows a decomposition of the RigSystem lifeline of the sequence diagram Release in Fig 1.

1.1 Modeling I

What is the first event/events in a positive trace for the sequence diagram Release in Fig 1? Explain your answer.

Format

Words: 0

Maximum marks: 5

1.2 Modeling II

Assuming that any positive trace of the sequence diagram getAdditionalInfo (referenced by the sequence diagram Release in Fig 1) is finite, what is the last event/events in a positive trace for the sequence diagram Release? Explain your answer.

Format

Words: 0

Maximum marks: 5

1.3 Modeling III

What is the length of the shortest possible positive trace of the sequence diagram Release in Fig 1? Explain your answer.

Format

Words: 0

Maximum marks: 5

1.4 Modeling IV

Assume that correct answer to Question 1c Modeling III is *n*. How many positive traces of length *n* does the sequence diagram Release in Fig 1 describe?

Format

Words: 0

Maximum marks: 5

1.5 Modeling V

Does the sequence diagram Release in Fig 1 describe negative traces? Explain your answer.

Format

Words: 0

Maximum marks: 5

1.6 Modeling VI

Explain why the shortest possible positive trace of the sequence diagram RigSys in Fig 2 is of length 11.

Format

Words: 0

Maximum marks: 5

1.7 Modeling VII

What is the first event/events in a positive trace for the sequence diagram RigSys in Fig 2? Explain your answer.

Format

Words: 0

Maximum marks: 5

2.1 Refinement I

We consider again the case from Question 1 Modeling as documented by the sequence diagram Release in Fig 1.

Explain how you would change the sequence diagram Release in Fig 1 into a sequence diagram

ReleaseSupplement that is a pure supplementing (pure in the sense that it does not involve narrowing) of Release.

Format

Words: 0

Maximum marks: 5

2.2 Refinement II

Explain how you would change the sequence diagram Release in Fig 1 into a sequence diagram ReleaseNarrow that is a pure narrowing (pure in the sense that it does not involve supplementing) of Release.

Format

Words: 0

Maximum marks: 5

2.3 Refinement III

Let ReleaseVeto be the sequence diagram obtained from the sequence diagram Release in Fig 1 by replacing the keyword **opt** with the keyword **veto**. Is ReleaseVeto a refinement of Release? Explain your answer.

Format | B I U x_2 x^2 | I_x | | | Ω | | | ∑ | ABC | |

Words: 0

Maximum marks: 5

2.4 Refinement IV

Explain from a methodological point of view whether the **alt** operator in Release in Fig 1 should be replaced by an **xalt** operator.

Format | B I U x_2 x^2 | I_x | | | Ω | | | ∑ | ABC | |

Words: 0

Maximum marks: 5

2.5 Refinement V

Let ReleaseXalt be the sequence diagram obtained from the sequence diagram Release in Fig 1 by replacing the keyword **alt** with the keyword **xalt**. Is ReleaseXalt a general refinement of Release? Explain your answer.

Format B I U x_2 x^2 I_x Ω Σ

Words: 0

Maximum marks: 5

2.6 Refinement VI

Consider ReleaseXalt as defined in the previous question. Explain why Release in Fig 1 is a general refinement of ReleaseXalt?

Format B I U x_2 x^2 I_x Ω Σ

Words: 0

Maximum marks: 5

2.7 Refinement VII

Explain from a methodological point of view how ReleaseXalt should be updated to make sure that both **xalt** options are preserved in any further refinement (for example, to avoid that Release in Fig 1 is a general refinement of ReleaseXalt).

Format | B I U x_2 x^2 | I_x | | | Ω | | | Σ | ABC | |

Words: 0

Maximum marks: 5

Background question 3 Security risk assessment

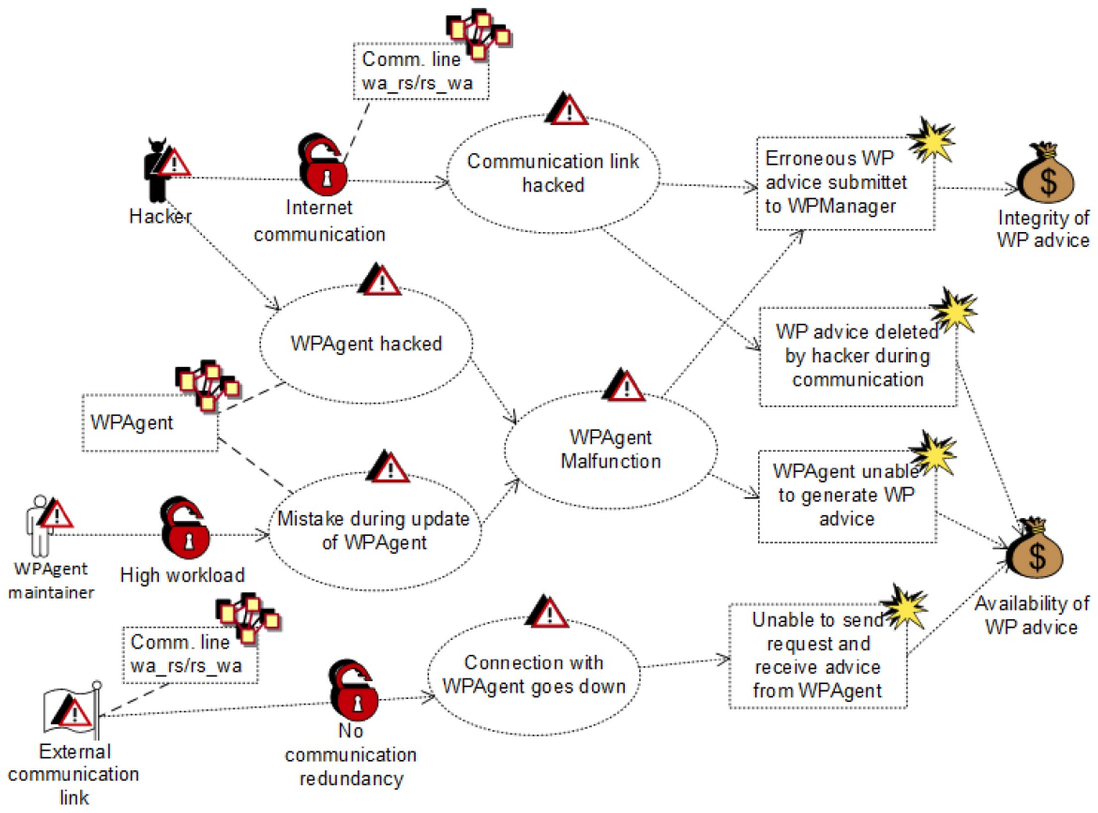

Fig 3

We consider again the case from Question 1 Modeling as documented by the sequence diagrams in Fig 1 and Fig 2. In the proposed solution, the WPAgent will run on a server deployed with the WPAgent Provider and made accessible on the rig through a web-based interface. This facilitates easy improvement, updating and maintenance of the WPAgent by the WPAgent Provider, but also implies more non-local communication which may lead to security problems. The threat diagram in Fig 3 describes new threat scenarios that may result from the introduction of the WPAgent.

3.1 Security risk assessment I

How many risks are described by the threat diagram in Fig 3? Explain your answer.

Format

Words: 0

Maximum marks: 5

3.2 Security risk assessment II

Assume we work with frequencies and conditional probabilities. Consider the scenario resulting in the unwanted incident **Unable to send request and receive advice from WPAgent**. Assign frequencies and conditional probabilities to this scenario so that the threat diagram becomes inconsistent independent of whether it is complete or not.

Format

Words: 0

Maximum marks: 5

3.3 Security risk assessment III

Assume we work with frequencies and conditional probabilities. Consider once more the scenario resulting in the unwanted incident **Unable to send request and receive advice from WPAgent** in Fig 3. Assign frequencies and conditional probabilities to this scenario so that the threat diagram becomes consistent under the assumption that it is incomplete and inconsistent under the assumption that it is complete.

Format

Words: 0

Maximum marks: 5

3.4 Security risk assessment IV

Define a qualitative consequence scale for the asset **Integrity of WP advice** in Fig 3.

Format

Words: 0

Maximum marks: 5

3.5 Security risk assessment V

Define a quantitative consequence scale for the asset **Availability of WP advice** in Fig 3.

Format

Words: 0

Maximum marks: 5

3.6 Security risk assessment VI

Define a qualitative likelihood scale with respect to the threat diagram in Fig 3.

Format

Words: 0

Maximum marks: 5

Question 1.1
Attached

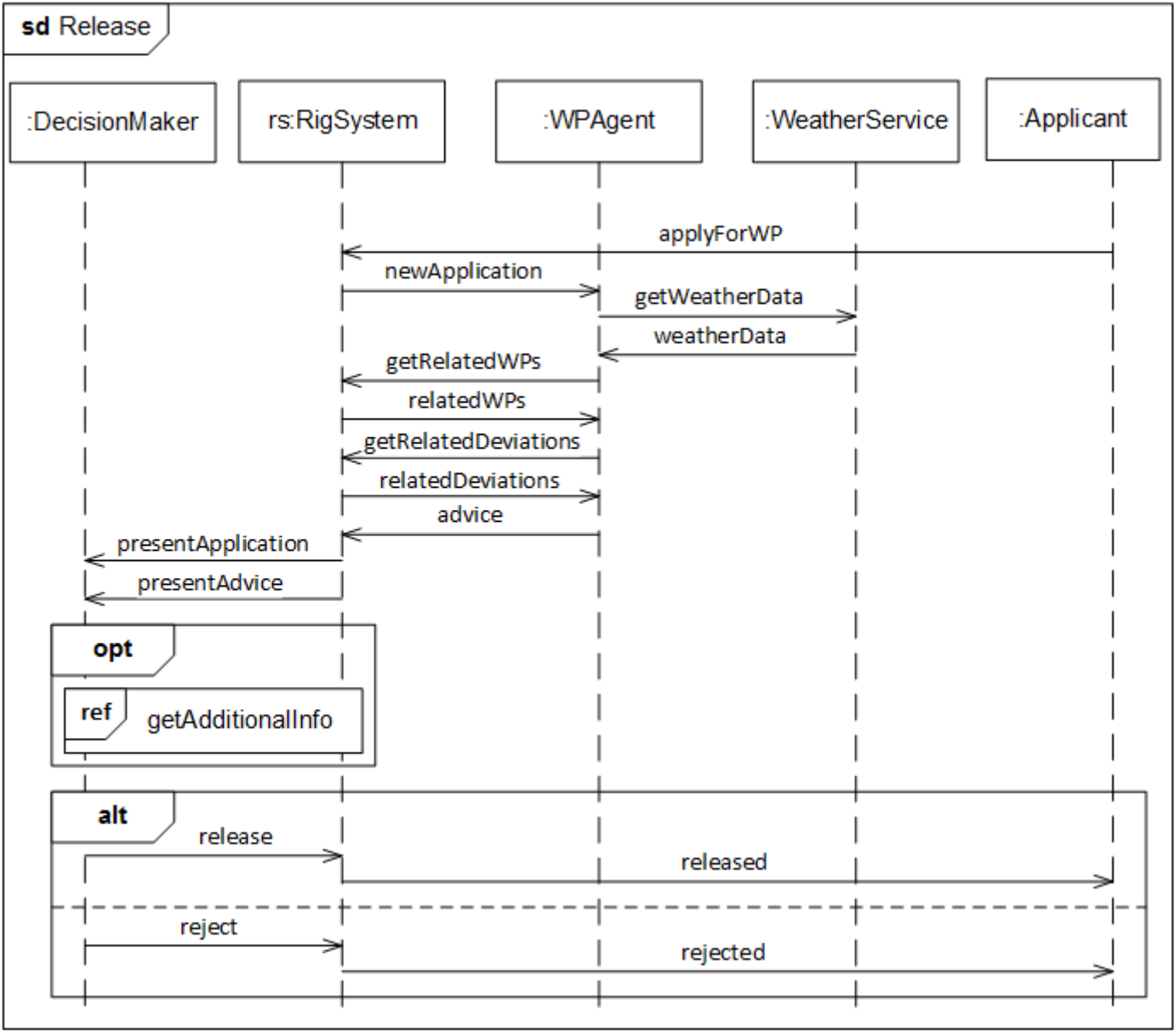
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Fig 1

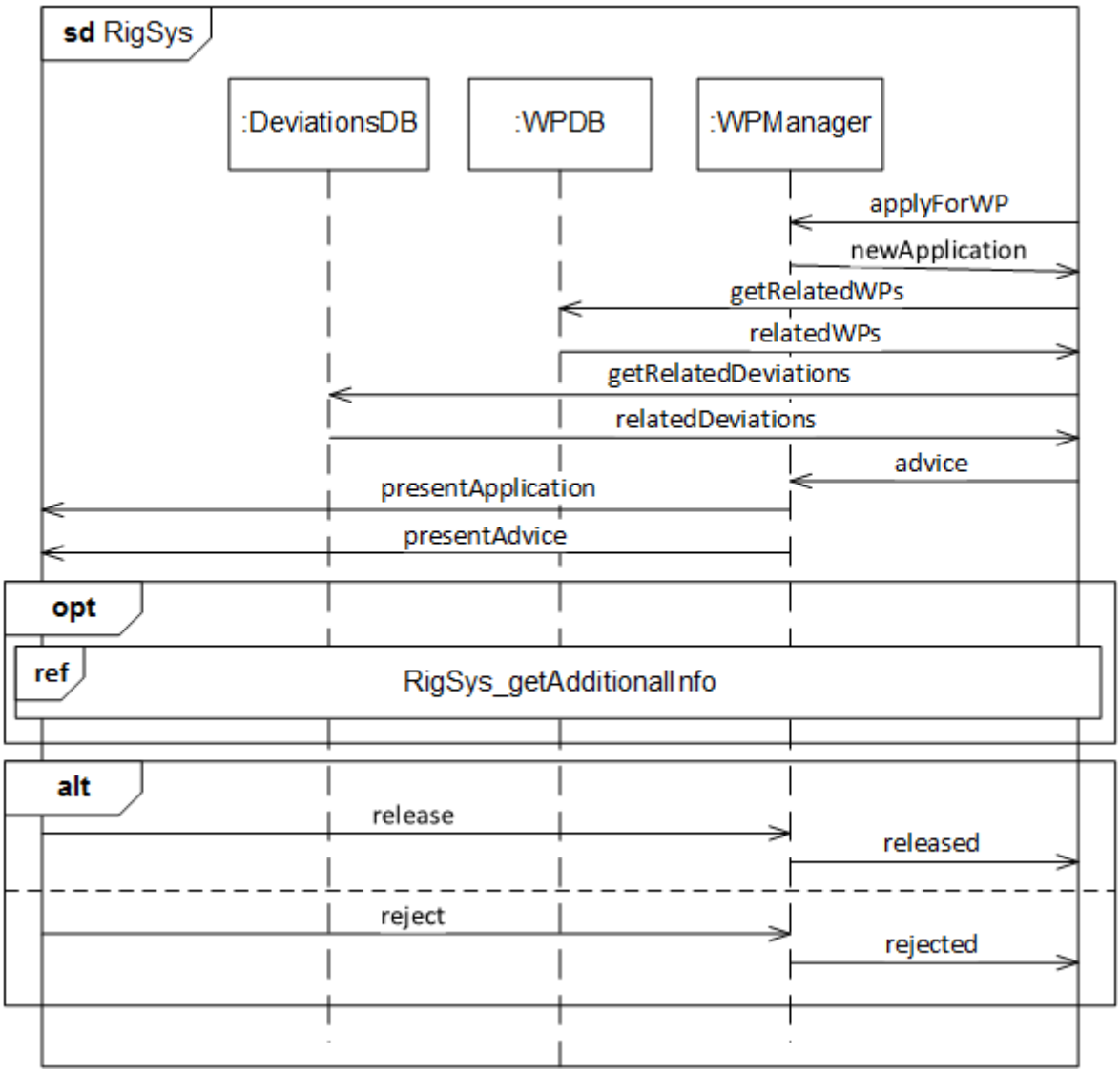
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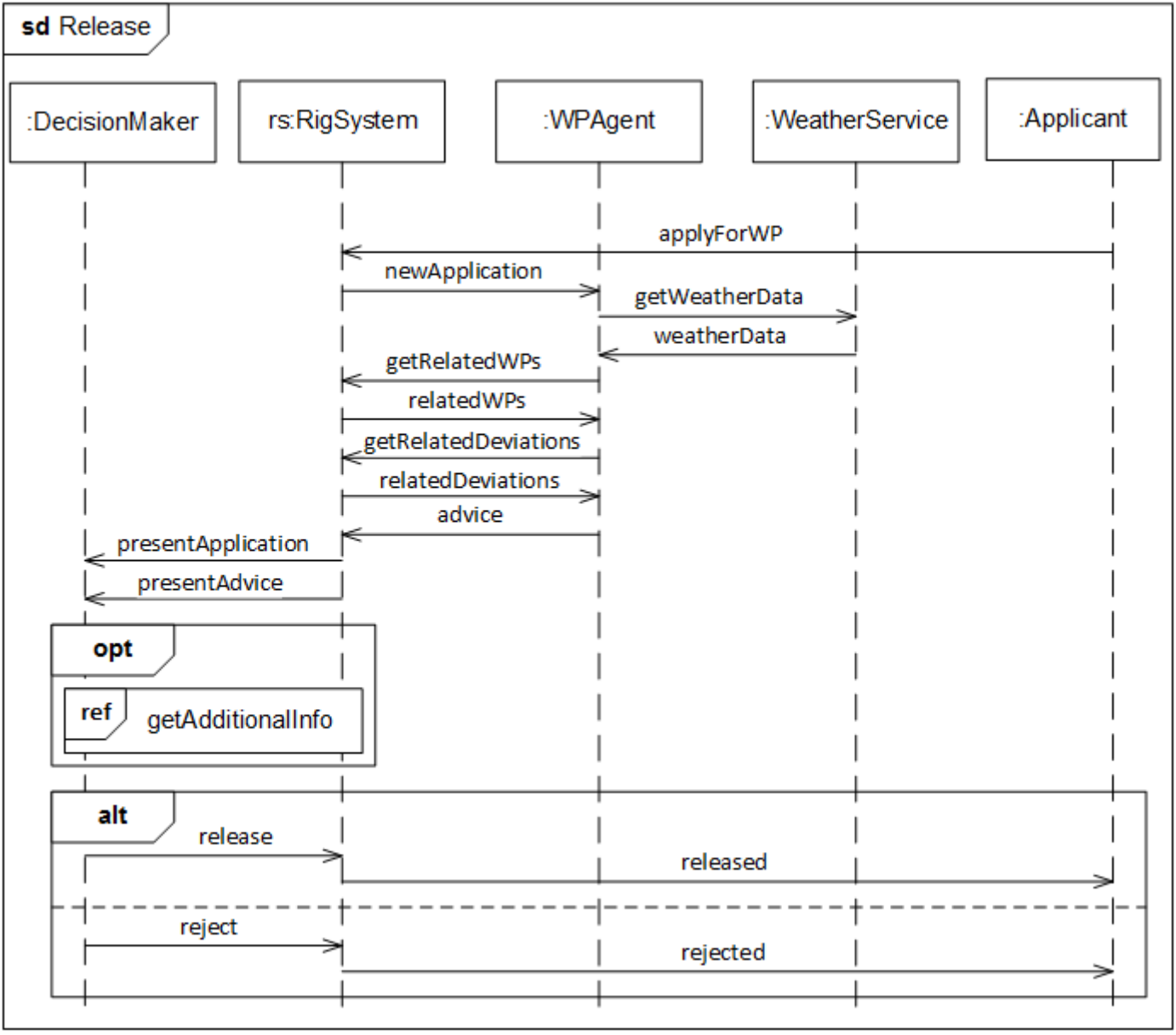
Fig 2

Question 1.2
Attached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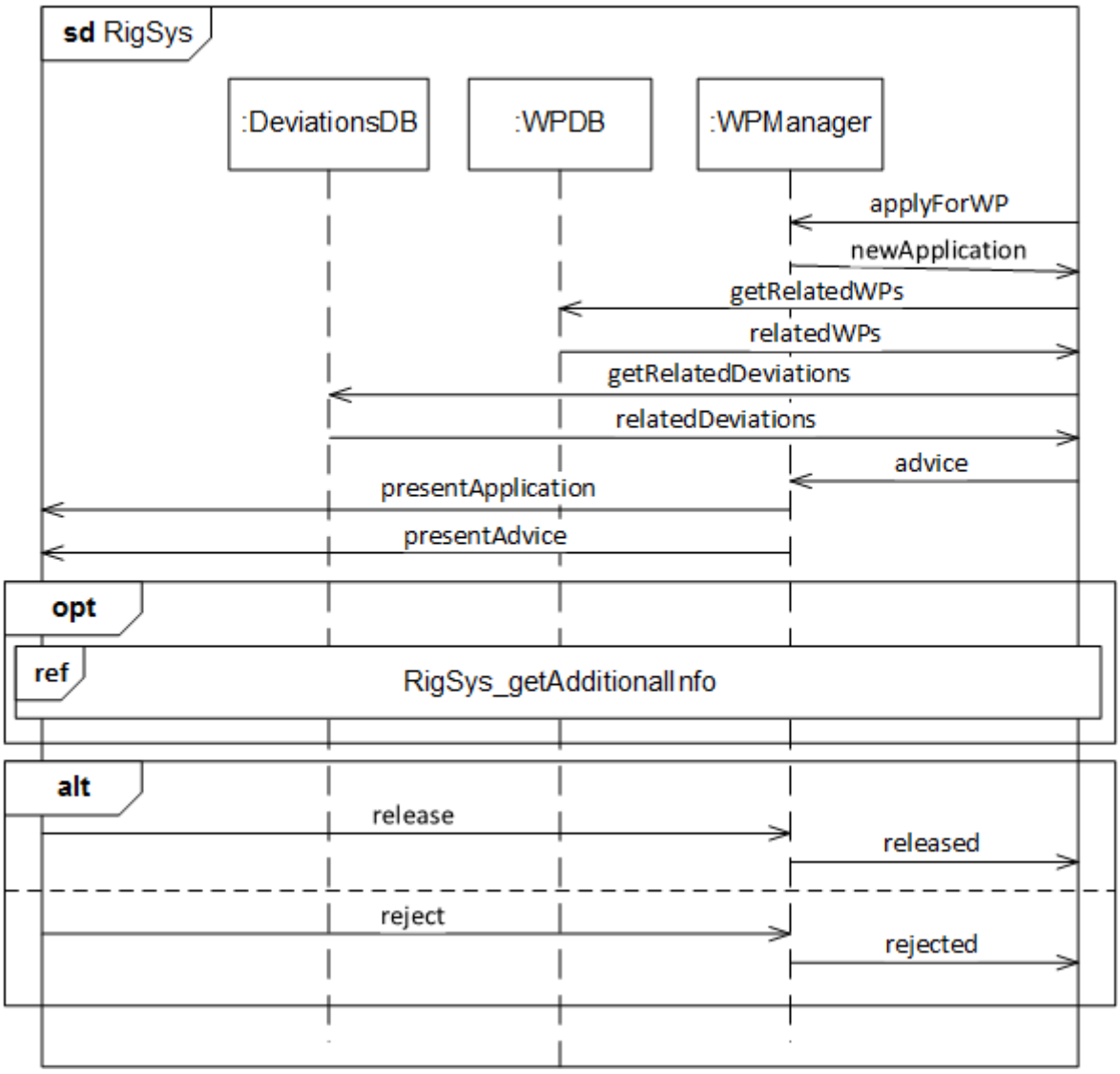
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Fig 2

Question 1.3
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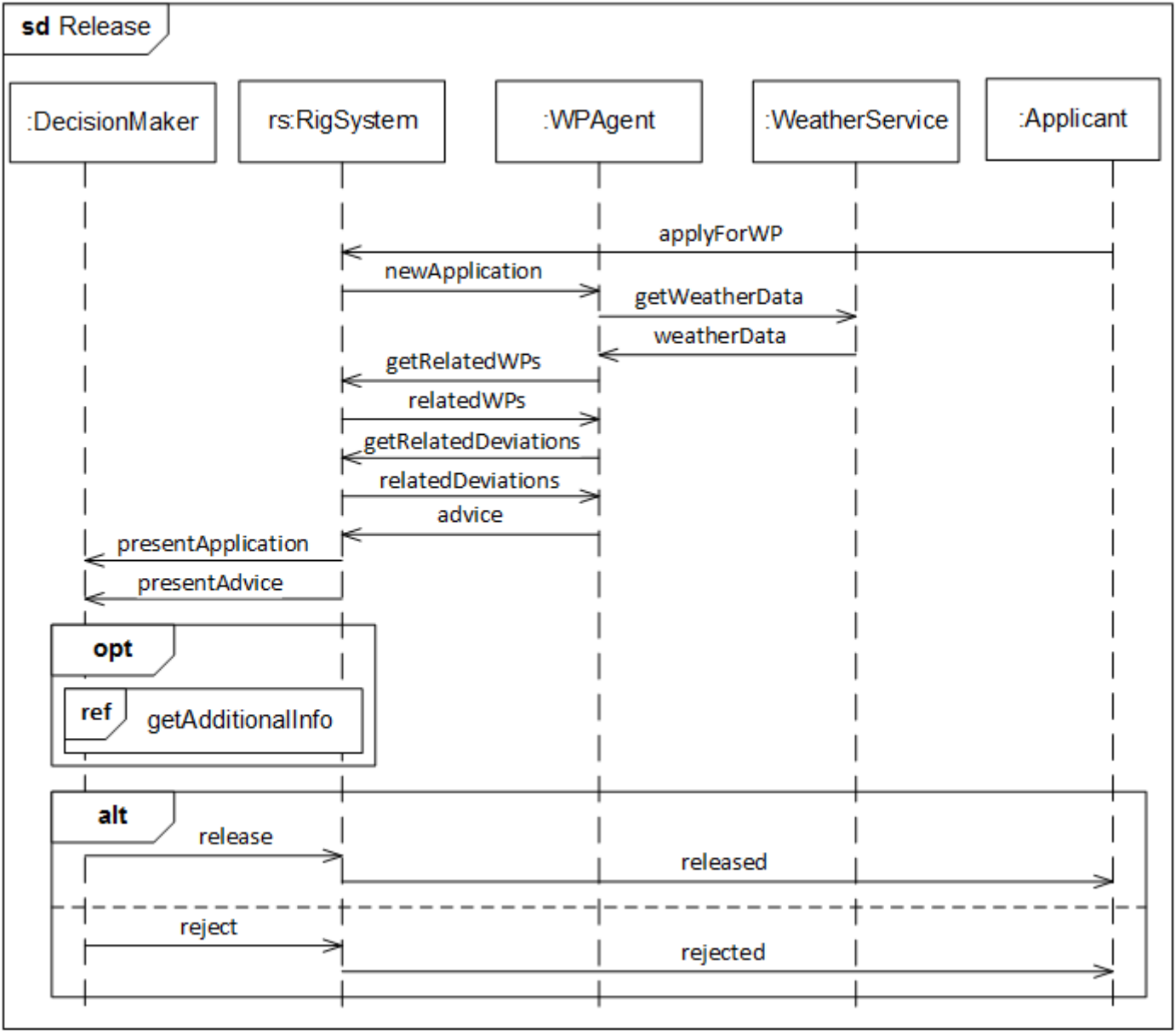
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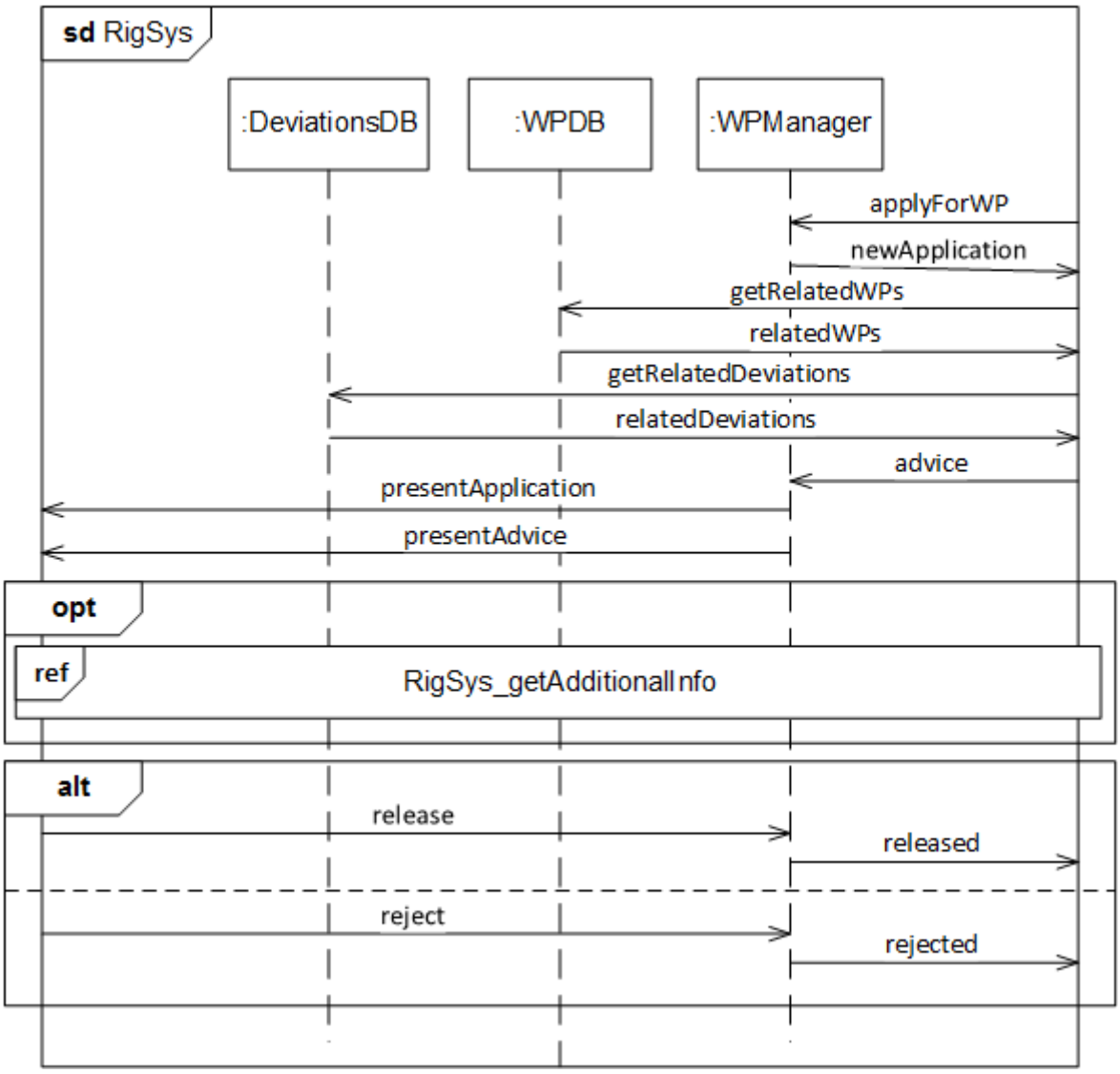
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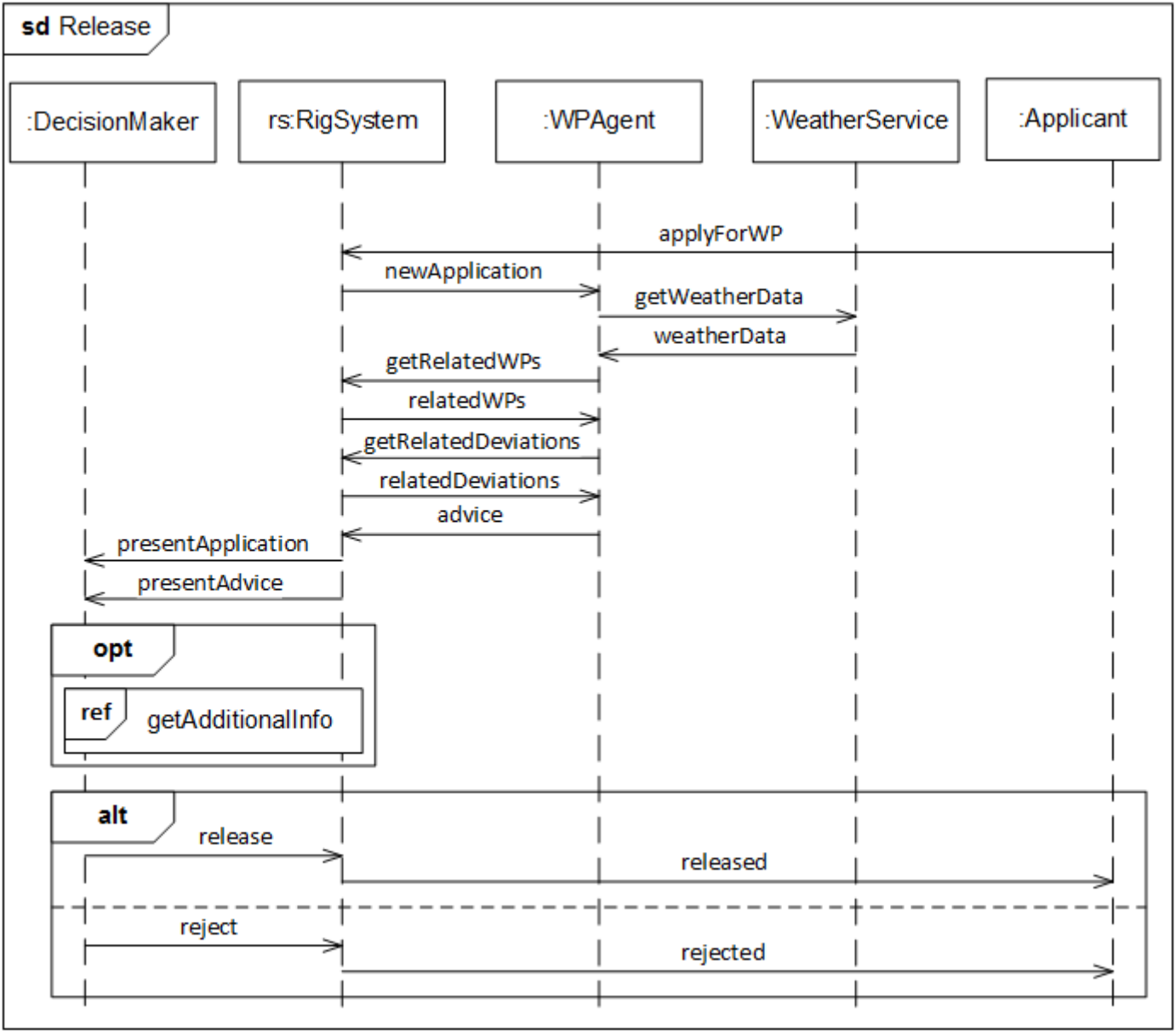
Fig 2

Question 1.4
Attached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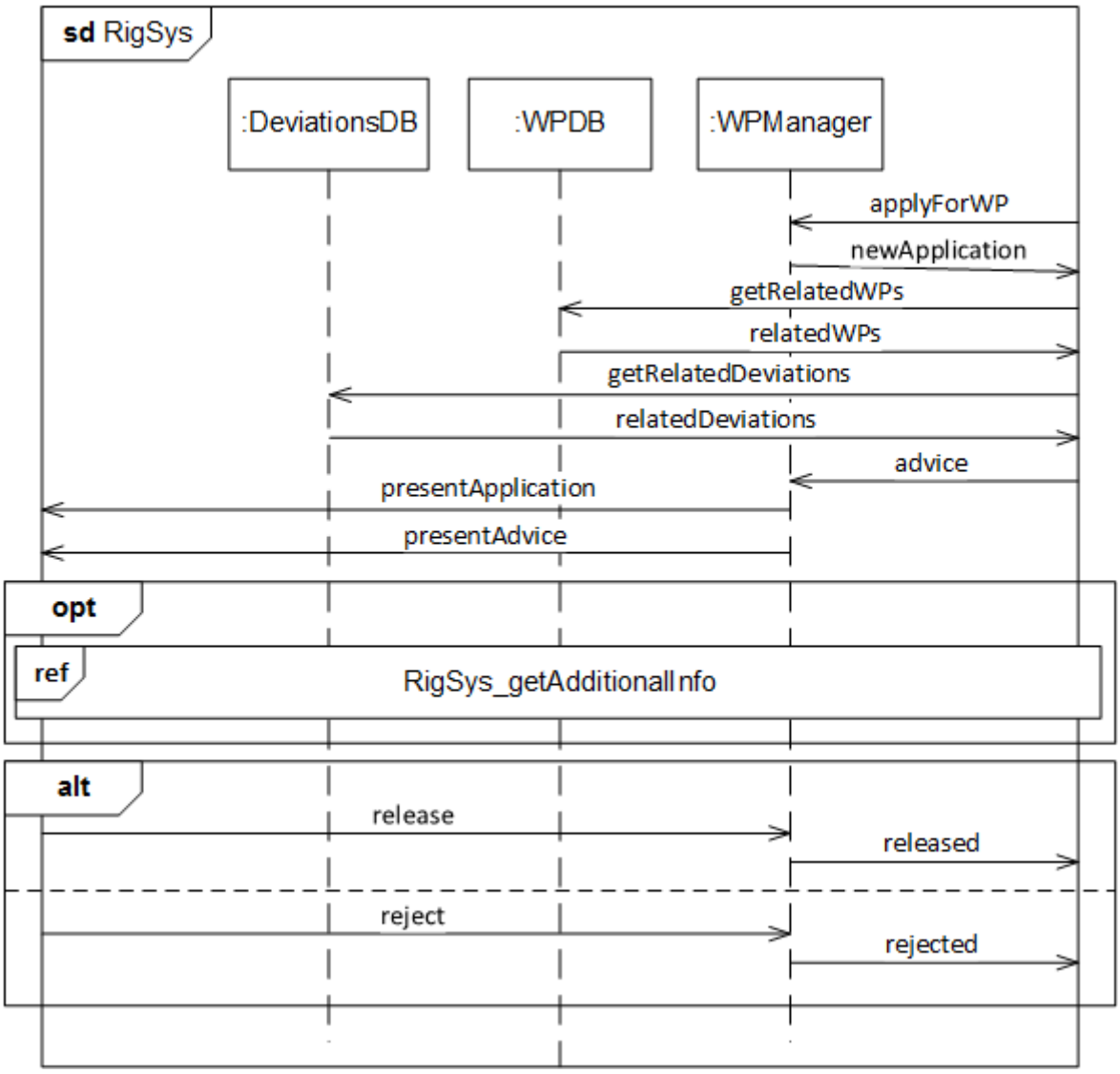
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Fig 2

Question 1.5
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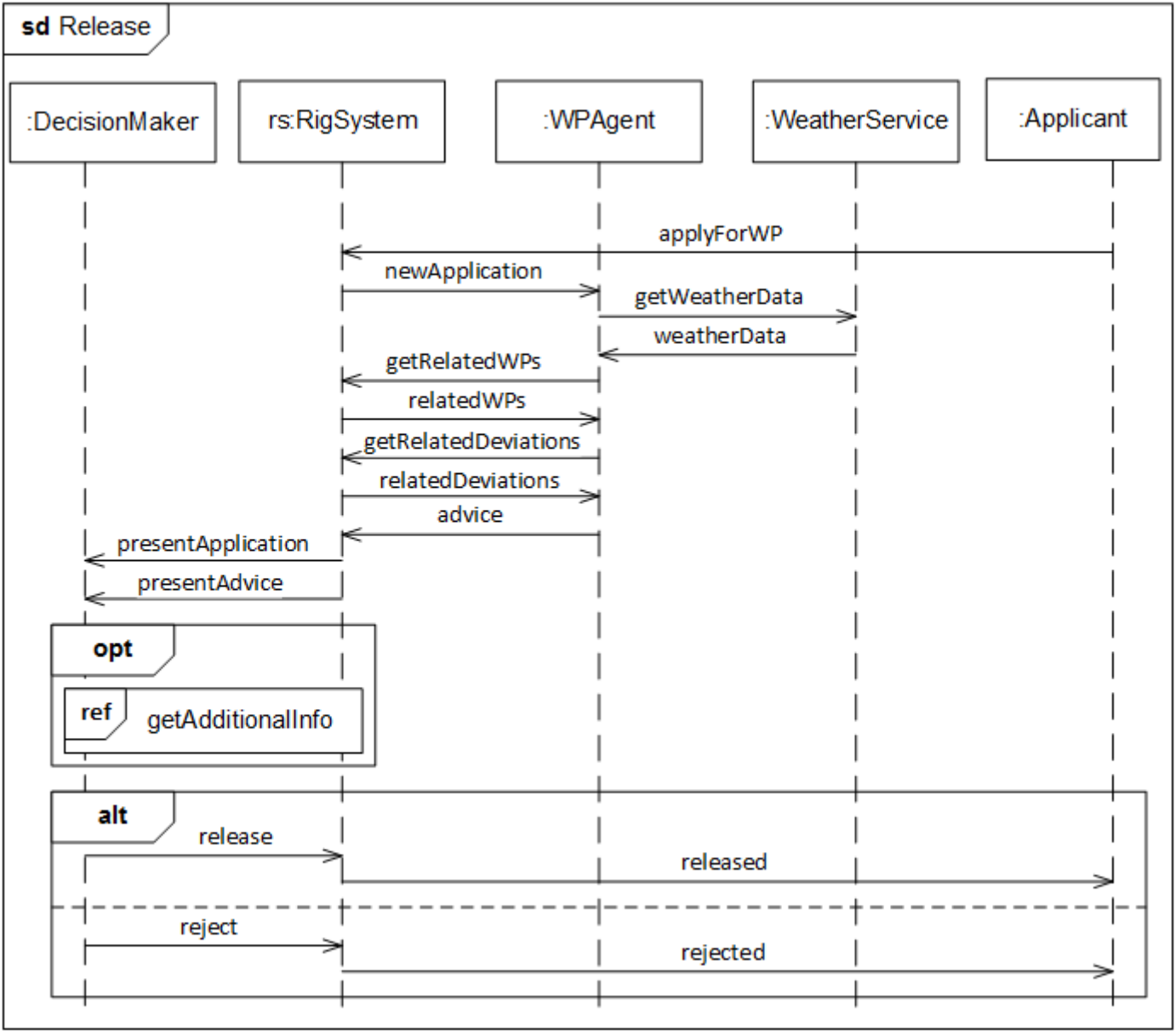
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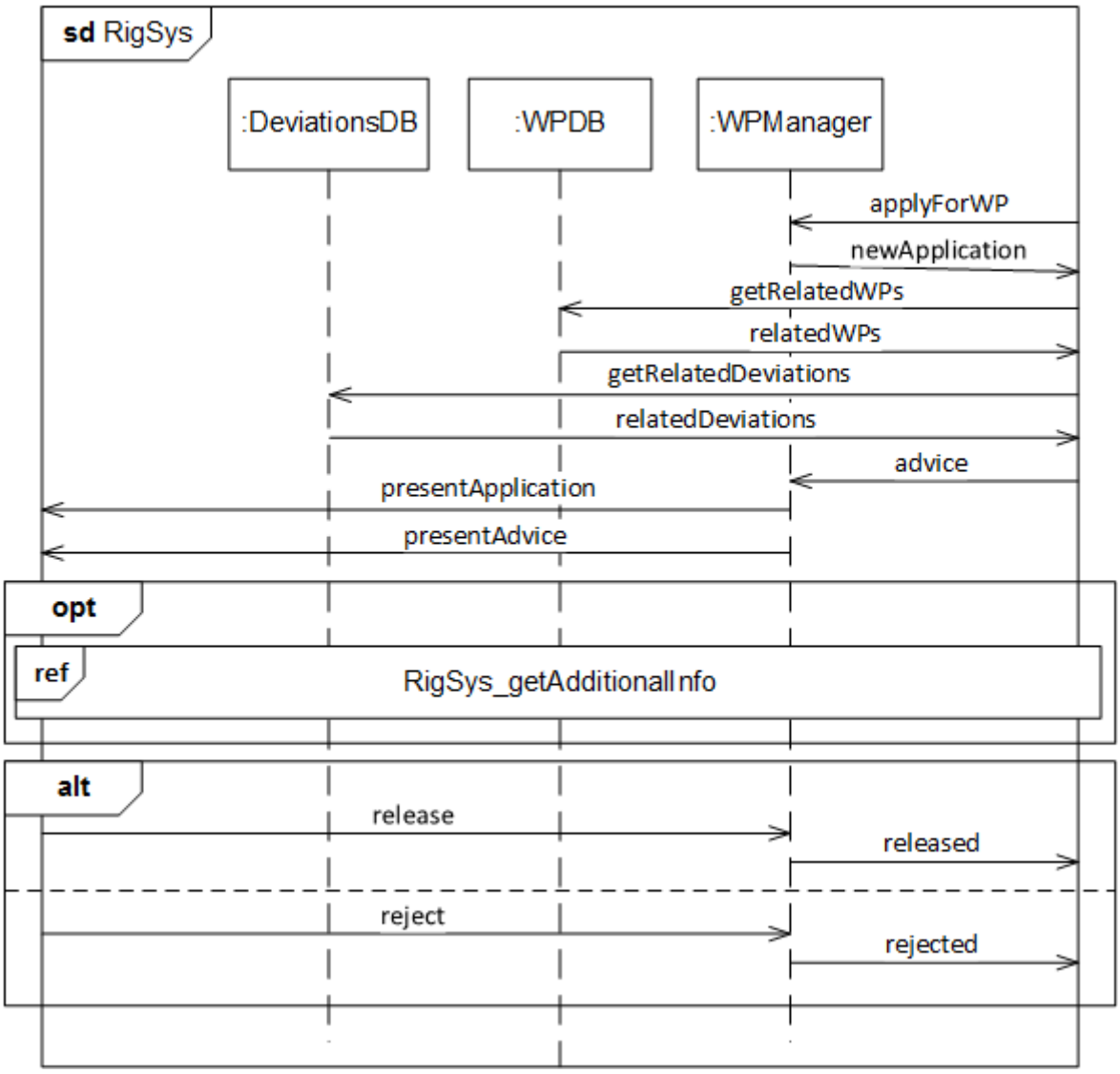
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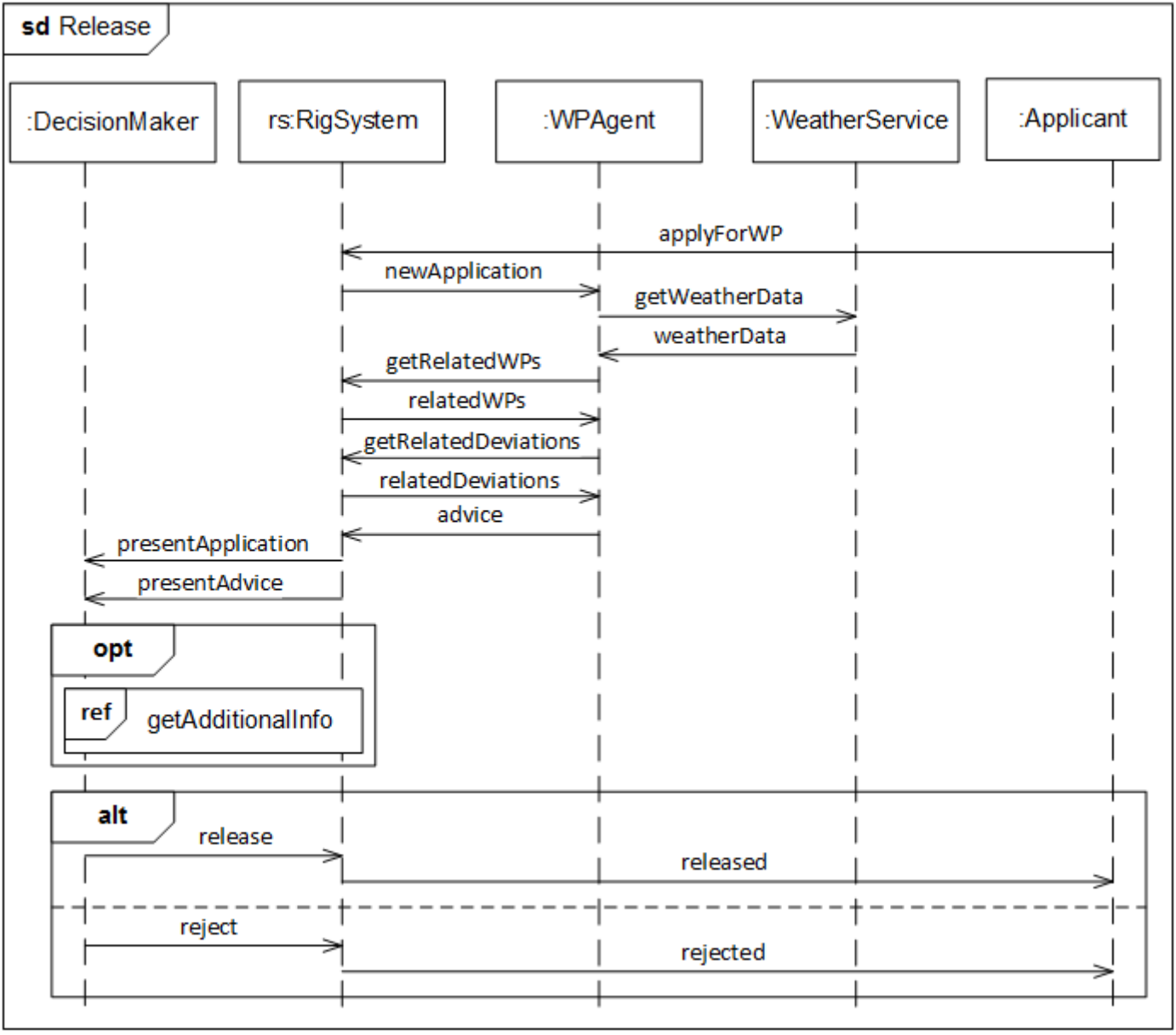
Fig 2

Question 1.6
Attached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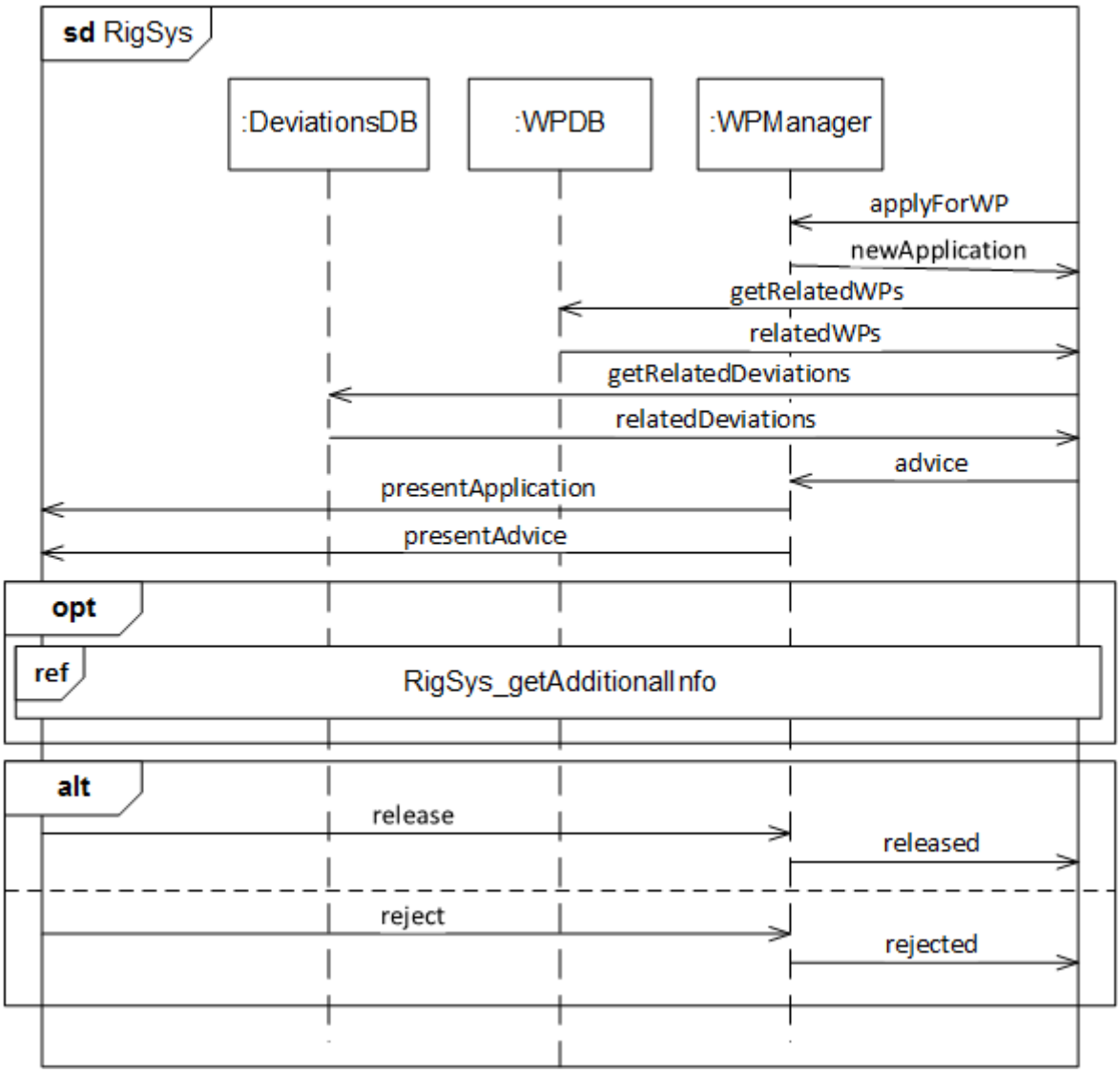
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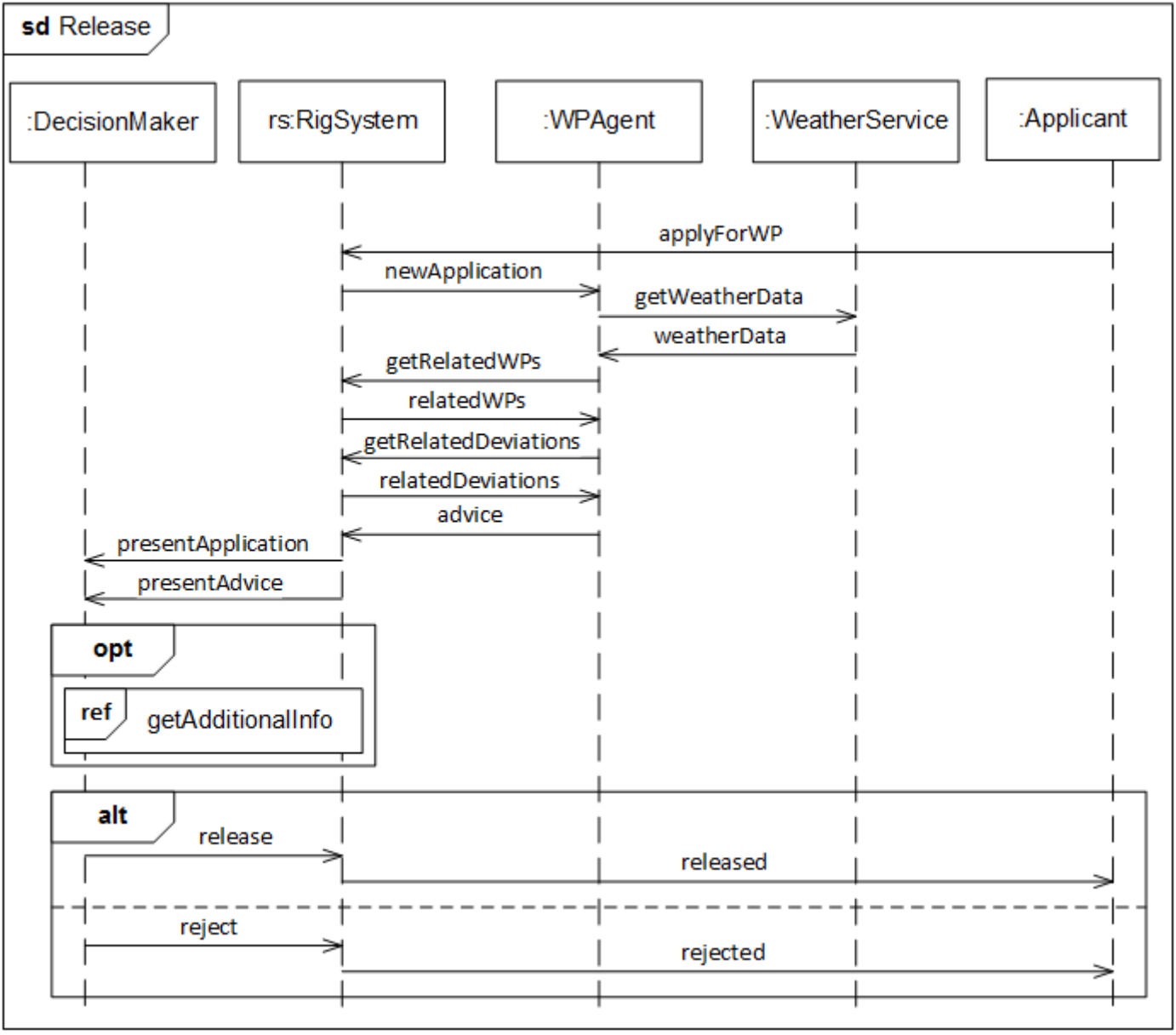
Fig 2

Question 1.7
Attached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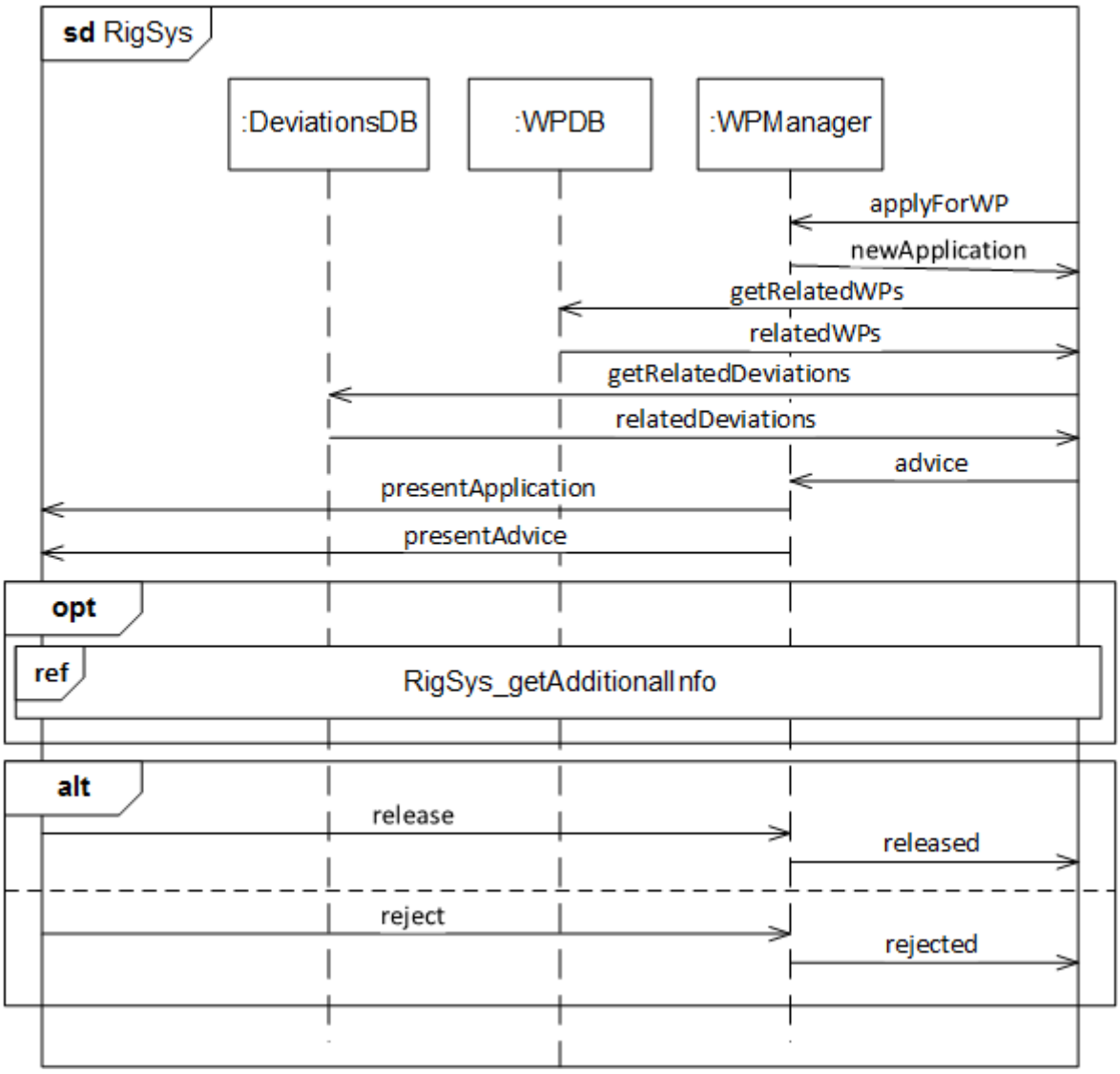
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Fig 2

Question 2.1
Attached

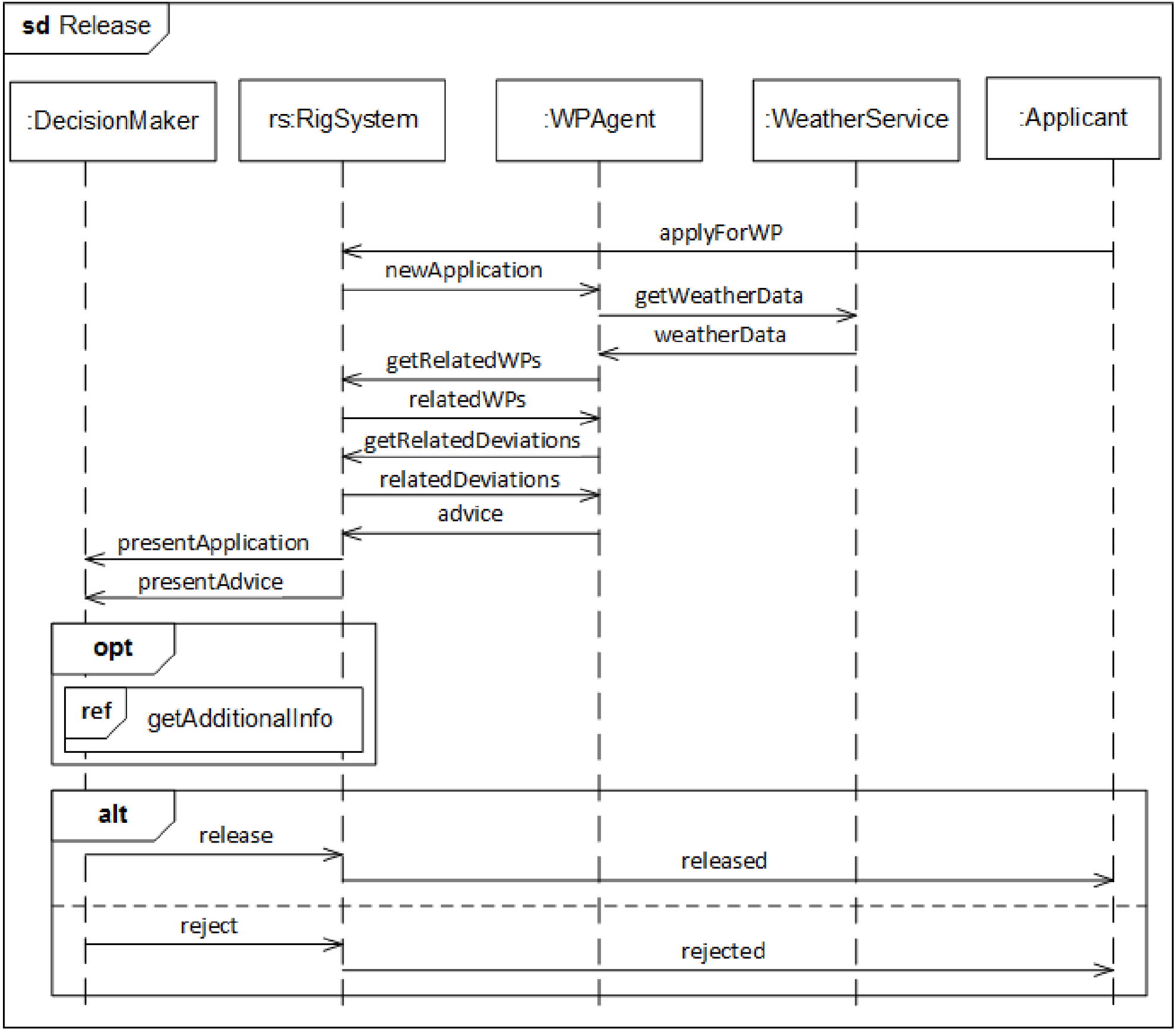
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Fig 1

Question 2.2
Attached

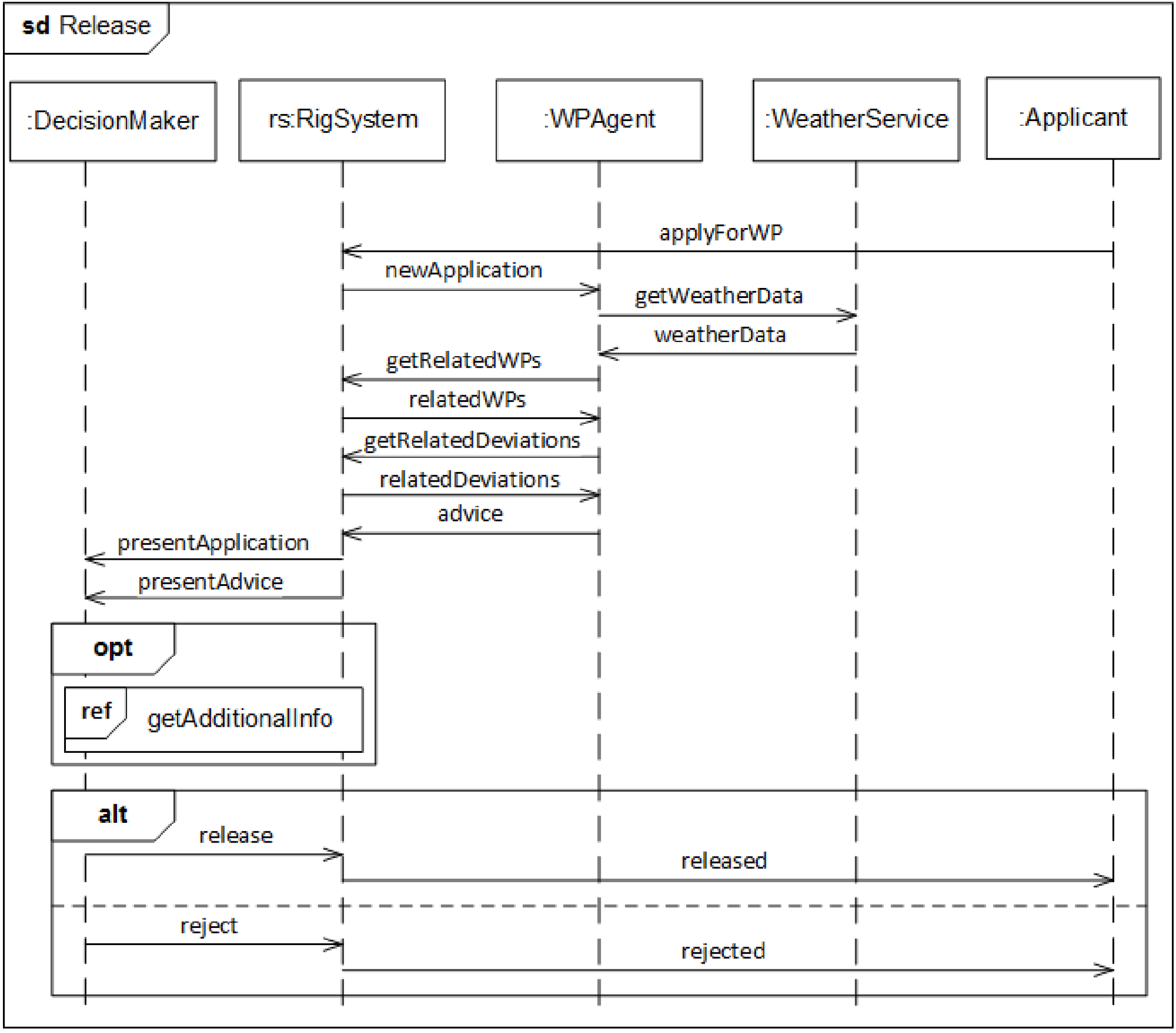
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Fig 1

Question 2.3
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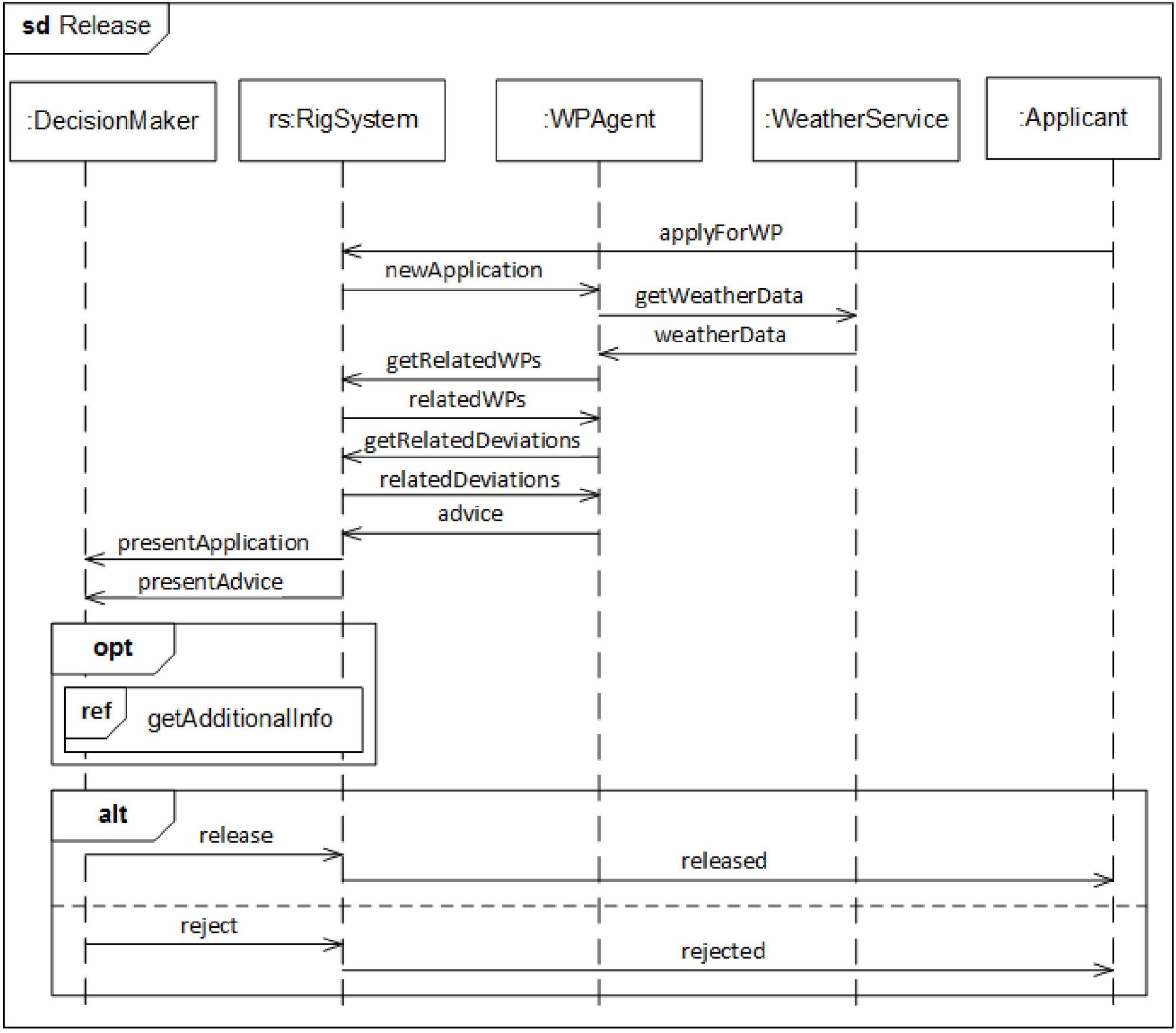
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Fig 1

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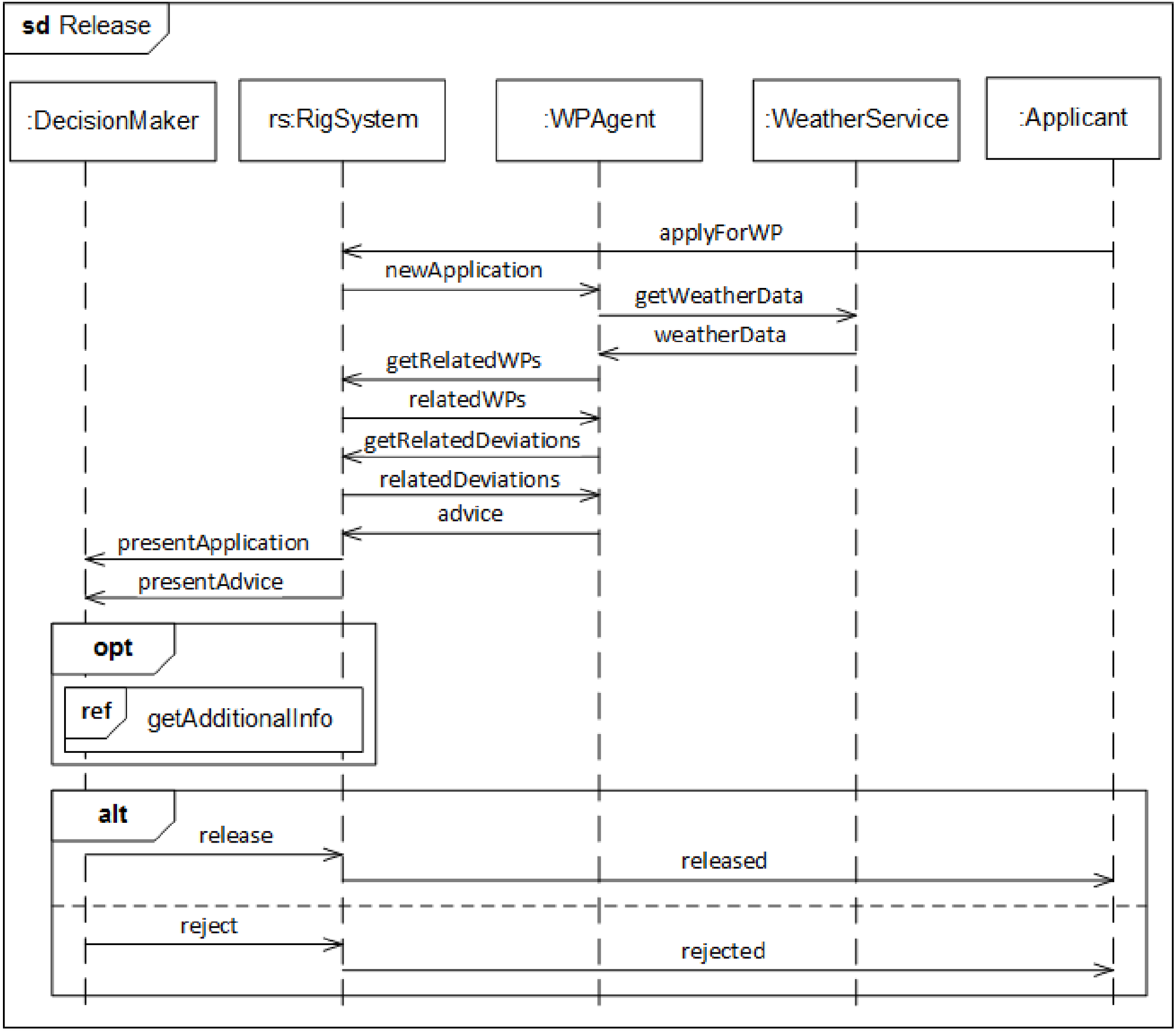
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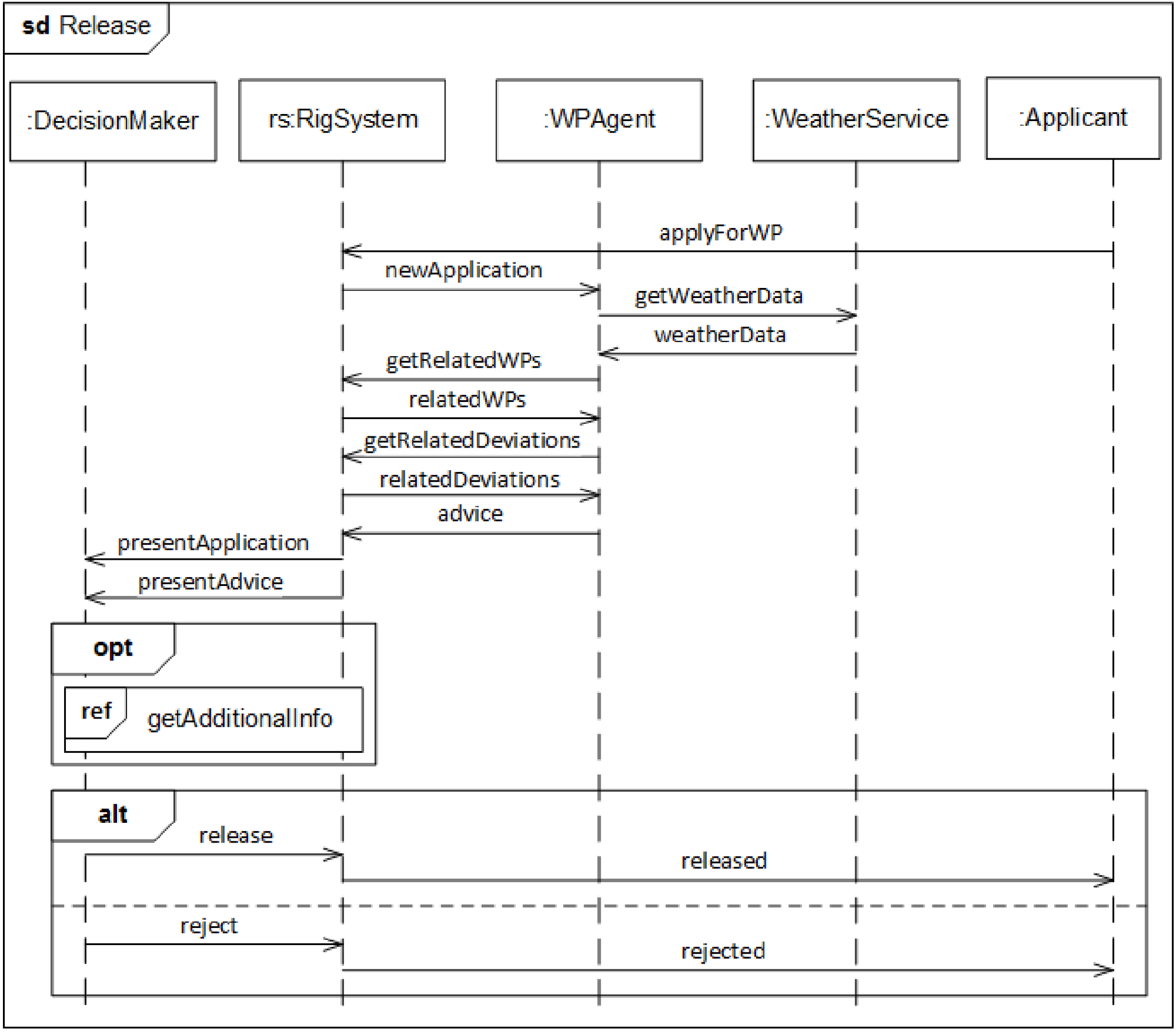
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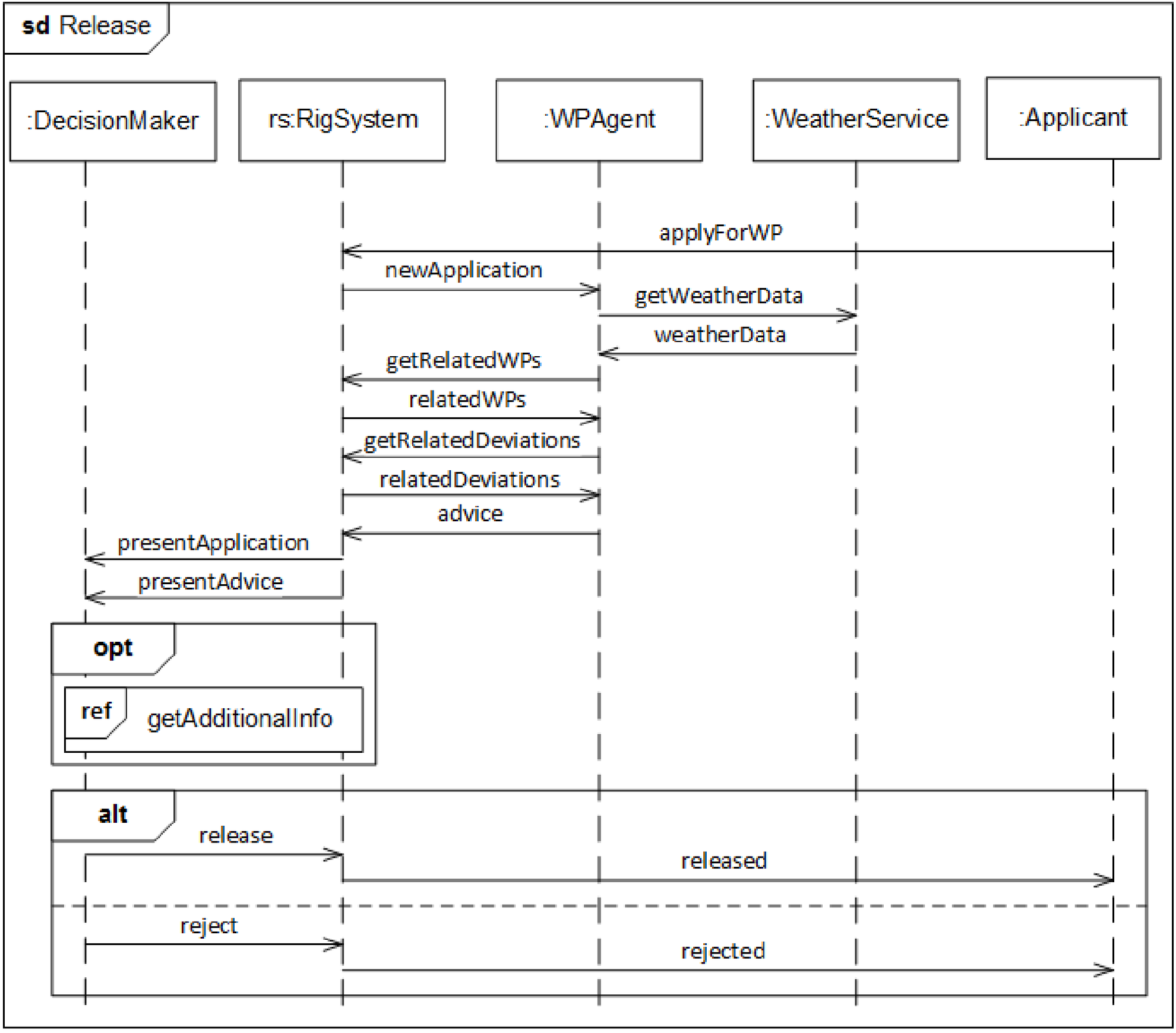
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Fig 1

Question 2.7
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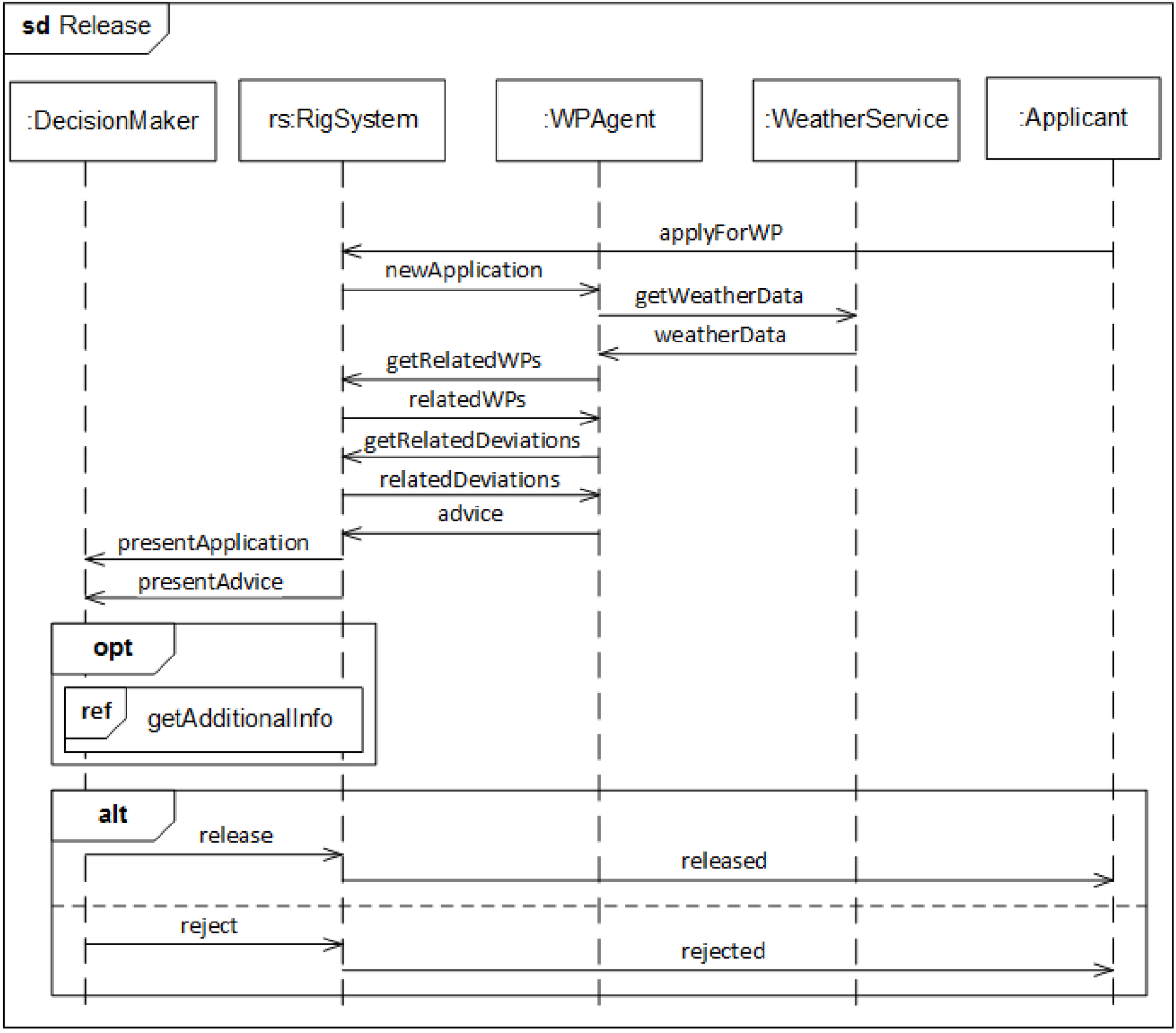
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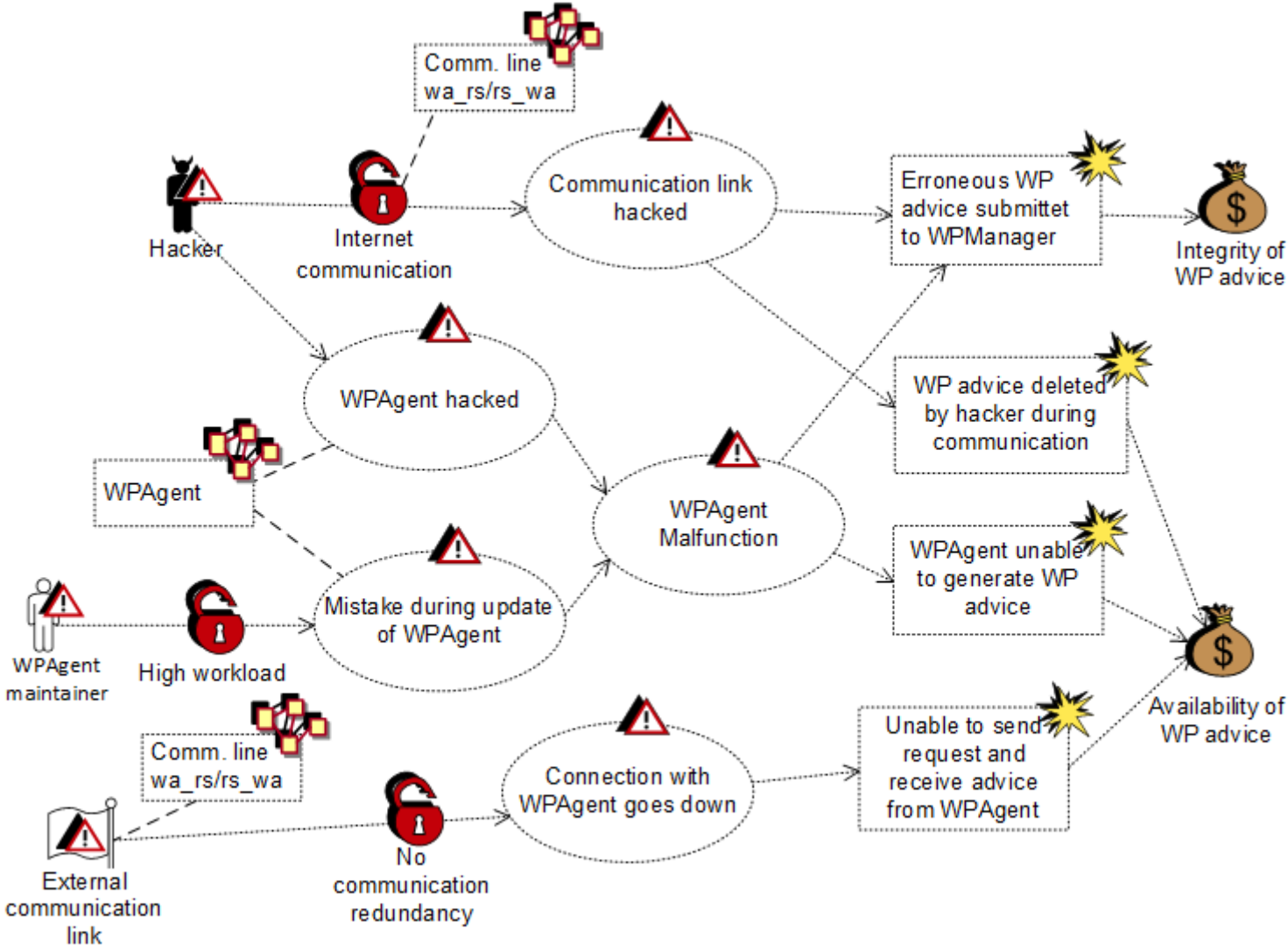
Fig 1

Question 3.1
Attached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WPAgent
maintainer
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Mistake during update
of WPAgent
Availability of
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request and
receive advice
from WPAgent
Connection with
WPAgent goes down
External
communication
link
No
communication
redundancy

Fig 3

Question 3.2
Attached

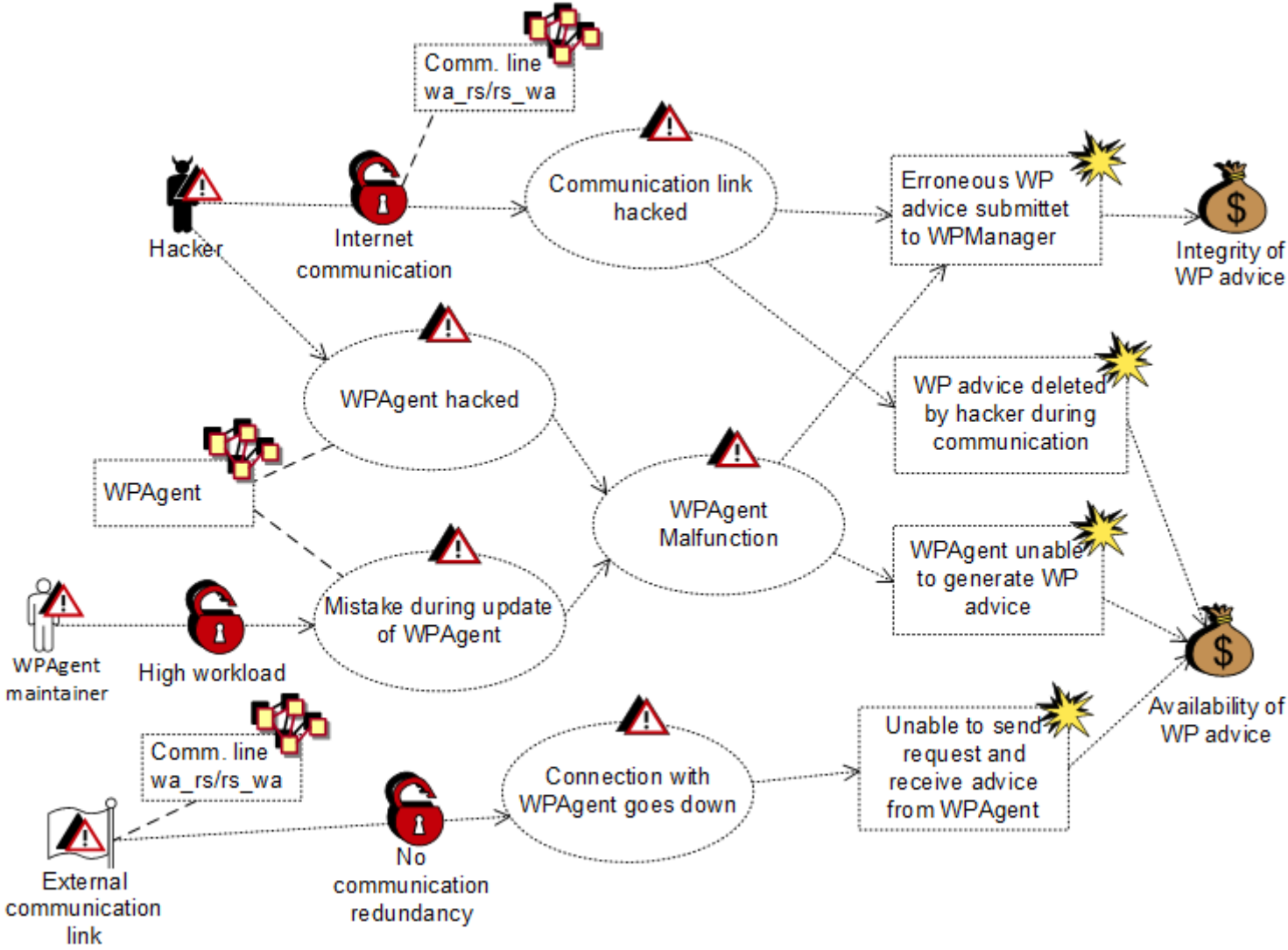
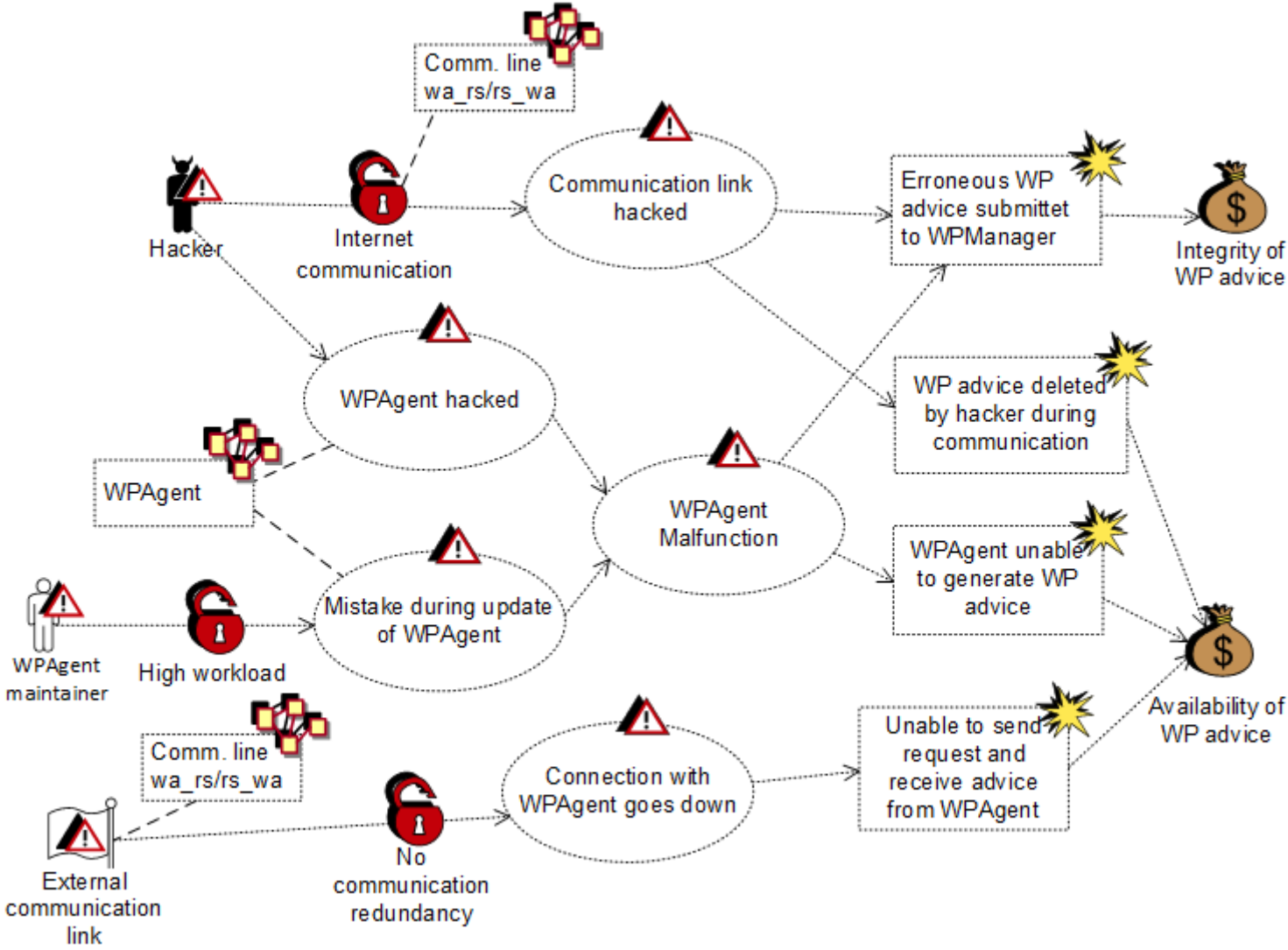

Comm. line
wa_rs/rs_wa
Hacker
Internet
communication
Communication link
hacked
Erroneous WP
advice submittet
to WPManager
Integrity of
WP advice
WPAgent hacked
WP advice deleted
by hacker during
communication
WPAgent
WPAgent
Malfunction
WPAgent unable
to generate WP
advice
WPAgent
maintainer
High workload
Mistake during update
of WPAgent
Availability of
WP advice
Comm. line
wa_rs/rs_wa
Unable to send
request and
receive advice
from WPAgent
Connection with
WPAgent goes down
External
communication
link
No
communication
redundancy

Fig 3

Question 3.3
Attached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No
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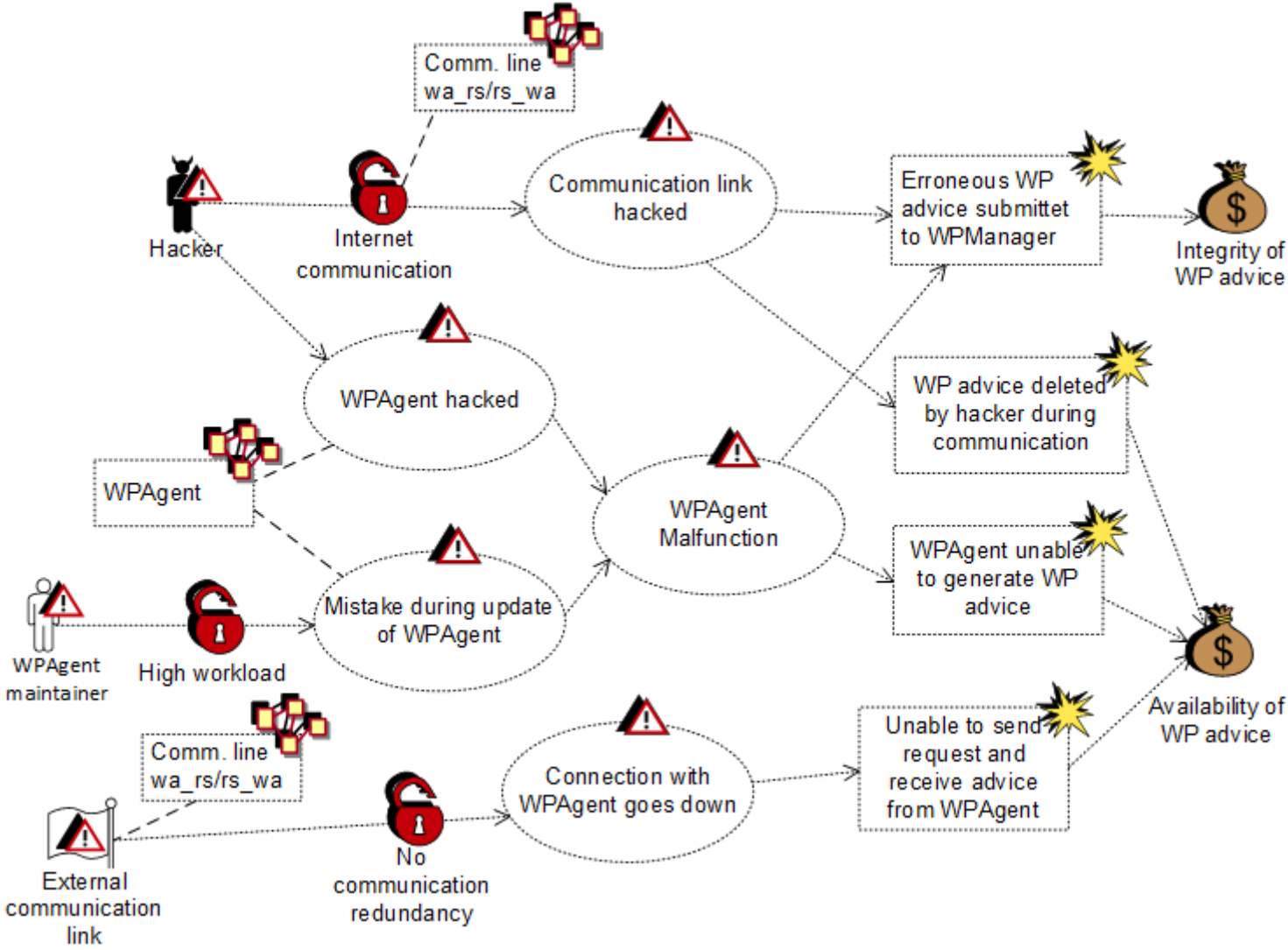
redundancy

Fig 3

Question 3.4
Attached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Connection with
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communication
link
No
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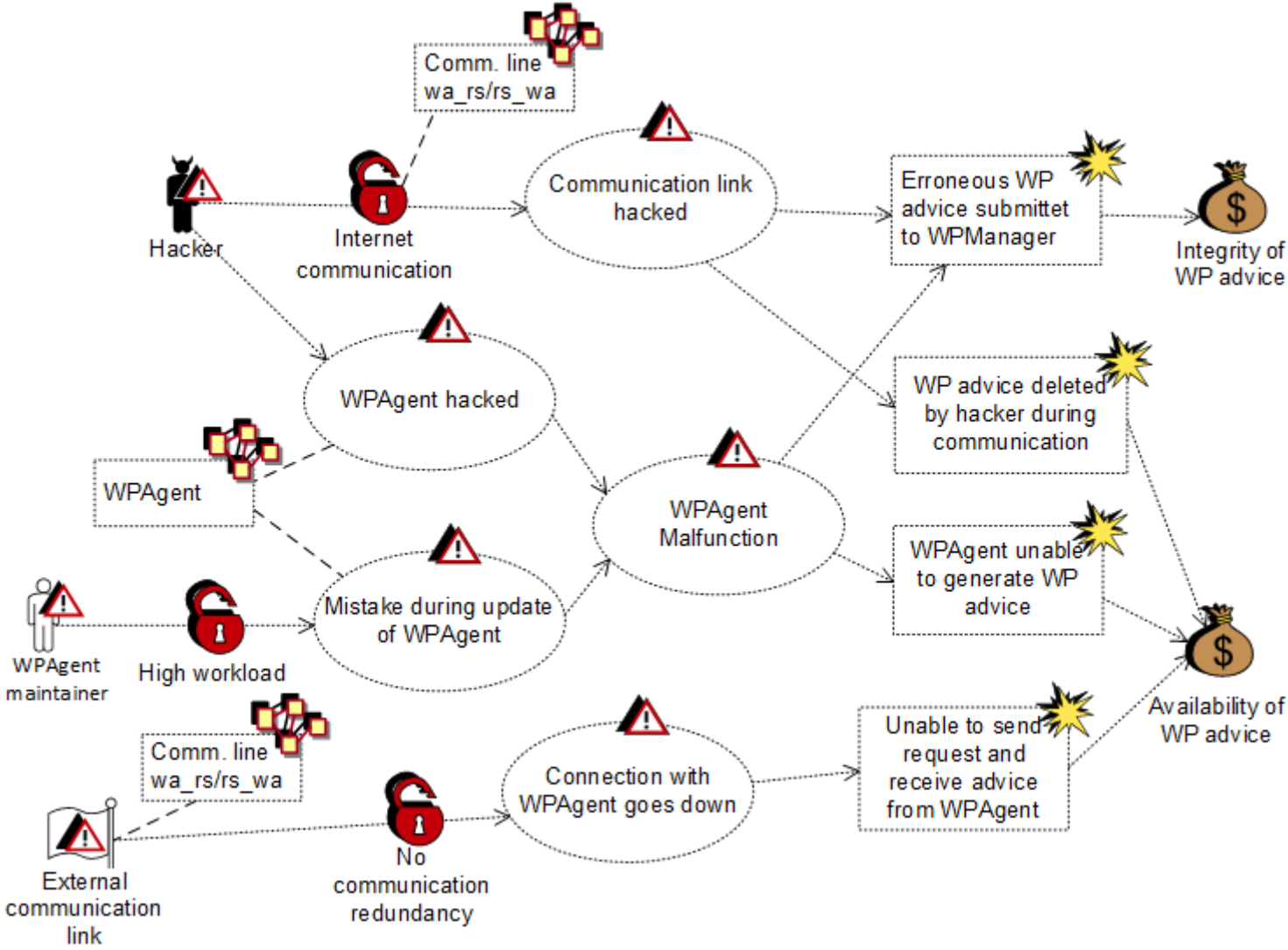
redundancy

Fig 3

Question 3.5
Attached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WPAgent goes down
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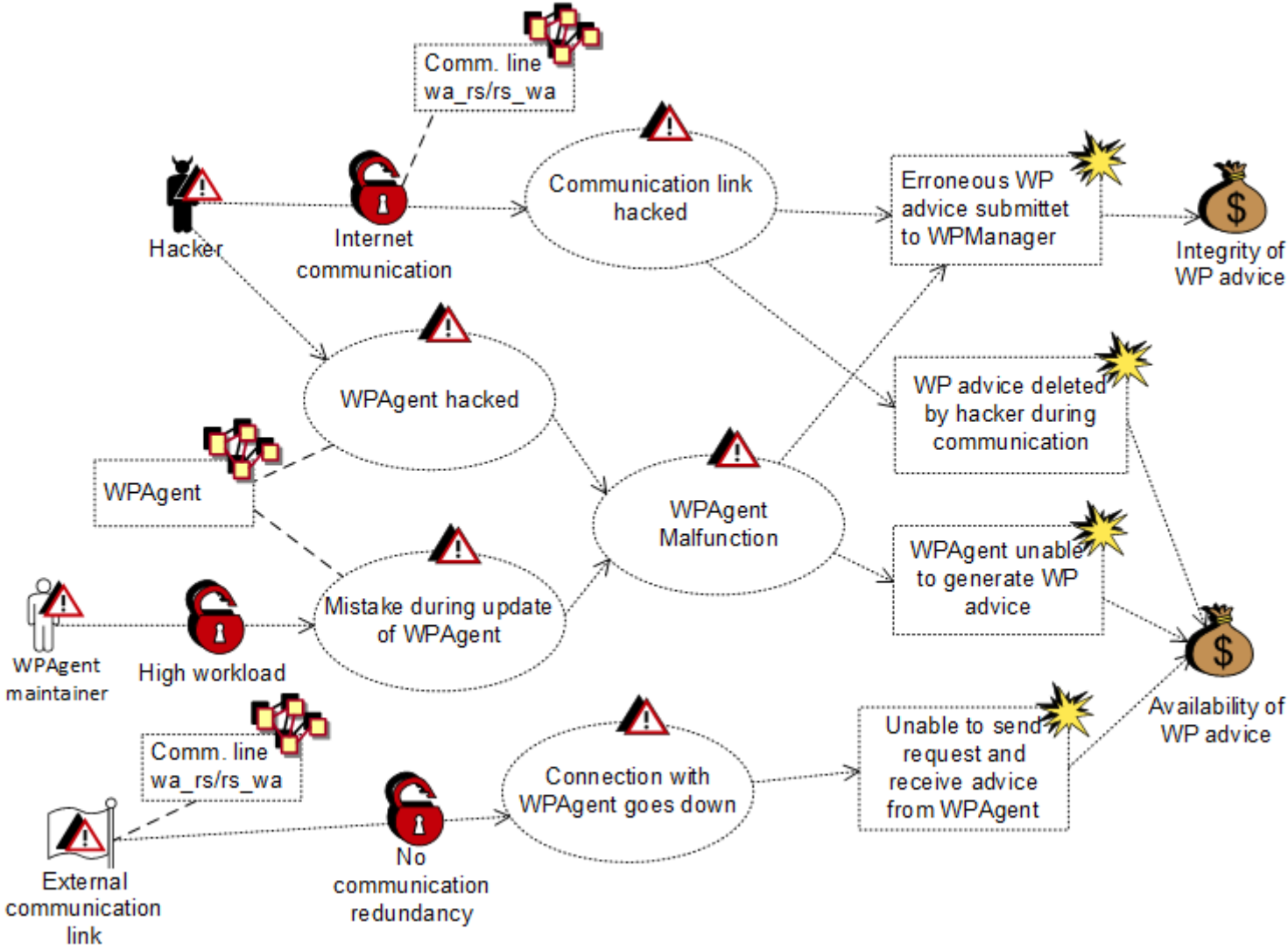
communication
link
No
communication
redundancy

Fig 3

Question 3.6
Attached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Hacker
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Communication link
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WPAgent
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communication
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Fig 3