

SOEN 342 - Sections H and II:
Software Requirements and Specifications
Project

Fadoua Doghmane (40198495)

Ihana Fahmy (40209686)

Tanya So Tin Yan (40208954)

November 19, 2023

1 Formal specification in Z

The formal specification of the system introduces the following three types:

$$SENSOR_TYPE, LOCATION_TYPE, TEMPERATURE_TYPE$$

The system's formal specification is given in the Z language and it consists of schemas and the definitions of operations that constitute the system's exposed interface.

1.1 Schemas

TempMonitor

$$\begin{array}{l} deployed : \mathbb{P} \, SENSOR_TYPE \\ map : SENSOR_TYPE \rightarrow LOCATION_TYPE \\ read : SENSOR_TYPE \rightarrow TEMPERATURE_TYPE \end{array}$$
$$\begin{array}{l} deployed = \text{dom } map \\ deployed = \text{dom } read \end{array}$$

DeploySensorOK

$$\begin{array}{l} \Delta TempMonitor \\ sensor? : SENSOR_TYPE \\ location? : LOCATION_TYPE \\ temperature? : TEMPERATURE_TYPE \end{array}$$
$$\begin{array}{l} sensor? \notin deployed \\ location? \notin \text{ran } map \\ deployed' = deployed \cup \{sensor?\} \\ map' = map \cup \{sensor? \mapsto location?\} \\ read' = read \cup \{sensor? \mapsto temperature?\} \end{array}$$

ReadTemperatureOK

$$\begin{array}{l} \exists TempMonitor \\ location? : LOCATION_TYPE \\ temperature! : TEMPERATURE_TYPE \end{array}$$
$$\begin{array}{l} location? \in \text{ran } map \\ temperature! = read(map^{-1}(location?)) \end{array}$$

<i>Success</i>
$\exists TempMonitor$ $response! : MESSAGE$
$response! = 'ok'$

<i>SensorAlreadyDeployed</i>
$\exists TempMonitor$ $sensor? : SENSOR_TYPE$ $response! : MESSAGE$
$sensor? \in deployed$ $response! = 'Sensor\ deployed'$

<i>LocationAlreadyCovered</i>
$\exists TempMonitor$ $location? : LOCATION_TYPE$ $response! : MESSAGE$
$location? \in \text{ran } map$ $response! = 'Location\ already\ covered'$

<i>LocationUnknown</i>
$\exists TempMonitor$ $location? : LOCATION_TYPE$ $response! : MESSAGE$
$location? \notin \text{ran } map$ $response! = 'Location\ not\ covered'$

ReplaceSensorOK $\Delta \text{TempMonitor}$ $\text{sensor?} : \text{SENSOR_TYPE}$ $\text{newSensor?} : \text{SENSOR_TYPE}$
$\text{sensor?} \in \text{deployed}$ $\text{newSensor?} \notin \text{deployed}$ $\text{deployed}' = (\text{deployed} \setminus \{\text{sensor?}\}) \cup \text{newSensor?}$ $\text{map}' = \text{map} \oplus \{\text{newSensor?} \mapsto \text{map}(\text{sensor?})\}$ $\text{read}' = \text{read} \oplus \{\text{newSensor?} \mapsto \text{read}(\text{sensor?})\}$

ReadCollectionOK $\Xi \text{TempMonitor}$ $\text{outputLocationsTemperatures!} : \mathbb{P}(\text{LOCATION_TYPE} \times \text{TEMPERATURE_TYPE})$
$\text{outputLocationsTemperatures!} = \{ l : \text{LOCATION_TYPE};$ $t : \text{TEMPERATURE_TYPE} \mid l \in \text{ran map} \wedge (t = \text{read}(l)) \}$

1.2 Operations

$$\begin{aligned} \text{DeploySensor} \hat{=} & \\ & (\text{DeploySensorOK} \wedge \text{Success}) \oplus \\ & (\text{SensorAlreadyDeployed} \vee \text{LocationAlreadyCovered}) \end{aligned}$$

$$\begin{aligned} \text{ReadTemperature} \hat{=} & \\ & (\text{ReadTemperatureOK} \wedge \text{Success}) \oplus \text{LocationUnknown} \end{aligned}$$

$$\begin{aligned} \text{ReplaceSensor} \hat{=} & \\ & (\text{ReplaceSensorOK} \wedge \text{Success}) \oplus \\ & (\text{OldSensorNotDeployed} \vee \text{NewSensorAlreadyDeployed}) \end{aligned}$$