



**SmartM2M;
Extension to SAREF;
Part 11: Lift Domain**

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ETSI
650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M).

The present document is part 11 of a multi-part deliverable covering the SmartM2M; Extension to SAREF, as identified below:

- Part 1: "Energy Domain";
- Part 2: "Environment Domain";
- Part 3: "Building Domain";
- Part 4: "Smart Cities Domain";
- Part 5: "Industry and Manufacturing Domains";
- Part 6: "Smart Agriculture and Food Chain Domain";
- Part 7: "Automotive Domain";
- Part 8: "eHealth/Ageing-well Domain";
- Part 9: "Wearables Domain";
- Part 10: "Water Domain";
- Part 11: "Lift Domain";**
- Part 12: "Smart Grid Domain";
- Part 13: "Maritime Domain".

Modal verbs terminology

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1 Scope

The present document presents SAREF4LIFT, an extension of SAREF for the Smart Lifts domain.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] [ETSI TS 103 264](#): "SmartM2M; Smart Applications; Reference Ontology and oneM2M Mapping".
- [2] [EN 81-31:2010](#): "Safety rules for the construction and installation of lifts - Lifts for the transport of goods only - Part 31: Accessible goods only lifts", (produced by CEN).
- [3] [EN 81-72:2020](#): "Safety rules for the construction and installation of lifts - Particular applications for passenger and goods passenger lifts - Part 72: Firefighters lifts", (produced by CEN).
- [4] [EN 81-20:2020](#): "Safety rules for the construction and installation of lifts - Lifts for the transport of persons and goods - Part 20: Passenger and goods passenger lifts", (produced by CEN).
- [5] [EN 81-41:2010](#): "Safety rules for the construction and installation of lifts - Special lifts for the transport of persons and goods - Part 41: Vertical lifting platforms intended for use by persons with impaired mobility", (produced by CEN).
- [6] [IETF RFC 3966](#): "The tel URI for Telephone Numbers".
- [7] [EN 81-28:2018+AC:2019](#): "Safety rules for the construction and installation of lifts - Lifts for the transport of persons and goods - Part 28: Remote alarm on passenger and goods passenger lifts", (produced by CEN).
- [8] [ETSI TS 145 008](#): "Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE Radio subsystem link control (3GPP TS 45.008)".
- [9] [ETSI TS 103 548](#): "SmartM2M; SAREF reference ontology patterns".
- [10] Void.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TR 103 546: "SmartM2M; Requirements & Feasibility study for Smart Lifts in IoT".
- [i.2] ETSI TS 103 735: "SmartM2M; Smart Lifts IoT System".
- [i.3] ISO 16484-5:2017: "Building automation and control systems (BACS) -- Part 5: Data communication protocol".
- [i.4] ETSI TR 103 510: "SmartM2M; SAREF extension investigation; Requirements for Wearables".
- [i.5] ETSI TR 103 781 (V1.1.1): "SmartM2M; Study for SAREF ontology patterns and usage guidelines".
- [i.6] [ETSI TS 103 673](#): "SmartM2M; SAREF Development Framework and Workflow, Streamlining the Development of SAREF and its Extensions".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

ontology: formal specification of a conceptualization, used to explicitly capture the semantics of a certain reality

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|------------|---|
| ASME | American Society of Mechanical Engineers |
| OWL | Ontology Web Language |
| OWL-DL | Ontology Web Language - Description Logics |
| RDF | Resource Description Framework |
| RDF-S | Resource Description Framework - Schema |
| SAREF | Smart Applications REference ontology |
| SAREF4LIFT | SAREF extension for the Smart LIFT's domain |
| SOS | Save Our Souls |

NOTE: SOS was chosen to signify a distress signal. In Morse code, SOS is signified by three dots, three dashes, three dots.

| | |
|-----|-----------------------------|
| STF | Specialist Task Force |
| UML | Unified Modelling Language |
| URI | Uniform Resource Identifier |

4 SAREF extension for the Smart Lifts domain

The present document is a technical specification of SAREF4LIFT, an extension of SAREF for the Smart Lifts domain. This SAREF extension is based on a limited set of use cases and existing data models identified within available initiatives that were detailed in previous documents ETSI TR 103 546 [i.1] and ETSI TS 103 735 [i.2]. The work was initially conducted (in 2021) in the context of the closed STF 602 (<https://portal.etsi.org/STF/STFs/STF-HomePages/STF602>), which was established with the goal of creating SAREF extension for the domain mentioned above, i.e. Smart Lifts. This work has been developed in close collaboration with the industrial world and alliances.

The related initiatives and use cases considered for the initial development (in 2021) of the SAREF4LIFT extension are the ones reported previously in ETSI TR 103 546 [i.1] and ETSI TS 103 735 [i.2]. Such related initiatives and use cases are not repeated in the present document. Hence, the reader can rely on those references for further details.

The present document is a major 2024 revision of SAREF4LIFT ontology extension, developed in the context of the STF 641 (<https://portal.etsi.org/xts/#/xTF/641>), using updated reference ontology patterns specified in ETSI TS 103 548 [9] to solve the harmonization needs identified in ETSI TR 103 781 [i.5], with updated development framework and tools defined in ETSI TS 103 673 [i.6].

5 Requirements

The requirements presented in this clause 5 have been derived from the previously presented use cases. Even if not every requirement is useful for every use case, the different categories of requirements taken into account are expected to support at least the use cases described in ETSI TS 103 735 [i.2].

The associated requirements have been grouped in different categories and are presented from Table 5-1 to Table 5-11.

Table 5-1: Requirements for the "Car Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|---|--|
| LIFT-1 | Which is the car position? | (Floor Number i.e. -2, -1, 0, 1, etc.) |
| LIFT-2 | What is the lift direction? | Upwards, Downwards, Standstill |
| LIFT-3 | Is the car in an unlocking zone? | Yes/No |
| LIFT-4 | Is there a test ride in execution? | Yes/No |
| LIFT-5 | Is there any fault? | Yes/No |
| LIFT-6 | Is the lift overloaded? | Yes/No |
| LIFT-7 | Are there ongoing inspection operations? | Yes/No |
| LIFT-8 | Are there fire operations? | Yes/No |
| LIFT-9 | Is the alarm in the car activated? | Yes/No |
| LIFT-10 | Is the car empty? | Yes/No |
| LIFT-11 | What is the limit load of the lift? | 90 kg |
| LIFT-12 | What is the power supply voltage of the lift? | 380 V |
| LIFT-13 | What is the value of the standard power supply of the lift? | 12 V |
| LIFT-14 | How many car stops has the lift? | 8 |
| LIFT-15 | How many doors are installed in the lift? | 2 |
| LIFT-16 | How many car services are available in the lift? | 8 |

Table 5-2: Requirements for the "Bidirectional Communication System Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|--|-----------------------------------|
| LIFT-17 | Signal related to the periodic test run every 24h has been received. | |
| LIFT-18 | The bidirectional communication system signal has been received. | |
| LIFT-19 | Which is the received signal strength/quality? | % of coverage, i.e. 87 |
| LIFT-20 | Which is the home network operator of the lift? | 289-88 |
| LIFT-21 | The types of signals that can be sent by the Bidirectional Communication System are: • timeOfLastPeriodicTest72hAttempt; • timeOfConfirmationOfLastPeriodicTest72hAttempt; • registeredNetworkOperator, networkQualityRSSI; and • networkQualityBER. | |
| LIFT-22 | Examples of network technologies supported by the Bidirectional Communication System of the lift are: Fixed_line, 2G, 3G, 4G or 5G. | |
| LIFT-23 | Which is the telephone number of the lift? | +3975528568888 |
| LIFT-24 | Which are the primary emergency numbers of the lift? | +3975528568889 |
| LIFT-25 | Which are the secondary emergency numbers of the lift? | +3975528568890, +3975528568891 |

Table 5-3: Requirements for the "Power Supply Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|--|---------------------------|
| LIFT-26 | Is the emergency power supply signal active? | Yes/No |
| LIFT-27 | Is the standard power supply signal active? | Yes/No |
| LIFT-28 | Which is the voltage of emergency power? | Voltage value, i.e. 330 V |

Table 5-4: Requirements for the "System Status Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|--|---------------|
| LIFT-29 | Is the lift out of service? | Yes/No |
| LIFT-30 | Is the lift overloaded? | Yes/No |
| LIFT-31 | Are there ongoing inspection operations? | Yes/No |
| LIFT-32 | Are there fire operations? | Yes/No |

Table 5-5: Requirements for the "Fault Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|--------------------------------------|---------------|
| LIFT-33 | The lift has a major fault. | |
| LIFT-34 | The lift has a minor fault. | |
| LIFT-35 | The lift has an audio fault. | |

Table 5-6: Requirements for the "Statistic Signal" category

| Id | Competency Question/Statement | Answer |
|-----------|---|---------------|
| LIFT-36 | How many times the lift has been called during its lifetime? | 245 |
| LIFT-37 | How many upward travels the lift did during its lifetime? | 167 |
| LIFT-38 | How many downward travels the lift did during its lifetime? | 153 |
| LIFT-39 | Which is the total number of floors covered during its lifetime? | 94 |
| LIFT-40 | How many times have been executed the reset sequence during its lifetime? | 26 |
| LIFT-41 | How many times the lift adopted the reversal direction during its lifetime? | 4 |
| LIFT-42 | How many times the door has been opened during its lifetime? | 362 |
| LIFT-43 | How many times the lift has been called from the floor X during its lifetime? | 46 |
| LIFT-44 | How many times the fault event X occurred during its lifetime? | 12 |

Table 5-7: Requirements for the "Alarms" category

| Id | Competency Question/Statement | Answer |
|-----------|---|---------------|
| LIFT-45 | Alarm button has been pressed for X seconds. | |
| LIFT-46 | Alarm call has been initiated. | |
| LIFT-47 | Alarm voice communication has been activated. | |
| LIFT-48 | Alarm in the well is active. | |
| LIFT-49 | Alarm in the car is active. | |
| LIFT-50 | Flood alarm is active. | |
| LIFT-51 | Emergency power alarm is active. | |

Table 5-8: Requirements for the "Commands" category

| Id | Competency Question/Statement | Answer |
|-----------|--|---------------|
| LIFT-52 | A command can call the car to a specific floor. | |
| LIFT-53 | A command can set the lift to out of service. | |
| LIFT-54 | The lift is subject to inspection operation. | |
| LIFT-55 | Which is the opening door time? | 4 seconds |
| LIFT-56 | Which is the closing door time? | 3 seconds |
| LIFT-57 | A command can test the emergency number. | |
| LIFT-58 | A command can test the proper functioning of the lift. | |
| LIFT-59 | A command can start the real time mode. | |
| LIFT-60 | What is the emergency number? | +1-555-1589 |
| LIFT-61 | Which is the current absolute counter of operating hours? | 1 634 hours |
| LIFT-62 | A command can initiate the board reset. | Yes/No |
| LIFT-63 | There are four emergency battery power status: • good; • warn; • critical; and • insufficient. | |

Table 5-9: Requirements for the "Smart Lift System" category

| Id | Competency Question/Statement | Answer |
|-----------|--|---------------|
| LIFT-64 | A Smart Lift Installation is contained into a Smart Lift System. | |
| LIFT-65 | A Smart Lift Edge Control Unit hosts the different Smart Lift modules. | |
| LIFT-66 | Examples of Smart Lift modules are signals or bidirectional communication systems. | |

Table 5-10: Requirements for the "Smart Lift identification" category

| Id | Competency Question/Statement | Answer |
|-----------|--|---------------|
| LIFT-67 | Each Smart Lift Installation should be globally and uniquely identified. | |
| LIFT-68 | Each Smart Lifts Group should be globally and uniquely identified. | |
| LIFT-69 | Which is the manufacturing lift company? | Company1 |
| LIFT-70 | Which is the installer lift company? | Company2 |

Table 5-11: Requirements for the "Smart Lift administrative information" category

| Id | Competency Question/Statement | Answer |
|-----------|---|---------------|
| LIFT-71 | Which is the maintenance lift company? | Company1 |
| LIFT-72 | Who is the building manager of the lift? | Company2 |
| LIFT-73 | Who is the legal owner of the lift? | Company3 |
| LIFT-74 | A lift is installed in a geographic location. | |
| LIFT-75 | The lift geographic location is provided by the geographic location validator. | |
| LIFT-76 | Examples of types of use of a lift are: Lift, Goods lift, Goods only lift, or Fireman lift. | |

6 SAREF4LIFT ontology and semantics

6.1 Introduction and overview

The present document is a technical specification of SAREF4LIFT, an extension of SAREF (ETSI TS 103 264 [1]) for the Smart Lifts domain. Clause 6.1 of the present document shortly introduces a high level view of the envisioned SAREF4LIFT semantic model and modular ontology, with the retained concepts (i.e. classes) and their relations.

SAREF4LIFT has been specified and formalized by investigating related resources in the Smart Lifts domain, as reported in ETSI TR 103 546 [i.1] and ETSI TS 103 735 [i.2]. Therefore, SAREF4LIFT shall both:

- allow the implementation of a limited set of related use cases already identified in ETSI TR 103 546 [i.1]; and
- fulfil the requirements provided in clause 5, mainly the ontological ones that were mostly taken as input for the ontology specification.

SAREF4LIFT is an OWL-DL ontology. For embedded semantic analytics purposes, SAREF4LIFT shall be designed using the modularity principle and can thus be mainly described by a set of knowledge modules. All these SAREF4LIFT modules are fully detailed in clause 6.2 of the present document.

The prefixes and namespaces used in SAREF4LIFT and in the present document are listed in Table 6.1-1.

Table 6.1-1: Prefixes and namespaces used within the SAREF4LIFT ontology

| Prefix | Namespace |
|------------|---|
| s4lift | https://saref.etsi.org/saref4lift/ |
| s4city | https://saref.etsi.org/saref4city/ |
| s4syst | https://saref.etsi.org/saref4syst/ |
| saref | https://saref.etsi.org/core/ |
| dcterms | http://purl.org/dc/terms/ |
| geo | http://www.opengis.net/ont/geosparql# |
| rdf | http://www.w3.org/1999/02/22-rdf-syntax-ns# |
| rdfs | http://www.w3.org/2000/01/rdf-schema# |
| owl | http://www.w3.org/2002/07/owl# |
| ssn-system | http://www.w3.org/ns/ssn/systems/ |
| vann | http://purl.org/vocab/vann/ |
| voaf | http://purl.org/voc-commons/voaf# |
| xsd | http://www.w3.org/2001/XMLSchema# |

6.2 SAREF4LIFT

6.2.1 General Overview

Figure 6.2.1-1 presents the high level view of the envisioned model of SAREF4LIFT ontology. In Figure 6.2.1-1, classes directly imported from SAREF ontology are in light orange, classes directly imported from other SAREF extension ontologies are in green. While, classes developed for SAREF4LIFT are in blue and, finally, individuals are illustrated in white blocks.

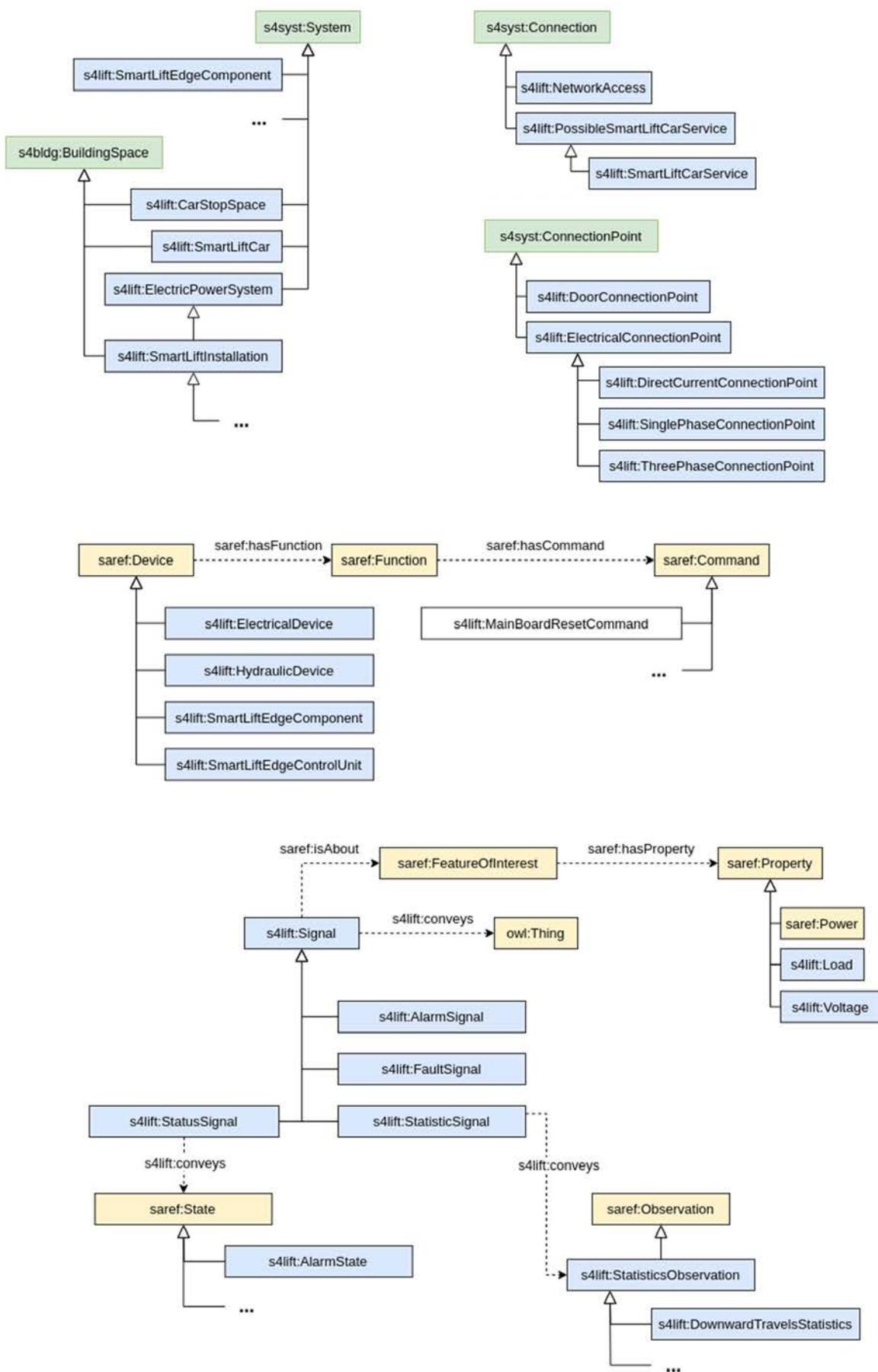


Figure 6.2.1-1: SAREF4LIFT overview

Within Figure 6.2.1-1, as well as within all the figures that are depicted in clause 8 of the present document, the following conventions are used:

- Arrows are used to represent properties between classes and to represent some RDF, RDF-S and OWL constructs, more precisely:
 - Plain arrows with white triangles represent the `rdfs:subClassOf` relation between two classes. The origin of the arrow is the class to be declared as subclass of the class at the destination of the arrow.
 - Dashed arrows between two classes indicate a local restriction in the origin class, i.e. that the object property can be instantiated between the classes in the origin and the destination of the arrow. The identifier of the object property is indicated within the arrow.
- Datatype properties are denoted by rectangles attached to the classes, in an UML-oriented way. Dashed boxes represent local restrictions in the class, i.e. datatype properties that can be applied to the class they are attached to.
- Individuals are denoted by rectangles in which the identifier is underlined.

As already introduced in clause 6.1 of the present document SAREF4LIFT is an OWL-DL ontology and shall be designed using the modularity principle (see ETSI TR 103 510 [i.4]) and can thus be mainly described by the following self-contained knowledge modules:

- **Systems and connections.** This module defines the different systems modelled within a smart lift environment. A system is described as a component virtually isolated from the environment, whose behaviour and interactions with the environment are specifically defined. Systems can be connected to other systems. Connected systems interact in some ways. Systems can also have subsystems. Properties of subsystems somehow contribute to the properties of the supersystem.
- **Devices and commands.** This module defines the devices included within a smart lift. A device is defined as a tangible object designed to accomplish a particular task. In order to accomplish this task, the device performs one or more functions. The root of this branch (`saref:Device`) is inherited directly from the SAREF Core ontology. Also, this module defines commands supported by the defined smart lift. A command is defined as a directive that a device should support to perform a certain function. A command may act upon a state, but does not necessarily act upon a state. For example, the ON command acts upon the ON/OFF state, but the GET command does not act upon any state, it simply gives a directive to retrieve a certain value. The root of this branch (`saref:Command`) is inherited directly from the SAREF Core ontology.
- **States and observations.** This module defines states that features of interest in a smart lift installation can be found in, and observations that can be made about features of interest in a smart lift.
- **Signals.** This module describes the types of signals supported by a smart lift. Four types of signals have been identified: car signal (`s4lift:AlarmSignal`), fault signal (`s4lift:FaultSignal`), status signal (`s4lift:StatusSignal`), and statistic signal (`s4lift:StatisticSignal`). Clause 6.2.5 provides a complete taxonomy of supported signals with respect to the ones reported in Figure 6.2.1-1.

Besides the four modules described above, the SAREF4LIFT extension defines also two new property types (`s4lift:Load` and `s4lift:Voltage`) defining the load in the smart lift car and the electric voltage of some electric power system.

6.2.2 Systems and connections

This module specializes the SAREF4SYST ontology pattern for the Smart Lift domain.

A Smart Lift system can be defined as a `s4syst:system` made by different components. This module defines the subcomponents that are part of Smart Lift. In particular, two subcomponents are denoted: the `s4lift:SmartLiftEdgeComponent` and the `s4lift:SmartLiftEdgeControlUnit`.

The former is dedicated to the hosting of smart lift additional modules in the case that they are not hosted directly in the `s4lift:SmartLiftEdgeControlUnit`. An example could be the case of an additional earthquake sensor added after the lift deployment and not controlled by the `s4lift:SmartLiftEdgeControlUnit`.

The latter is the main element of a Smart Lift installation and it is typically associated with the lift control cabinet.

A **s4lift:SmartLiftInstallation** corresponds to a single lift, with all its elements. Such a concept is equipped with the list of properties shown in Figure 6.2.2-1. Seven types of installations are considered relevant for this extension: namely **s4lift:AccessibleGoodsOnlySmartLift** as per EN 81-31 [2], **s4lift:FirefightersSmartLift** as per EN 81-72 [3], **s4lift:GoodsSmartLift**, and **s4lift:MachineRoomLessSmartLift**, **s4lift:PassengerAndGoodsPassengerSmartLift** as per EN 81-20 [4], **s4lift:SmartLiftWithoutEmergencyCallSupport**, **s4lift:VerticalSmartLiftingPlatform** as per EN 81-41 [5]. All these concepts represent a type of smart lift that can be instantiated by the ontology.

A **s4lift:SmartLiftGroup** represents the correlation of multiple Smart Lifts Installation and it is supported by the introduction of a Smart Lift Group identifier common each Smart Lifts Installation belonging to the same Smart Lift Group. Such kind of installations usually presents control units connected one each other to coordinate the movement and position of the different lifts, where the common commands (e.g. the call buttons) are given to one of these control units that acts as a principal master and coordinates the other installations or is composed by peer installations that coordinates one each other.

A **s4lift:SmartLiftCar** represents the car of a Smart Lift. A **s4lift:SmartLiftInstallation** usually contains different **s4lift:CarStopSpaces** serving different spaces of different floors at **s4lift:SmartLiftCarService**. A **s4lift:SmartLiftCar** can connect to some **s4bldg:BuildingSpace** through some **s4lift:SmartLiftCarService** at some **s4lift:DoorConnectionPoint**.

A **s4lift:Network** is the class of communication networks. Systems can connect to other networks through a potential **s4lift:NetworkAccess** connection.

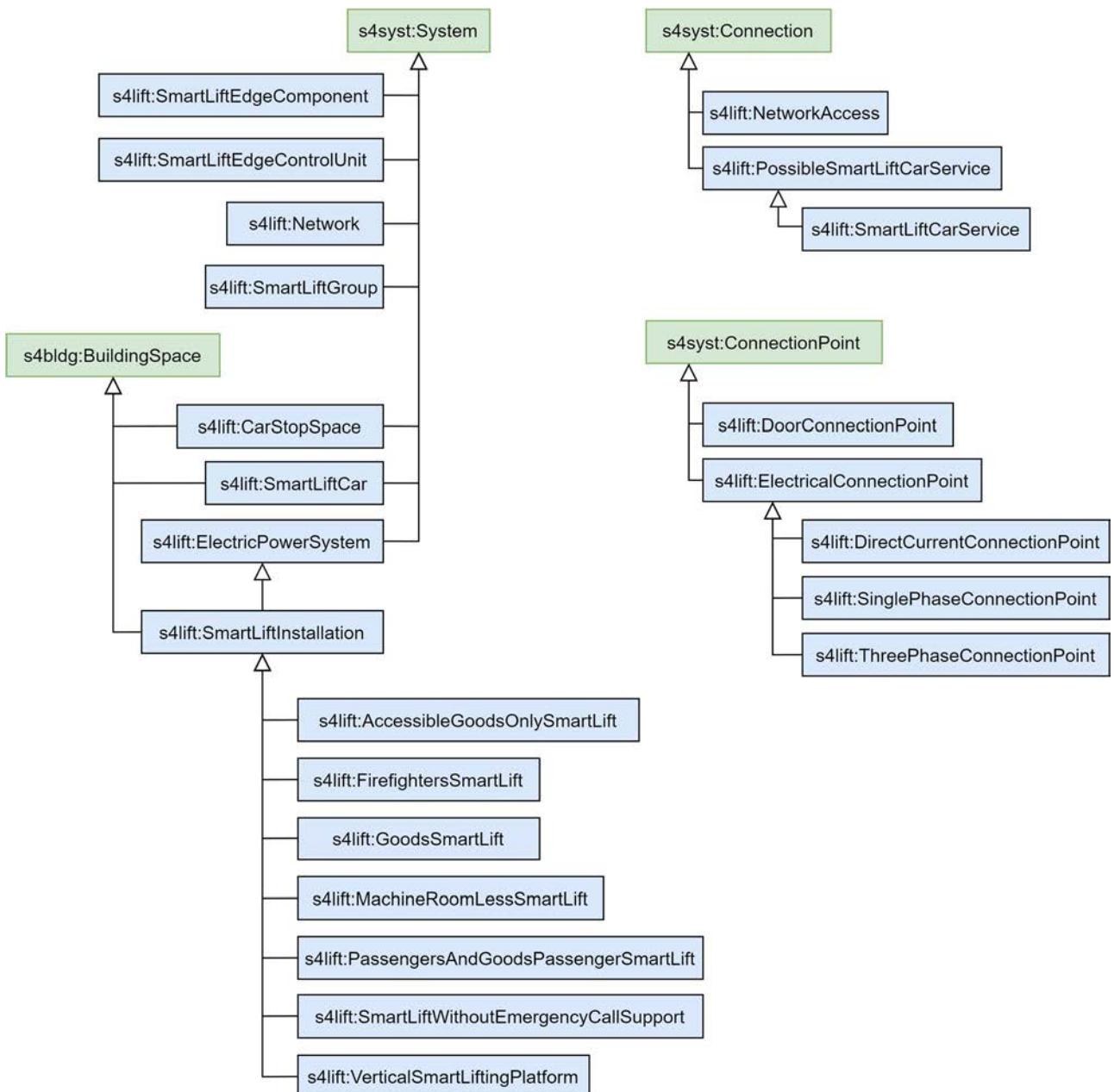


Figure 6.2.2-1: Systems and connections model

6.2.3 Devices and commands

This model specifies the list of commands that is considered relevant for the smart lift domain. Six new commands are defined as instances of the **saref:Command** concept that can be triggered, in turn, by a **saref:Function** as presented in Figure 6.2.3-1:

- **s4lift:MainBoardResetCommand** defines the command for resetting the main board of a smart lift;
- **s4lift:SendCarToSpecificServiceCommand** defines the internal command for sending the car to a specific service;
- **s4lift:SetOutOfServiceCommand** defines the command for putting the smart lift in out of service mode;
- **s4lift:SetRealTimeModeCommand** defines the command for putting the smart lift in out of service mode;
- **s4lift:TestEmergencyNumberCommand** defines the command for testing if the emergency number is working;

- **s4lift:TestRideCommand** defines the command for performing a test ride of a smart lift.

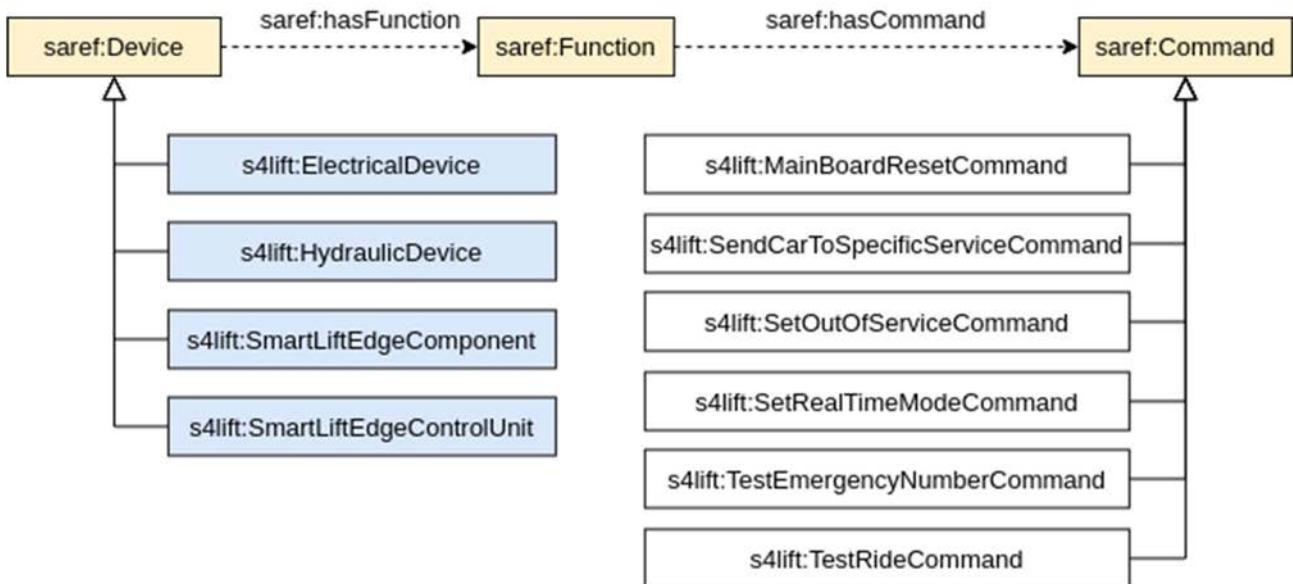


Figure 6.2.3-1: Command model

6.2.4 States and observations

This module defines states that features of interest in a smart lift installation can be found in, and observations that can be made about features of interest in a smart lift.

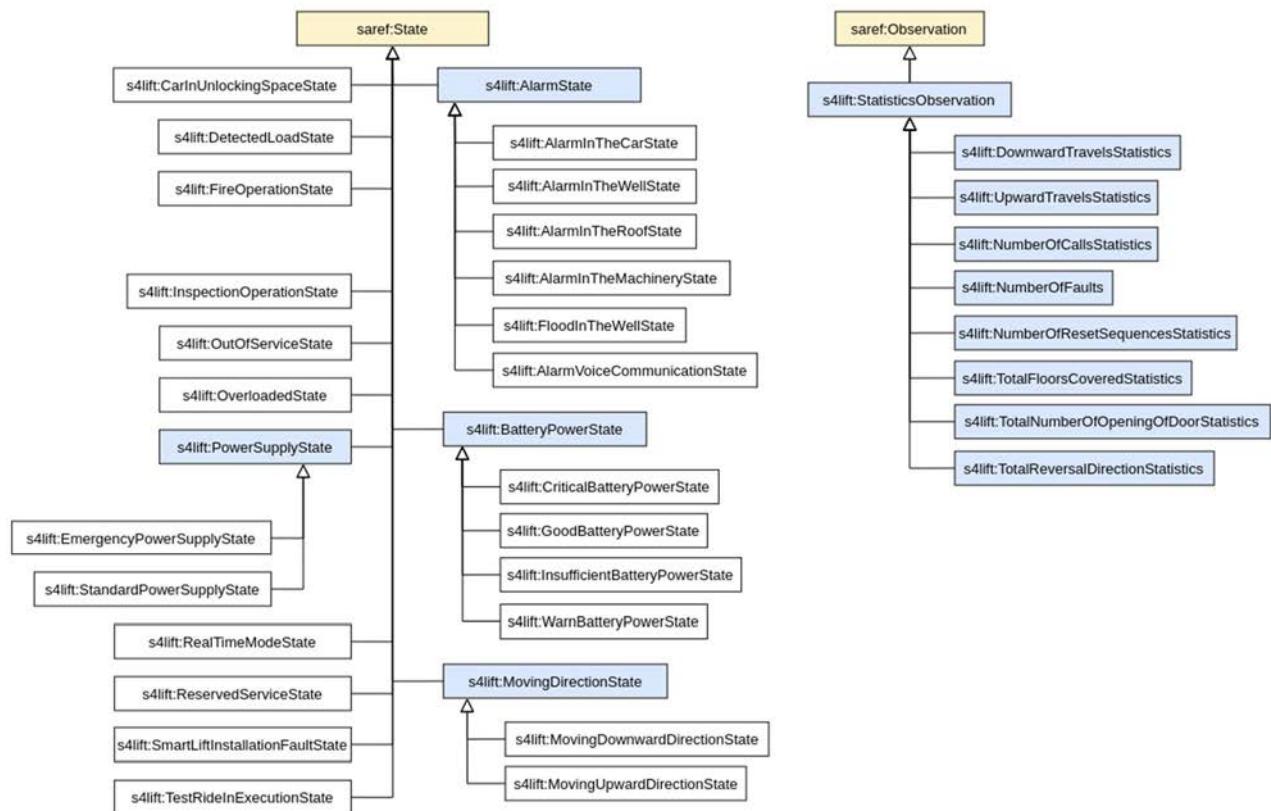


Figure 6.2.4-1: States and observations model

6.2.5 Signals

This module describes the types of signals that can be read from a smart lift console. Figure 6.2.5-1 shows the taxonomy of the relevant types of signals foreseen within this extension.

It is possible to observe a set of four main types of signals:

- **s4lift:AlarmSignal**: this defines high priority signals used to attract the operator's attention to important deviations or abnormal events in system operation.
- **s4lift:StatisticSignal**: such signals convey (**s4lift:conveys**) a **s4lift:StatisticsObservation** about the smart lift usage.
- **s4lift:FaultSignal**: these are the signals sent by the smart lift car about its overall status. This concept subsumes three further concepts grouping likewise car signal types.
- **s4lift:StatusSignal**: these are signals that convey (**s4lift:conveys**) a **saref:State** of a feature of interest.

Descendants of the **s4lift:Signal** inherit the **saref:hasTimestamp**, **saref:isAbout**, and **s4lift:conveys** properties defining the timestamp when the signal has been generated and its value, respectively.

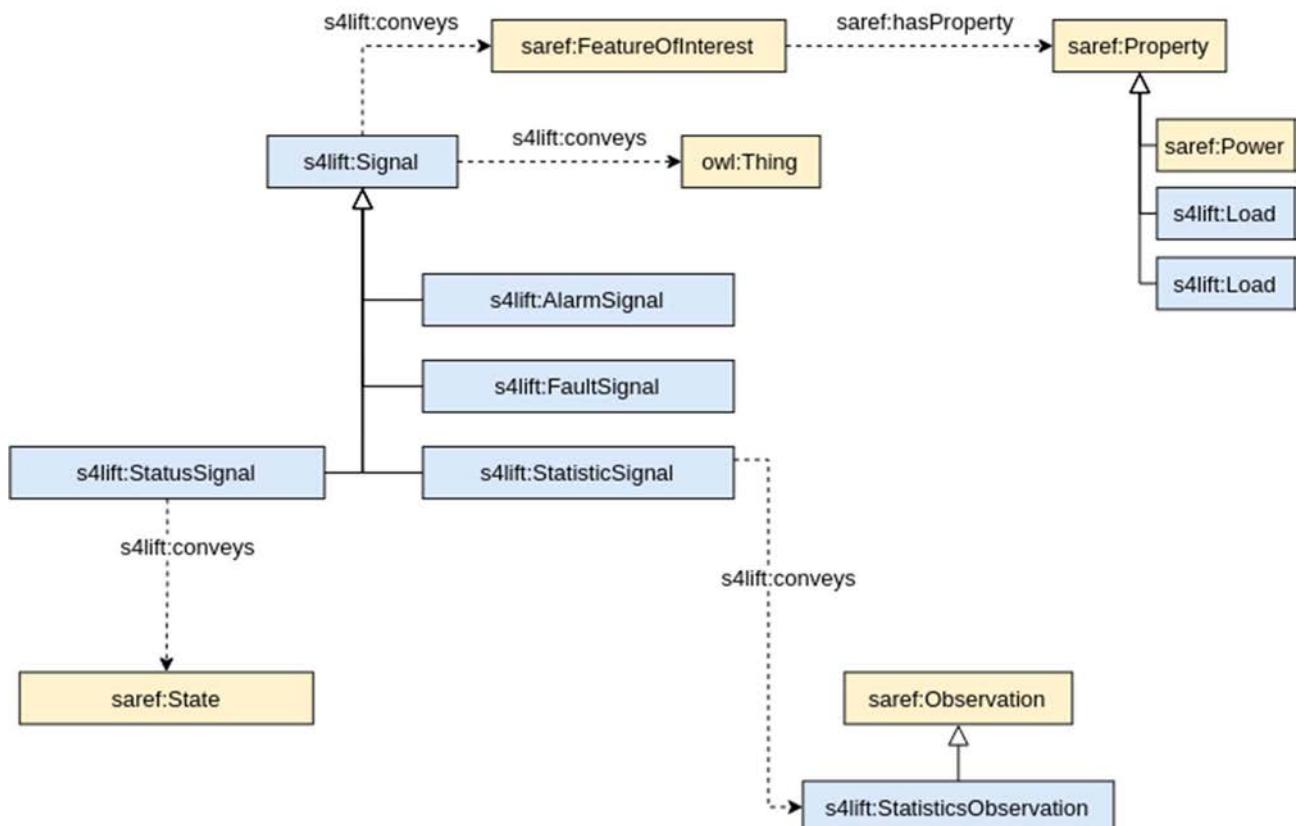


Figure 6.2.5-1: Signal model

6.2.6 Object properties

A list of the object properties defined into the SAREF4LIFT extension is reported in Table 6.2.6-1. For each object property, the name, the domain, the range, and its definition are reported.

Table 6.2.6-1: List of the object properties defined within the SAREF4LIFT extension

| Object property | Domain | Range | Definition |
|---|------------------------------|-----------------------|---|
| s4lift:isGroupedIn | s4lift:SmartLiftInstallation | s4lift:SmartLiftGroup | A relationship specifying the smart lift installations grouped into smart lift groups. |
| s4lift:isMasterInGroup (sub property of s4syst:containsCar) | s4lift:SmartLiftInstallation | s4lift:SmartLiftGroup | The smart lift installation acts as master for the common capabilities in the smart lift group. |
| s4lift:isPeerInGroup (sub property of s4syst:containsCar) | s4lift:SmartLiftInstallation | s4lift:SmartLiftGroup | The smart lift installation is part of a smart lift group and composed by peers of smart lift installation respect to the common capabilities. |
| S4lift:isSecondaryInGroup (sub property of s4syst:containsCar) | s4lift:SmartLiftInstallation | s4lift:SmartLiftGroup | The smart lift installation acts as depends on the master smart lift installation in the smart lift group for the common capabilities. |
| s4lift:hasAlarmSOSSystem (sub property of s4syst:hasSubSystem) | s4syst:System | s4syst:System | A relationship defining the alarm SOS subsystem of a system. |
| s4lift:hasCarTemperature (sub property of saref:hasProperty) | s4lift:SmartLiftInstallation | saref:Temperature | A relationship between a smart lift installation and the temperature of the smart lift car. |
| s4lift:hasChannelBitErrorRate (sub property of saref:hasProperty) | s4lift:NetworkAccess | saref:Property | Channel Bit Error Rate (via AT commands from the module); 0..7 as for RXQUAL defined by ETSI TS 145 008 [8]. |
| s4lift:hasCoverage (sub property of saref:hasProperty) | s4lift:NetworkAccess | saref:Property | Coverage of the network. |
| s4lift:hasElectricPowerConsumption (sub property of saref:hasProperty) | saref:FeatureOfInterest | saref:Energy | A relationship between a feature of interest and its power consumption. If a property of a s4syst:System, or the property of a s4syst:ConnectionPoint thereof, by convention the power consumption is positive if the electric energy enters the system. |
| s4lift:hasEngineRoomTemperature (sub property of saref:hasProperty) | s4lift:SmartLiftInstallation | saref:Temperature | A relationship between a smart lift installation and the temperature of the engine room. |
| s4lift:hasReceivedSignalStrengthIndicator (sub property of saref:hasProperty) | s4lift:NetworkAccess | saref:Property | Received Signal Strength Indicator of the network access. (via AT commands from the transmission module): <ul style="list-style-type: none"> • 0: -113 dBm or lower quality; • 1: -111 dBm; • 2 .. 30: -109 dBm .. -53 dBm; • 31: -51 dBm or greater; • 99: Not Known or non-detectable. |
| s4lift:hasShaftTemperature (sub property of saref:hasProperty) | s4lift:SmartLiftInstallation | saref:Temperature | A relationship between a smart lift installation and the temperature of the shaft. |

| Object property | Domain | Range | Definition |
|--|------------------------------|------------------------------------|---|
| s4lift:hasTimeOfConfirmationOfLastPeriodicTest72hAttempt (sub property of saref:hasProperty) | s4lift:SmartLiftInstallation | saref:Property | A relationship to the time of the confirmation of the last periodic test 72h attempt of a lift. In UE and other applicable countries, the periodic test shall comply with EN 81-28 [7]. |
| s4lift:hasTimeOfLastPeriodicTest72hAttempt (sub property of saref:hasProperty) | s4lift:SmartLiftInstallation | saref:Property | A relationship to the time of the last periodic test 72h attempt of a lift. In UE and other applicable countries, the periodic test shall comply with EN 81-28 [7]. |
| s4lift:hasVoltage (sub property of saref:hasProperty) | saref:FeatureOfInterest | s4lift:Voltage | A relationship defining the voltage of a feature of interest. |
| s4lift:hasMainPowerSupply (sub property of s4syst:connectsAt) | s4lift:ElectricPowerSystem | s4lift:ElectricalConnectionPoint | A relationship defining the main power supply of an electric power system. |
| s4lift:hasStandardPowerSupply (sub property of s4syst:connectsAt) | s4lift:ElectricPowerSystem | s4lift:ElectricalConnectionPoint | A relationship defining the standard power supply of an electric power system. |
| s4lift:canConnectToNetwork (sub property of s4syst:connectedTo) | s4syst:System | s4lift:Network | A relationship between a system and a network it can connect to. |
| s4lift:connectedToEmergencyBattery (sub property of s4syst:connectedTo) | s4lift:ElectricPowerSystem | s4lift:ElectricPowerSystem | A relationship defining the emergency battery of an electric power system. |
| s4lift:hasCarService (sub property of s4syst:connectedThrough) | s4lift:SmartLiftInstallation | s4lift:PossibleSmartLiftCarService | A relationship between a system and a car service. |
| s4lift:hasCarloadLimit | s4lift:SmartLiftCar | s4lift:Load | A relationship defining the limit load to be safely carried by the car, as a design parameter. |
| s4lift:conveys | s4lift:Signal | saref:State saref:Observations | A relationship specifying an information (e.g. observation, state) that is conveyed by a signal. |
| s4lift:containsCar (sub property of s4bldg:hasSpace) | s4lift:SmartLiftInstallation | s4lift:SmartLiftCar | A relationship between a smart lift installation and its car. |

6.2.7 Datatype properties

A list of the datatype properties defined into the SAREF4LIFT extension is reported in Table 6.2.7-1. For each datatype property, the name, the domain, the range, and its definition are reported.

Table 6.2.7-1: List of the datatype properties defined within the SAREF4LIFT extension

| Object property | Domain | Range | Definition |
|---------------------------------|---------------|-------|--|
| s4lift:hasAlarmMonitoringCentre | s4syst:System | | A relationship identifying the monitoring centre of the alarms, as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |
| s4lift:hasBuildingManager | s4syst:System | | A relationship identifying the manager of the building where a system is located, as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |

| Object property | Domain | Range | Definition |
|--|------------------------------|--------------|--|
| s4lift:hasCarServices | s4lift:SmartLiftInstallation | xsd:integer | The number of car services, taking care of the case where the car has multiple doors that give independent access to different locations on a given floor. It is expected to be greater or equal to the number of Car Stops. |
| s4lift:hasDoorCloseTime | saref:FeatureOfInterest | xsd:duration | A relationship defining the time spent by an entity (e.g. a lift, a building space, a door) to close its doors. |
| s4lift:hasDoorOpenTime | saref:FeatureOfInterest | xsd:duration | A relationship defining the time spent by an entity (e.g. a lift, a building space, a door) to open its doors. |
| s4lift:hasDoors | s4bldg:BuildingSpace | xsd:integer | The number of door connection points in a building space (e.g. a smart lift car) |
| s4lift:hasGeographicLocationValidator | s4syst:System | | Name of who has provided the validation of the correctness of the geographic location of the system. The value is expected to be a string or a string with language tag. |
| s4lift:hasInspectionAuthority | s4syst:System | | A relationship identifying the Authority that is entitled to periodically inspect the system installation and certify its suitability for the intended use, as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |
| s4lift:hasInstallerCompany | s4syst:System | | A relationship identifying the installer company of a system (e.g. device), as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |
| s4lift:hasLegalOwner | s4syst:System | | A relationship identifying the legal owner of a system, as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |
| s4lift:hasMainEmergencyTelephoneNumber | s4syst:System | xsd:anyURI | Main emergency telephone number to be called in case of emergency. The value is expected to be a URI with the tel: URI scheme as defined in IETF RFC 3966 [6]. |
| s4lift:hasMaintenanceCompany | s4syst:System | | A relationship identifying the maintenance company of a system, as per ISO 16484-5 [i.3]: inclusion in Description Property. The value is expected to be a string or a string with language tag. |
| s4lift:hasManufacturingCompanyRepresentative | s4syst:System | | A relationship identifying the local representative of the manufacturing company of a system, as per ISO 16484-5 [i.3]: Profile_Name. The value is expected to be a string or a string with language tag. |

| Object property | Domain | Range | Definition |
|--|------------------------------|--------------|---|
| s4lift:hasPlateInformation | s4lift:SmartLiftInstallation | xsd:string | An information usually also inscribed on a plate attached to the lift car. |
| s4lift:hasSecondaryEmergencyTelphoneNumber | s4syst:System | xsd:anyURI | Secondary emergency number to be called in case of emergency. The value is expected to be a URI with the tel: URI scheme as defined in IETF RFC 3966 [6]. |
| s4lift:hasStops | s4syst:System | xsd:integer | The number of stops by an entity (e.g. a lift). |
| s4lift:hasTelephoneNumber | s4syst:System | xsd:anyURI | Number corresponding to the lift communication module to be used for call terminated to the lift car. The value is expected to be a URI with the tel: URI scheme as defined in IETF RFC 3966 [6]. |
| s4lift:hasTravelTime | saref:FeatureOfInterest | xsd:duration | A relationship defining the time spent by an entity (e.g. a lift car) to travel between stops. |

7 Instantiating SAREF4LIFT

This clause shows different examples of how to instantiate the SAREF4LIFT extension of SAREF.

The example presented in Figure 7-1 demonstrates how to represent information from group name SLIdentification as described in ETSI TS 103 735 [i.2], clause 6.2a.

There are two new global identifiers of respective smart lifts installations defined:

(mailto:lift.1415@company1.com and mailto:lift.1416@company1.com) and the global identifier of the associated group (mailto:group.10354@company1.com). Through the object properties

s4lift:isMasterInGroup and s4lift:isSecondaryInGroup it is possible to define the importance level of each identifier.

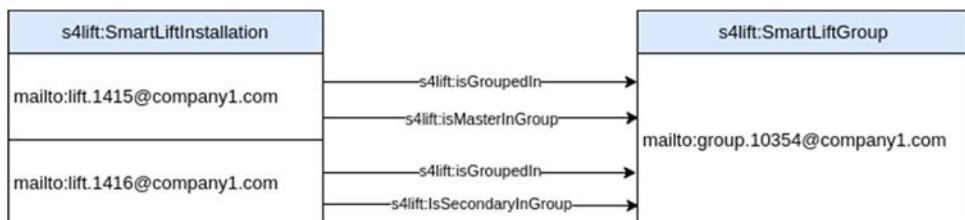


Figure 7-1: Smart Lift installation identification example

The example presented in Figure 7-2 demonstrates how to represent administrative information associated with a s4lift:SmartLiftInstallation as described in ETSI TS 103 735 [i.2], clause 6.3.

The individual mailto:lift.1415@company1.com is subclass of both s4lift:SmartLiftInstallation and s4lift:PassengerAndGoodsPassengerSmartLift concepts in order to specify precisely the type of smart lift. Then, data properties describing the installation are provided and associated with it.

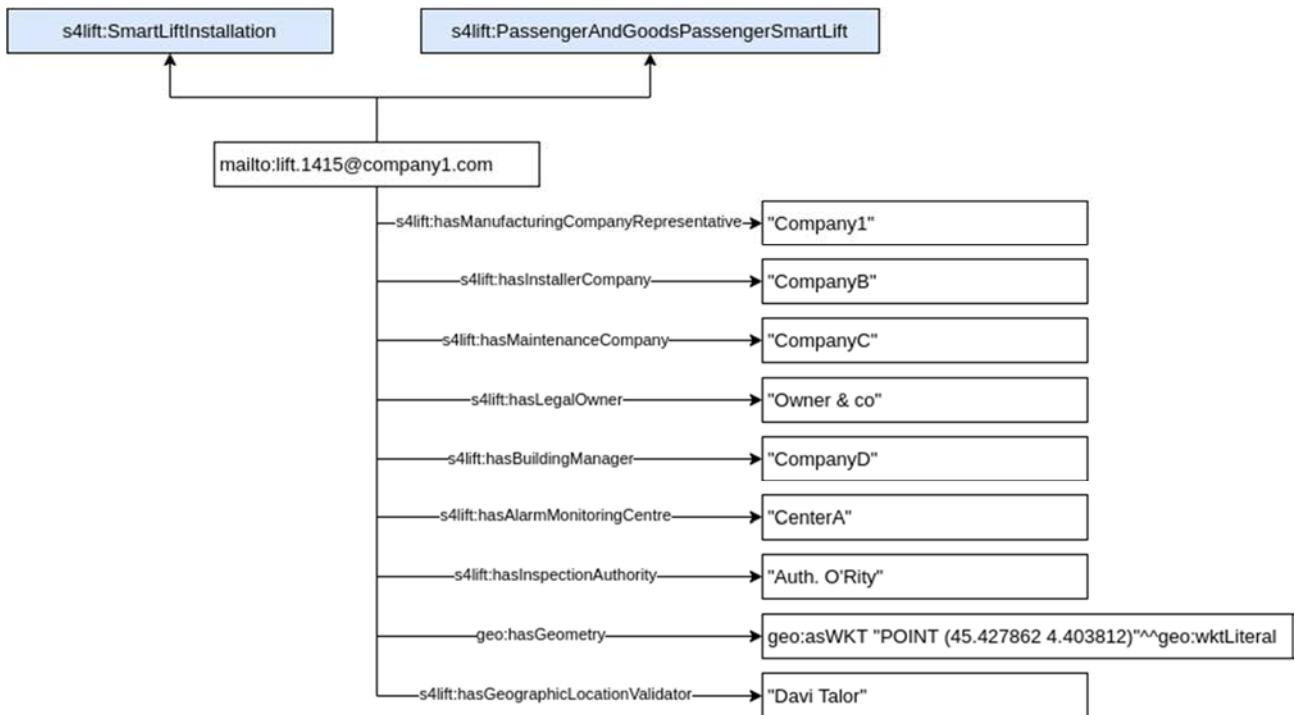


Figure 7-2: Administrative Information example

Finally, the example presented in Figure 7-3 demonstrates how to represent information from group name SLInstallation as described in ETSI TS 103 735 [i.2], clause 6.4.

As shown in Figure 7-1 and Figure 7-2, the installation labelled as `mailto:lift.1415@company1.com` is associated with the respective group and the related administrative information are defined.

Here is shown how the load capacity is defined through the definition of a the `s4lift:carloadlimit` property (linked through the `s4lift:hasCarLoadLimit` object property) that is associated with the related `saref:Observation` (`s4lift:CarLoadLimitObservation`).

Then, both the main power supply and the standard power supply are defined.

The `s4lift:mainPowerSupply` individual instantiates both the `s4lift:ElectricalConnectionPoint` and `s4lift:ThreePhaseConnectionPoint` concepts, it is associated with the measure property (`s4lift:mainPowerSupplyVoltage`) that in turn relates to the `saref:Observation` individual `s4lift:mainPowerSupplyVoltageObservation`.

Similarly, the `s4lift:standardPowerSupply` individual instantiates both the `s4lift:ElectricalConnectionPoint` and `s4lift:SinglePhaseConnectionPoint` concepts, it is associated with the measure property (`s4lift:standardPowerSupplyVoltage`) that in turn relates to the `saref:Observation` individual `s4lift:standardPowerSupplyVoltageObservation`.

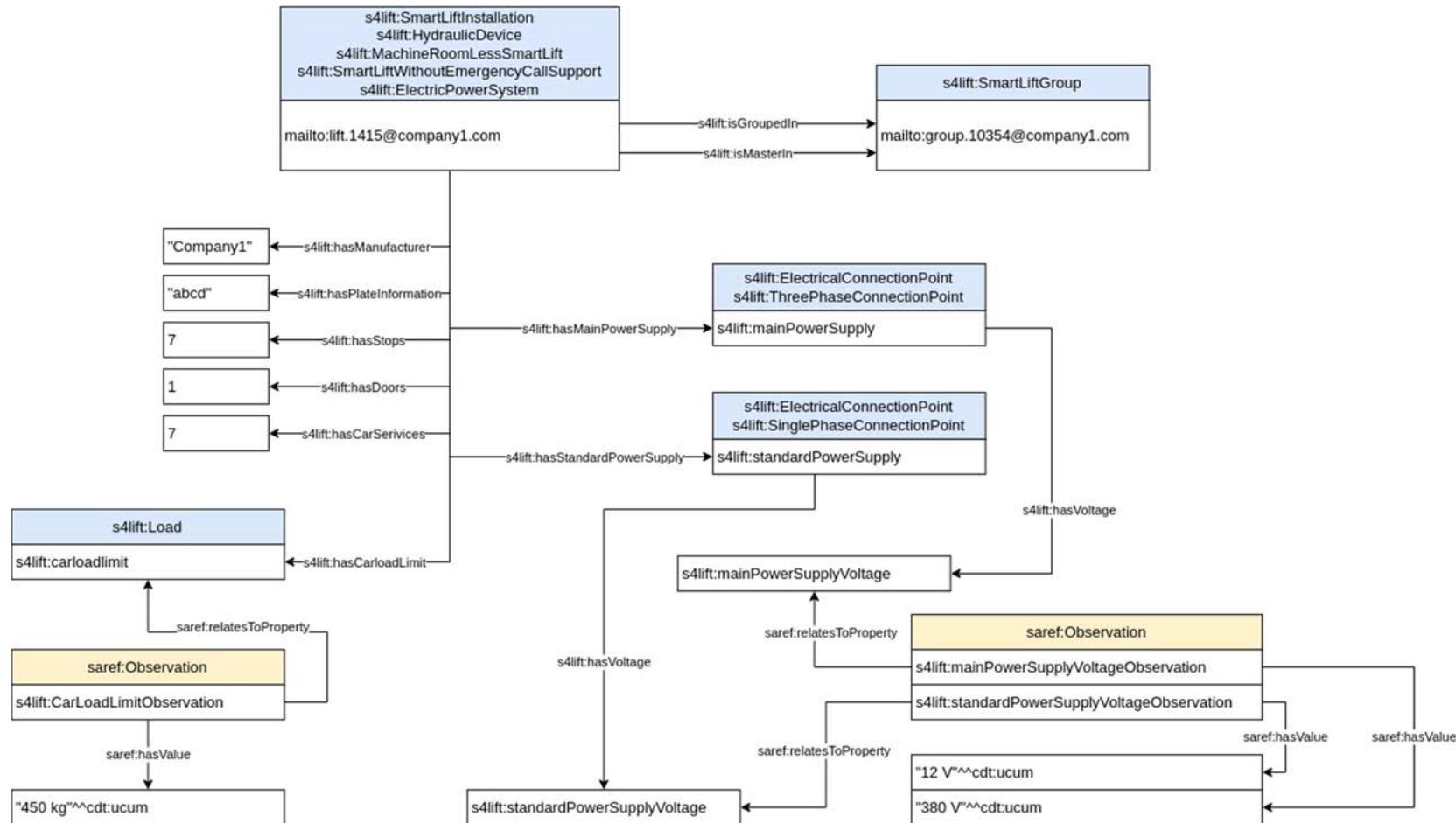


Figure 7-3: Smart Lift Installation example

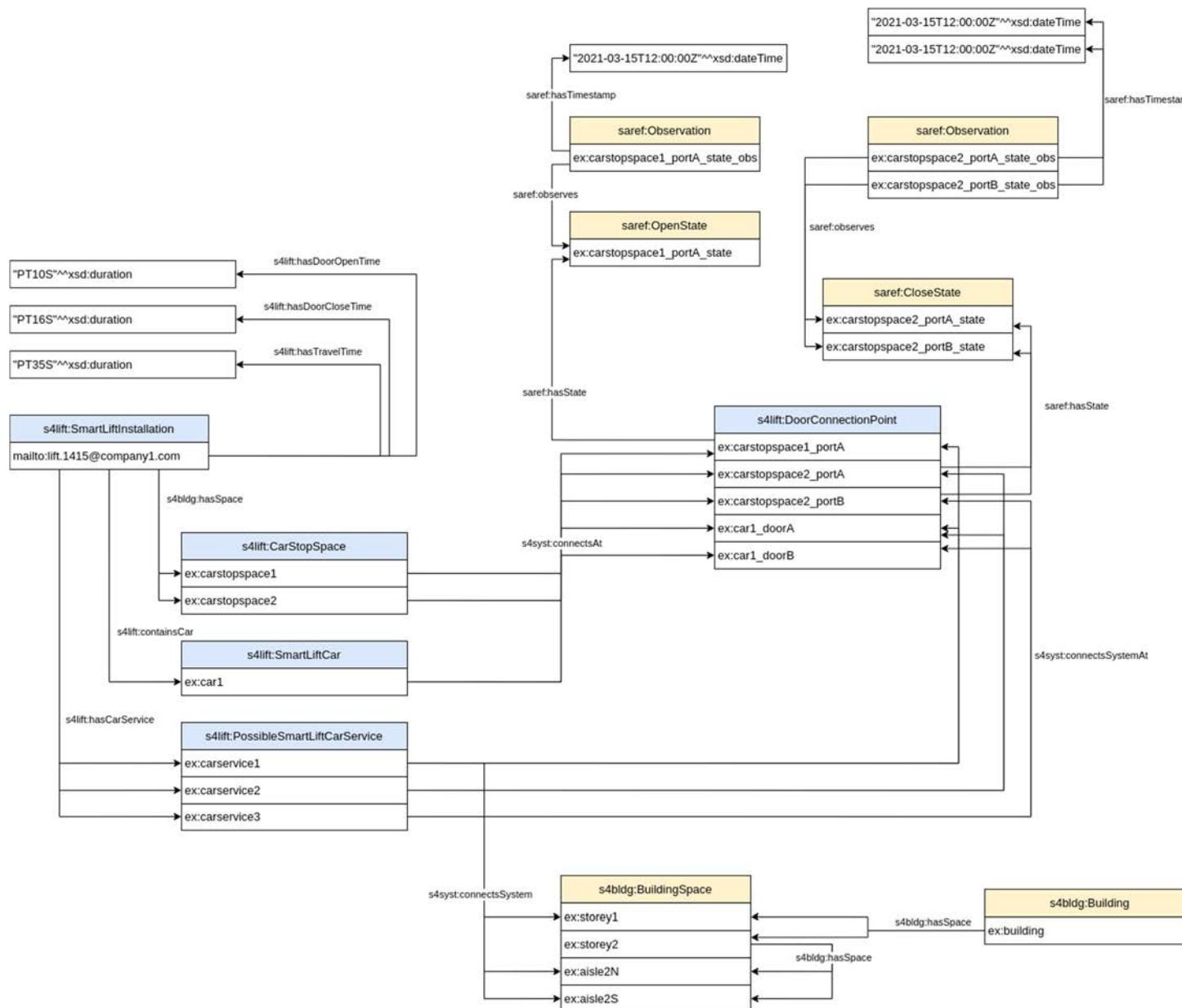


Figure 7-4: Smart Lift General Configuration example

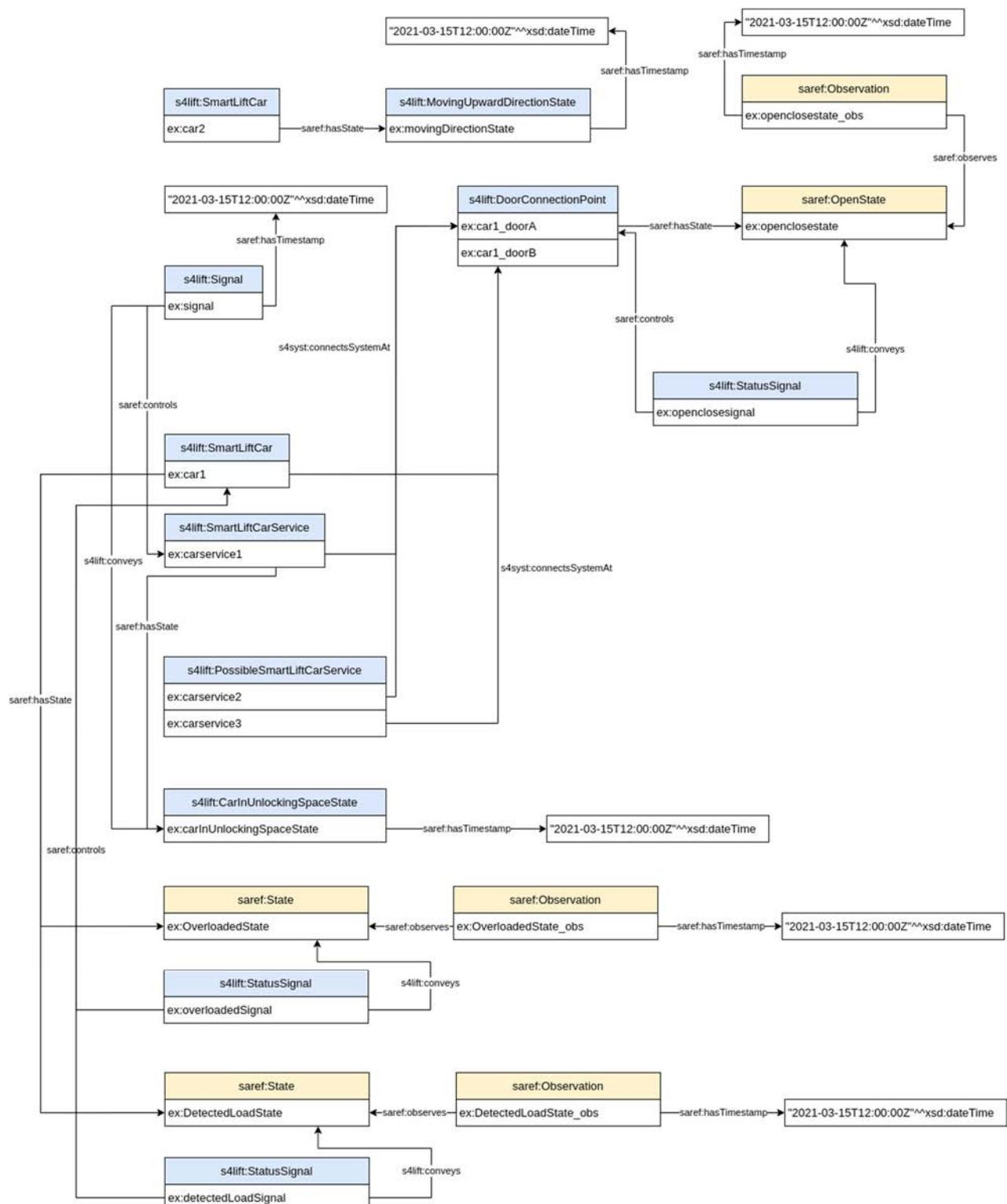


Figure 7-5: General Signals example

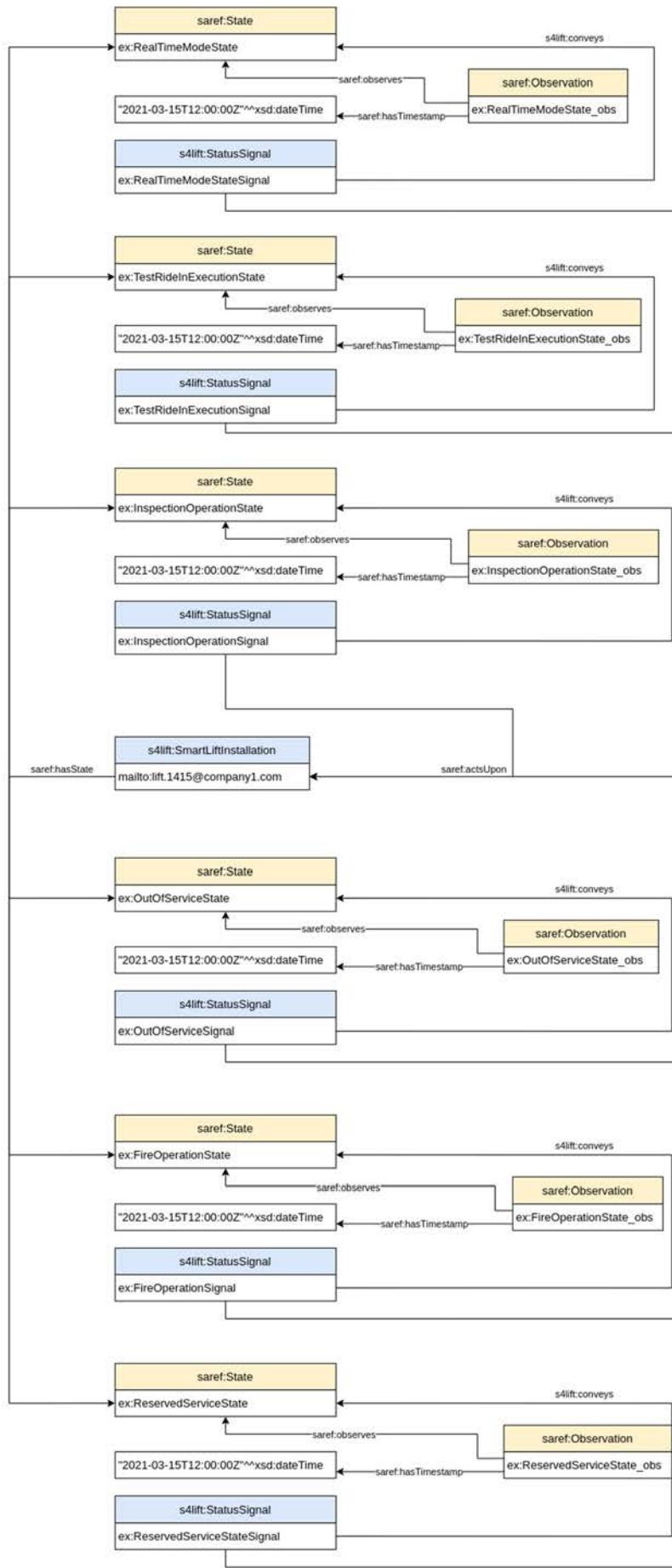


Figure 7-6: Status Signals example

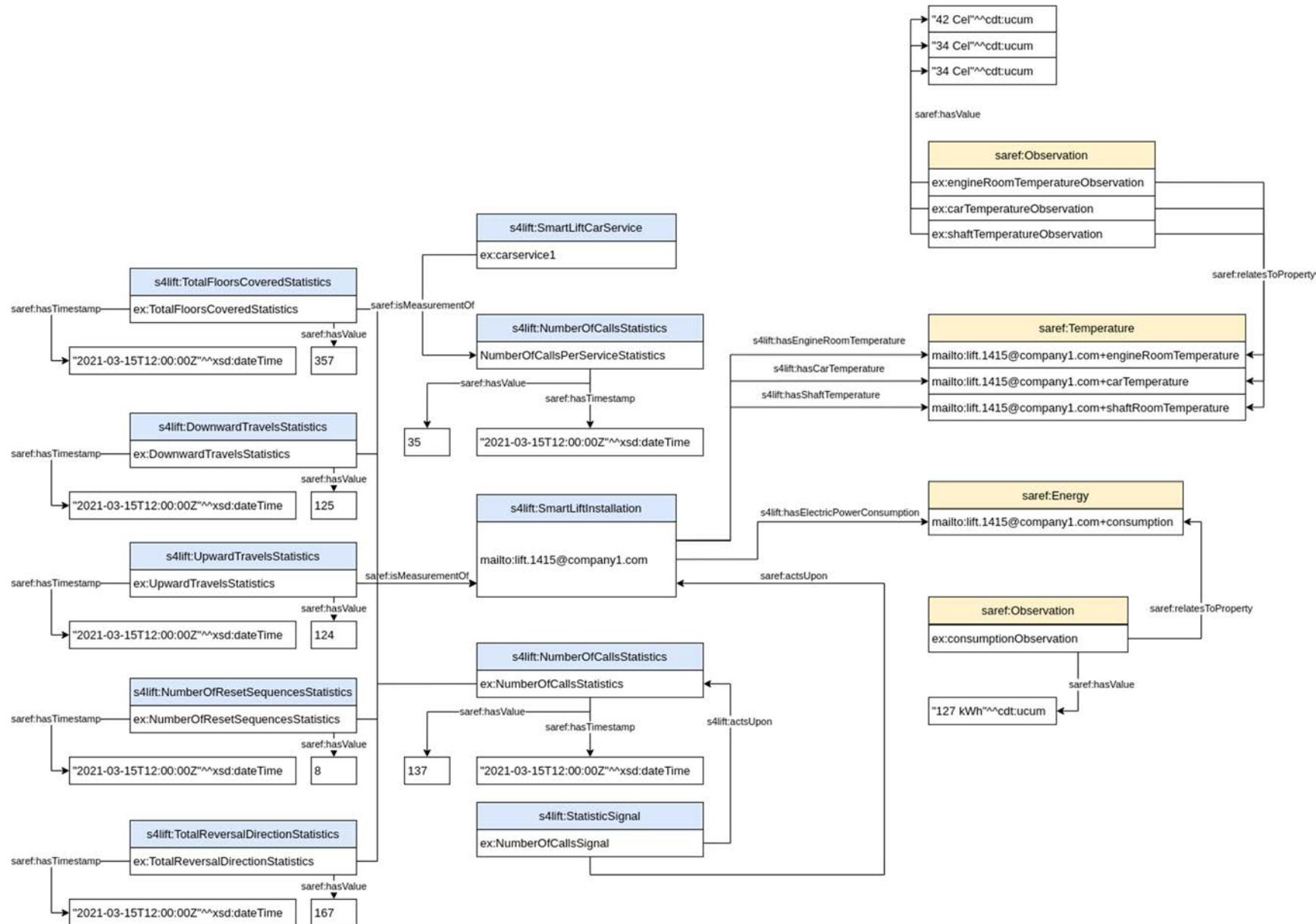


Figure 7-7: Statistic Signals example

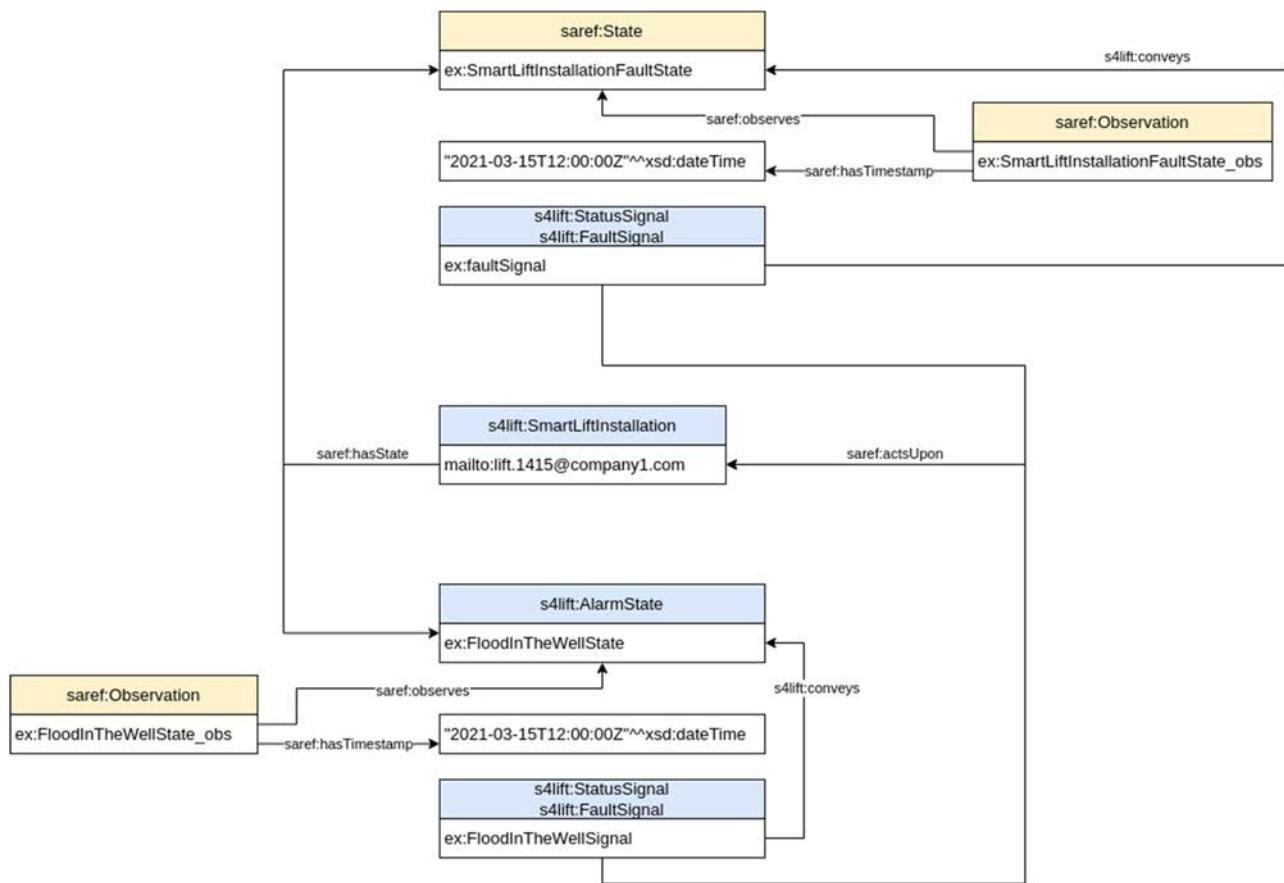


Figure 7-8: Fault Signals example

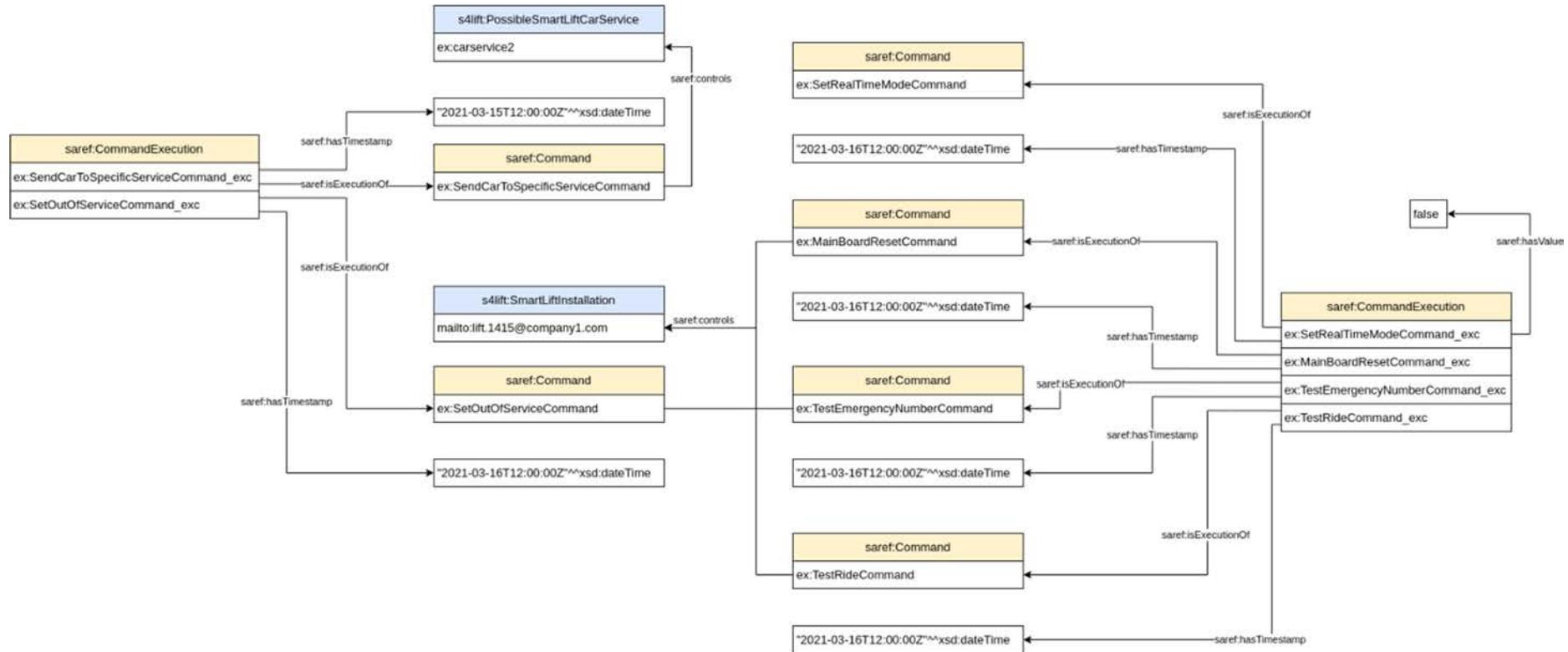


Figure 7-9: General Command example

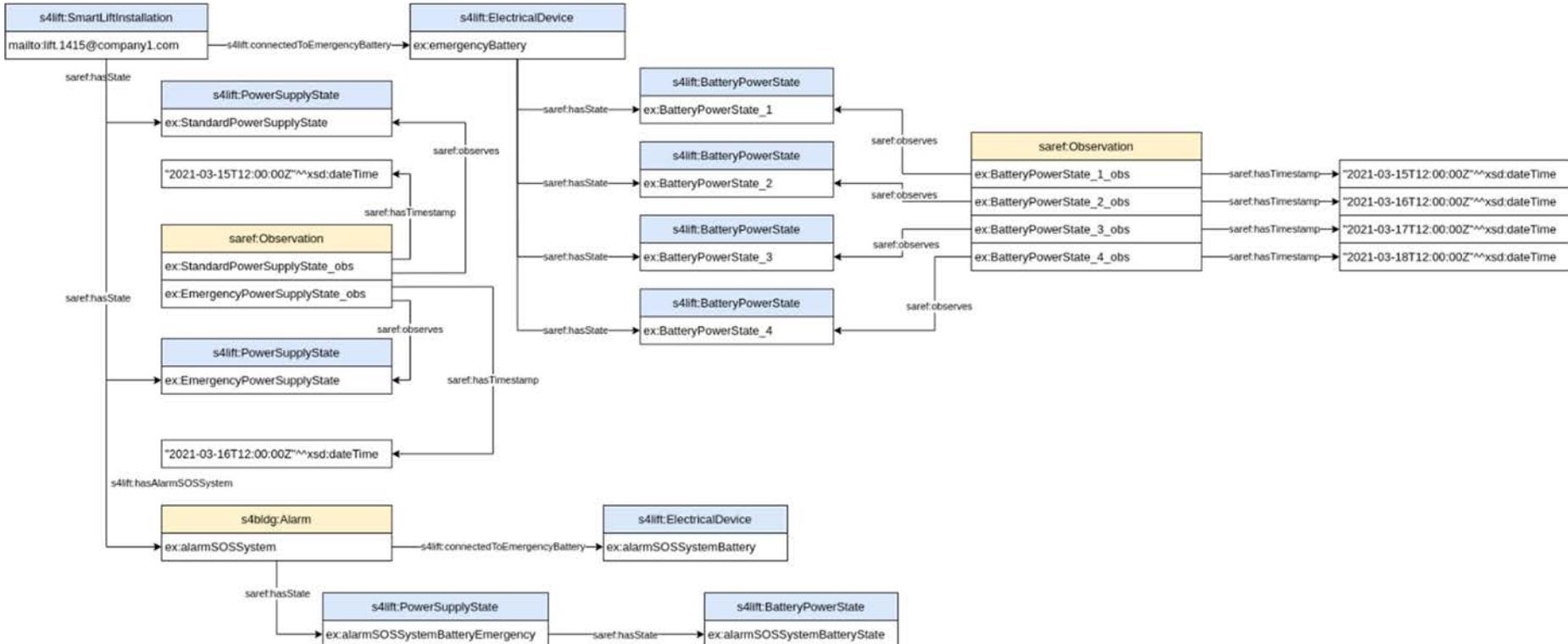


Figure 7-10: Power Supply Signals example

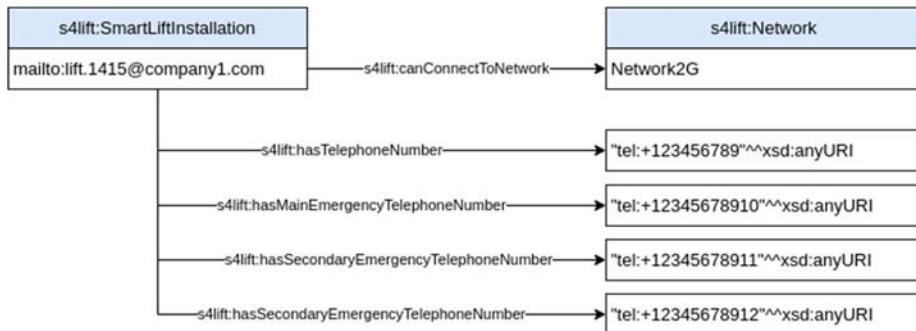


Figure 7-11: Bidirectional Communication System Configuration example

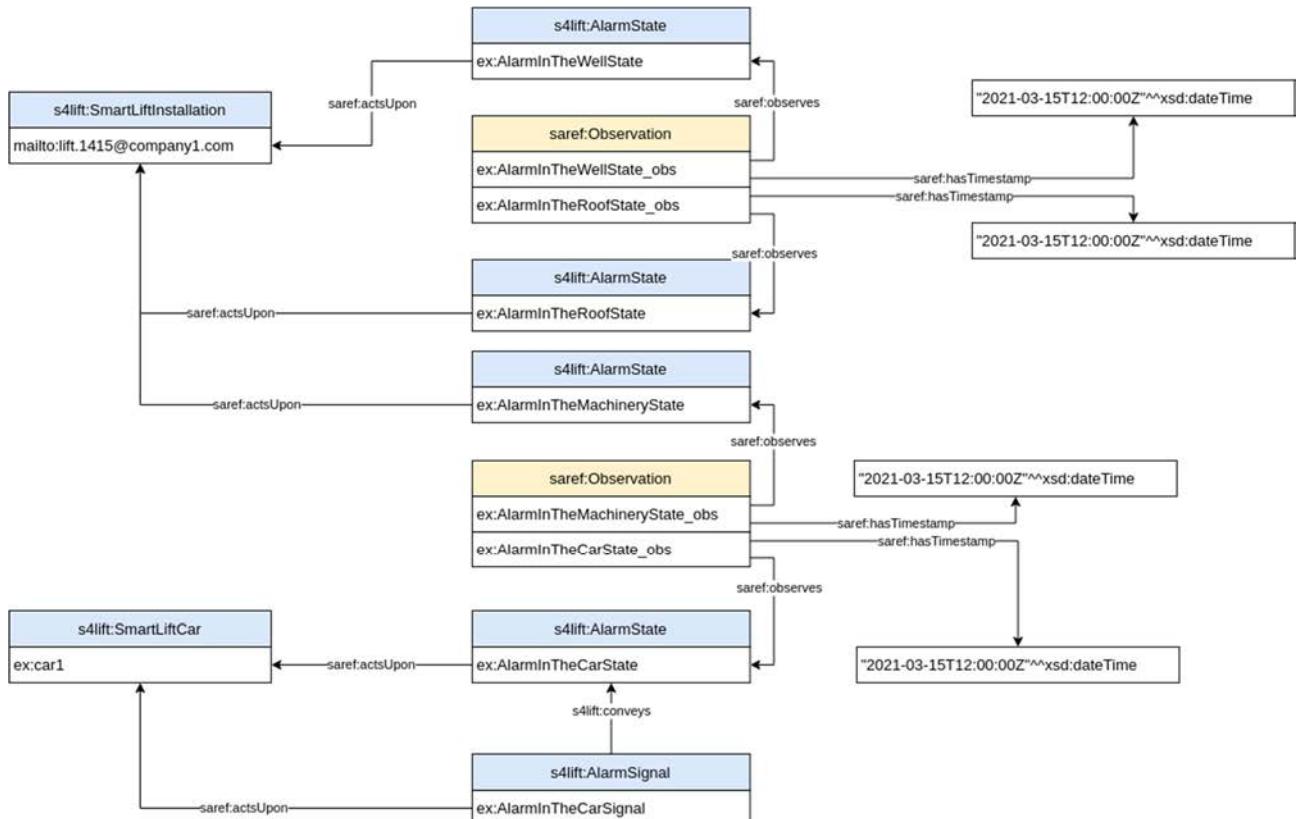


Figure 7-12: Bidirectional Communication System Alarms example

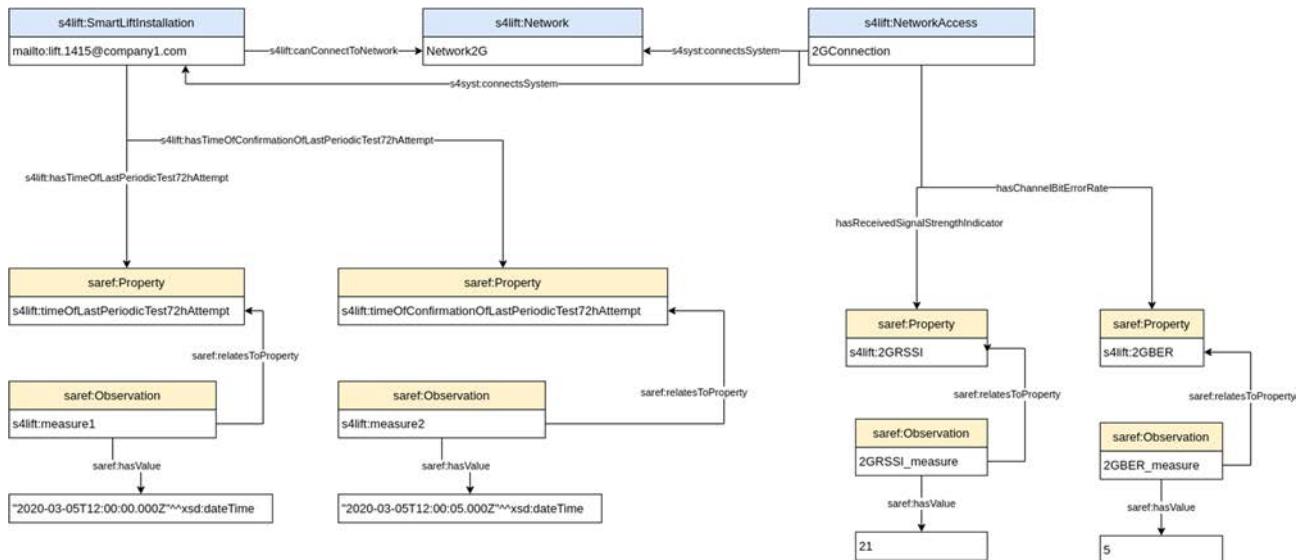


Figure 7-13: Bidirectional Communication System Signals example

8 Discussion

In the present clause 8, several observations about the SAREF4LIFT ontology and its usage are mentioned.

The hierarchies and individuals defined in the extension should not be considered exhaustive, the ontology currently represents those devices described in different relevant standards and directives. It might be needed to extend the hierarchies and lists of individuals for particular use cases, as well as to specialize some of the defined classes.

A last attention point is related to the possibility that this extension will overlap with existing standards related to the smart lifts domain, in particular, people can find on the web the mentions to a standard defined by the American Society of Mechanical Engineers (ASME, see <https://www.asme.org/>).

However, on the ASME's website people are looking for the standard's documentation, but without succeed. Hence, people were not able to compare such a standard with the structure of SAREF ontology.

The SAREF4LIFT extends the SAREF core ontology by defining new subclasses of **saref:Device**, **saref:Observation** and **saref:Property** concepts. Details are reported below:

- **saref:Device**
 - **s4lift:ElectricalDevice**
 - **s4lift:HydraulicDevice**
 - **s4lift:SmartLiftEdgeComponent**
 - **s4lift:SmartLiftEdgeControlUnit**
- **saref:Observation**
 - **s4lift:StatisticsObservation**
 - **s4lift:DownwardTravelsStatistics**
 - **s4lift:NumberOfCallsStatistics**
 - **s4lift:NumberOfFaults**
 - **s4lift:NumberOfResetSequencesStatistics**
 - **s4lift:TotalFloorsCoveredStatistics**
 - **s4lift:TotalNumberOfOpeningOfDoorStatistics**

- s4lift:TotalReversalDirectionStatistics
- s4lift:UpwardTravelsStatistics
- saref:Property
 - s4lift:Load
 - s4lift:Voltage

The two new properties, since they are generic and could be used in other extensions, might be included in a future version of the SAREF ontology.

Annex A (informative): Change history

| Date | Version | Information about changes |
|------------|---------|--|
| 2021-02-04 | 0.0.1 | First skeleton. |
| 2021-02-09 | 0.0.2 | First list of requirements. |
| 2021-02-17 | 0.0.3 | Refined list of requirements. |
| 2021-03-09 | 0.0.4 | Finalized clauses 2 and 3. First draft of the extension description. |
| 2021-03-10 | 0.0.5 | Added description of the SAREF4LIFT extensions and diagrams. |
| 2021-03-13 | 0.0.6 | Finalized description of the SAREF4LIFT extensions and diagrams. |
| 2021-04-01 | 0.0.7 | Added examples and observations. |
| 2021-04-10 | 0.0.8 | First stable draft release. |
| 2021-04-28 | 0.0.9 | Added new examples. |
| 2021-05-15 | 0.1.0 | Second stable draft release including fixes discussed during the fourth STF602 meeting. |
| 2021-05-25 | 0.1.1 | Update after ETSI forge merge request #6 March 23. |
| 2021-06-16 | 1.1.1 | Technical Officer review for EditHelp publication pre-processing. |
| 2021-07-05 | 1.1.1 | Final Rapporteur and Technical Officer changes requested by ETSI editHelp! |
| 2024-10-01 | 2.1.1 | Technical Officer final review before ETSI EditHelp publication pre-processing after TB Approval |

History

| Document history | | |
|-------------------------|--------------|-------------|
| V1.1.1 | July 2021 | Publication |
| V2.1.1 | October 2024 | Publication |
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