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SmartM2M;
Requirements & Feasibility study for Smart Lifts in IoT

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Foreword

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

Modal verbs terminology

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1 Scope

The present document has been elaborated to facilitate the potential preparation of a standard for Smart Lifts collecting and developing type and range of data to be potentially exchanged between lifts and their relevant management applications. This information allows the monitoring of the activities and the performance of such lifts, and interaction with IoT devices and applications.

It includes:

- the identification of potential users of the information currently collected and their role in the system;
- the combination of the data exchanged and the possible widening of the current types and ranges (signals and commands);
- the identification of a set of use cases showing examples of the use of the identified signals and commands in the context of the relevant described user roles.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

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] oneM2M website.

NOTE: Available at www.oneM2M.org.

[i.2] Eclipse OM2M.

NOTE: Available at www.eclipse.org/om2m/.

[i.3] Ocean Mobius.

NOTE: Available at developers.iotocean.org/archives/module/mobius.

[i.4] oneM2M TS-0030: "Ontology based Interworking".

[i.5] oneM2M TS-0034: "Semantics Support".

[i.6] SAREF.

NOTE: Available at https://saref.etsi.org/.

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

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

QR Code	Quick Response Code
SAREF	Smart Applications REFerence ontology
SDT	Smart Device Template

4 User roles

4.1 Overview of user roles

There are several type of user roles and there are three main categories:

- The users of the lift (the passengers) that could have different need
- The people and companies that work on the lift market
- The owner of the building or administrator of group of building

4.2 Description of user roles

Building owner

The owner of the building or a group of buildings.

Maintenance companies

The companies that are in charge of the maintenance of the lifts, with the organization to manage every problem that could be arise on the lift.

Maintenance technicians

The technicians of the maintenance companies, they are the people that work often on site to fix problems and perform maintenance-related activities.

Passengers without priority

The standard passenger of the lift.

Passengers with priority

All the other kind of passenger that could have priority to use the lift, e.g. disabled people, elderly people, etc.

Supplier technicians (especially of control cabinet)

The control cabinet is the brain of the lift, all the information is managed by the control cabinet; these are the technicians of the company that manufactured the control cabinet.

Control room operator

People located in a (usually remote) control room, whose task is to supervise and control the operations of lifts or group of lifts.

5 Signals and commands

5.1 Overview

Some signals are "direct" signals read directly from the devices; other signal could be "indirect" signal generated by the software using a combination of direct signal; all the signals could be available as output.

As the signals, the control cabinet manage also the input that are the command that move the lift; as inputs they are available by the main board.

5.2 Description of monitoring signals

CAR SIGNALS

Signal	Value	Additional comments
Car position	(Floor Number i.e.: -2, -1, 0, 1,…)	
Upward direction	Yes/No	
Downward direction	Yes/No	
Car in unlocking zone	Yes/No	
Test ride in execution	Yes/No	
Fault	Yes/No	
Out of service	Yes/No	
Overload	Yes/No	
Inspection operations	Yes/No	
Fire operations	Yes/No	
Car alarm	Yes/No	
Car empty	Yes/No	

BIDIRECTIONAL COMMUNICATION SYSTEM SIGNAL

Signal	Value	Additional comments
Periodic test 72 h	Yes/No	
Bidirectional communication system	Yes/No	
Network coverage	(% of coverage)	

POWER SUPPLY SIGNAL

Signal	Value	Additional comments
Emergency power supply	Yes/No	
Standard power supply	Yes/No	
Voltage of emergency power	(Voltage value)	

SYSTEM STATUS SIGNAL

Signal	Value	Additional comments
Out of service	Yes/No	
Overload	Yes/No	
Inspection operation	Yes/No	
Fire operation	Yes/No	

FAULT SIGNAL

Signal	Value	Additional comments
Dangerous fault	Yes/No	
Minor fault	Yes/No	
Audio fault	Yes/No	

STATISTIC SIGNAL

Signal	Value	Additional comments
Total number of calls	Value	
n. upward travel	Value	
n. downward travel	Value	
Total number of floors covered	Value	
Total number of reset sequence	Value	
Total number of reversal direction	Value	
Total number opening door	Value	
Number of calls per floor	Value	
Number of each fault event	Value	

5.3 Description of alarms

Signal	Value	Additional comments
Alarm button pressed	Yes/No	
Alarm initiated	Yes/No	
Alarm voice communication activated	Yes/No	
Alarm in the well	Yes/No	
Alarm in the machinery	Yes/No	
Flood alarm	Yes/No	
Emergency power alarm	Yes/No	

5.4 Description of commands

Signal	Value	Additional comments
Call to a specific floor	Value	
Send car to a specific floor	Value	
Out of service	Yes/No	
Inspection mode	Yes/No	
Open door time	Value	
Close door time	Value	
Test emergency number	Yes/No	
Emergency number	Value	
Travel time	Value	
Board reset	Yes/No	
Test ride	Yes/No	

6 Use cases

6.1 Management of group of lifts

6.1.1 Overview

This case is about the control room operator that is in charge of monitoring and manage a group of lifts (in this use case the lifts installed in the railways stations). The company responsible for the buildings and the people accessing the buildings (e.g. the railway company) want the possibility of monitoring the status of each lift and the possibility of controlling the lifts from the remote control room.

To achieve this purpose the control cabinet of the lift needs to expose the status of several systems making available the related signals and to give the possibility to send the commands to the lift (e.g. to make a ride to a specific floor).

This case could be extended to all the cases where the building's owners want to manage and monitor a group of lifts in a single building or in several buildings (like railway stations, hospitals, office buildings, etc.); the objective is to manage and control the situation of all the lifts from a single and centralized control room.

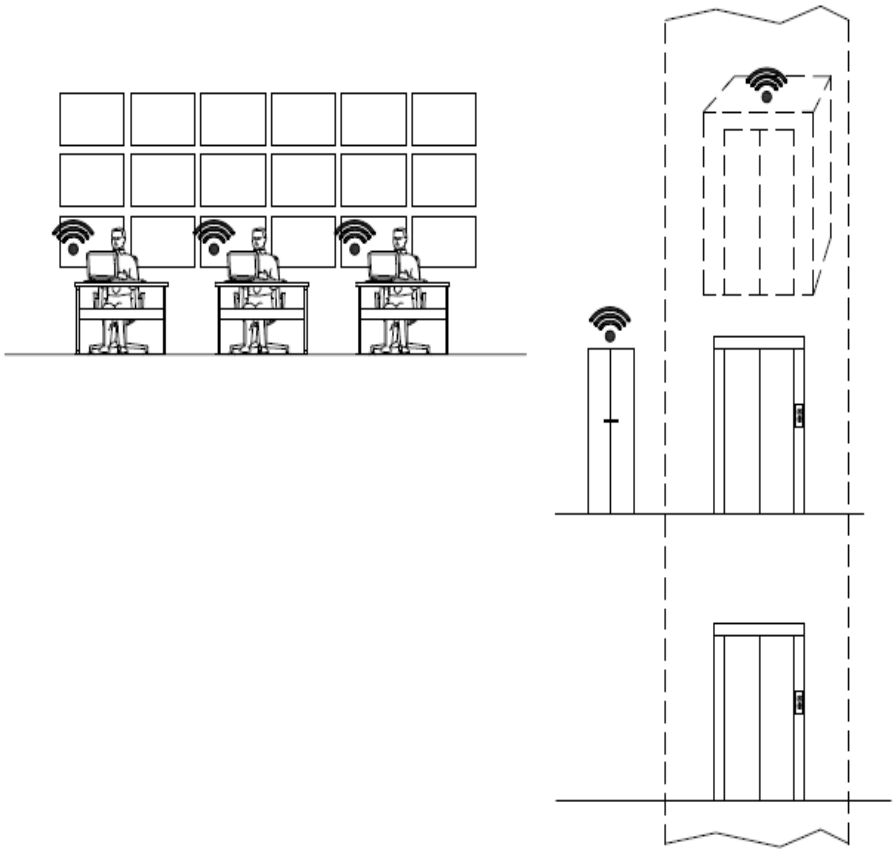

Figure 6.1.1.1: Management of Group of Lifts: Overview

6.1.2 Users roles involved

- Building owner
- Maintenance companies
- Maintenance technicians
- Passengers without priority

- Passengers whit priority (disabled people, elderly people, etc.)
- Supplier technicians (especially of control cabinet)

X Control room operator

6.1.3 Analysis

The regulations for the railway stations are mandating that every day - before the opening of the railway station - the person in charge of the station needs perform a test ride; in this case this test ride can be performed from the control room by the remote operator.

The operator - by means of a control panel where he can see the status of the lifts - can evaluate if the test ride can be performed and - if all the parameters are OK - can conduct the test; if the result of the test is positive, the lift can be put in service. Result of test ride can be traced and communicated to the relevant parties, e.g. by email or other means.

These test rides could be scheduled according to the opening times of the railway stations, so the operator would not need to run manually all the tests from the control room.

Another situation that the operator can manage from the control room, is when a fault occurs or an alarm is activated: for example he can have an overview about what is happening in the lift from the camera in the lifts and - if necessary - activate the people in the railway station, the company that is in charge of the maintenance of the lift, the police or the firefighter.

6.1.4 List of information to be exchanged

In the control room the operator would receive this kind of signals:

- Monitoring signals: all the monitoring signals except the statistic signals
- Alarms signals: all the alarm signals
- Command signal: call to a specific floor, send car to a specific floor, out of service, test ride

6.2 Predictive maintenance and fault resolution

6.2.1 Overview

This case is about how the maintenance companies and technicians can use the available information to set a predictive maintenance program for the lift, and how they can use the remote connection with the lift to fix the faults or the problems.

Predictive maintenance is the "new" trend in lift industry even if it has been applied in several industrial sector for ages; the scope of predictive maintenance is to anticipate the event of a fault, evaluating the fault rate of the single components based on the number of runs of the lift. So, the maintenance companies can substitute the components before the fault arise and they can reduce the out of service for the lift.

With the remote connection between the lift and the technicians of the control cabinet supplier, the maintenance technicians can fix the fault very quickly (by an e-mail report or by a message sent automatically by the lift).

Furthermore, there are some faults very hard to discover and that require long time to be fixed, so the capability for the maintenance technician to have the direct and real-time support by the control cabinet's technician could drastically reduce the out of service necessary to fix the fault.

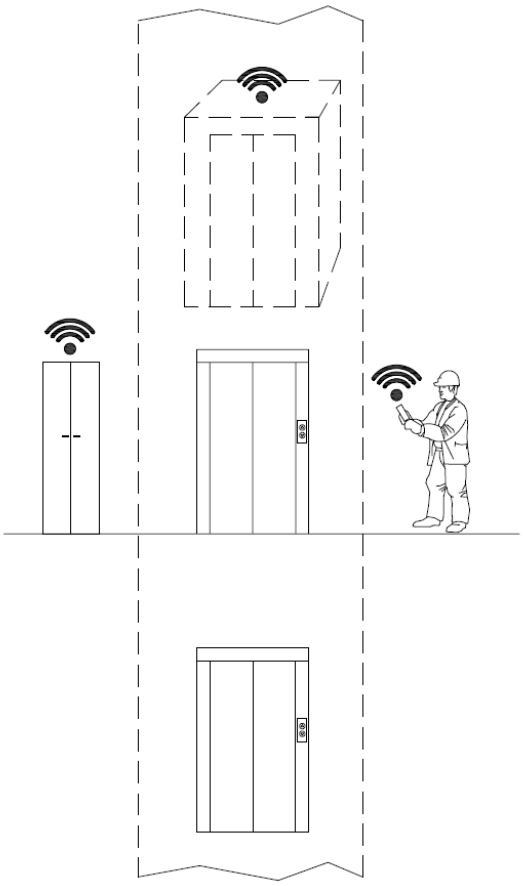

Figure 6.2.1.1: Preventive Maintenance and Fault Resolution: Overview

6.2.2 Users roles involved

- ☐ Building owner
- X Maintenance companies
- X Maintenance technicians
- ☐ Passengers without priority
- ☐ Passengers whit priority (disabled people, elderly people, etc.)
- X Supplier technicians (especially of control cabinet)
- ☐ Control room operator

6.2.3 Analysis

A typical problem is that a fault appears but - when the maintenance technician is on site - the lift runs properly; this is a typical case of misuse by the users that some time smash the manual landing doors and the consequence is that the locking devices work sometime well and sometime badly.

In this case for the maintenance technician it is very hard to discover the fault; the best solution is that the technician of the control cabinet supplier connects the lift from the remote position and analyses the faults; by the history of the faults recorded and the capability of analysing the single input and output of the main board, he can very quickly identify which landing door causes the fault and understand why the fault appears.

With predictive maintenance the system sends a message to the maintenance company that the lifetime of a component (for example: wheel of the doors, pushbutton, etc.) has expired; the maintenance company can send a technician to substitute the component with a new one, so the time of substitution could be very short and the possible out of service of the lift avoided.

6.2.4 List of information to be exchanged

For the predictive maintenance:

- Monitoring signals: statistic signals

For the fault's resolution:

- Monitoring signals: all the monitoring signals except the statistic signals
- Command signal: call to a specific floor, send car to a specific floor, out of service, board reset

6.3 Servicing priority people

6.3.1 Overview

There are some cases in which the system should manage passengers with priority (like disabled people) to give them the access to the lift - or better a group of lifts - in the faster and appropriate way.

In other cases, blind people could have a smart system when they can have access to a building more or less like all the other people, except the tactile path on the floor and/or tactile plan to understand where are the stairs, the lifts, the toilettes, etc.

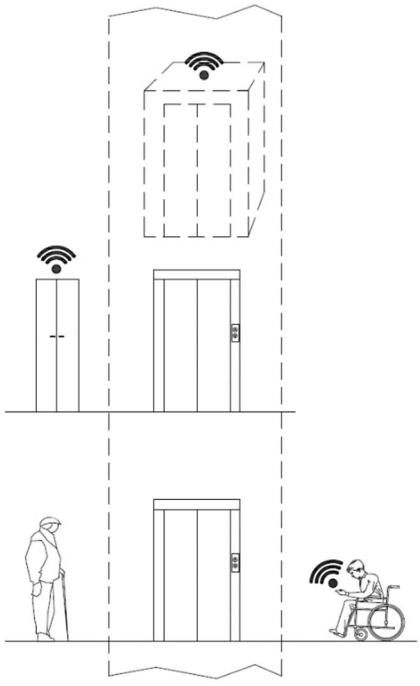

Figure 6.3.1.1: Servicing Priority People: Overview

6.3.2 Users roles involved

X Building owner

☐ Maintenance companies

☐ Maintenance technicians

X Passengers without priority

X Passengers whit priority (disabled people, elderly people, etc.)

☐ Supplier technicians (especially of control cabinet)

☐ Control room operator

6.3.3 Analysis

In a building with a group of lifts (for example: office building, hospital, railway station, etc.), due to the traffic during the peak time, the cars of the lifts are full; if a system can recognize people with disability (especially people on a wheelchair), the system can give priority to them and "reserve" a specific lift run.

Another case is about blind people: if the system can recognize them at the entrance of the building and if the building is a Smart building, by an app on the mobile phone or similar device, the blind people can use the information available on the app to find the appropriate path inside the building, reach the lift and go to the office (or the train, etc.).

To achieve this the building has to manage and exchange the information through the devices and put the information available to the application. Both for the disabled people and blind people, the capability to do by them self every task is very important and with a simple application for mobile phone they can improve their quality of life.

6.3.4 List of information to be exchanged

All the signals:

- Monitoring signals: all the monitoring signals except the statistic signals
- Alarms signals: all the alarm signals
- Command signal: call to a specific floor, send car to a specific floor

6.4 Management of maintenance and inspection visits of the lift or group of lifts

6.4.1 Overview

This case is about how to check the visits scheduled by the maintenance company, as well as those of verification of the notified body.

The owner or manager of the lift checks that the scheduled maintenance visits defined in the contract with the maintenance company are carried out with the agreed deadline and also checks that the notified body performs the pertinent checks.

In this case the control panel has to recognize and record the access to the system in case of maintenance and/or verification and send a signal (e-mail report or a message).

The owner or manager of the lift records the event and can make the data available to the owners of the building.

Figure 6.4.1.1: Management of maintenance and inspection visits of the lift or group of lifts: Overview

6.4.2 Users roles involved

X Building owner

X Maintenance companies

X Maintenance technicians

 Passengers without priority

 Passengers whit priority (disabled people, elderly people, etc.)

 Supplier technicians (especially of control cabinet)

 Control room operator

6.4.3 Analysis

Building managers (condominium administrators or real estate management companies) report property owners on the expenses incurred in general building management. In the specific case of the lift, a maintenance contract is stipulated with the company in charge that provides for a number of maintenance visits (defined according to the type of plant) to keep the plant in efficient service. Furthermore, periodically, a notified body is called to verify the lift safety devices according to regulations.

The maintenance technician, who arrives on the plant, by means of the control panel, activates the maintenance operation mode and automatically sends a signal (e-mail or message) to the operator who can record the intervention and check whether it is congruous with the planned dates of the contract.

6.4.4 List of information to be exchanged

The plant manager receives:

- maintenance start signal
- end of maintenance signal
- inspection start signal
- end of inspection signal

6.5 Call/Reserve Lift Car via Smartphone app

6.5.1 Overview

This case concerns the passenger's interaction with the elevator via an application downloaded to the smartphone. The application allows a person to call the lift car and take it to the desired floor using an application and/or voice control. There is also the possibility of receiving notifications about scheduled maintenance or down time.

In this case, the application is made to provide an acknowledgment of the elevator or elevators to be used (an application can register and recognize multiple installations) e.g. via a QR Code. At this point, the passenger near the elevator can proceed to the choice of the lift, its identification and the call of the lift car on the desired floor. The application will exchange the request with the lift controller framework that will verify the ability to handle the call by bringing the cabin to the desired floor.

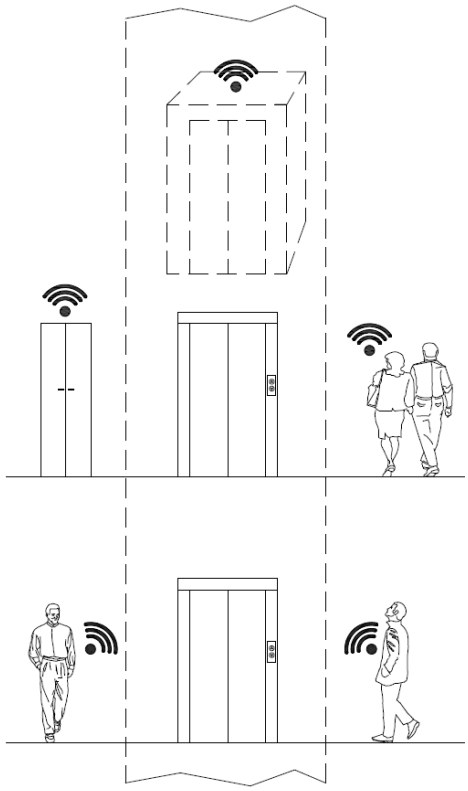

Figure 6.5.1.1: Call/Reserve Lift Car via Smartphone App: Overview

6.5.2 Users roles involved

- ☐ Building owner
- ☐ Maintenance companies
- ☐ Maintenance technicians
- X Passengers without priority
- X Passengers whit priority (disabled people, elderly people, etc.)
- ☐ Supplier technicians (especially of control cabinet)
- ☐ Control room operator

6.5.3 Analysis

The plant manufacturer or maintainer makes a QR code of the elevator visible (in and/or near the elevator), and a suitable application is installed on the passenger's smartphone.

- The user of the system, with the smartphone or similar device, recognizes through the QR code the application downloaded to the device. Once the application installed, the passenger will be able to identify the system and send the call request to the floor both near the elevator and at a distance. The control panel recognizes the request, verifies the status of the system and accepts the call, sending the lift car to the desired floor.

6.5.4 List of information to be exchanged

Passenger receives from lift car:

- lift car position (floor number)
- lift car status (if doors open/closed)
- lift car direction (ascent/descent)
- lift car status (moving/out of service)

7 Conclusions and recommendations

7.1 Analysis of requirements

The above use cases show that a set of different players need to exchange information with the smart lifts, each one with different roles and different rights where retrieving or sending information and commands to the smart lift. An initial set of roles is identified in clause 4 of the present document: this is just an initial set, likely to be extended as soon as additional services are added to the Smart Lift system, to include more players (e.g. automobiles interacting with car elevators), ventilation systems, more public authorities and sectors, etc.

These use cases also demonstrate the need to exchange information with data sources from different actors, such as:

- the need to identify impaired people (so likely the need to interact with public databases certifying their status);
- the need to interact with the building environment, so exchange information with the building management systems;
- the need to interact with service providers (e.g. the railway system in terms of opening hours, peak times etc.);

- the need to interact with public services: the systems run by public safety authorities, but more in general the public authorities (e.g. the city authorities for energy management, e.g. in order to prioritize power to the lifts in case of regional outage).

Another relevant consideration is about the fact that all these interactions requires to be established independently from the Lift makers, and that typically the current market is composed by a very large number of maintenance companies whose maintenance technicians need to perform their duties on lifts provided by a wide set of different makers.

This means that the smart lift is not a standalone element: it is a complex system composed of local and remote components that need to interact one with each other and to interact with external systems belonging to very different sectors. To exploit these needs the Smart Lift needs to become part of the digital environment taking benefit of the technologies offered by such digital environment. In such a context standard Internet of Things technologies at communication level (fixed and wireless, including Wi-Fi and the innovative 5G), interworking framework capabilities, semantic support and interoperability, represent the best opportunity to adopt state-of art of available technologies.

7.2 Opportunities offered by the standard technologies

In the context of standards, there is an extreme scarcity of solutions matching all the needs identified for a Smart Lift system. It is needed a full communication and interworking framework capable to reuse multiple communication technologies, to support interworking with other technologies, to integrate IoT devices and Human interactions, and to provide semantic support and semantic interoperability.

In the context of ETSI, OneM2M [i.1] provides these capabilities as a full interoperable standard, supported by testing specifications and a certification program. Additionally, there are several open source projects providing accessible and cross-interoperable implementations, such as the Eclipse OM2M [i.2] project and the Ocean Mobius [i.3] project (which is a certified open source solution).

OneM2M also provides semantic support and interoperability via the SDT [i.4], [i.5] and SAREF [i.6] methodologies. In particular, for SAREF it is the adopted communication framework.

7.3 Recommendations

It is recommended to consider the standardization of a Smart Lift System based on SAREF, oneM2M and SDT.

This would potentially require the development of:

- a specification for the Smart Lift System;
- a SAREF extension for Smart Lifts and its development on the SAREF ETSI portal;
- the inclusion of Smart Lifts in existing oneM2M SDT specification.

A reasonable timeframe, considering the standardization methodologies and tools already available in ETSI for SAREF and oneM2M for SDT, is 4Q2020-1Q2021.

History

Document history		
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