Understanding GB/T 24476 – 2017 China's Technical Specifications for Internet of Things For Lifts, Escalators And Moving Walks

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Abstract. The People's Republic of China has a new code that requires all new or modernized lifts, escalators and moving walks to be equipped with a remote monitoring system. The Standard specifies every detail of the standardized monitoring system.

The data from the monitoring system is transmitted via the internet to a Safety Monitoring Platform. This Safety Monitoring Platform is operated by regional governments.

The system and the data that it acquires is explained. Additionally, the potential effects of this system on safety and the lift industry are explored.

1 INTRODUCTION

The Chinese Standard, GB/T 24476, requires all new or modernized lifts, escalators and moving walks to be equipped with remote monitoring equipment that sends data to a safety Monitoring Platform operated by government agencies [1].

The Standard specifies every detail of the monitoring system. It defines the performance of the hardware and software, details the system architecture, describes what data will be collected and defines the format of the data.

This Standard is far more than a standard to promote safety. It is a strategic initiative to improve the status of the Chinese lift industry. It is important for the global lift industry to understand this Standard and to consider how it has the potential to change the industry.

2 LIST OF ACRONYMS

1. API: Application Programing Interface
2. ATD: Acquisition and Transmission Device
3. CPS: Controller Protocol Converter
4. EAP: Enterprise Application Platform
5. IoT: Internet of Things
6. LMAP: Lift Manufacturer's Application Platform
7. ML: Machine Learning

3 THE GOALS OF THE STANDARD

The goals of the Standard are stated in its Introduction. The following is a summary of those goals:

1. Improve the long-term competitiveness of the lift industry.
2. Improve products, service and management of the lift industry.
3. Increase passenger satisfaction.
4. Improve products and service by acquiring and analyzing data.
5. Reduce the time that passengers spend entrapped in lifts.
6. Create a method of providing remote technical support for field personnel.
7. Create a platform to improve supervision efficiency.

8. Improve the efficiency of the Chinese lift industry.
9. Improve the status of the Chinese lift industry by being the first country to apply the Internet of Things (IoT) on all lifts, escalators and moving walks.

4 SYSTEM ARCHITECTURE

Two system architectures are defined in the Standard. One is oriented for large lift companies who manufacture, install and maintain lifts. The alternative architecture is for lift companies that purchase lift packages from suppliers and then install and maintain these lifts.

Fig. 1 is an architecture diagram for the larger, vertically integrated lift companies.

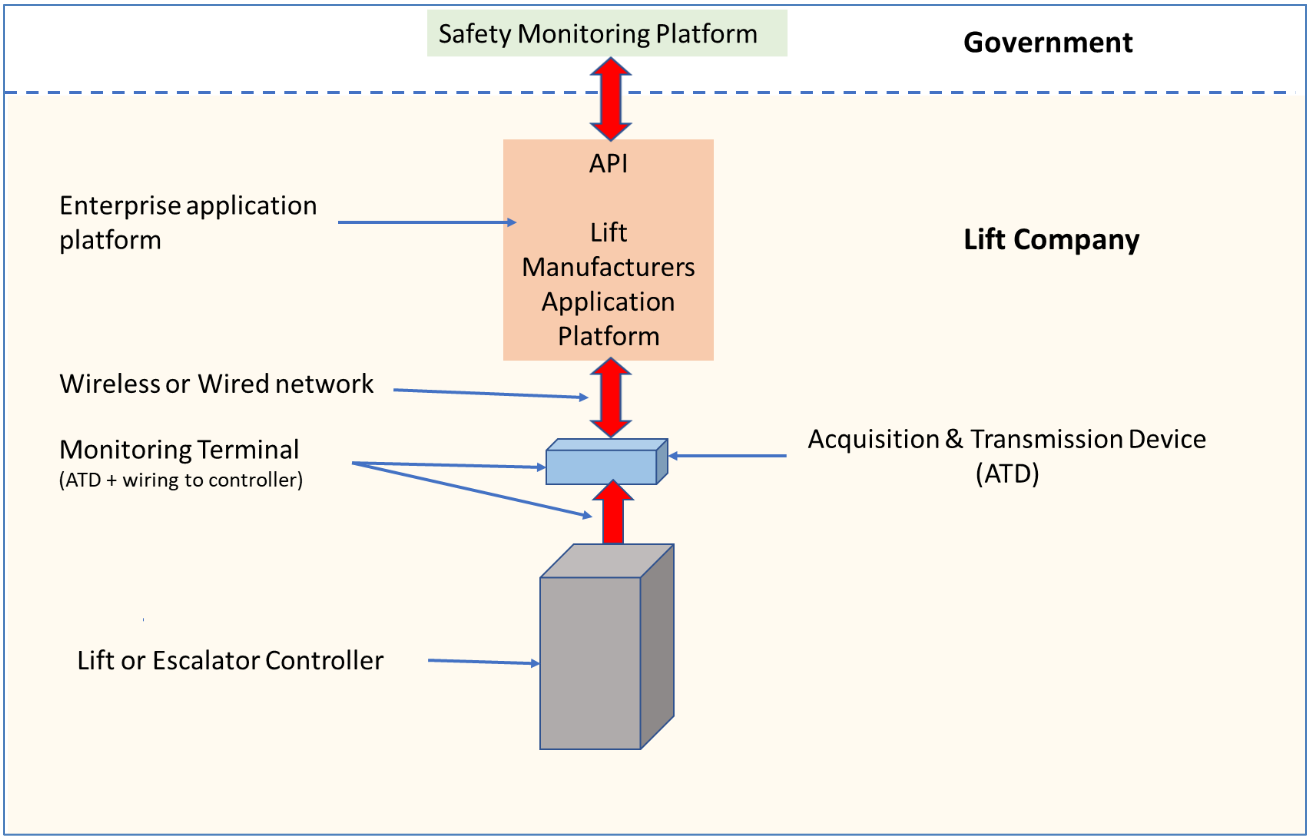

Figure 1: Architecture for vertically integrated lift companies

The Standard refers to the wiring between the controller and the Acquisition and Transmission Device (ATD) as the Monitoring Terminal. The ATD receives data from the controller and sends it to the Lift Manufacture's Application Platform (LMAP). In most cases this device is a cellular modem with the ability to process the data. In some cases, where the device is wired, the device sends the data using RS-485 communication.

Note that the data only flows from the controller to the ATD. No commands can be sent to the controller.

The LMAP has an Application Programing Interface (API) that allows the government's Safety Monitoring Platform to communicate with the LMAP using the internet.

The yellow-shaded lower portion of the diagram represents the portion of the architecture that is the responsibility of the lift manufacturer. The upper portion is the responsibility of the government.

Fig. 2 is an architectural diagram of the system for smaller companies who can out-source the transmission of data to the government. Please note that this diagram has three layers. The blue-shaded lowest layer is the layer provided by the controller manufacturer. The middle, yellow-shaded layer is the out-sourced layer that processes the data from the controller and makes it available to the government's Safety Monitoring Platform through an API.

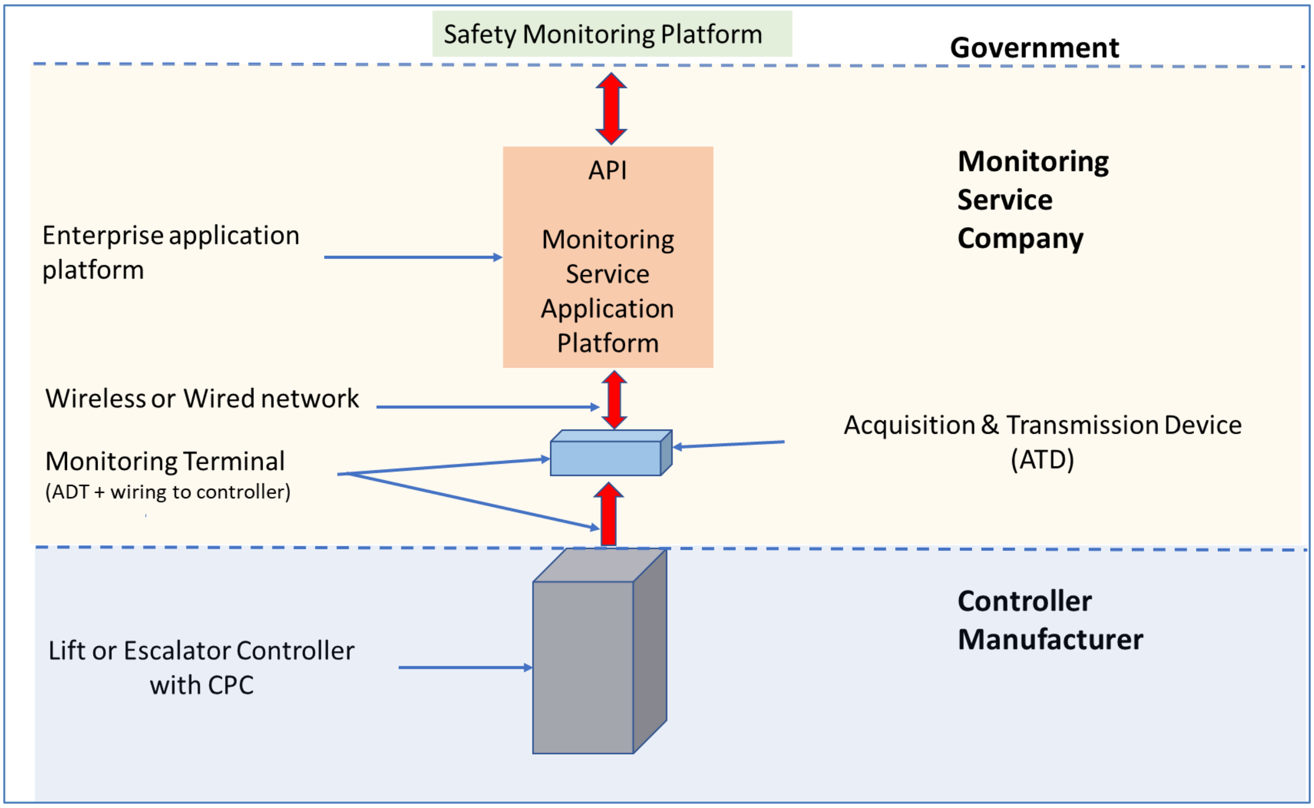

Figure 2: Architecture with outsourced monitoring

The controller has a Controller Protocol Converter (CPC) that converts the data from the controller to a common format that the Monitoring Service Application can utilize.

5 MONITORING TERMINAL

The monitoring terminal has the following requirements:

1. The monitoring terminal must be isolated from the controller in such a way that it does not affect the normal running of the lift, escalator or moving walk.
2. The monitoring terminal must continue to operate for a minimum of 1 hour in the event of a power failure.
3. If the monitoring terminal is provided by a vendor, the power for the terminal must be connected on the line side of the controller.
4. The real time clock in the ATD must be synchronized to the real time clock in the application platform. All clocks will use Beijing time.
5. The memory in the monitoring terminal shall be large enough to store at least the last 100 event records.

6 DATA

The Standard requires several types of data be sent ultimately to the Safety Monitoring Platform. The data types are the following:

1. Static data.
2. Real-time operation status.
3. Statistical data.
4. Faults, event alerts and alarms.

6.1 Static Data

The following static data for each lift, escalator or moving walk is stored in the Enterprise Application Platform (EAP):

1. Identification Number. The number assigned to lift, escalator or moving walk by the EAP.
2. Installation ex-factory number. The number that appears on the certificate of conformity.
3. Registration Number. The number assigned to the lift or escalator when the installation is registered.
4. Installation variety. The variety number assigned by AQSIQ, a government quality agency [2].
5. Installation type. Product type assigned by the manufacturer.
6. Product installation address.
7. Installation internal number. The name that the building management uses, such as “High Rise Car 2”.
8. Installation Manufacturer.
9. Dealer of the imported installation. Only applies to units not produced in China.
10. Installation ex-factory date. The date that appears on certificate of conformity.
11. Modernization company of installation.
12. Modernization date of installation.
13. Product installation company.
14. Product installation date.
15. Name of maintenance company.
16. Emergency rescue phone number. Phone number of maintenance company or building engineer.
17. Name of user entity.
18. Lift data:
    a. Landing number. Number of stops.
    b. Rated speed.
    c. Rated load.
    d. Landing names. Floor designations as displayed on the car position indicator.
19. Escalator data:
    a. Nominal speed.
    b. Hoisting height. Distance between floors.
    c. Angle of inclination.
    d. Nominal width.
20. Moving walk data:
    a. Nominal speed.
    b. Hoisting height. Distance between floors.
    c. Angle of inclination.
    d. Nominal width.

6.2 Real-time operation status

Real-time operation status information is available in the API. The Safety Monitoring Platform, the Government, can access the API in the EAP to remotely monitor any lift in the country.

The following is the real-time data that the Standard requires be sent to the EAP:

1. Data generation time stamps. The "BACnetDateTime" format must be used.
2. Lift data:
    a. BACnetLiftServiceMode data is used as follows:
        i. Out of service.
        ii. Normal operation.
        iii. Inspection. (Faults, events and alarms are not generated while in this mode).
        iv. Fire return.
        v. Firefighters operation.
        vi. Emergency power operation.
        vii. Earthquake mode.
        viii. Unknown.
    b. Car status. Stopped or in motion.
    c. Car direction. No direction, Up, or Down.
    d. Door Zone:
        i. True: Car is in the door zone.
        ii. False: Car is outside the door zone.
    e. Car position. Position is by floor.
    f. Door status:
        i. True: Door is closed.
        ii. False: No door closed signal.
    g. Car occupied:
        i. True: Passengers in car.
        ii. False: No passengers in car.
3. Escalator and Moving Walk Data:
    a. BACnetEscalatorServiceMode
        i. Out of service.
        ii. Normal operation.
        iii. Inspection. (Faults, events and alarms are not generated while in this mode).
        iv. Unknown.
    b. Operation status. Stopped or travel.
    c. Operation direction. No direction, Up, or Down.

6.3 Statistical Data

Two types of statistical data are sent by the Acquisition and Transmission Device (ATD) to the Enterprise Application Platform (EAP):

1. Total running time. This is the cumulative time when the unit was in motion.
2. Motor starts.

6.4 Faults event alerts and alarms

This Standard requires control systems to be capable of generating a prescribed list of faults, event alerts and alarms. These faults, event alerts and alarms must be forwarded to EAP by the ATD.

6.5 Lift faults

The following is a list of the required lift faults:

1. No fault.
2. Safety circuit is interrupted while lift is running.
3. Door closing fault.
4. Door opening fault.
5. Unintended movement.
6. Actuation of motor run limiter.
7. Loss of position.

6.6 Lift events

The following is a list of event alerts:

1. Lift returns to automatic mode.
2. Power failure.
3. Lift enters inspection mode.
4. Lift enters out of service mode.
5. Lift enters fire return mode.
6. Lift enters firefighter’s mode.
7. Lift enters emergency power operation.
8. Lift enters earthquake mode.

6.7 Lift alarm code

When the emergency alarm button is activated, an alarm notification must be sent to the EAP.

6.8 Fault codes for escalators and moving walks

The following is a list of the required faults:

1. No Fault. This fault is issued when the unit exits a fault mode.
2. Safety circuit interruption.
3. Overspeed.
4. Unintentional reversal of direction.
5. Missing step or pallet.
6. Other fault. Any other fault that prevents the unit from starting or running.

6.9 Event codes for escalators and moving walks

The following is a list of the required event alerts:

1. Unit returns to automatic mode.
2. Unit enters inspection mode.

6.10 Alarms for escalators and moving walks

There are no alarms for escalators and moving walks.

7 OBSERVATIONS

7.1 Machine Learning

This Standard requires a large amount of data be sent to the EAP and this data is available to the government. The hardware required by the standard could easily and inexpensively be used to gather much more data. The required data and the additional data that can be collected could be used for Machine Learning (ML). ML evolved from Artificial Intelligence (AI). The goal of AI is to develop computers and software that mimic human intelligence. One of the goals of AI is learning. Machine Learning involves making predictions based on properties learned from data [3].

Machine learning on a larger data set than the minimum required by the Standard, is in the spirit of the goals of the Standard. ML can have the ability to identify product deficiencies, it can identify the strengths and weaknesses of a service program, improve customer satisfaction and most of all, ML can improve safety.

7.2 Transparency

This Standard will create a new level of transparency.

It will be possible to rank companies by such things as call backs per unit per year, injuries per unit per year and maintenance hours per unit per year.

It will be possible to identify problem products and problem companies.

If the government makes their findings available to the public, it will have a great impact on the industry. The impact will be positive for companies that have good reports. It could be disastrous for a company with a poor safety record.

8 LOCAL VARIATIONS

The cities of Hangzhou, Nanjing, Ningbo, Shanghai, Suzhou, and Wuxi have all developed their own variations of the GB/T 24476 code [4].

Shanghai is one of four municipalities governed directly by the central government and the largest city in China [5]. Because of Shanghai's prominent position in China it is widely believed that the Shanghai variation of the code will be adopted nationally [4].

The Shanghai variation of the GB 24476 code is known as DB 31/T 1123-2018 [6]. This code is essentially the GB 24476 standard with additional requirements that include video monitoring.

9 CONCLUSIONS

The GB/T Standard has the possibility to achieve the goals stated in its Introduction. One of those goals is to improve the international status of China's lift industry. One should remember what Japan's adoption of W. Edwards Deming's quality philosophy did for Japanese industry [7].

Proper implementation of the Standard will improve safety and customer satisfaction.

The Standard will change the industry. Those members of the industry who take advantage of this Standard to improve products and operations will be successful. Those who do not, will not fare as well.

10 LITERATURE REFERENCES

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BIOGRAPHICAL DETAILS

Rory Smith is Visiting Professor in Lift Technology at the University of Northampton. He has over 50 years of lift industry experience during which he held positions in research and development, manufacturing, installation, service, modernization, and sales. His areas of special interest are robotics, machine learning, traffic analysis, dispatching algorithms, and ride quality. Numerous patents have been awarded for his work.