The trend of international standardization in the field of railway technology has been set mainly in Europe. And I am afraid that we could be severely affected by that, preventing our technical advance if the trend continues and Japan is caught up in the tide. In order to prevent that, we have many times stated Japan’s standpoints and viewpoints in the process of deliberation whether to establish European standards as international ones, and some of our recent appeals have been accepted.

In light of the situation, we have started a committee to establish ATACS developed by JR East as a Japanese standard in JIS (Japanese Industrial Standards), bearing in mind international standards. On the other hand, the UIC (Union Internationale de Chemins de Fer, the International Union of Railways) is showing their willingness to adopt ETCS (European Train Control System) as an UIC standard for interoperability in Europe.

In this paper, I will introduce the history and future efforts in international standardization and Japan’s actions in regard to that.

1 Introduction

International standardization in railways has been brought about mainly in Europe, and many international standards have come about in the trend that European standards be adopted as international ones. Examples are the RAMS standard that specifies items such as safety and reliability, a standard that specifies software related to safety, and a standard that specifies communications related to safety. Currently, the UGTMS standard that specifies the total structure of train operation control systems regulating management and command of transport systems and the AUGT standard that specifies safety requirements for unmanned train operation are under discussion as to whether they should be adopted as international standards.

In light of the circumstances, Japan’s attitude and actions will weigh heavily in building systems for future railway transport. In the course of preparing the above-mentioned standards, some of our appeals have been accepted; but it will be important for Japan to make more proposals on new systems ourselves, not being passive.

In this paper, I will introduce the standardization of radio train control systems, one of the standards that Japan offers, and the standardization of train control systems that UIC is making efforts for. I hope that this paper could give some ideas how JR East should address international standardization.

2 Trend of International Standardization and Train Control System

Today, international standardization of railway technologies is expanding. In particular, European standards (EN, European Norm) are actively being internationalized. Some of the main examples of such internationalized standards are IEC (International Electrotechnical Commission) 62278 (RAMS: Reliability, Availability, Maintainability, Safety), IEC62280-1 to 2 (Safety-related communication in closed transmission systems, Safety-related communication in open transmission systems), IEC62279 (Software for railway control and protection systems) and IEC62236-1 to 7 (EMC: Electro-Magnetic Compatibility). They are based on European standards, and it is difficult to apply the Japanese situation to international standards.

As for world trends, Europe is proceeding with development and introduction of ERTMS (European Rail Traffic Management System)/ETCS (European Train Control System) for interoperability within Europe. Meanwhile, the USA and Asian nations are introducing to subways and new traffic systems CBTC (Communication Based Train Control), a radio train control system for urban transportation.

For international standardization of train control systems, IEC has started a working group (IEC/TC9 WG40) that discusses on the standard of UGTMS (Urban Guided Transport Management and Command/control System), which is a standard of signalling system of urban railways. In that, members examine standards also incorporating ERTMS/ETCS and CBTC.
2.1) Trends in International Standardization

[RAMS: IEC62278]

This is a standard that requires railway systems to maintain general and good balance in four reliability management indicators of reliability, availability, maintainability and safety throughout the life cycle of the systems, considering economical efficiency. It is named with the initials of each indicator. As this standard has no specific scope of application, it is actually applicable to any component system of railways related to safety, regardless components on ground or on car.

The life cycle of systems is categorized into 14 stages, from concept, through risk analysis, design and implementation, manufacturing, application and maintenance, and finally removal and disposal.

[Software for railway control and protection systems: IEC62279]

This is a standard that specifies software development tools and development rules according to safety integrity level (SIL) of the applicable device. It specifies ADA and PASCAL as the programming languages recommended for SIL 4, the highest safety level. Thus, one of our issues to add C — the mainstream language in Japanese signalling systems — to this standard.

[Safety-related communication: IEC62280]

This incorporates two standards. One is the standard that specifies highly safe data transmission for protection purposes over closed systems such as private transmission systems and transmission using track circuits. The other is the standard that specifies requirements for open transmission systems that are assumed to be accessible by unspecified users such as ordinary service networks and radio transmission. Both specify system safety requirements.

[EMC: IEC62236]

This is a standard for electromagnetic compatibility performance of rolling stock and wayside equipment. That standard has been drafted in Europe based on EN standards, considering actual status of each railway. After being amended upon Japan’s appeal on the measurement method of electromagnetic field etc., it was established as an IEC standard. It is an important standard these days, since electronic devices are installed near tracks. But safety requirements are not specified in this standard.

2.2) ERTMS/ETCS

ETCS (European Train Control System) is included in ERTMS (European Rail Traffic Management System) now under development mainly by the EU. The ETCS project is very large, with many different members taking part, such as railway operators, the railway industry, railway institutes in Europe, and organizations from the EU and member countries. The system is classified into three levels. Level 1, corresponding to ATS-P in Japan, and Level 2 that enables radio transmission of train detection using track circuits have already been put into practical use; but actual use of Level 3, a radio train control system, is not scheduled yet, mainly due to the following reasons.

1) It has many unnecessary functions, because it has to cover the different systems currently in use in each country.
2) Current systems can still be used, and replacement with ETCS will require much cost.
3) It takes a long time to verify interoperability while conducting parallel use and replacement with current systems.

2.3) CBTC (Communication Based Train Control)

This is in actual use in 14 lines in the world, and a system under development is used on a further 23 lines. It is mainly used for monorails and subways, and has two different radio methods. The inductive loop (IL) method, which uses inductive radio near tracks, has been often introduced, but these days the trend is shifting to the radio frequency (RF) method that uses spatial waves. Among the 14 lines that have already put CBTC in practical use, 11 lines are of the IL method and three lines are of the RF method.

2.4) UGTMS (Urban Guided Transport Management and Command/control System)

UGT, urban guided transport, means railways using reserved tracks that are built in urban areas. Unless defined otherwise by national governments, they are differentiated from usual railway networks. A working group of IEC (IEC/TC9 WG40) started examination of a standard for UGT in 2002, studying a wide range of “command, control and management systems” from manual operation to unmanned automatic operation. Japan has expected that ERTMS standards would be recommended as IEC standards later; so, it expressed comments to make Japan’s views satisfactorily incorporated and to adapt those standards to general railways in Japan. The UGTMS standard consisting of Parts 1 to 4 is already put into practical use; but actual use of Level 3, a radio train control system, is not scheduled yet, mainly due to the following reasons.

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Special feature article

2.5) AUGT (Automated Urban Guided Transport)
AUGT is driverless or unmanned railways using reserved tracks that are built in and around urban areas. The standard is to specify safety requirements for all types of AUGT systems. Since the standard is to be applied while complementing ordinances and rules of each country that railway operators must conform to, careful and appropriate consideration of laws and regulations of each country is necessary before application.

At first, the international working group for this standard had worked on a schedule to complete drafting in Autumn 2005; but the IEC general assembly pointed out the length of time required for drafting and instructed a committee draft (CD) be recompiled by the ad hoc group by 2008. Now the working group is proceeding with this job, discussing hazard analysis and levels of automation within bases. Upon a schedule of preparing a committee draft for voting (CDV) by 2009 and implement international standardization in 2011, the committee is meeting three times or so a year. But Japan and France have different views than Germany on many issues. Japan has a policy of describing only general performance in the standard as in ministry ordinances in Japan, not giving weight to numeric specification.

3) Japan’s Actions toward International Standardization

The Japanese Industrial Standards Committee (JISC, set up within the Ministry of Economy, Trade and Industry), which conducts surveys and deliberation about industrial standardization based on the industrial standard law, has prepared the "Action Plan to Strengthen the Foundations of International Standardization in Railway Technology". The action plan points out more than ten standards including the UGTMS standard as important standardization issues in railway technology.

This was done because the introduction of detailed product specifications could severely impact Japanese railway systems, preventing technical advance. The principal objective is to reflect the design concepts of Japanese railways in international standards, avoiding having European concepts adopted as-is.

In those circumstances, we expect that radio train control systems will gain more importance in future train control systems.

4) Standardization of Radio Train Control System

4.1) Establishment of the Committee
JR East had developed ATACS (Advanced Train Administration and Communications System), a radio train control system, completing that three-stage development in February 2005. Upon completion, JR East has held internal meetings about the future direction for ATACS and decided to conduct further study to put it in practical use. The ATACS project team was formed at that time.

At that time, JR East Vice Chairman Yoshio Ishida suggested we foster ATACS not only as a Japanese standard but also as an international standard, considering that Level 3 of ETCS is not showing progress. When we invited comments on this suggestion from internal and external experts, there were disapproving and negative views given, such as "it is inappropriate to make out standards before practical implementation", "putting ATACS into practical use should be given priority", and "it is not good to disclose technology developed by JR East". But most views were positive with opinions such as "it should be standardized in JIS", "the radio train control system is the very system to be proposed to the world for standardization", and "we should break through the status quo that Japan is not leading standardization in the world". This would be a good opportunity to demonstrate Japan’s excellent technology to the world; and consequently, we are going to proceed with standardization of ATACS.

We then decided to form a committee to prepare a JIS standard for ATACS in the Railway Electrical Engineering Association of Japan (REEA), taking international standardization into account too. The committee was formed as the "exploratory committee of radio train control system standardization" in October 2005, with a wide range of members from Ministry of Land, Infrastructure and Transport, public research institutes, universities, railway operators, manufacturers, associations, and others under the chairmanship of Tokyo University of Science Professor Eisuke Shoda (current chairman of the Railway Technical Research Institute) with Nihon University professor Hideo Nakamura as vice chairman. In order to prepare the draft for standardization in JIS, this exploratory committee worked to coordinate and classify functional requirements and system requirements of the Japan Radio Train Control system (JRTC) with a train interval control function and to discuss about the functions to be achieved by ATACS at executive meetings and working groups up to January 2007.

As the scope of study, we included not only general railways and Shinkansen, but also monorails and new transport systems. At the first stage, we mainly examined basic requirements of radio train control systems, framing system requirements. We worked under a schedule of completing the first draft of functional requirement specifications by the end of April 2006 and finishing framing of system requirement specifications by December 2006, while continuing improvement of functional requirements.

JIS draft preparation committees are formed to invite draft standards three times a year. We decided to make an application with our JRTC basic specification draft at the second committee meeting after the deliberation about that draft, based on the progress of the work. So, we made the actual application through the Railway Electrical Engineering...
Association of Japan in June 2006, the nearest deadline at that time, and finally a JIS draft preparation committee was held under the auspices of the Japanese Standards Association in January last year.

The JIS draft preparation committee decided on the following three-part composition for the JIS Train Control System Using Radio Communication standard.

**Part 1: General requirements and functional requirements**

**Part 2: System requirements**

**Part 3: Interface requirements**

Part 1 General requirements and functional requirements correspond to IEC 62290 Part 1 and Part 2 under discussion. Chapters 1 - 6 in the content of the JIS draft also correspond to IEC 62290 Part 1.

JIS draft preparation committee has completed preparation of Part 1 of the JIS draft, and system requirement specifications are being prepared at the exploratory committee of radio train control system standardization.

Most recently, UEC has suggested adopting ETCS as a UIC standard. Specifically, they made a proposal of “a strategy to shift to international train control systems for cost reduction arising from new technology adaptation through a global strategy” at the UIC executive board in March last year. They also said “we will adopt ERTMS/ETCS as a real international standard and promote that as a safe and universal solution for individual usage to establish satellite-supported train operation”. That is, UIC is trying to adopt as an international standard ETCS that they are promoting for interoperability within EU.

So, JR East Vice President Ishida who was participating as a member of the executive board of UIC, expressed a clear objection, saying, “we stand against such standardization that could prevent free technical advance.” Finally, UIC decided to form a special workshop where members disclose all their current developments in signalling and operation management systems and report the results and the direction of the discussion at that workshop to the next executive board meeting (June).

The workshop was held at UIC headquarters in Paris for two days from June 5 to 6. More than 30 participants including technical experts from UIC executive boards, UIC Deputy Chief Executive Vipin Sharma, and UIC Infrastructure Director Gerard Dalton took part in the meeting under the chairmanship of Mr. Ishida. Other participants were representatives of JR East, the Association of American Railroads, Deutsche Bahn AG, FS (Italian State Railways), SBB (Swiss Federal Railways), China Ministry of Railways, Indian Railways, Korean National Railroad and Spoornet (now Transnet) of South Africa.

On the first day, participant countries made presentation about their latest operation, dispatching and signalling technologies and then had Q&A session. On the second day, participants separated in the following three working groups to make further discussions and presentations.

**WG1: Radio and data transmission** (Mr. Konno, General Manager, JR East)

**WG2: Satellite application in the signalling area** (Mr. Kato, General Manager, JR East)

**WG3: On-board signalling technology** (Mr. Matsumoto, General Manager, JR East)

In the general meeting after the presentation of discussion results of each working group, JR East made some assertions mainly on:

a. We agree with application of privately developed technologies, but we disagree with the view that all countries utilize ETCS. Since situations concerning railways, position and handling of radio technology in actual administration and the GPS environment differ greatly by country, it is impossible to focus only one solution.

b. There would be no evidence that proves that only one technology is the key solution. It would prevent free technical advance if we forcedly limit technologies to be studied.

c. There is no necessity to expand application of current ERTMS/ETCS beyond the European continent to other continents. Since the situations concerning radio technology are different from country to country, ERTMS/ETCS could not be a standard in other environments.

d. Standards should not bind technology, rather accepting and promoting technical development.

After the general discussion, our assertions were accepted almost as-is, and the direction was decided as “the working groups this time gave us good understanding that each country had developed different systems in different circumstances; so, we would continue study and discussion at a venue for communicating to each other about the latest technologies between participant countries.” Mr. Ishida reported this conclusion to the executive board meeting in June and the board accepted that.

You might not realize in your daily work, but as stated above, our jobs are becoming linked to some extent to international standards. We might have been passive about how we could minimize the impact on ourselves, but we should take more active attitude in development as to how to obtain the world’s acceptance to our system development and how to register our systems in international standards. I am sure that such thinking and attitude are what determine a real world-leading railway company.