Practical use of Earthquake Early Warning (EEW) System for Shinkansen

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RTRI did various research and development to secure the safety of the train immediately after the earthquake occurrence. UrEDAS is the main our result. In 2000, we aimed the more high reliability improvement, started new algorithm of EEW in cooperation with the Japan Meteorological Agency. This is separately reported by Odaka et al 1). The new EEW system for Shinkansen was developed based on this result in 2004, and the update to a new system was completed in the all Shinkansen line in 2007 (Fig.1). The new EEW system is characterized, and the following two points are given.

(1) Adoption of train stop judgment function by single observation point
The seismograph station in the railway is set up at intervals of about 20km in place along railway-tracks in the substation. To judge the earthquake detection and the train stop surely even when the electric power and the communication line are cut off when the earthquake occurs, only information on the seismograph single point the earthquake detection and the train stop judges, and checks an electric power, communicates, and own condition. It can be called not the central processing type system but a decentralized processing type system (Fig. 2).
(2) Correspondence to the subduction zone earthquake
The seismograph was set up in the shore at intervals of about 100km aiming to detect the subduction zone earthquake ahead of time. This is called a coast seismograph, and (1) is called a railway-tracks seismograph. As for the coast seismograph, when the subduction zone earthquake is detected, earthquake parameter information is offered to the railway-tracks seismograph, and the railway-tracks seismograph judges the train stop based on this information.

The maximum result of the new EEW system for Shinkansen that had been developed was to have developed the earthquake detection algorithm in 2004. As a result, the position of the hypocenter in a few seconds of the P-wave and the estimation magnitude improve by about 20% 2). It contributes to the safe driving of Shinkansen. Moreover, when the new EEW system was put to practical use, the enhancement of the alarm function based on the two way communication to which the reliability improvement of the communication network was required maintaining the fundamental concept of the distributed system was aimed at. The improvement of the communication specification of information and the reliability improvement of hardware were additionally examined in that. The following three points are the improvement points of the EEW system for new Shinkansen.

(1) Adoption of standard telegram that doesn't depend on seismograph model
The communication telegram that had depended on the seismograph maker up to now was standardized by RTRI. Because it becomes easy for the new seismograph maker to enter as the main advantage, the risk decrease when a large-scale system is made with two or more seismographs is enumerated.
(2) Adoption of complete two way communication
The railway-tracks seismograph can exchange warning information on P-wave and S-wave was newly added based on the experience of the Mid Niigata Prefecture Earthquake in 2004. We think that this function will be an effective method because the warning judgment becomes possible in the region where the P-wave and S-wave have not reached either as shown in Fig.3.
(3) Introduction of simple EMC examination
The seismograph for Shinkansen is often chiefly set up in the substation in the railway track. Then, the seismograph maker was made to execute a simple EMC examination this time. In the future, we want to decide EMC examination for the Shinkansen seismograph, and to reflect EMC examination in the seismograph production in full scale.

The policy in the future, we aim at the construction of the EEW system for Shinkansen with high reliability more than before. In addition, we thought that it aims at the EEW system with high reliability, and the research and development on hardware and software both sides are necessary.

References
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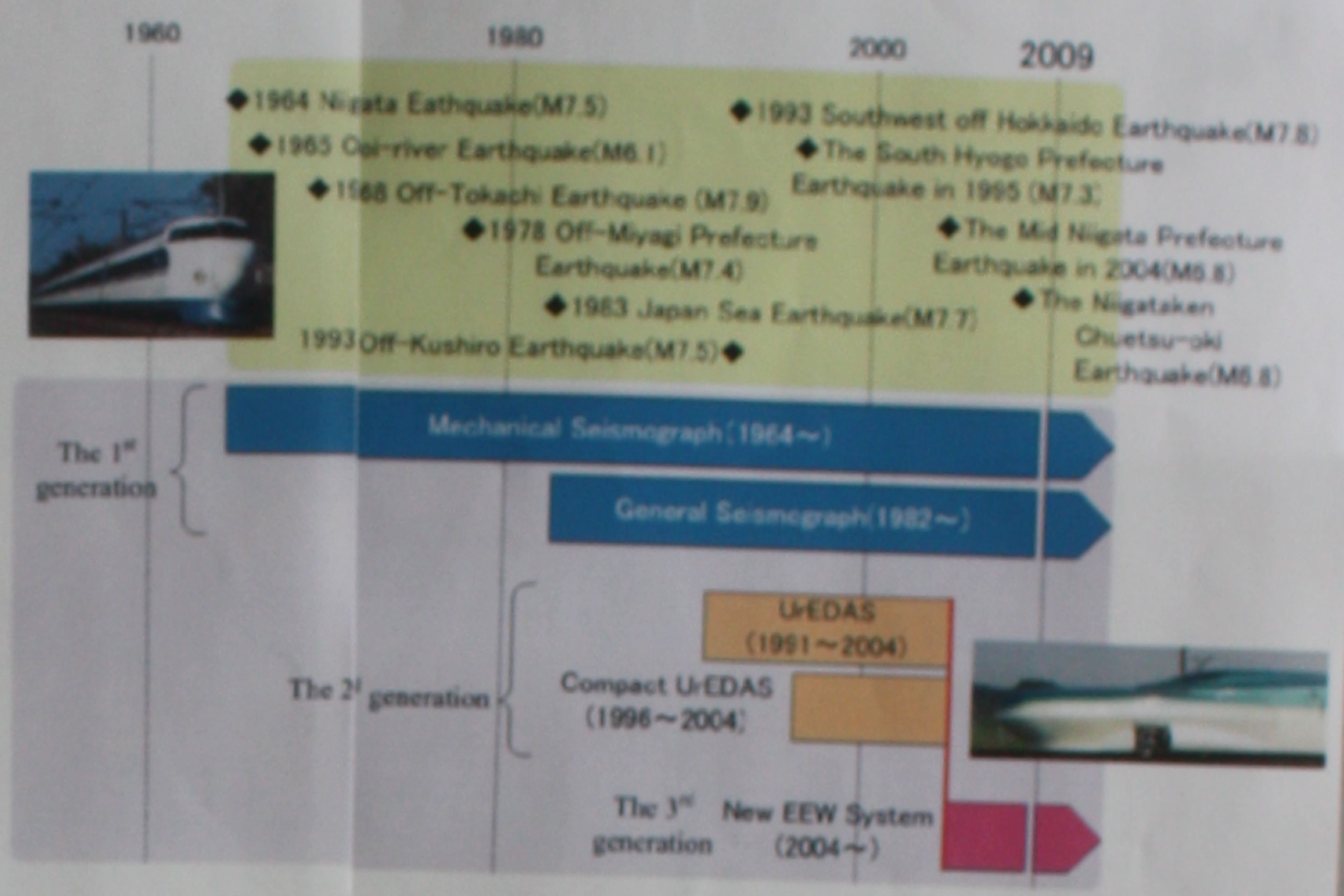

Fig.1 Background of EEW system in RTRI

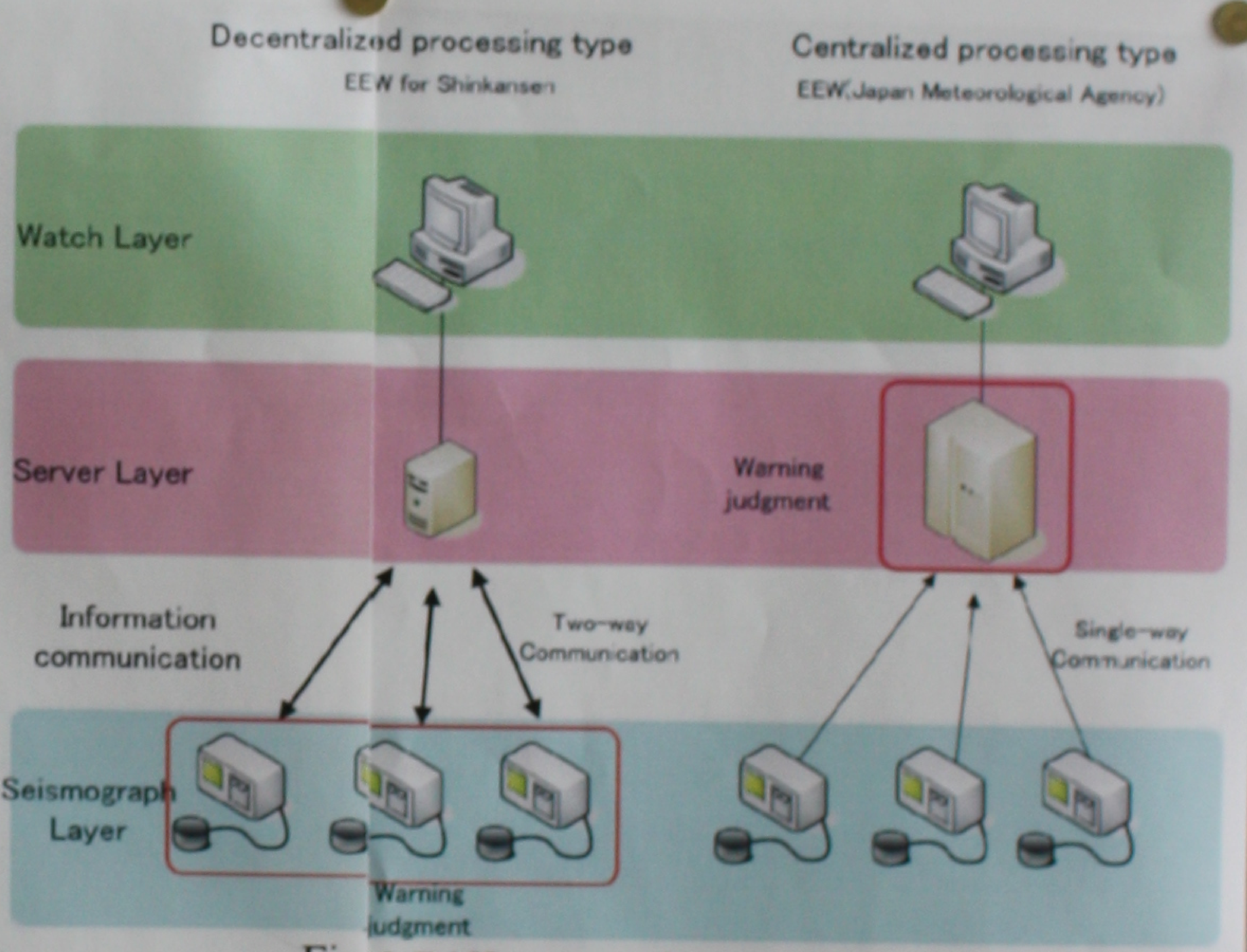

Fig.2 Difference of processing type

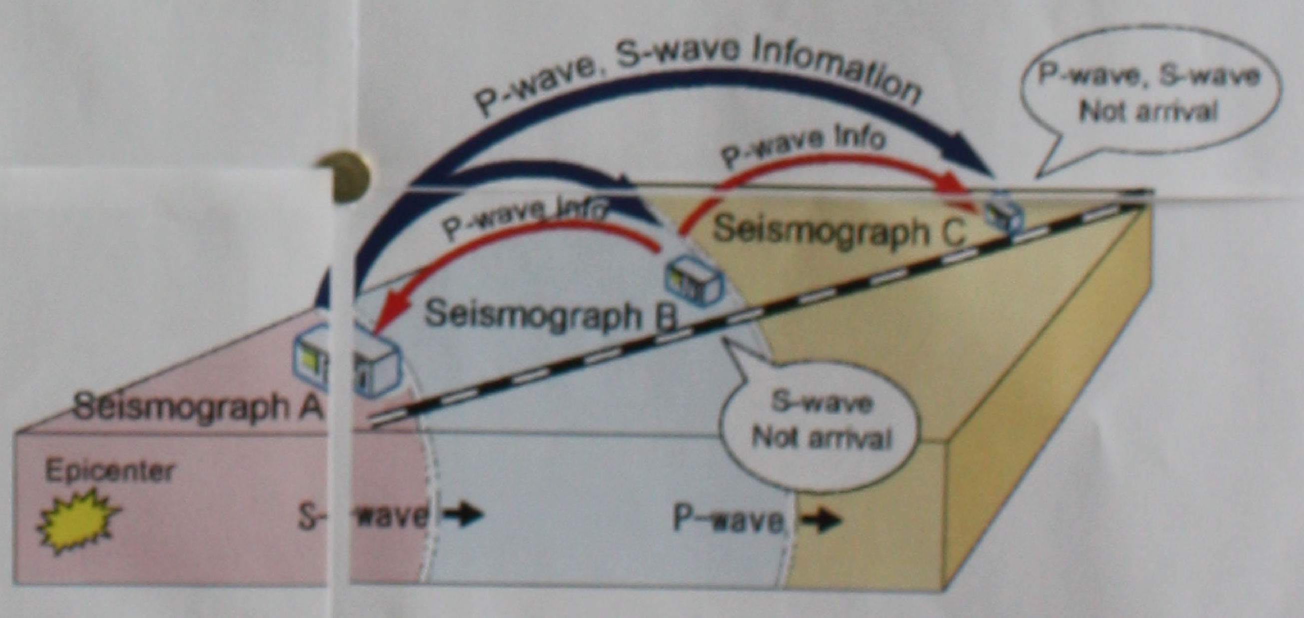

Fig.3 Two-way communication of seismograph


Fig.4 New EEW System (The 3rd gen)


Fig.5 Mechanical Seismograph (The 1st gen)