ATTACHMENT 3

MOBILE RECEPTION

In the future, almost all the high-quality television programs will likely be provided via fiber to the home (FTTH) or satellite (BS, CS) networks. There is a strong requirement for terrestrial broadcasting to support mobile services. Moreover, the VHF and UHF bands, which are allocated for terrestrial broadcast services, are suitable for mobile reception in essence. The Digital Terrestrial Television Broadcasting (DTTB) within these bands will provide ultimate broadcast services for mobile viewers.

From the technical point of view, the most of the error correction codes that have been devised for increasing the reliability in the transmission of data are effective when the errors are caused at random, for instance, the AWGN channel. However, there are channels that have bursty error characteristics in mobile reception. An effective method for dealing with burst error channels is to interleave the coded data stream so that the bursty channel is transformed into a channel having random errors.

Importance of Time Interleaving

In the mobile reception field strength of received signal may be changed with moving of the mobile. At slow speed, fading and flutter cause rather long duration of reduced signal which results an uncorrectable burst error. Errors with uncorrectable with FEC are shown as Red zoon in Fig.1.

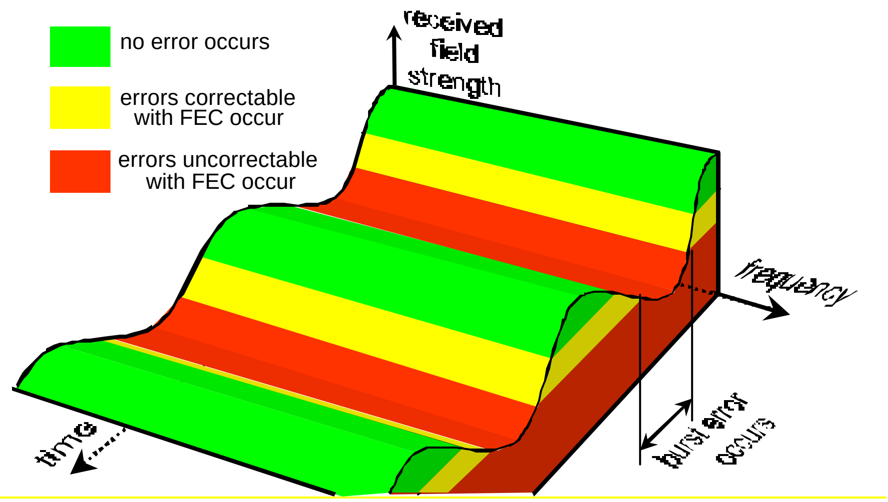

Fig.1 Field strength changing with moving of mobile

Prior to transmission adjacent data are placed the maximum of 0.5sec apart by the time interleaving, therefore, in the receiver a burst error is converted to random errors after de-interleaving and become correctable with error control system (as shown in Fig.2).

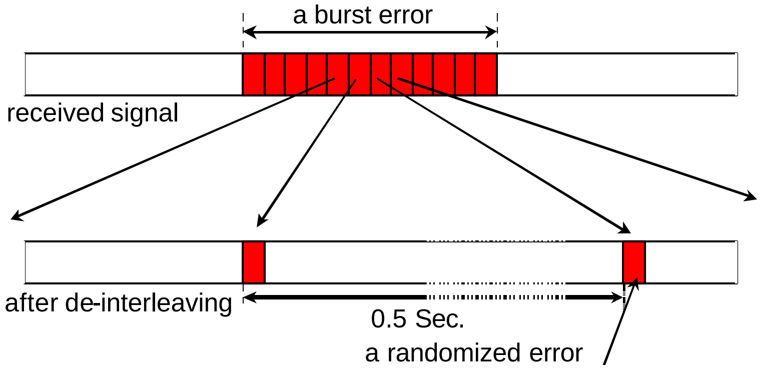

Fig. 2 A burst error is converted to random error

The bit error rates and field strengths were measured on roads about 3,000km in Tokyo area.

Figure 3 shows the time rates of correct reception. It shows that the required field strength for 99% -correct reception is about 50 dBuV/m in case of time interleaving for 427.5ms. The figure compares the correct reception rates for transmission with and without time interleaving. If it does not adopt the time interleaving, the rate of 99% is hardly attained.

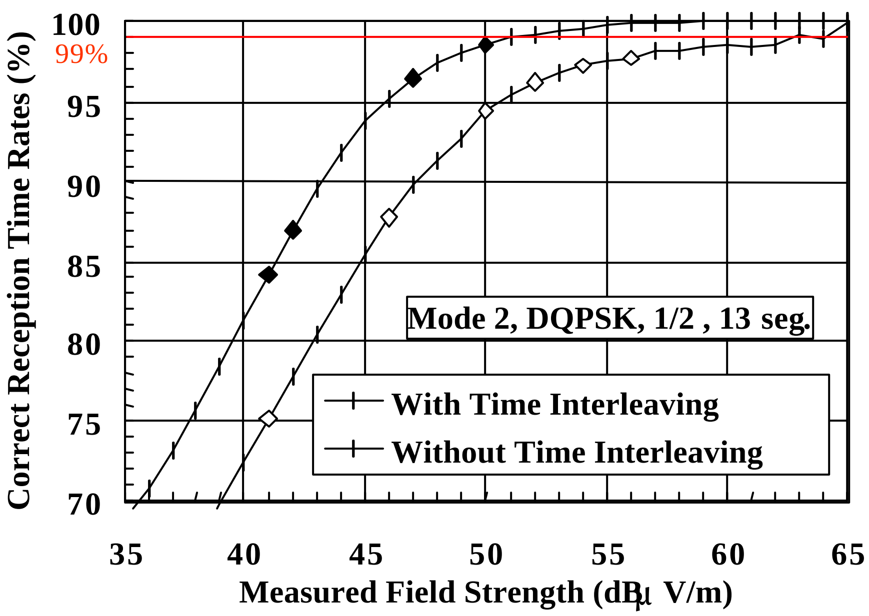

Figure 3 Correct reception rate in mobile reception

It is not surprising that ISDB-T showed the best results in Brazil's comparison tests, because similar test results were obtained in Singapore and Hong Kong. Time interleaving is therefore very effective for mobile reception and is also effective to cope with impulse noise degradation.
Time interleaving is not used in DVB-T system. Therefore ISDB-T system shows always better performance than DVB-T.
Time interleaving brings 0-1sec time-delay disliked by broadcasters. But Better reception should take priority over this disadvantage.

The ISDB-T system has the time interleaving function justly, because the system was designed from the first considering a mobile reception. This adoption of the key technology for mobile reception is a big difference between the ISDB-T and other DTTB systems. In fact, there are many experimental results that prove the time interleaving to be very effective for mobile reception. The ISDB-T system has shown its ability in several comparison experiments.

Furthermore, the mobile services via both broadcast and telecommunication networks promise well for the future. The segment structure that is one of superb features of ISDB-T facilitates the implementation of a common terminal for both broadcast and telecommunication. Because the single segment signals can be received by this type of terminal that has small size FFT circuit with low sampling clock.

In Japan, there is active discussion on valid mobile services using the ISDB-T system, for instance, a development of PDA type receiver, IPv6 application, scalable data structure for various receiver, position relating data service etc. The ISDB-T system offers the possibility of expanded mobile services with a wide variety of businesses.

World's first signal-reception experiment on a high-speed train

A very interesting experiment was carried out in Japan recently to prove the excellence of mobile reception in ISDB-T.
Some information regarding this experiment can be found below.

Aboard the Tokaido Shinkansen Bullet Train, Running at 270 km/h

Ground-based digital-broadcasting experiment carried out by TODEC on a Shinkansen bullet train. The upper photo shows a scene inside the train, and the lower one shows the high quality of the video image received in the course of the experiment.

On April 17, the Tokai Ground-Based Digital Broadcasting Experiment Council (TODEC) carried out an experiment testing high-speed mobile-broadcasting signal reception using a moving Shinkansen bullet train. The ground-based digital television broadcasting system uses the broadcasting system for moving objects. This was the world's first experiment designed to test signal reception in a train running at high speeds, and was carried out based on the hierarchical transmission system for mobile portable phones.

The modulation system used in the experiment was "DQPSK" with a coding rate of 2/3, and the experiment was carried out in mode 2. The test bullet train was run between Toyohashi City and Oogaki City within the TODEC service areas, sequentially receiving radio signals on the same channel (ch. 15) from the Hongusan Transmitting Station (Toyohashi City), (Toki City), and Higashiyama Transmitting Station (Gifu City). The image received was sufficiently clear and sharp, even in the train that ran at 270 km/h through each of the areas covered by the respective transmitting stations. The companies sponsoring the experiment were the Central Japan Railway, Matsushita Electric Industrial, Maspro Antenna, TAO, and Nagoya TV.

Terrestrial digital broadcasting will permit reception of TV signals by car navigators and portable terminals. This experiment has proven that video signals can be received by a moving object running at a speed as high as 270 km/h.