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MANAGING MULTIMEDIA DATA SERVICES WITH MULTIPLE ENSEMBLE DECODING ARCHITECTURE IN DIGITAL AUDIO BROADCASTING SYSTEM

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Abstract

This paper proposes the architecture of multiple ensemble service in DAB network, in which they can transmit and receive more than one ensemble through multiple transmitters, which covers the same service area. Using this architecture, ensemble providers and transmission network providers can have more flexible management environment of DAB networks as well as they can accommodate more than 1.5 Mbps data limit of one ensemble.

1. Introduction

Eureka-147 DAB(Digital Audio Broadcasting) system has 2.3 Mbps of data delivery capability. However, the data payload reduces to 1.5 Mbps when we take into account the overheads such as the bits for data synchronization, error correction and multiplex configuration information. DAB broadcasters are providing CD quality audio services and multimedia data services through this 1.5 Mbps channel[1].

Dual band receiver and the receiver with two tuners tried to compromise the quality or weakness of the received DAB signal through analog audio broadcasting channel or by taking advantage of the technologies such as diversity effect[2~3]. They were all for the improvement of the quality of the received signal through the use of more than one RF receiver. The architecture in this paper has the similar structure described above, but the proposed idea is mainly focused on the efficient management of the service and data rate improvement.

In the view of multimedia data service providers, although DMB service can provide higher data rate per channel than existing analog broadcasting systems or cellular mobile communication systems, still, it is not enough to provide sufficient data delivery capability for the services such as SD(Standard Definition) video and real time traffic status contents including GIS(Geographic Information Service) information[4~6].

This paper proposes a new architecture of Eureka-147 ensemble handling scheme, a multiple ensemble decoding architecture of DAB network, in which they can transmit and receive more than one ensemble through multiple transmitters, which cover all the receivers of the service.

2. Data Service Architecture with Multiple Ensemble

In conventional DAB network, a service must be provided and received with only one ensemble. This means that a service is being provided through one or several sub-channels of one DAB transmission ensemble. Thus, the maximum data rate of the service cannot exceed the limit of the capacity that one ensemble can provide.

Figure 1 shows an example of providing a service with multiple ensembles in DAB network. In the Figure, the receiver can receive the DAB ensembles both from the transmission site 1 and transmission site 2. In this case, the program 1 comes from both of the transmission sites after being divided into two parts at the multiplexer.

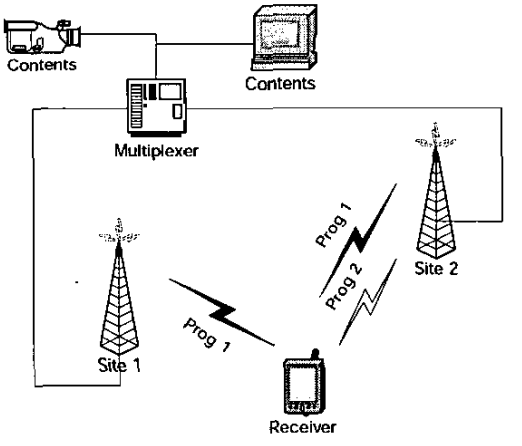

Figure 1. Multiple ensemble transmission structure in DAB network

The reasons of this program division comes from the fact that the data rate needed by the program 1 exceeds the capacity remained for that service in the ensemble 1 from the transmitter site 1, or the program 1 itself needs the data rate of more than one ensemble.

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Figure 2 shows the example of ensemble structure for one data service using two Eureka-147 ensembles. The service 1 in DAB ensemble 1 has two audio services and one data service. The data service channel of the service 1 is divided into two and each of them is transmitted through ensemble 1 and ensemble 2 respectively. Finally, they are merged into one data service at the receiver for their application.

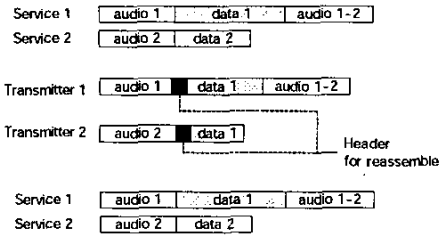

Figure 2. Frame handling of two ensembles

In the aspects of ensemble and transmission network providers, this architecture will provide highly efficient ensemble management environment, because they can utilize remaining pieces of sub channels for another data services by merging them into one service channel. For multimedia data service providers, another high capacity data service such as SD type video is possible, because the whole three ensembles can be merged into one 4.5 Mbps data channel. For this to be done, another type of ensemble planning is needed to give sufficient number of ensembles for the receivers for given services.

3. Performance Analysis

When we assume that the receiver exists in the service area of the transmitters and the requests of the transmission of the data packets by the data providers(or by on-demand data scheduling) follow Poisson distribution, this situation becomes the case which is similar to M/M/n Queue, where the number of server is the number of ensembles and the service rate is defined between the data rate requirement and the remnant capacity in all the ensembles. Figure 3 shows the blocking probability comparison with the numbers of ensembles(1~3) when we assumed that both the average service time and the interval between the starts of the services as one hour. We can see the efficiency improvement of the ensemble management by estimating the service blocking probabilities of several numbers of ensemble usages in the figure.

4. Conclusion

This paper proposes a multiple ensemble service architecture of DAB network, which can transmit and receive more than one ensemble through multiple transmitters and receivers. Using this architecture, ensemble providers and transmission network providers can have more flexible environment in the management of DAB networks as well as they can overcome the limit of one ensemble capacity(1.5 Mbps). There needs to be further studies on an optimal ensemble planning for multiple ensemble services as well as SDR technologies for multiple frequencies handling for each ensemble.

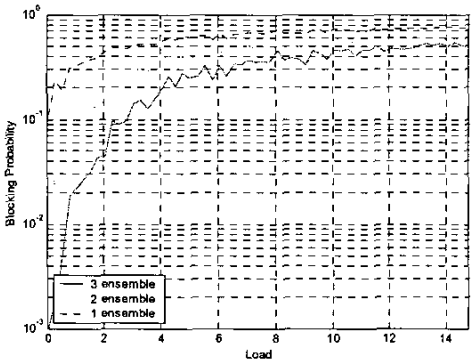

Figure 3. Blocking probabilities of various ensemble utilization

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Reference

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