Lesson 09
Digital Audio Broadcasting
Digital Audio Broadcast System (DAB)

- OFDM carrier FHSS based technique for distribution (spreading) of data over large number of sub-carriers that are spaced at precise frequency intervals with the help of a coding scheme
- Multi-carrier transmission and multiplexing in each carrier facilitates single frequency networks (SFN) for multiple applications
DAB

- OFDM enables separation of carriers in spite of the multi-path transmissions and interference of signals
- Multiplexing of stereo radios and radios for traffic reports
- Each carrier using mutually orthogonal codes
- Frequency spectrum in VHF Band III and UHF L band
Frequency Spectrum and Bandwidth

- Eureka 147 protocol, VHF Band III (174 to 240 MHz) and UHF L band (1.452 to 1.492 GHz), bandwidth 1.5 MHz block (192 to 1536 sub-carriers) per carrier multi-carrier transmission
Audio Coding

- MP2 (MPEG-1 layer-2) audio codec needs 192 kbps plus for good stereo audio, but at 192 kbps, only six DAB stations can multiplex.
- 1.5 MHz block of the frequency band is used and 1.5 MHz block multiplexes six 192 kbps stations by frequency multiplexing.
DAB

- UK adopted DAB 128 kbps codec
- Dual rate codec (128 kbps and 192 kbps) protocols are being adopted
- DABv2 (DAB version 2, DAB-2) adopted in 2006
DABv2

- Supports MPEG2, AAC (advanced audio coding), MPEG4, BSAC (bit slice arithmetic error resilient coding), AAC+ (only in new DAB+ standard), SBR2 (spectral band replication), and Windows Media audio codecs together with convolution coding and RS coding
Dynamic label segment (DLS) multiplexes text with audio to provide radio text real-time information such as weather report, stock-quotes, and traffic congestion reports.

The text can be read on LCD screens.
Carriers and inter-symbol multiplexing

- OFDMA multiple carriers for broadcast from a single radio station
- For example, three short wave radios (SWR) of 192 kbps stereo, one 160 kbps stereo, two SWR services for traffic reports at 18 kbps use a SFN in Germany
Broadcast transmission

- Needs lower power
- Same SFN of all stations in a country for same radio program network and using OFDM same frequency spread multiplexing
- Common interleaved frame (CIF) which transmits after the time–space interleaving of data fields in the frame
Frame and Time–space interleaving and Modulation,

- Frame consists of main service channel (MSC), synchronization channel (SynC), and fast information channel (FIC)
- Time space Interleaving transmitted in different time slots $t_s$ in sequence other than that in which generated
- Receiver rearranges the sequence and generates the original analog signals
- Differential QPSK (DQPSK)
Guard interval $t_g$

- Period provided before synchronization of the transmitted bits takes place in the receiver
CIF Frame Channels

- Fast information channel (FIC) carries control information and has 240 bits plus a 16-bit checksum.
- Interleaved in the frame along with the MSC and the synchronization channel.
- The synchronization channel of the duration of the transmission time of two symbols \([2 \times (t_g + t_s)]\) and is also interleaved with the MSC and the FIC.
OFDM Advantages

• Error bursts resulting from multi-path interference in a case of moving vehicle are averaged out over the time
• Effect of delay is felt only in time reference signals
Delays

- Computation delay occurs due to this sequencing and re-sequencing.
- The data buffering and other processing also contribute to delay, typically of a few seconds, between the studio source and the receiver.
Bit-error correction

- Viterbi method
- Based on forward error correction (FEC)
- Very low BER (bit error rate) in FEC for the control of critical features in the receiver (e.g., synchronization channel) and normal BER in FEC for traffic channel
Architecture of a DAB transmission unit
Object

- An object consists of a collection of logically bonded data fields and properties which define the state of the object and methods (functions) which manipulate the state of the object.
DAB Objects

- A DAB transmitter transfers the DAB objects with each object consisting of the data fields and services.
- A device can be considered as receiving DAB objects in real-time environment and the server disseminating or broadcasting these objects to the devices.
Server (broadcaster) transmission of the objects

- The objects examples—Traffic reports, news as text, weather report, and stock quotes)
- Objects with high subscription (demand) can be repeated more often with defined push frequencies proportional to subscription probability
Broadcasting interleaved segments of different objects

- Can broadcast such that only object header repeated
- Similar to index \((I, m)\) technique in which index \(I\) repeats \(m\) times
Multimedia object transfer (MOT) protocol

- A standard, which supports DAB and multimedia formats—JPEG, Java, HTML, GIF, BMP, ASCII, and HTTP)
- DAB receiver of various types
- For example, audio only, audio with colour graphic display, audio with multi-line text display, audio with single-line text display, audio with slide show, and audio with HTML web page
• The DAB objects or interleaved segments form the body of the transferred data
• The body can have arbitrary data the content type of which is given in the header field
MOT protocol

- Involves transmission of data with a core header, a header extension, and body.
- The core has seven byte fields for header size, body size, and content type.
The receiver using MOT

- Identifies the object as well as assess its resources
- For example, whether the data object received is a JPEG file, a text in ASCII, or an audio codec output
MOT extension header fields

- After the core provide additional information
- Push frequency for a data file
- Priority of the data
- Segmentation and supporting caching mechanism (e.g., method to be used for selective tuning and caching of DAB objects or segments)
Summary

- DAB Eureka 147 protocol, VHF Band III (174 to 240 MHz) and UHF L band (1.452 to 1.492 GHz), bandwidth 1.5 MHz block (192 to 1536 sub-carriers) per carrier multi-carrier transmission

- OFDM

- SFN of all stations in a country
Summary

- Common Interleaved Frame
- Frame consists of main service channel (MSC), synchronization channel (SynC), and fast information channel (FIC)
- DAB objects
- MOT protocol
End of Lesson 09
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