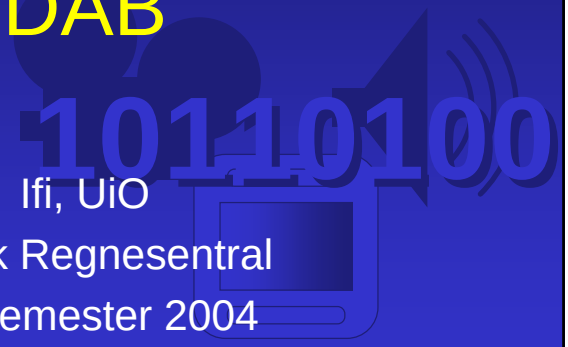
Seminar: Multimedia Coding and Transmission

DAB



Ifi, UiO
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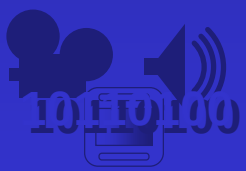
Vårsemester 2004
Wolfgang Leister

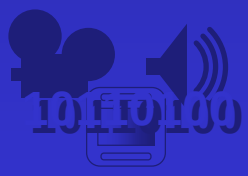
This part of the course ...

- ... is prepared by
  Wolfgang Leister
- … uses material from Eureka 147



EUREKA DAB

- reliable multi-service digital broadcasting system for
- mobile, portable and fixed receivers
- with non-directional antenna
- audio programmes
- data services



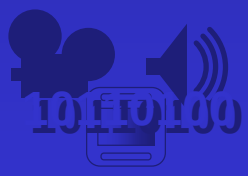
EUREKA DAB

- EUREKA-147 (1992)
- ITU-R recommendation (1994)
- ETS 300401 European Standard (1997)

- useful bit rate up to 1.5 Mbit/s
- error protection (25-300 % of bitrate)

DAB Services

- MPEG 1 / MPEG 2 Audio Layer 2
- Flexible audio bit-rate 8 - 384 kbit/s
  (5-6 hq. stereo / 20 rq. mono programmes)
- Data services
- Programme Associated Data (PAD)
- Conditional Access (CA)
- Service Information (SI)

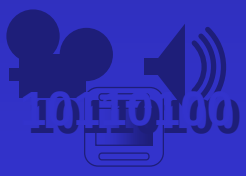


Data Services

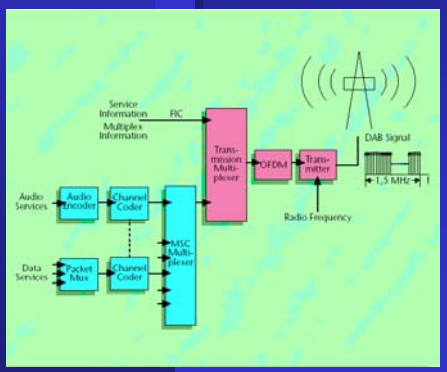
- Programme Associated Data (PAD): 667 bit/s - 65 kbit/s; at the end of DAB/ISO audio frame.
- Independent Data Services:
  - 24 ms logical frames with nx8 kbit/s
  - packet mode
  - part of FIC (Fast Information Channel)

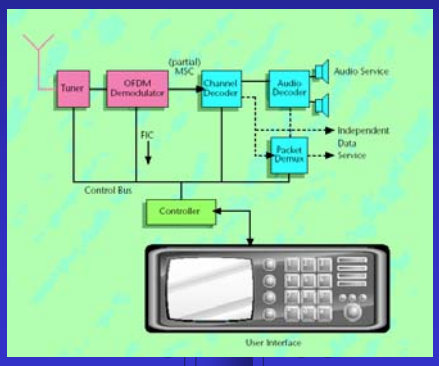
Data Services

- Conditional Access
- Service Information
  - basic programme service label
  - programme-type label
  - dynamic text label
  - programme language
  - time and date for display or recorder control
  - switching to traffic reports, announcements
  - cross reference to the same service
  - transmitter identification



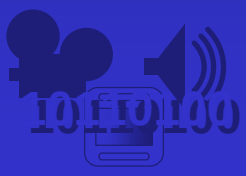
Generation / Reception





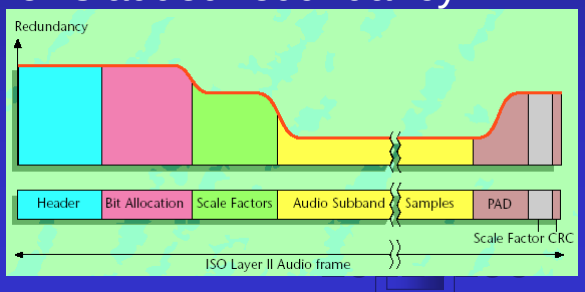
Channel Coding

- energy dispersal scrambling
  - add pseudo-random bit sequence to data
  - to randomize shape of data (power saving)
- convolutional encoding
  - adding redundancy to data
  - UEP: Unequal Error Protection
- time interleaving
  - reduce risk for total loss of data
  - spread data over longer time



Unequal Error Protection

- Parts of audio signal are less sensitive to transmission errors!
- Drawing shows added redundancy:



Main Service Multiplex

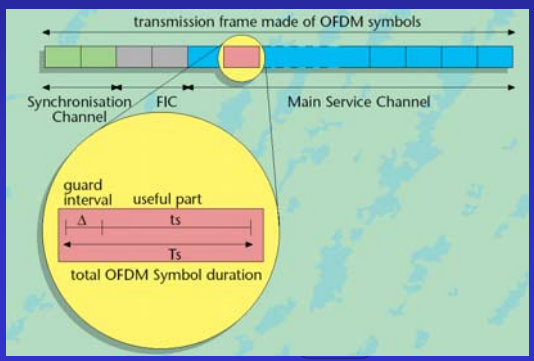
- encoded / interleaved data ⇒ MUX
- data gathered to sequences every 24 ms
- combined bit-stream = MSC (Main Service Channel)
- net bit-rate: 0.6 - 1.8 MBit/s (dependent on convolution rate)
- DAB signal 1.536 MHz bandwidth
- possible bit-rates ⇒ ⇒ ⇒ ⇒ ⇒ ⇒
- MCI (Multiplex Configuration Info)
- MCI is part of FIC

Audio bit-rate kbit/s	Protection level (increasing protection) 5	4	3	2	1
24*	n/a	64	48	36	24
32	54	41	36	29	24
64	27	20	18	14	12
128	13	10	9	7	6
192	9	7	6	5	4
224	7	6	5	4	3
256	6	5	4	3	3

*Equal Error Protection

Transmission frame

- Fixed frame structure
- Three channels:
  - Sync
    - null symbol
    - phase ref
  - FIC
  - MSC

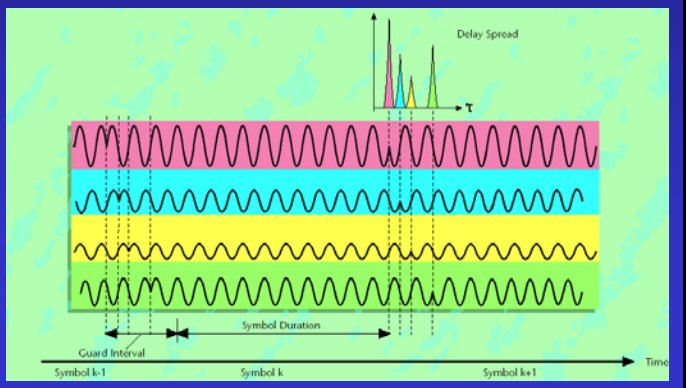


OFDM

- Orthogonal Frequency Division Multiplexing
- divide into large number of bit-streams
- with low bit-rates each
- orthogonal carriers
- differential QPSK
- symbol duration larger than delay spread
- insert a temporal guard interval

OFDM

- large number of orthogonal carriers with FFT
- signal spectrum is ~ rectangular, Gaussian noise like
- DAB block

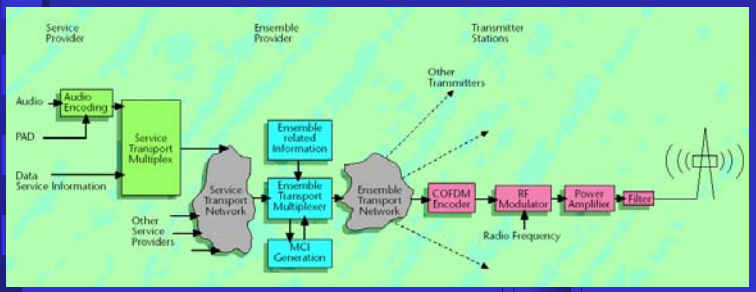


Transmission Modes

System Parameter	Transmission Mode I	II	III	IV
Frame duration	96 ms	24 ms	24 ms	48 ms
Null symbol duration	1297 µs	324 µs	168 µs	648 µs
Guard interval duration	246 µs	62 µs	31 µs	123 µs
Nominal maximum transmitter separation for SFN	96 km	24 km	12 km	48 km
Nominal frequency range (for mobile reception)	≤ 375 MHz	≤ 1.5 GHz	≤ 3 GHz	≤ 1.5 GHz
Speed/coverage trade-off	No	No	No	Yes
Useful symbol duration	1 ms	250 µs	125 µs	500 µs
Total symbol duration	1246 µs	312 µs	156 µs	623 µs
No. of radiated carriers	1536	384	192	768

DAB Distribution Network

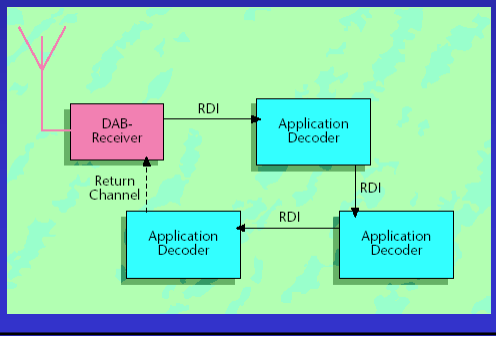
- DAB Ensemble
- ETI: Ensemble Transport Interface



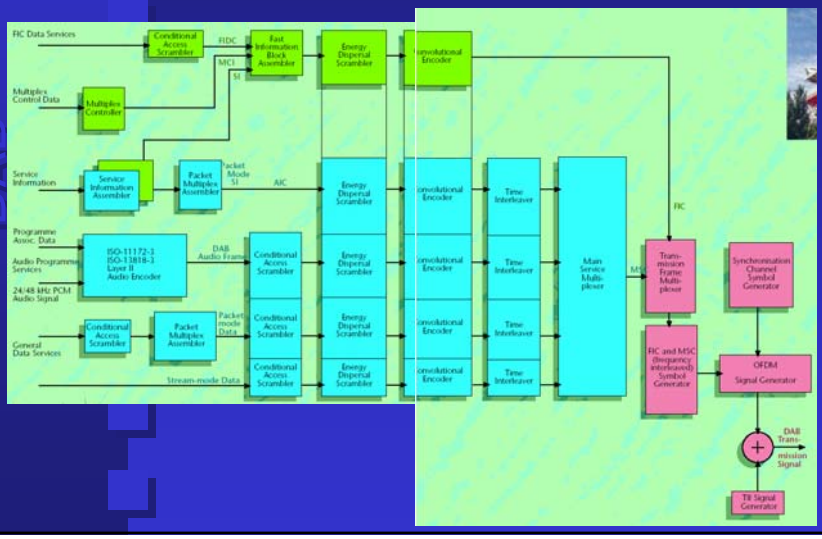
Receiver Data Interface

- RDI: Receiver Data Interface (up to 1.8 Mbit/s)
- DAB based MM services
- Transport mechanisms:
  - stream mode
  - packet mode
  - PAD
- MOT

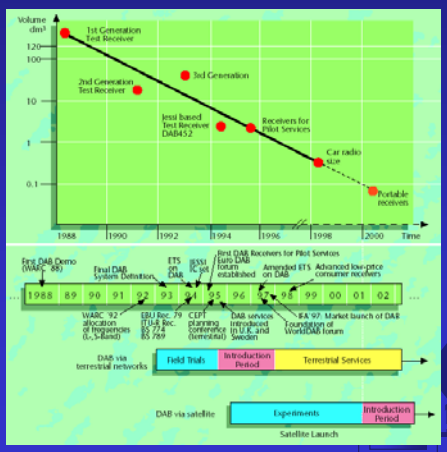
(Multimedia Object Transfer Protocol)



DAB Signal Generation



Deployment



Applications

other than audio ...

- Data management
- Traffic and Travel Information
- Text Transmission
- Electronic Newspaper
- Picture Transmission (JPEG + HTML)
- TV Transmission to Mobiles (MPEG1/2)
- Fax Printout
- Differential GPS

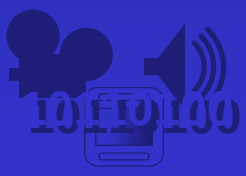
Literature and Links

DAB:

http://www.worlddab.org

http://www.worlddab.org/public_documents/eureka_brochure.pdf

Wolfgang Hoeg, Thomas Lauterbach:
“Digital Audio Broadcasting - Principles and Applications“
Wiley, 2001



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