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# Mobile Communications
# Chapter 6: Broadcast Systems

- Unidirectional distribution systems
- DAB
  - architecture
- DVB
  - Container
  - High-speed Internet

# Unidirectional distribution systems

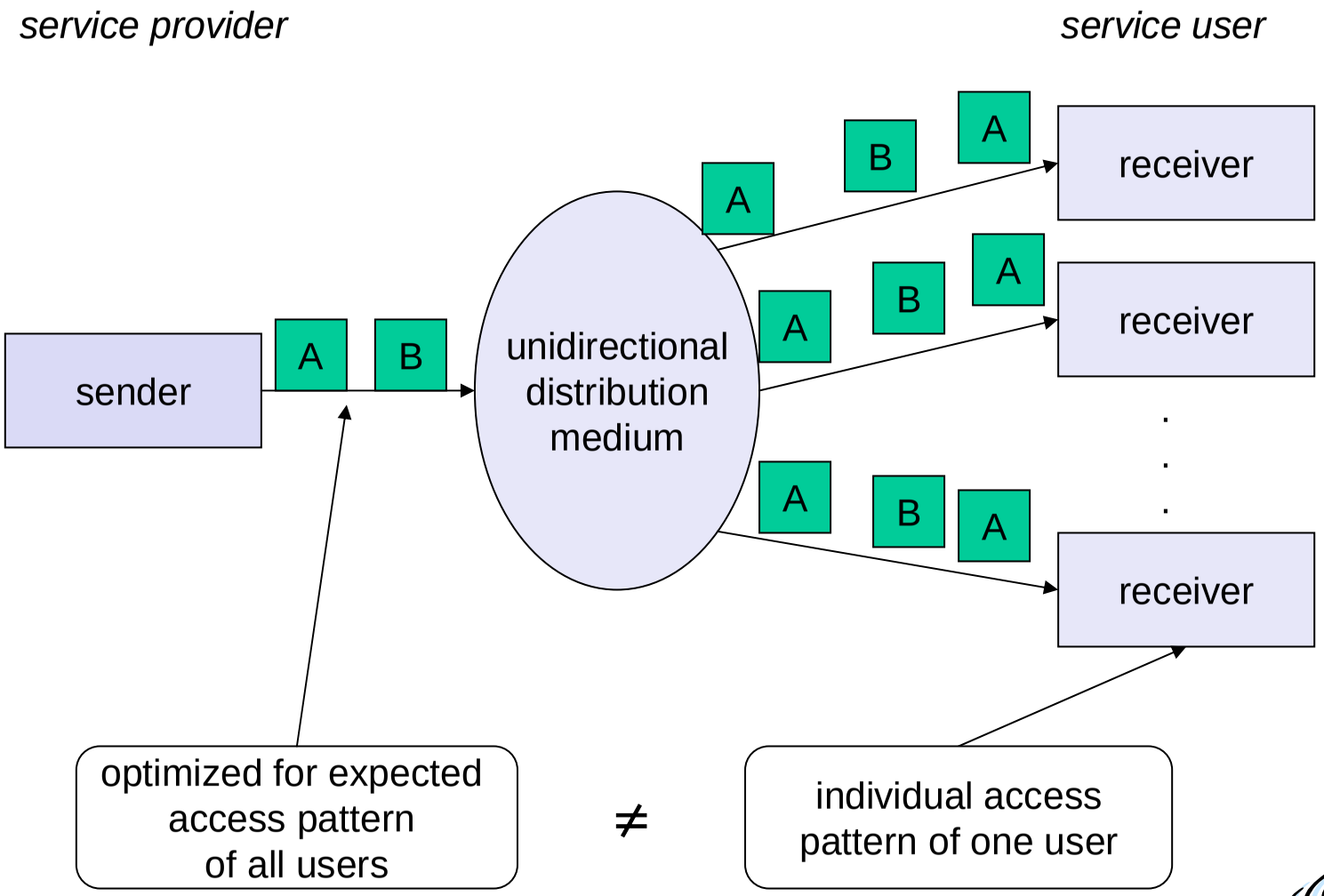
Asymmetric communication environments

- bandwidth limitations of the transmission medium
- depends on applications, type of information
- examples
  - wireless networks with base station and mobile terminals
  - client-server environments (diskless terminal)
  - cable TV with set-top box
  - information services (pager, SMS)

Special case: unidirectional distribution systems

- high bandwidth from server to client (downstream), but no bandwidth vice versa (upstream)
- problems of unidirectional broadcast systems
  - a sender can optimize transmitted information only for one group of users/terminals
  - functions needed to individualize personal requirements/applications

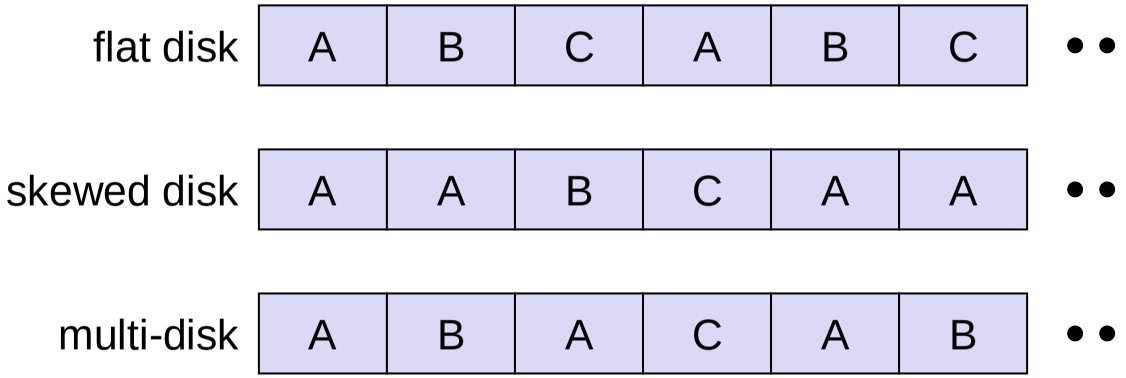
# Unidirectional distribution



# Structuring transmissions - broadcast disks

## Sender

- cyclic repetition of data blocks
- different patterns possible (optimization possible only if the content is known)




## Receiver

- use of caching
  - cost-based strategy: what are the costs for a user (waiting time) if a data block has been requested but is currently not cached
  - application and cache have to know content of data blocks and access patterns of user to optimize

# DAB: Digital Audio Broadcasting

- Media access
  - COFDM (Coded Orthogonal Frequency Division Multiplex)
  - SFN (Single Frequency Network)
  - 192 to 1536 subcarriers within a 1.5 MHz frequency band
- Frequencies
  - first phase: one out of 32 frequency blocks for terrestrial TV channels 5 to 12 (174 - 230 MHz, 5A - 12D)
  - second phase: one out of 9 frequency blocks in the L-band (1452- 1467.5 MHz, LA - LI)
- Sending power: 6.1 kW (VHF, Ø 120 km) or 4 kW (L-band, Ø 30 km)
- Date-rates: 2.304 Mbit/s (net 1.2 to 1.536 Mbit/s)
- Modulation: Differential 4-phase modulation (D-QPSK)
- Audio channels per frequency block: typ. 6, max. 192 kbit/s
- Digital services: 0.6 - 16 kbit/s (PAD), 24 kbit/s (NPAD)

# DAB transport mechanisms

MSC (Main Service Channel)

- carries all user data (audio, multimedia, ...)
- consists of CIF (Common Interleaved Frames)
- each CIF 55296 bit, every 24 ms (depends on transmission mode)
- CIF contains CU (Capacity Units), 64 bit each

FIC (Fast Information Channel)

- carries control information
- consists of FIB (Fast Information Block)
- each FIB 256 bit (incl. 16 bit checksum)
- defines configuration and content of MSC

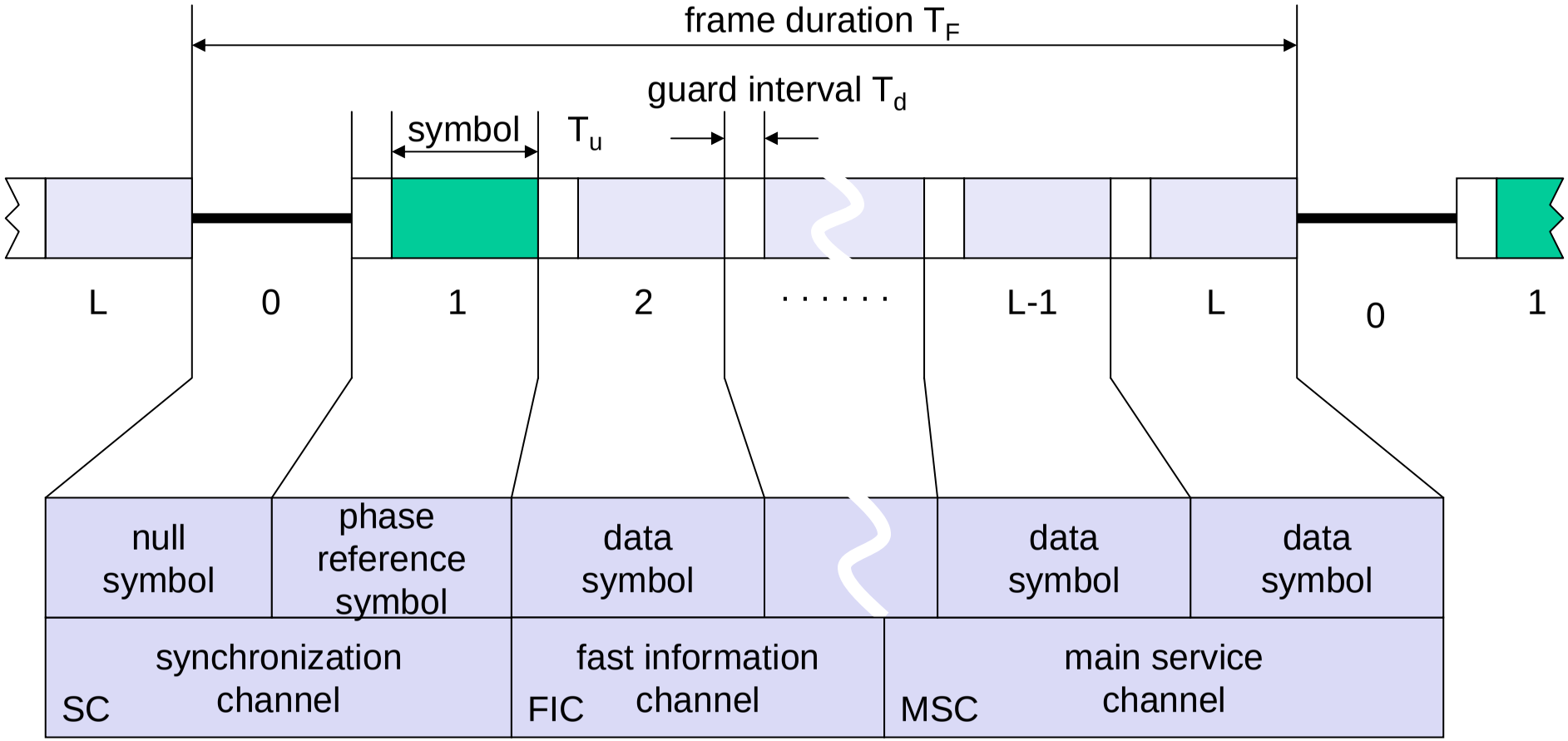
Stream mode

- transparent data transmission with a fixed bit rate

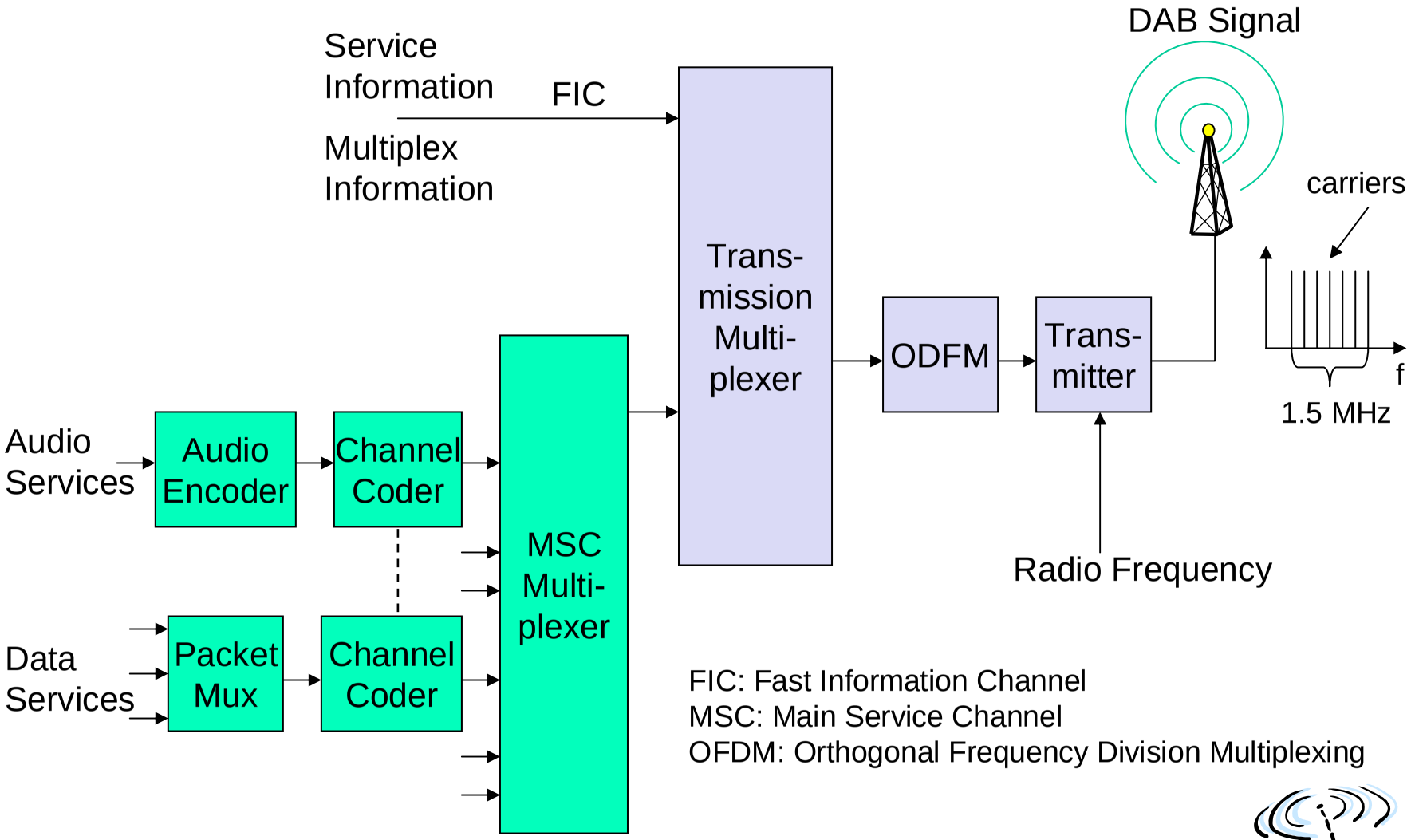
Packet mode

- transfer addressable packets

# Transmission frame

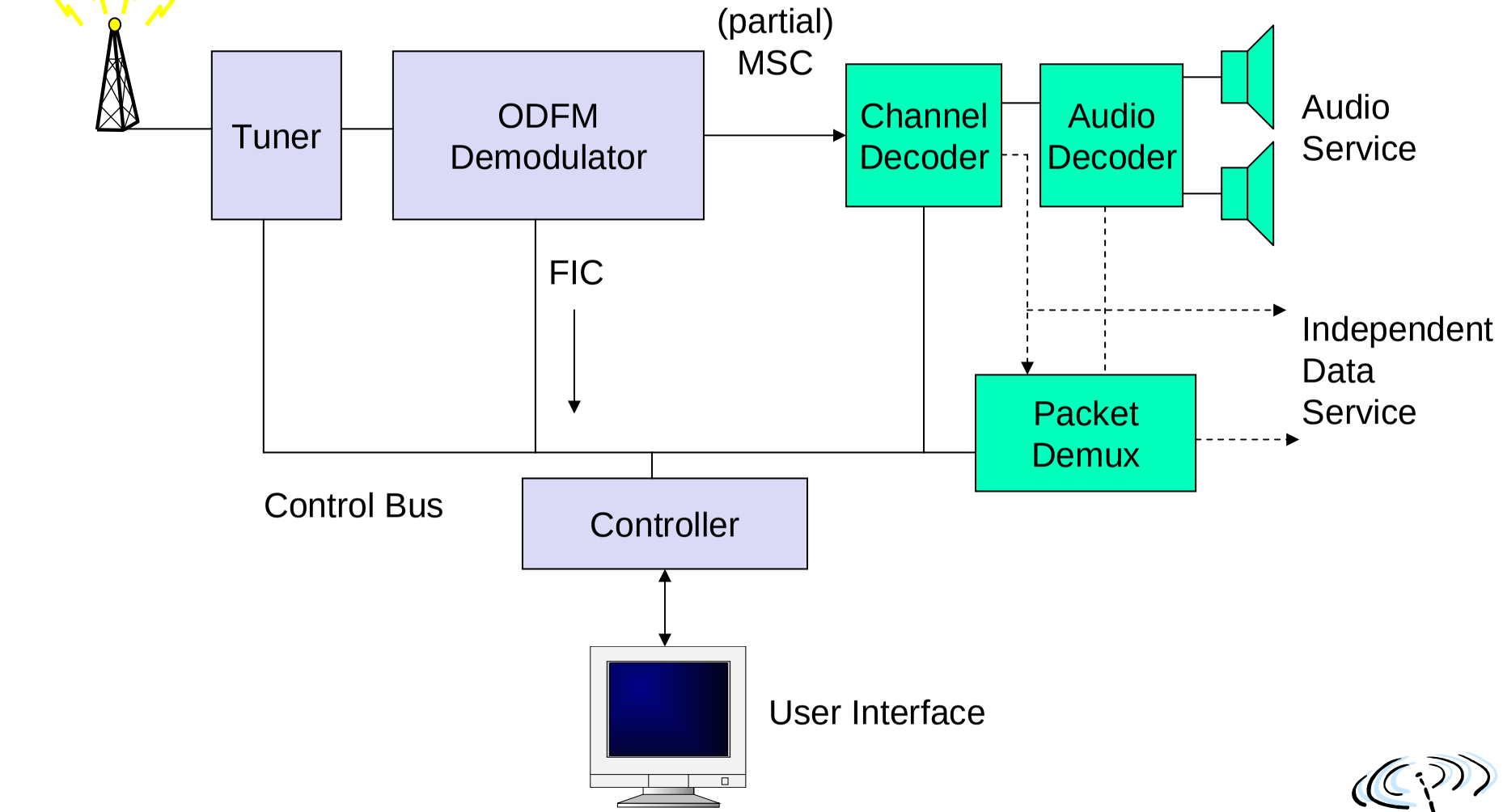



# DAB sender




FIC: Fast Information Channel
MSC: Main Service Channel
OFDM: Orthogonal Frequency Division Multiplexing

# DAB receiver



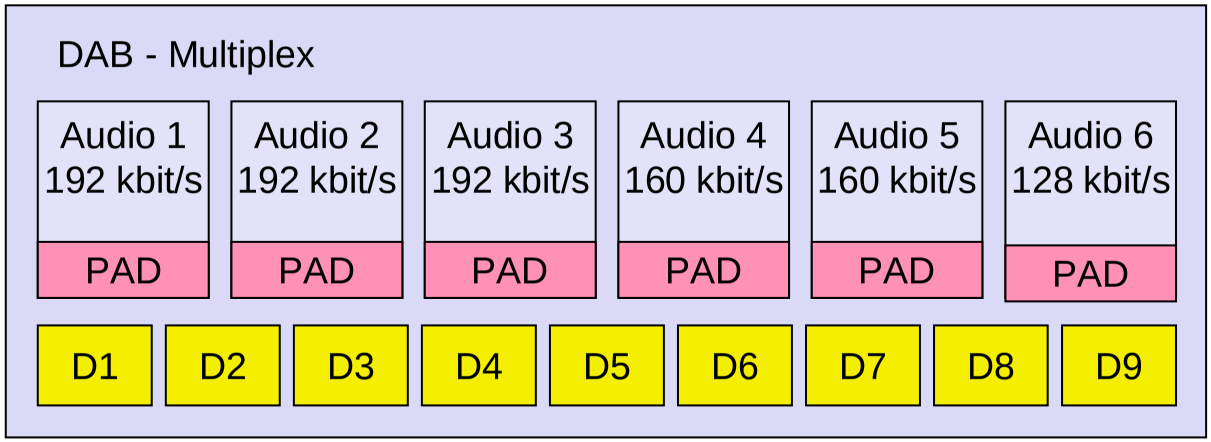
# Audio coding

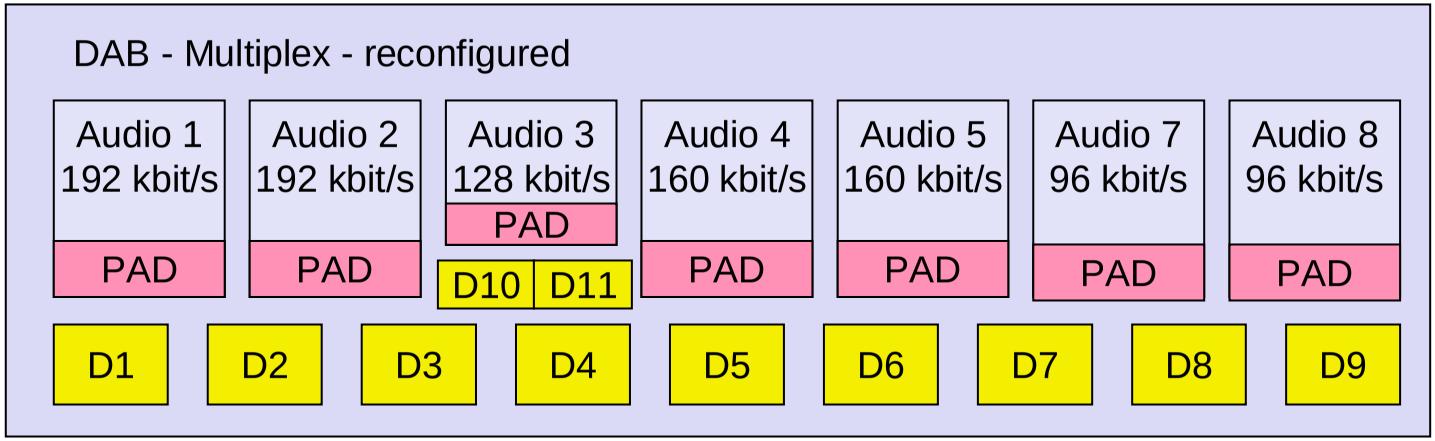
- Goal
  - audio transmission almost with CD quality
  - robust against multipath propagation
  - minimal distortion of audio signals during signal fading
- Mechanisms
  - fully digital audio signals (PCM, 16 Bit, 48 kHz, stereo)
  - MPEG compression of audio signals, compression ratio 1:10
  - redundancy bits for error detection and correction
  - burst errors typical for radio transmissions, therefore signal interleaving - receivers can now correct single bit errors resulting from interference
  - low symbol-rate, many symbols
    - transmission of digital data using long symbol sequences, separated by guard spaces
    - delayed symbols, e.g., reflection, still remain within the guard space

# Bit rate management

- a DAB ensemble combines audio programs and data services with different requirements for transmission quality and bit rates
- the standard allows dynamic reconfiguration of the DAB multiplexing scheme (i.e., during transmission)
- data rates can be variable, DAB can use free capacities for other services
- the multiplexer performs this kind of bit rate management, therefore, additional services can come from different providers

# Example of a reconfiguration




# Multimedia Object Transfer Protocol (MOT)

## Problem

- broad range of receiver capabilities
  audio-only devices with single/multiple line text display, additional color graphic display, PC adapters etc.
- different types of receivers should at least be able to recognize all kinds of program associated and program independent data and process some of it

## Solution

- common standard for data transmission: MOT
- important for MOT is the support of data formats used in other multimedia systems (e.g., online services, Internet, CD-ROM)
- DAB can therefore transmit HTML documents from the WWW with very little additional effort

# MOT structure

MOT formats

- MHEG, Java, JPEG, ASCII, MPEG, HTML, HTTP, BMP, GIF, ...

Header core

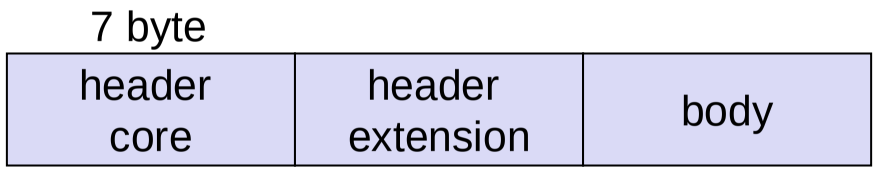
- size of header and body, content type

Header extension

- handling information, e.g., repetition distance, segmentation, priority
- information supports caching mechanisms

Body

- arbitrary data

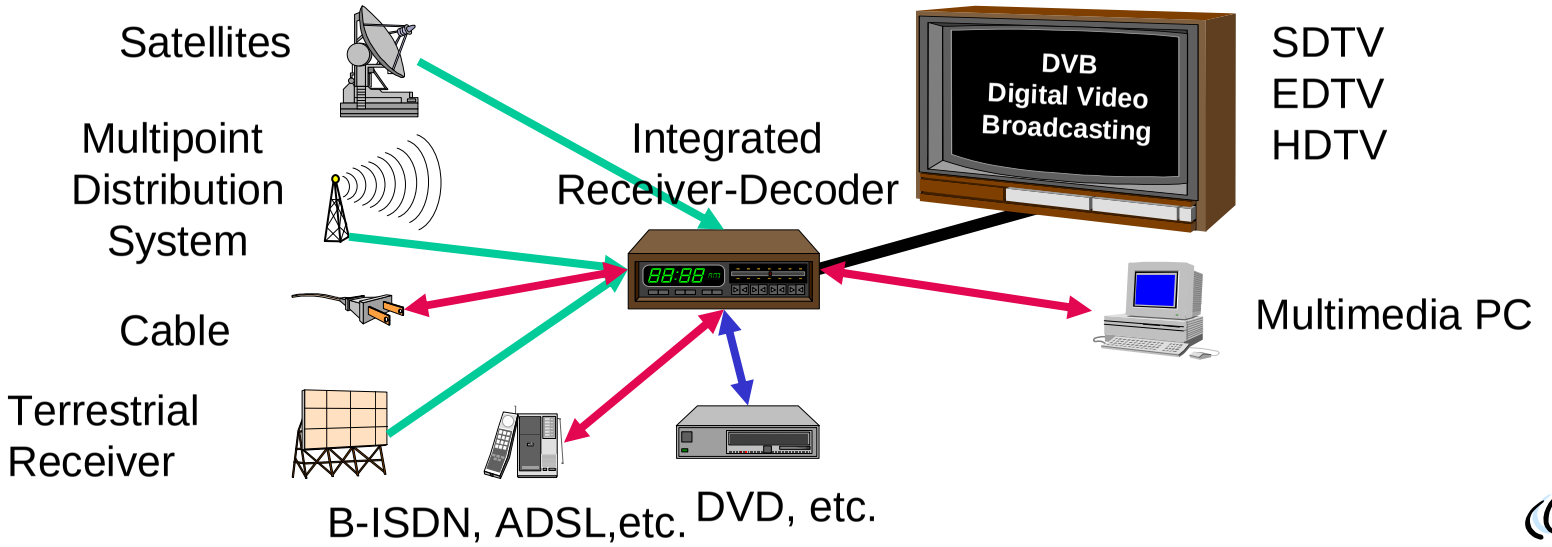



DAB allows for many repetition schemes

- objects, segments, headers

# Digital Video Broadcasting

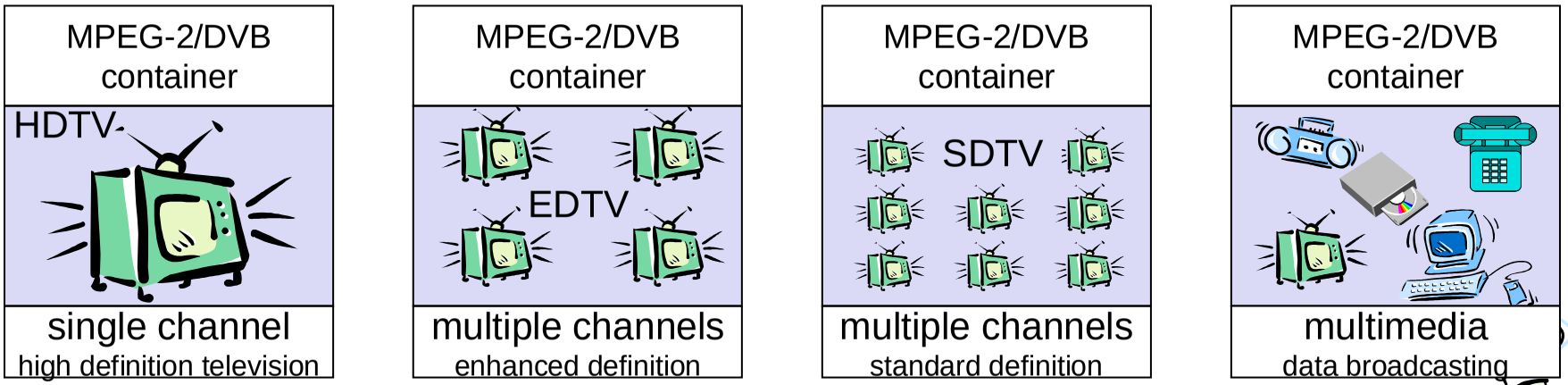
- 1991 foundation of the ELG (European Launching Group)
  goal: development of digital television in Europe
- 1993 renaming into DVB (Digital Video Broadcasting)
  goal: introduction of digital television based on
  - satellite transmission
  - cable network technology
  - later also terrestrial transmission




# DVB Container

## DVB transmits MPEG-2 container

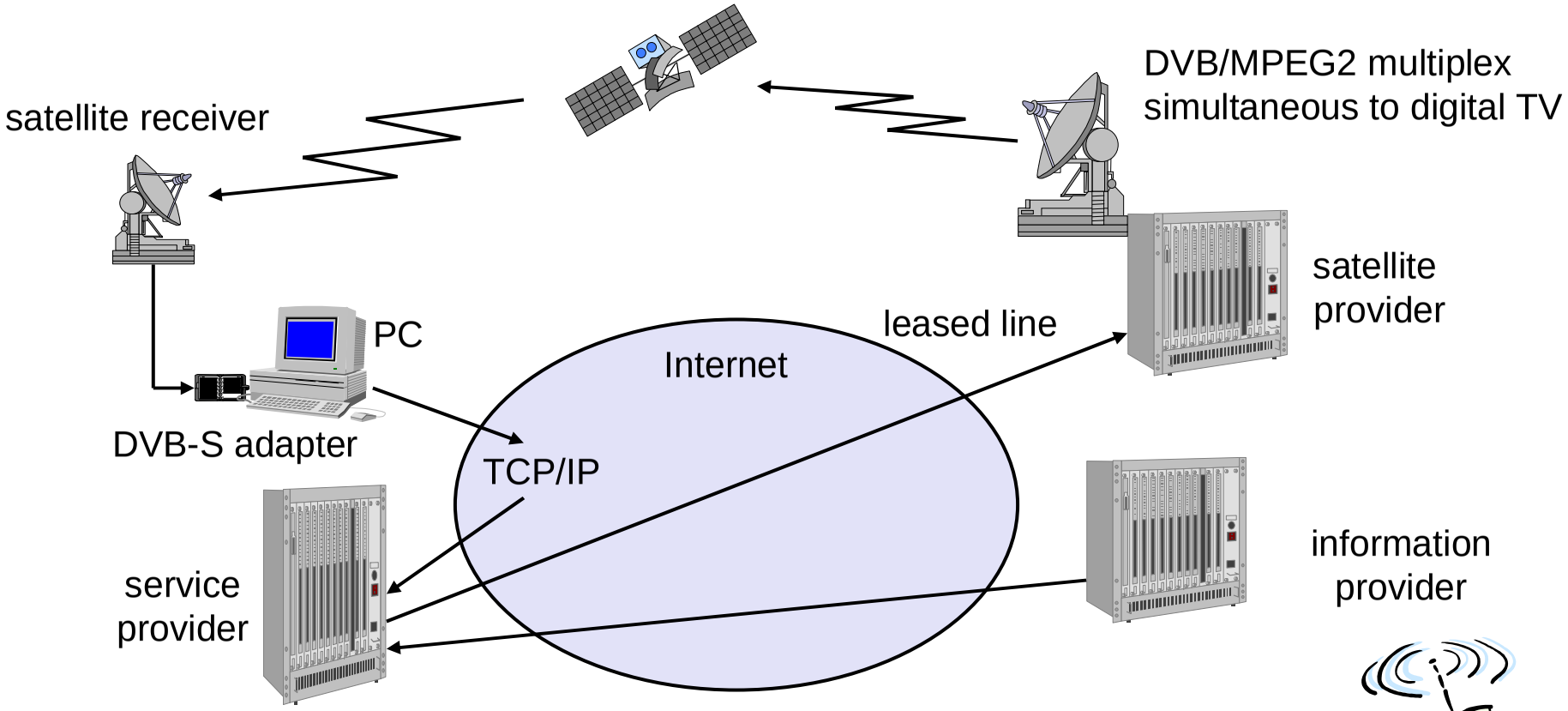
- high flexibility for the transmission of digital data
- no restrictions regarding the type of information
- DVB Service Information specifies the content of a container
  - NIT (Network Information Table): lists the services of a provider, contains additional information for set-top boxes
  - SDT (Service Description Table): list of names and parameters for each service within a MPEG multiplex channel
  - EIT (Event Information Table): status information about the current transmission, additional information for set-top boxes
  - TDT (Time and Date Table): Update information for set-top boxes



# Example: high-speed Internet access

## Asymmetric data exchange

- downlink: DVB receiver, data rate per user 6-38 Mbit/s
- return channel from user to service provider: e.g., modem with 33 kbit/s, ISDN with 64 kbit/s, DSL with several 100 kbit/s etc.

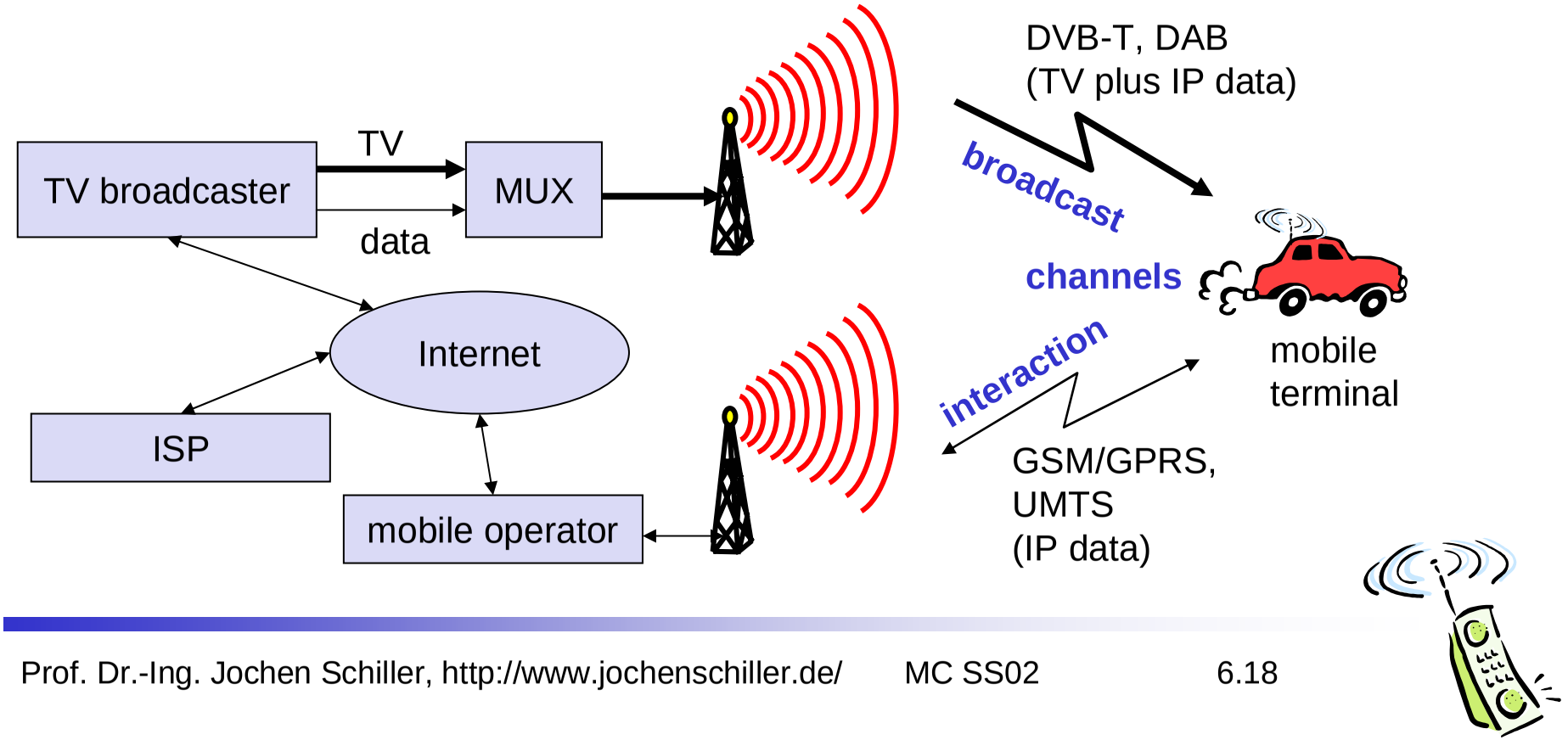


# Convergence of broadcasting and mobile comm.

Definition of interaction channels

- Interacting/controlling broadcast via GSM, UMTS, DECT, PSTN, …

Example: mobile Internet services using IP over GSM/GPRS or UMTS as interaction channel for DAB/DVB



# Comparison of UMTS, DAB and DVB

| | UMTS | DAB | DVB |
|---|---|---|---|
| Spectrum bands (depends on national regulations) [MHz] | 2000 (terrestrial), 2500 (satellite) | 1140-1504, 220-228 (UK) | 130-260, 430-862 (UK) |
| Regulation | Telecom, licensed | Broadcast, licensed | Broadcast, licensed |
| Bandwidth | 5 MHz | 1.5 MHz | 8 MHz |
| Effective throughput | 30-300 kbit/s (per user) | 1.5 Mbit/s (shared) | 5-30 Mbit/s (shared) |
| Mobility support | Low to high | Very high | Low to high |
| Application | Voice, data | Audio, push Internet, images, low res. video | High res. video, audio, push Internet |
| Coverage | Local to wide | Wide | Wide |
| Deployment cost for wide coverage | Very high | Low | Low |