Week 4: Interactive Services
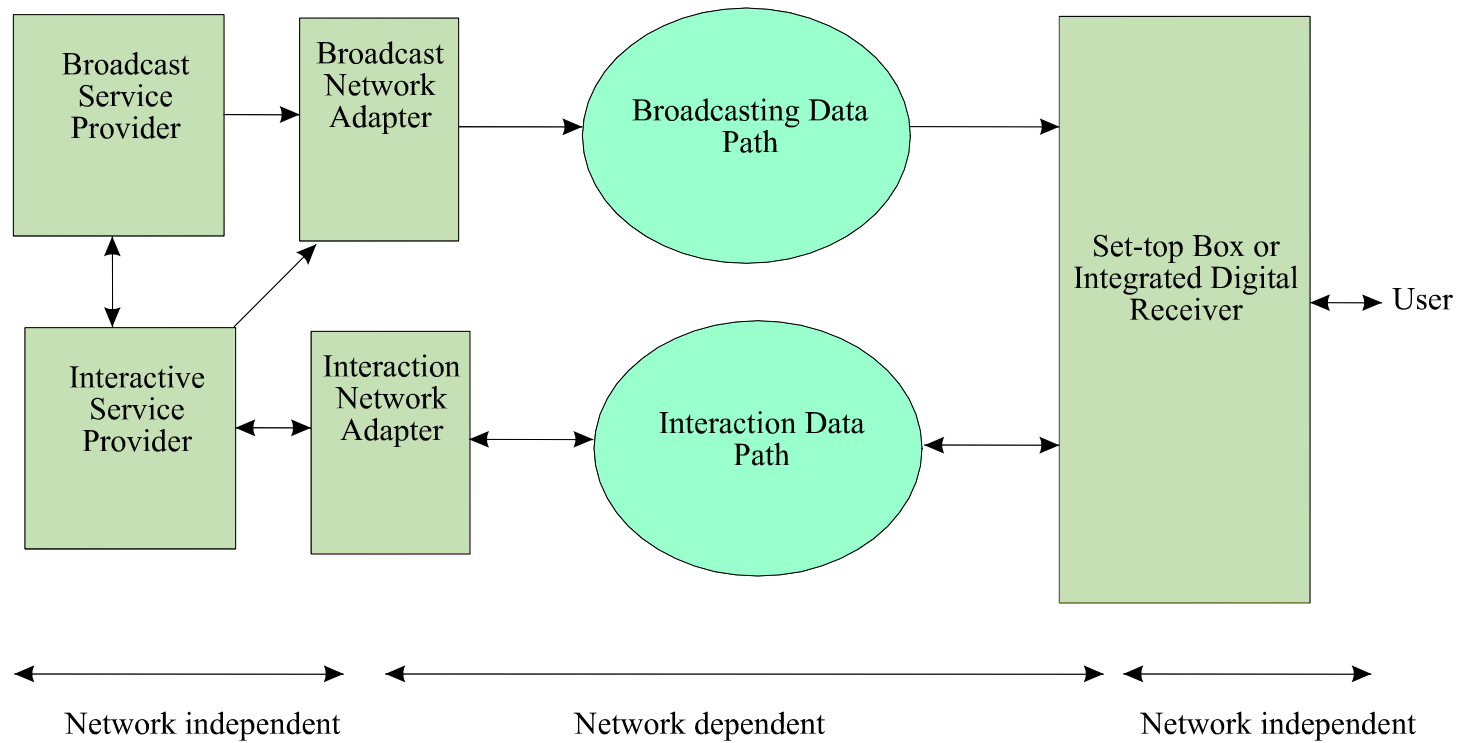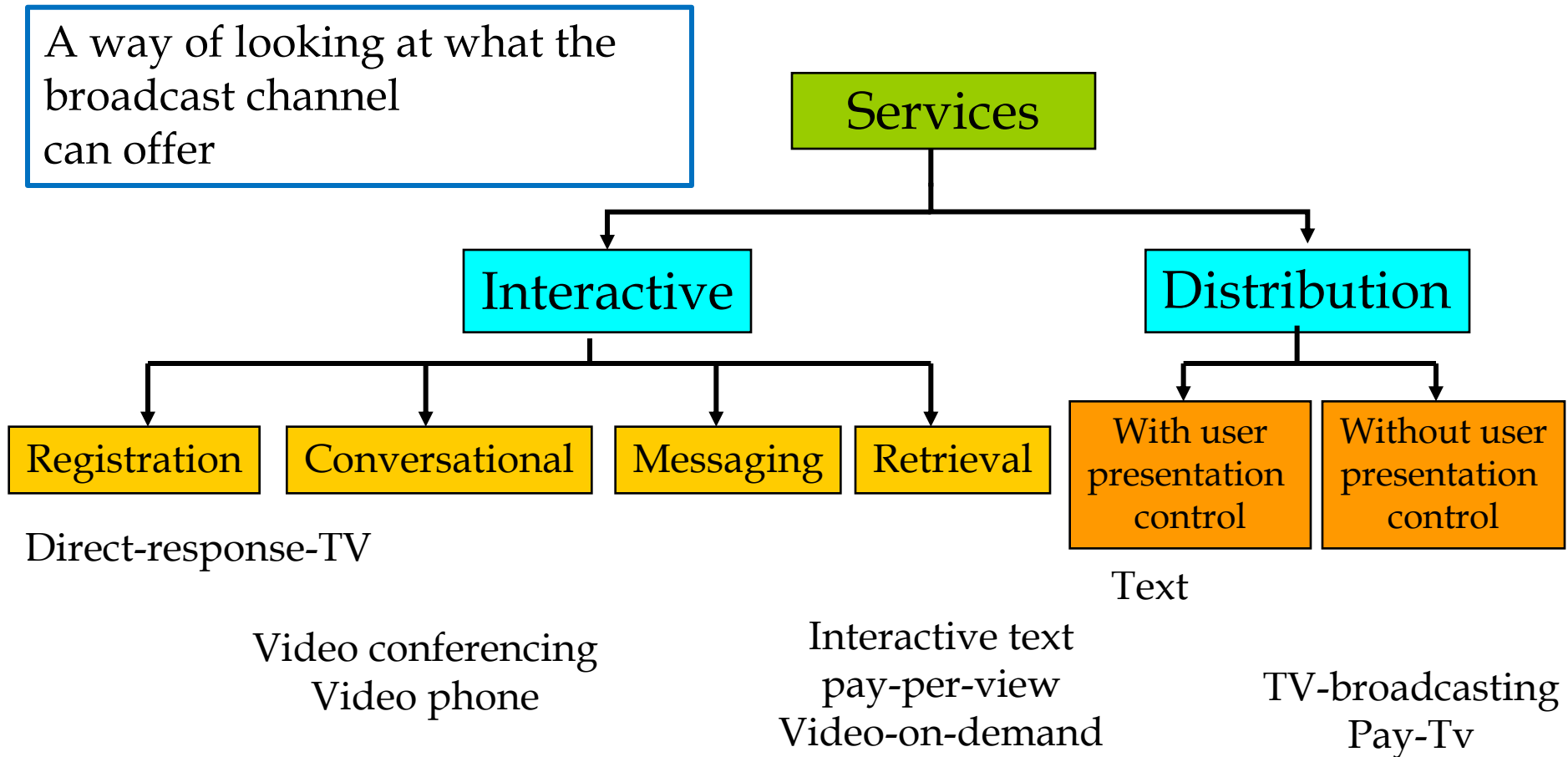
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Interactivity

- User can (re)act to information presented by service provider (digital innovation).
  - E.g., purchase pay-per view events, video on demand, voting, video mail, interactive teletext, interactive advertising, gambling, shopping channel purchases, etc.
  - Improves viewer's experience and enables broadcasters to generate extra revenue – a win-win situation
- Most basic form: 'local interactivity' (no return channel required).
  - Datacast service

Interaction

Extra features offered by digital broadcasting

Services Model

A way of looking at what the broadcast channel can offer

Services

Interactive

Distribution

Registration

Conversational

Messaging

Retrieval

With user presentation control

Without user presentation control

Direct-response-TV

Video conferencing
Video phone

Interactive text
pay-per-view
Video-on-demand

Text

TV-broadcasting
Pay-Tv

Services

- *Direct-response TV:* e.g. interactive quiz shows or interactive commercials

- *Pay-TV:* encrypted programming package can only be viewed using an authorized set-top box (STB)

- *Pay-per-view:* similar to Pay-TV, but authorizes a programme instead of a package

- *Video on-demand:* allows individual users to select a programme from a server and access it at a chosen time, with pause and rewind facility

Text Services

- Transmitted in a data channel that is multiplexed with the broadcast
  - *Linear text*: has a number of pages transmitted and stored on the STB that can then be accessed if desired
  - *Interactive text*: allows user to choose particular pages to be downloaded from server to STB
- Digital text is more sophisticated than (analog) Teletext
  - Different fonts, larger range of colours
  - High-definition images

Interactivity

- All other forms require an **interaction channel** to enable user to respond and enable service provider/network operator to listen and react.

- Types of channels:
  - one-way (backwards) narrowband (e.g. voting)
  - bi-directional narrowband (e.g. purchasing)
  - bi-directional broadband (e.g. request for extra information)
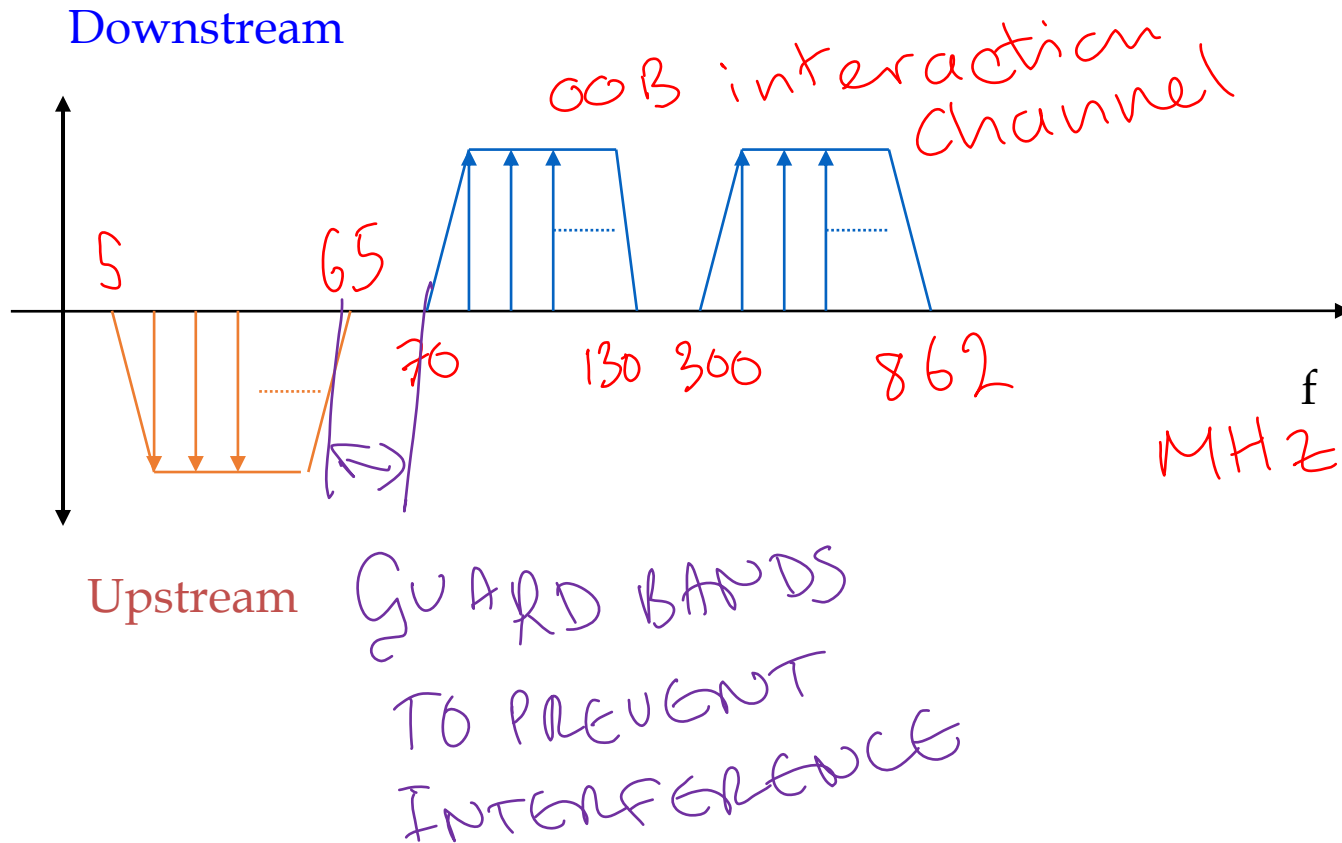
Types of Interaction Channel

- Narrowband uni-directional
  - pay-per-view
  - video on demand
  - voting

- Narrowband bi-directional
  - text
  - advertising
  - gambling
  - shopping

- Broadband bi-directional
  - video mail
  - selective advertising

Interaction Channels

- **upstream** channel: path from receiver to broadcaster.

- **downstream** channel: path from broadcaster to receiver .
    - **out-of-band** downstream signalling: when downstream channel is separate from broadcast channel.
    - **in-band** downstream signalling: when downstream channel is mixed with programme data (part of the MPEG-2 transport stream).

Frequency Allocation for Interaction Channels

Downstream

OOB interaction Channel

5

65

70

130 300

862
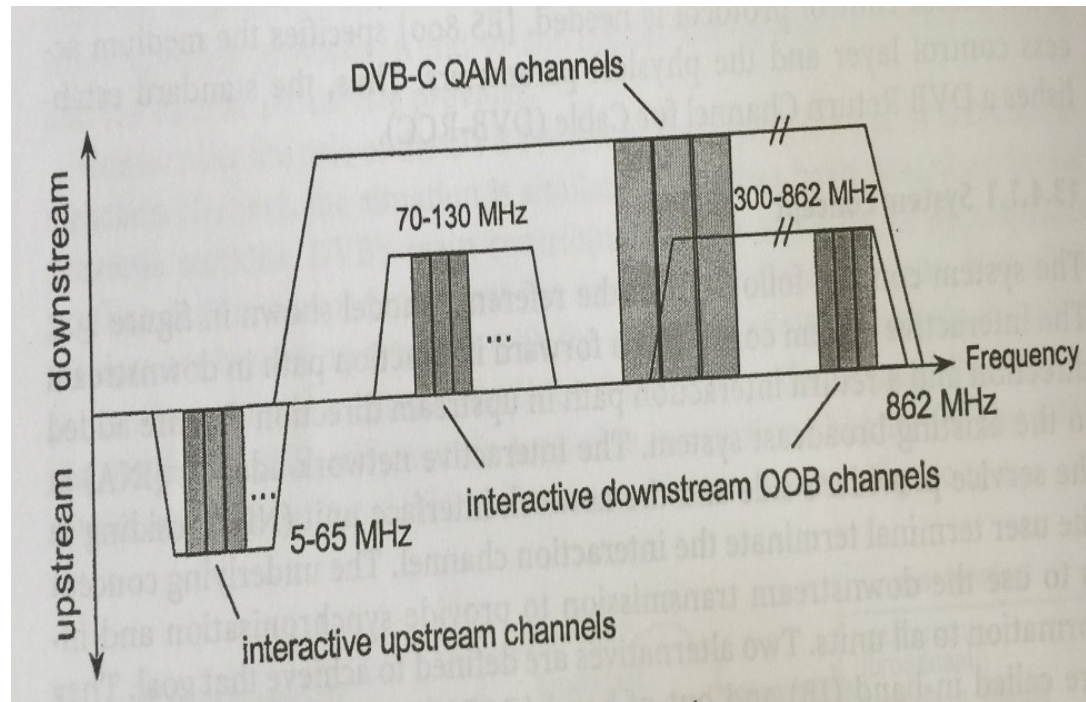
MHz

f

Upstream

GUARD BANDS
TO PREVENT
INTERFERENCE

If the interaction channels are part of the same network as the broadcast system then there must be a separate frequency allocation for the interaction channels.

The return interaction channel and the forward interaction channel must be allocated in a different frequency range (to avoid interference).

The diagram shows FDMA (frequency division multiple access). The available bandwidth is divided into slots – one slot for each message signal.

Cable TV distribution system

Table 13.2. Supported bit-rates on interactive channels

Modulation	Bandwidth			
	200 kHz	1 MHz	2 MHz	4 MHz
QPSK	256 kbit/s	1.544 Mbit/s	3.088 Mbit/s	6.176 Mbit/s
16-QAM	512 kbit/s	3.088 Mbit/s	6.176 Mbit/s	12.352 Mbit/s

- If the interaction channels are part of the same network as the broadcast system then there must be a separate frequency allocation for the interaction channels.
- The return interaction channel and the forward interaction channel must be allocated in a different frequency range (to avoid interference).
- 70-130MHz & 300 to 862 MHz for OOB FW path.
- 5 to 65MHz for return interaction path.
- 1 to 2 MHz BW for downstream and 0.1, 1, 2, 4 for upstream

Frequency Allocation

- Previous diagram showed FDMA (Frequency Division Multiple Access).
  - available bandwidth divided into different frequencies for each interaction channel with small guard bands between channels
  - Problem of interference when many channels

- Alternative is TDMA (Time Division Multiple Access)
  - different time slots in the same frequency are used to give the different channels

Interactive System for Cable

- Cable system provides both channels (down- and upstream) over same network.

- Data in interaction channel is treated similarly to MPEG-2 transport stream.

- DVB-C suggests frequency bands for the channels
  - 70-130 MHz or 300–862 MHz for downstream and either 1 MHz or 2 MHz channel bandwidth

Upstream Channel Control

- Each STB has unique **media access control** (MAC) address (48 bits, usually hard-coded).
- MAC address allows data to be routed to the intended STB.
- MAC address allows service provider to identify origin of interactive service request.
- For TDMA, upstream channels are divided into time slots that can be accessed by the users.
  - Slots are allocated by the Interactive Network Adaptor (INA – see interaction system model on earlier slide).
  - Synchronisation is crucial:
    - ensure data is only sent in valid time slots.
    - synchronisation for upstream transmission is provided by the downstream INA.

Upstream Access Modes

Ways of accessing the upstream slots:

- **Contention:** All users have equal access and can send MAC messages or data. More than one may try at one time. Automatic Repeat Request (ARQ) operates to sent ACK of reception of packet

- **Fixed-rate access:** User has a reservation of one or more time slots in each frame allocated by INA.

- **Reservation access:** STB sends request for time slots to the INA. The INA then assigns these slots to a connection on a frame-by-frame basis.

Upstream Channel Coding

- The upstream channel is coded in a similar way to the downstream channel except that a **unique word** is added.
- Upstream data is bursty – not all users transmit all the time, rather they will sometimes want to send data and not at other times.
- The position of these bursts within the channel is random.
- Q: How do we locate the start of a specific burst?

  A: The burst is made to contain a unique word

  - Word = a sequence of 1s and 0s with good correlation properties; allows receiver to locate position of the burst.
  - If the unique word is not detected in the TDMA system an entire traffic burst is lost.

Providing Internet Services via Broadcast Networks

- Cable network providers derive much of their revenues by providing broadband internet connections with the cable TV service.

- A cable modem is used at the subscriber end and at the ISP end
    - cable modem: separate unit or integrated into STB.
    - cable modem modulates IP data onto carrier similar modulation of TS in MPEG-2 TS.

DVB specification for interaction channels

**Table 13.1.** Set of specifications for interaction channels in DVB

	DVB acronym	Standard	Implementation guidelines
Network-independent protocols for interactive services	DVB-NIP	ETS 300 802	TR 101 194
Interaction channels			
PSTN/ISDN	DVB-RCP	ETS 300 801	
DECT	DVB-RCD	EN 301 193	
GSM	DVB-RCG	EN 301 195	
CATV	DVB-RCC	ETS 300 800, ES 200 800	TR 101 196
LMDS	DVB-RCL	EN 301 199	TR 101 205
Satellite	DVB-RCS	EN 301 790	TR 101 790
SMATV	DVB-RCCS		TR 101 201
Terrestrial	DVB-RCT	EN 301 958	

Protocol stack for DVB interactive services
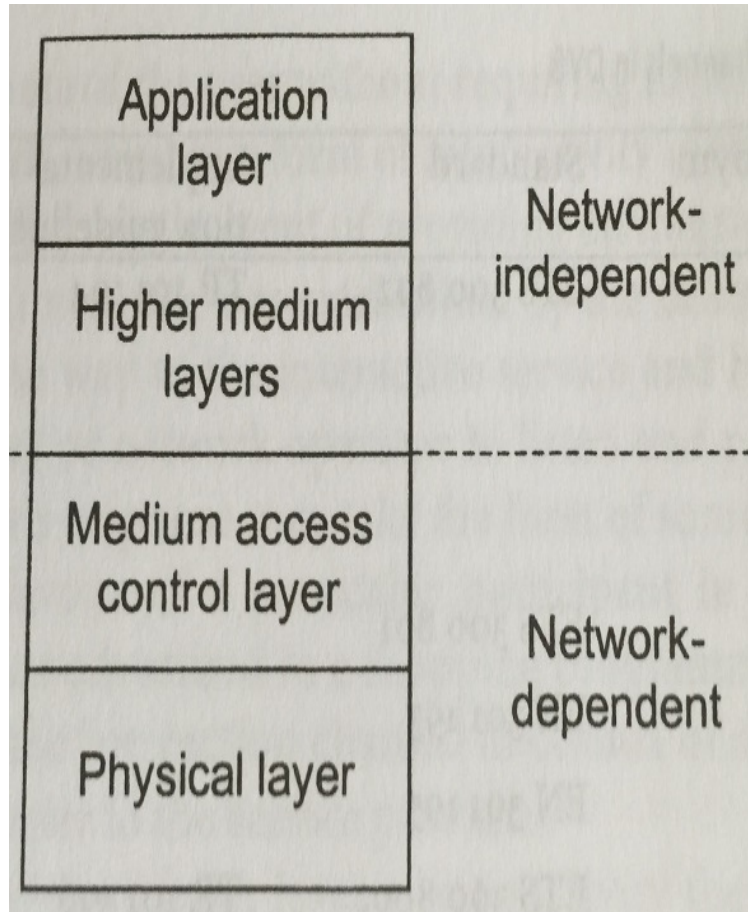
- PHY Layer: Modulation scheme, channel coding, frequency range, filtering, equalisation and transmit power.

- MAC: interface to higher layer protocol, give the data independence of the PHY

- Upper layer goals: to develop interactive applications which can be used commonly with different interactivity-enabled networks.

# Generic System Model for interactive service
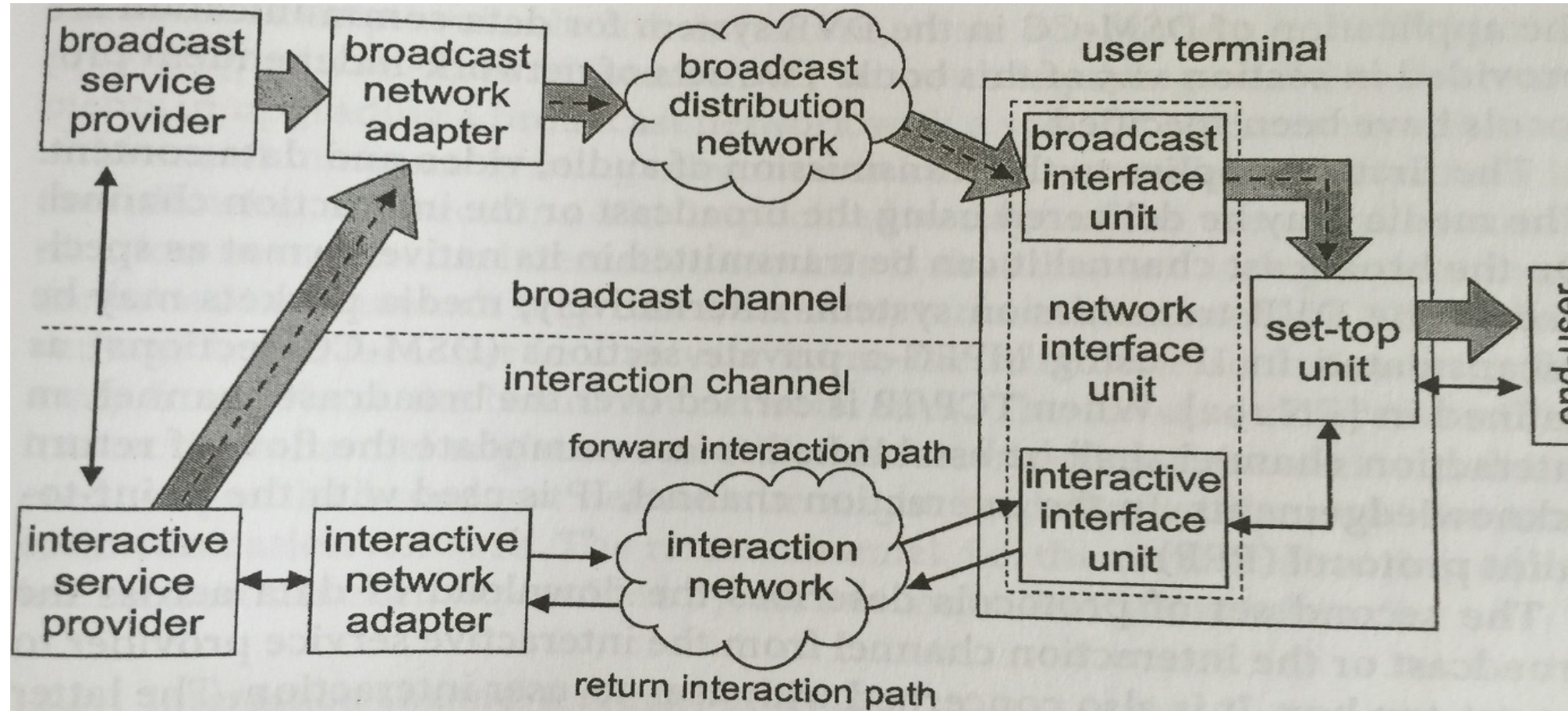
Generic System Model

- Network adapter provides connectivity between service provider and the network
- Interface unit connects the network to the end user
- Generally broadcasts MPEG-2 transport system over unidirectional broadcast channel to the STB.
- Interactive service provider offer bidirectional interaction channel
  - FW interaction path and Return interaction path
  - To ensure high speed service, it can be embedded in MPEG-2 TS.
- Broadcast channel contains control and communication data
- User can utilise cable model instead of STB
- A bidirectional communication channel is also required between different service providers for <u>synchronisation</u>

# Network dependant Solution

- Makes use of traditional telecommunication system
  - PSTN/ISDN
  - DECT
  - GSM
  - DVB-C, DVB-S, DVB-T
- Saves investment in infrastructure by avoiding upgrading broadcast channel (+)
- Independent of broadcast network. (+)
- Telephone socket may be far away from broadcast network ends (-)
- Alternate option:
  - FW channel via broadcast network and RETURN channel via telephone network (Sync an issue)

System Reference Model for IAS through DECT
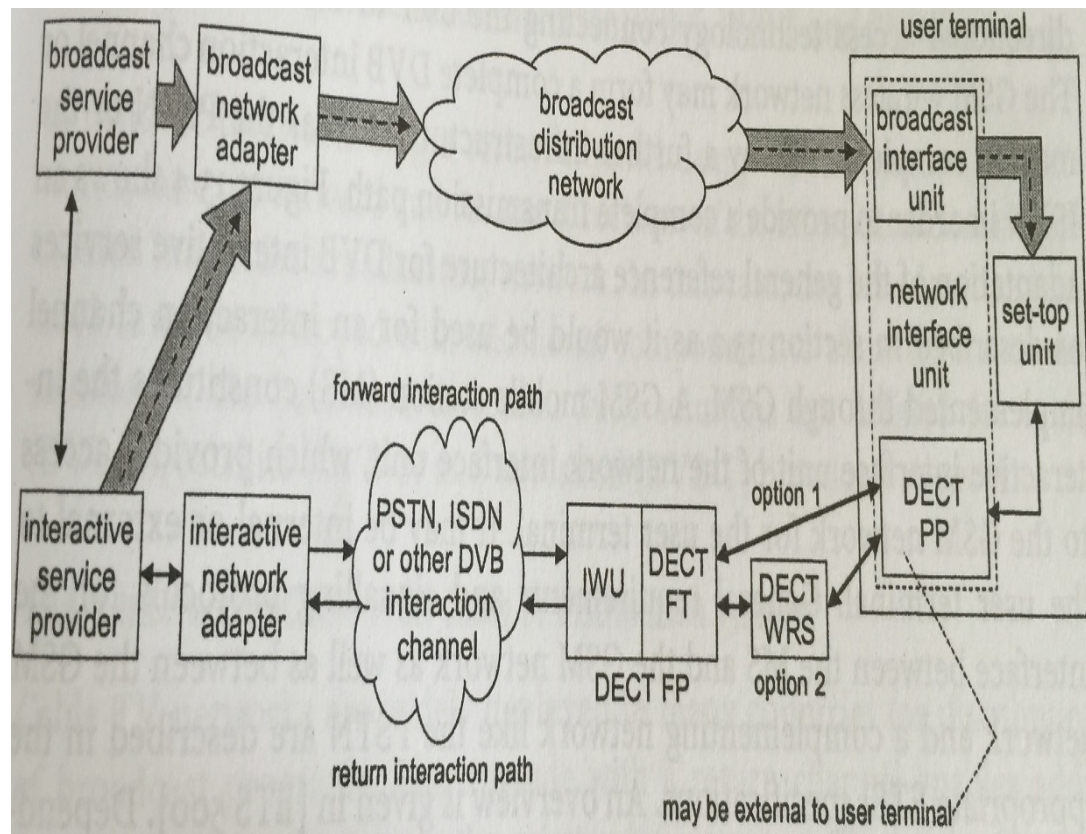
- Digital Enhanced Cordless Telecommunications: local, wireless and bidirectional access technology.
- Portable part (PP) constitutes the interactive interface unit of the NIU. It connects the user terminal to interaction channel. It can be internal or external to the user terminal
- Fixed part (FP): is the part of the functional components establishing interaction channel. It is connected by the fixed terminal (FT) to the local access portion of the network.
- provides an interface to bidirectional channel via internetworking unit (IWU)

System Reference Model for GSM

Fig. 13.4. System reference model with an interaction channel through GSM
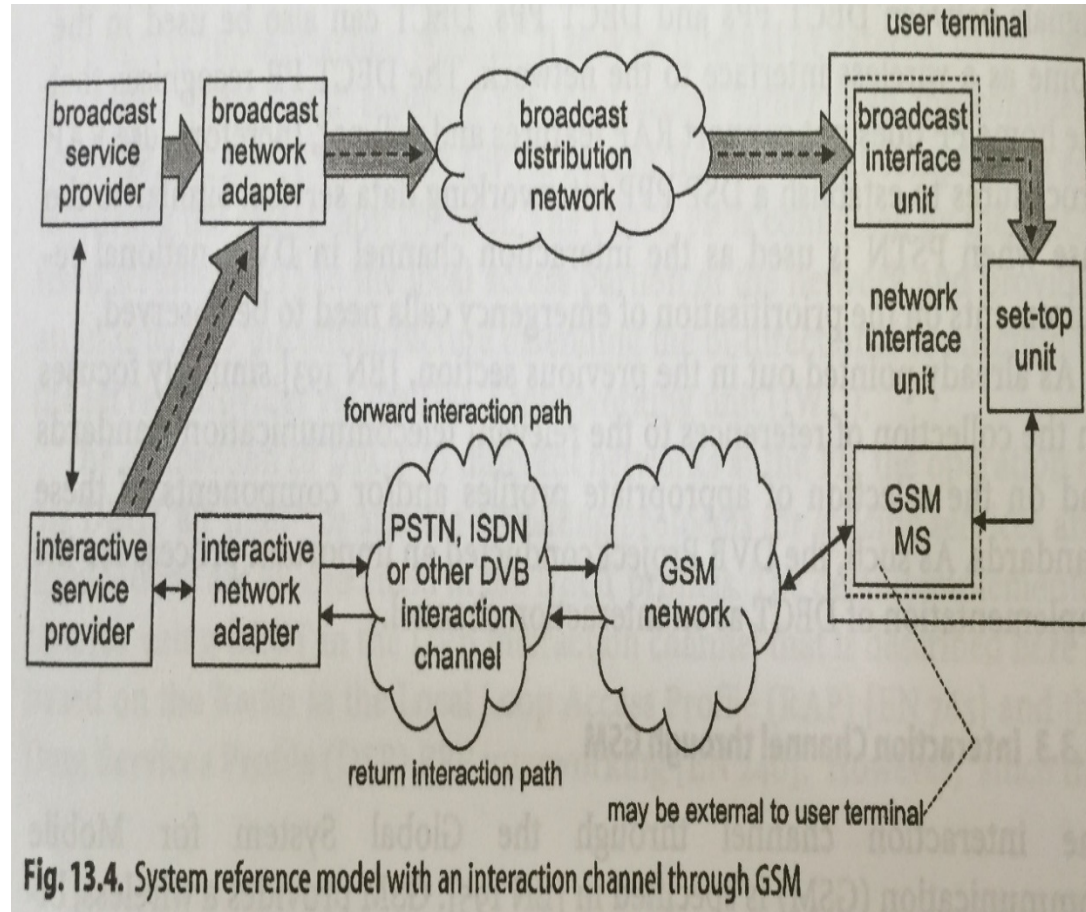
- Mostly similar to DECT
- MS constitutes the interactive interface unit of the NIU
- MS must be configured to support correct bearer capabilities to provide complete interaction service
- If possible, GSM-ISDN interworking should be implemented to provide complete E2E digital link.
- Extension such as GPRS provides better data service.

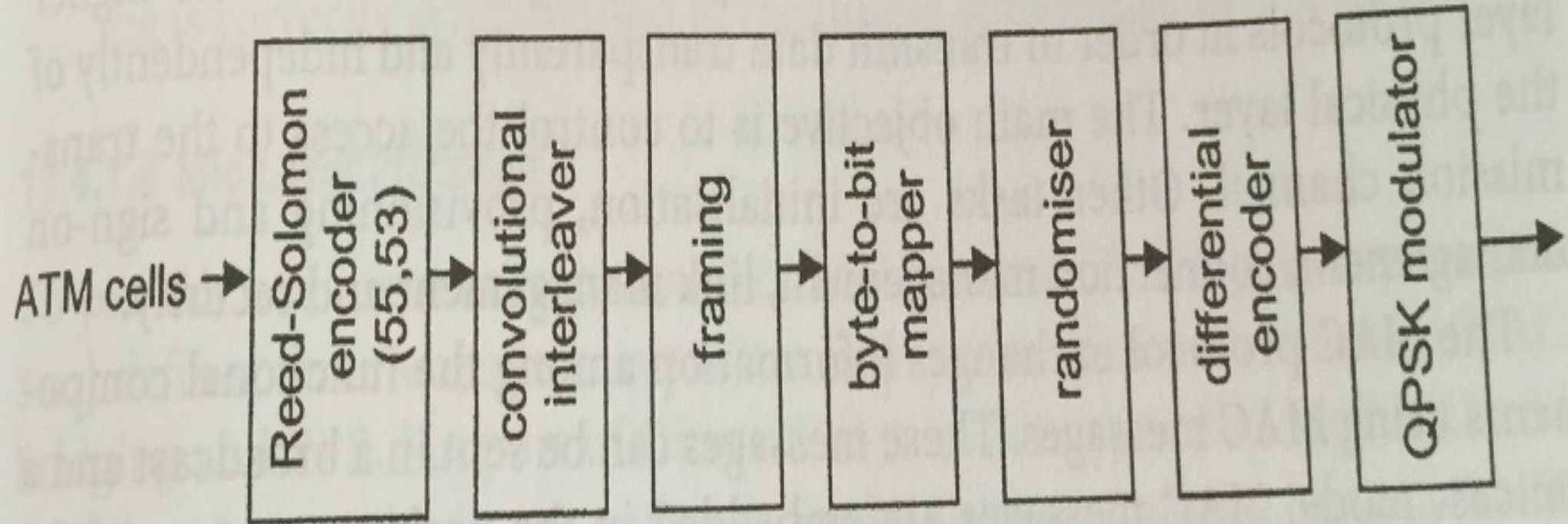# Signal processing for OOB downstream Tx in INA

Fig. 13.6. Signal processing for OOB downstream transmission in the INA

Upstream processing

Fig. 13.7. Signal processing for upstream transmission in the NIU