

Chapter 4

The Physical and Link Layers 2: Going Further

Going Further

ADSL

- A technology to send data down telephone lines, *Asymmetric Digital Subscriber Line*
- The current technology of choice for Internet to the home

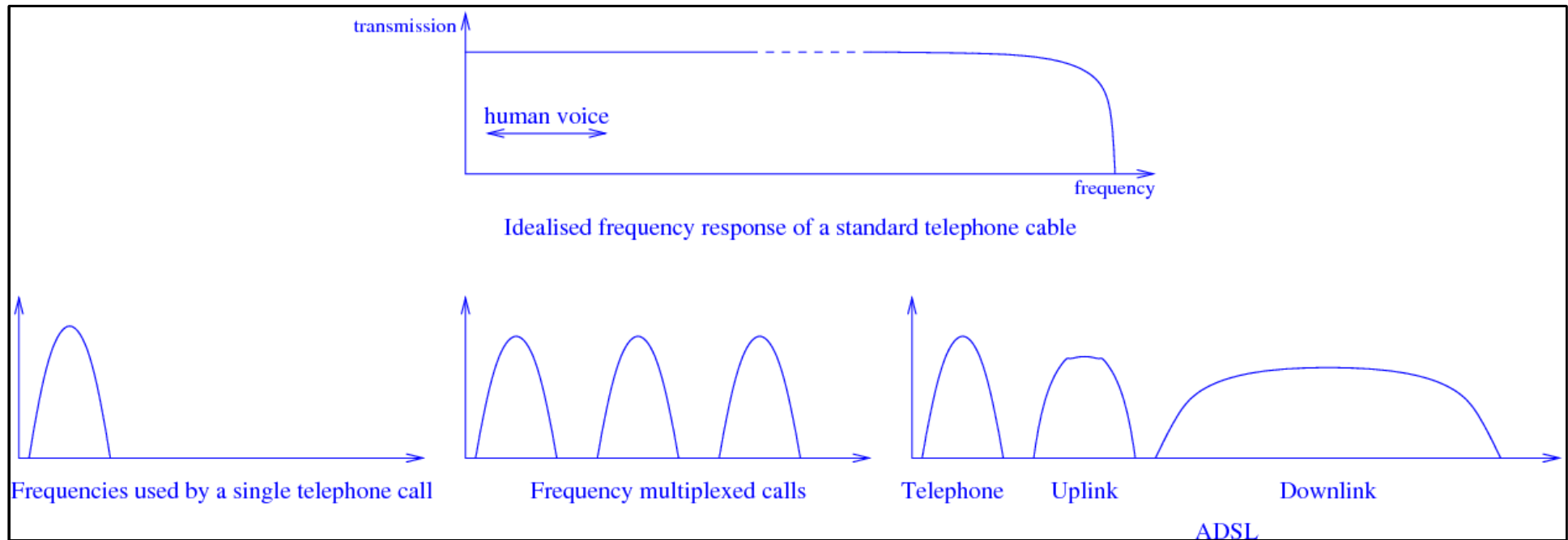
Going Further

ADSL

- Analogue modems are limited to 56Kb/s, the maximum speed available from a standard analogue telephone line: all frequencies apart from a 3KHz chunk centred on the human voice are filtered out and thrown away
- The telephone cable is capable of more, ADSL tries to take advantage of this
- ADSL (one of a series of DSL standards) requires new hardware in the home and in the telephone exchange

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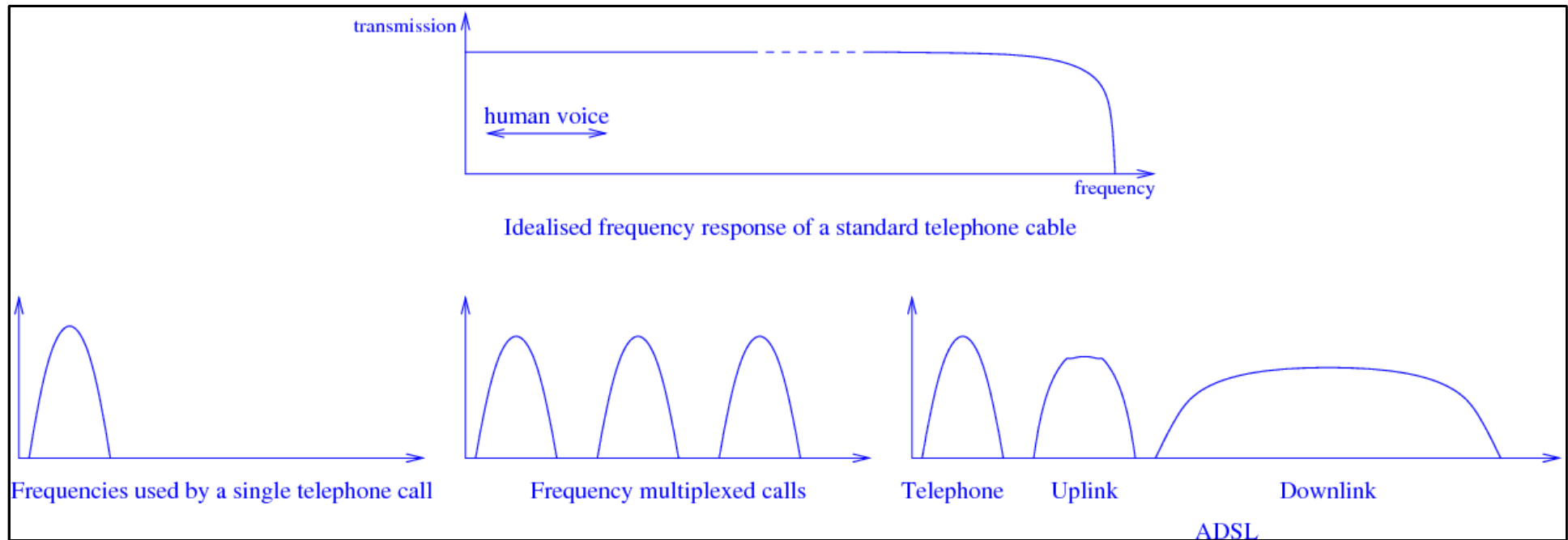
ADSL



- A certain amount of bandwidth is available on the wire: limited by the quality of the wire, its length, local electrical interference and so on

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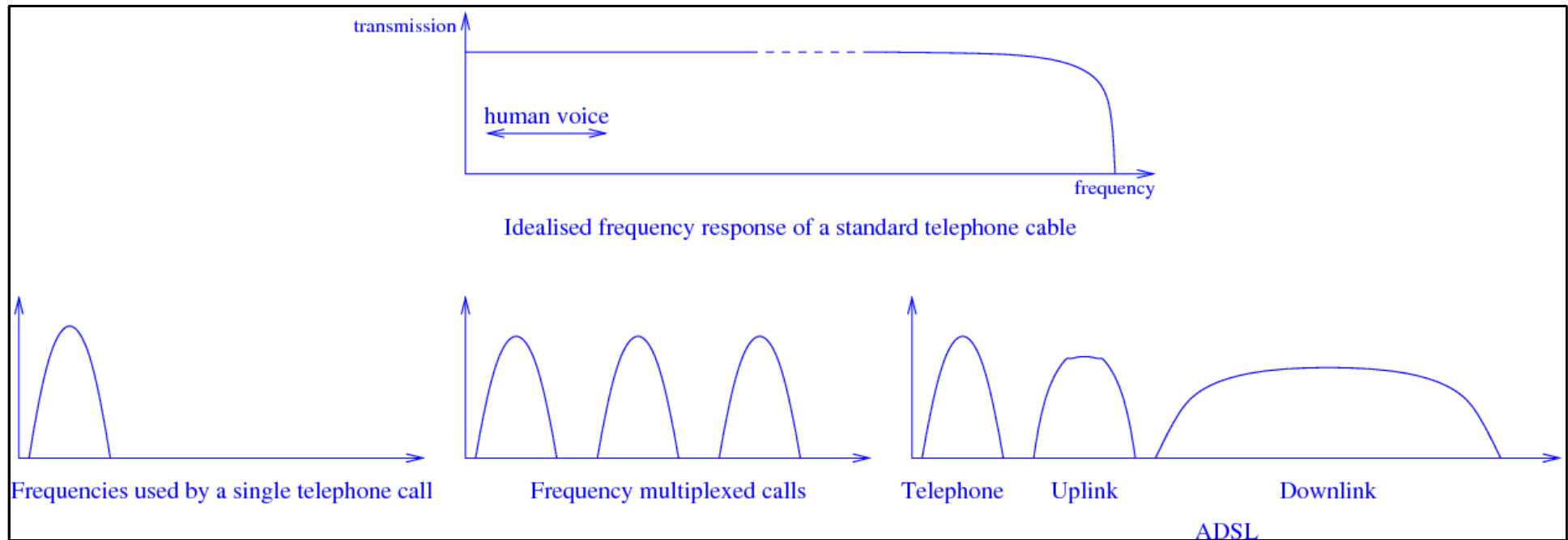
ADSL



- ADSL splits this into uplink and downlink parts, e.g., 256Kb/s up and 2Mb/s down (appropriate for a home user)

Going Further

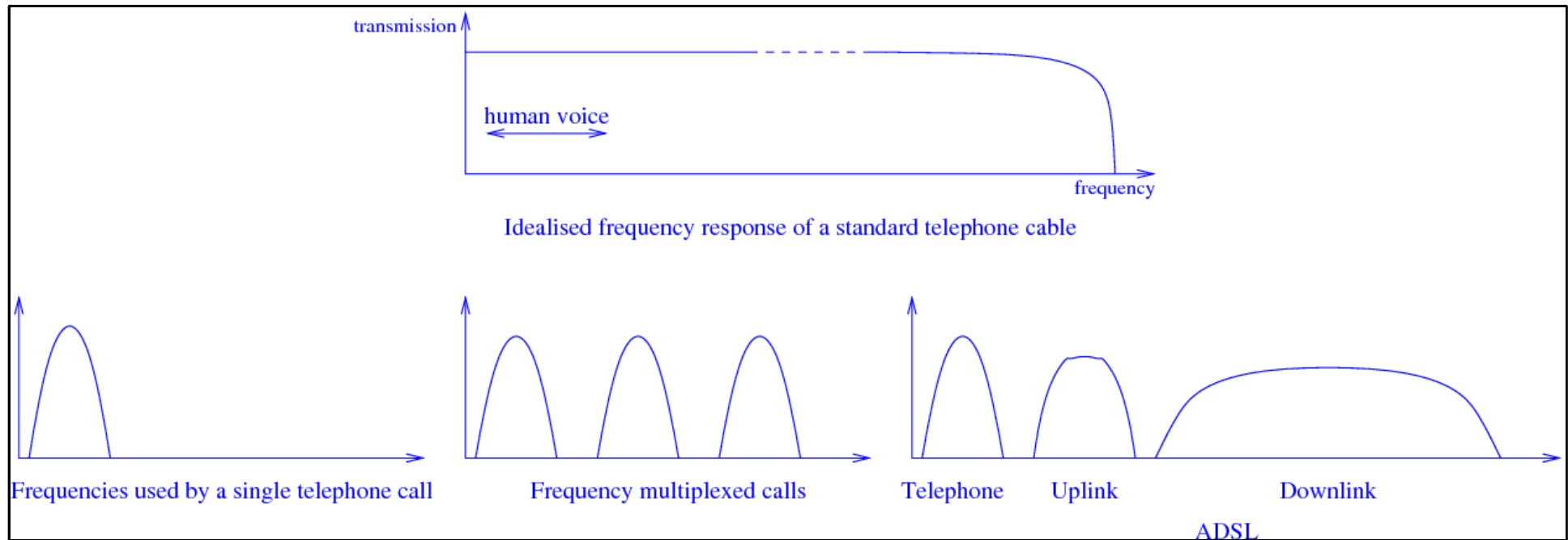
ADSL



- Also keep the voice channel (POTS: plain old telephone system)

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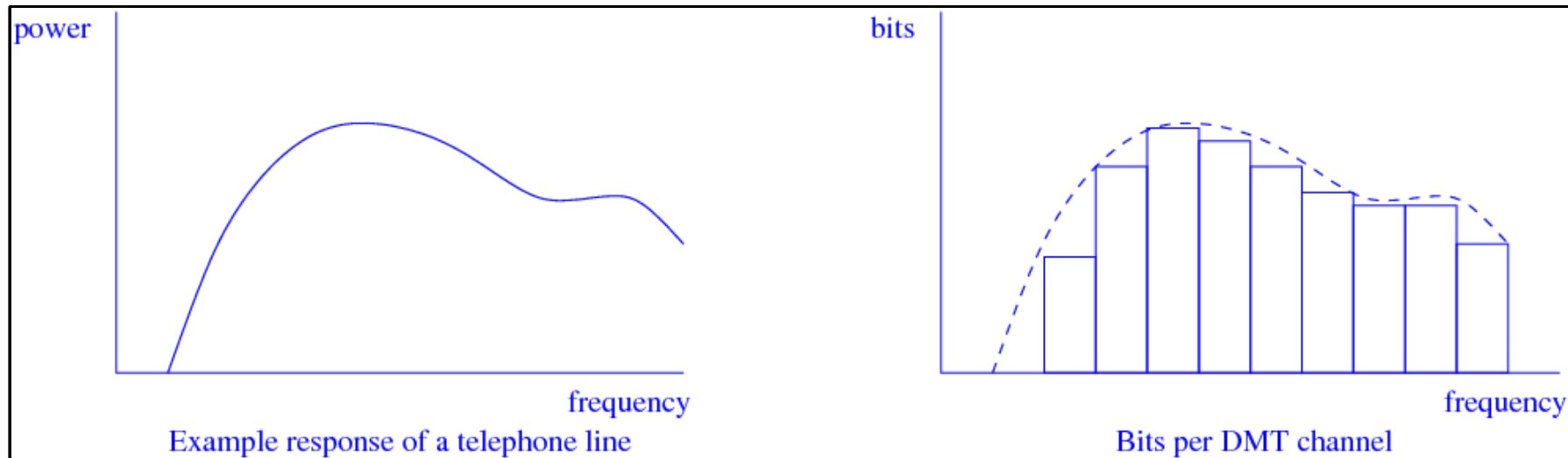
ADSL



- ADSL is permanently connected; no need to dial up

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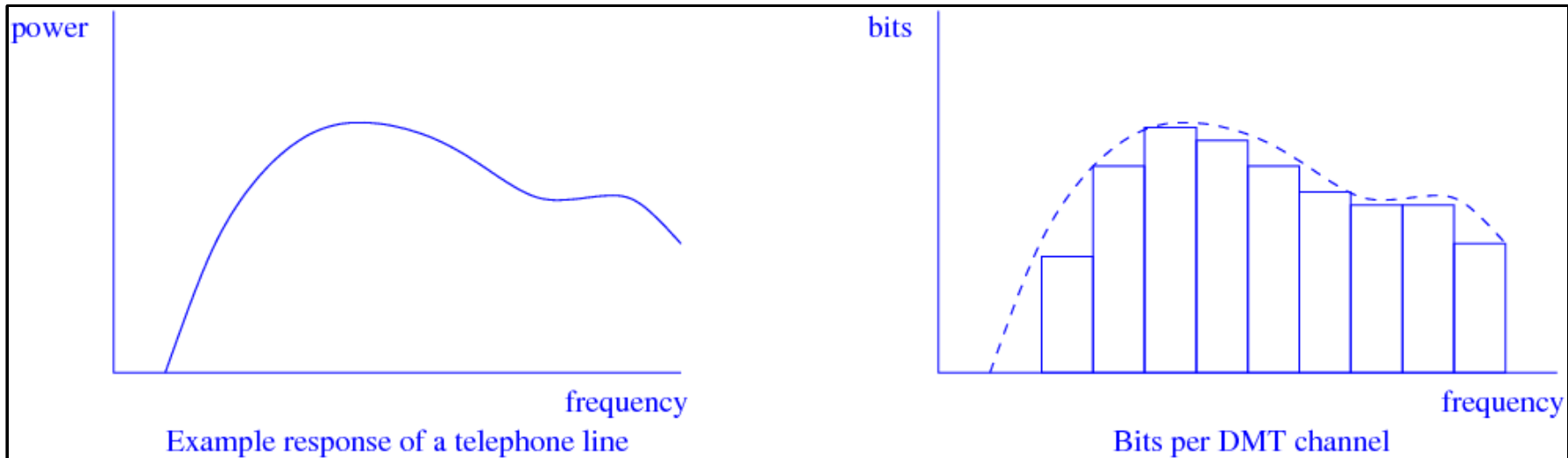
ADSL



- Often encoded using *Discrete Multi Tone* (DMT)
- This splits the available frequency range (0Hz to 1.104MHz) into 256 channels of 4kHz

Going Further

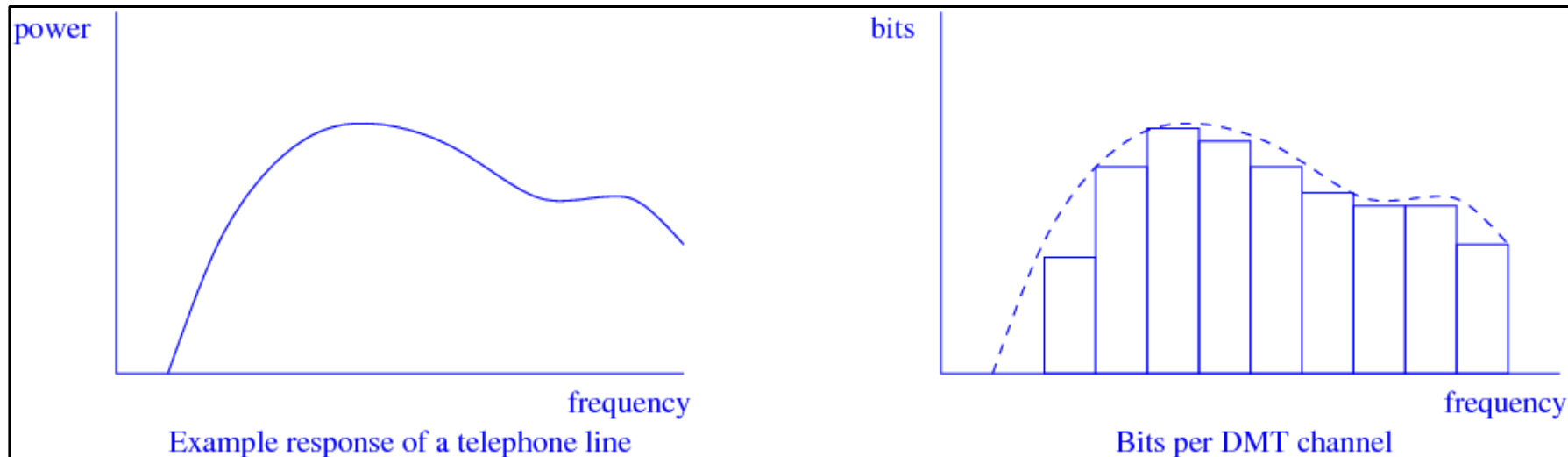
ADSL



- Channels 1-6 are used for telephony, including the voice channel

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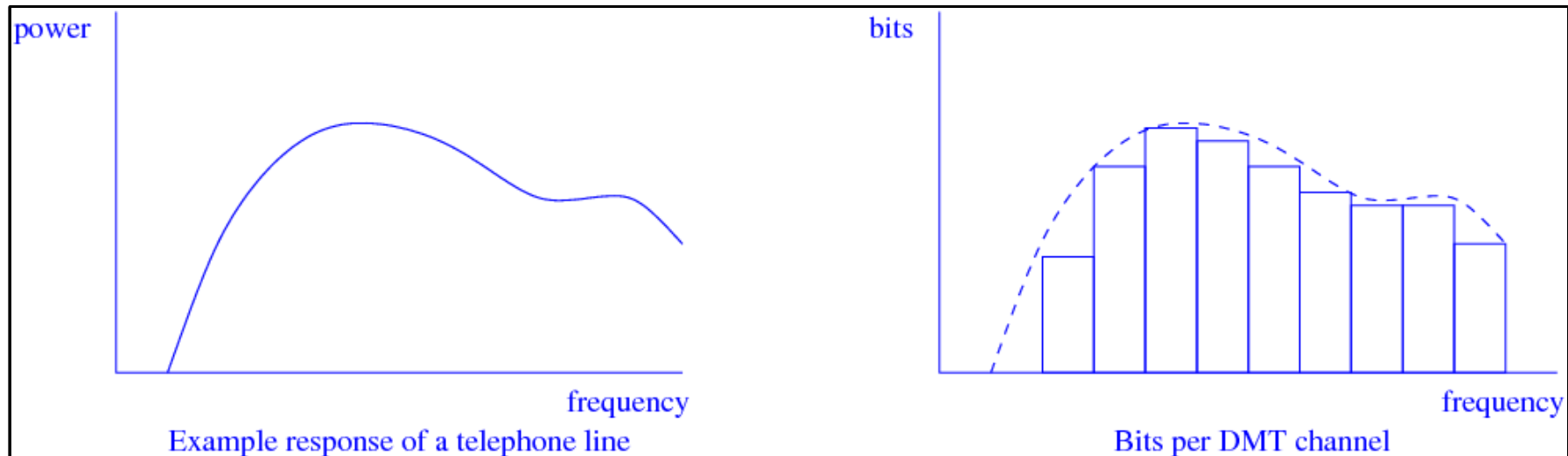
ADSL



- Each channel encodes as many bits as the current environment allows: possibly 0 to 15 bits/Hz
- A noisy channel (e.g., a nearby fluorescent light) might encode only one or two bits/Hz

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ADSL



- Other channels outside the interference can encode at their full rates
- Encoding is using *Quadrature Amplitude Modulation* (QAM)

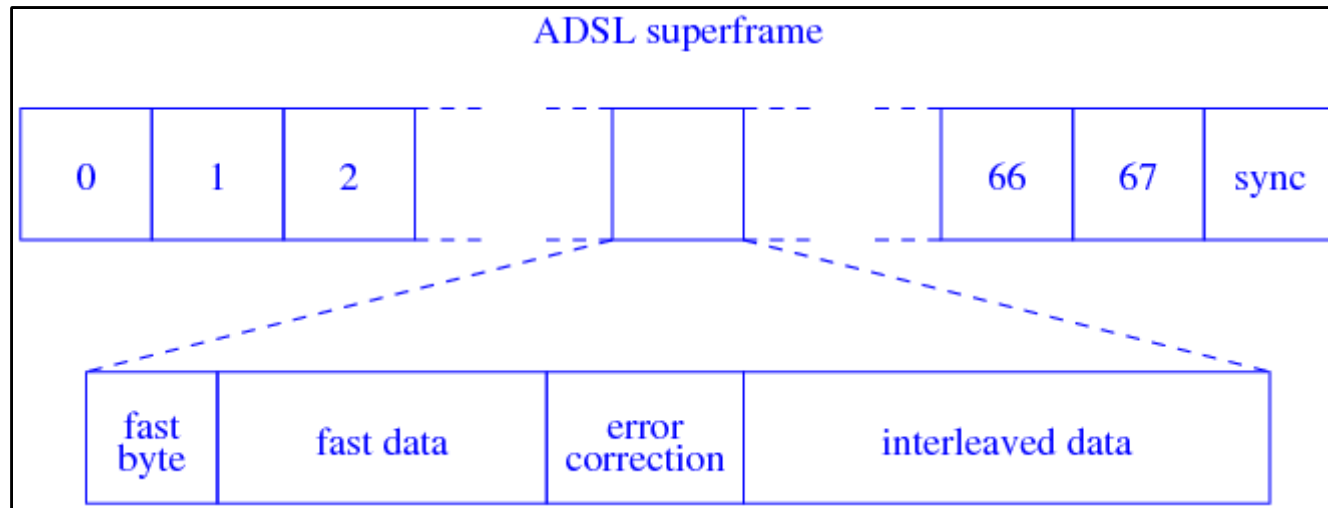
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ADSL

- Available bandwidth decreases as cable length increases: a practical limit of about 5-6km (3-3.5 miles)
- *Rate Adaptive Digital Subscriber Line (RADSL)* tests the line and adopts the optimum rates

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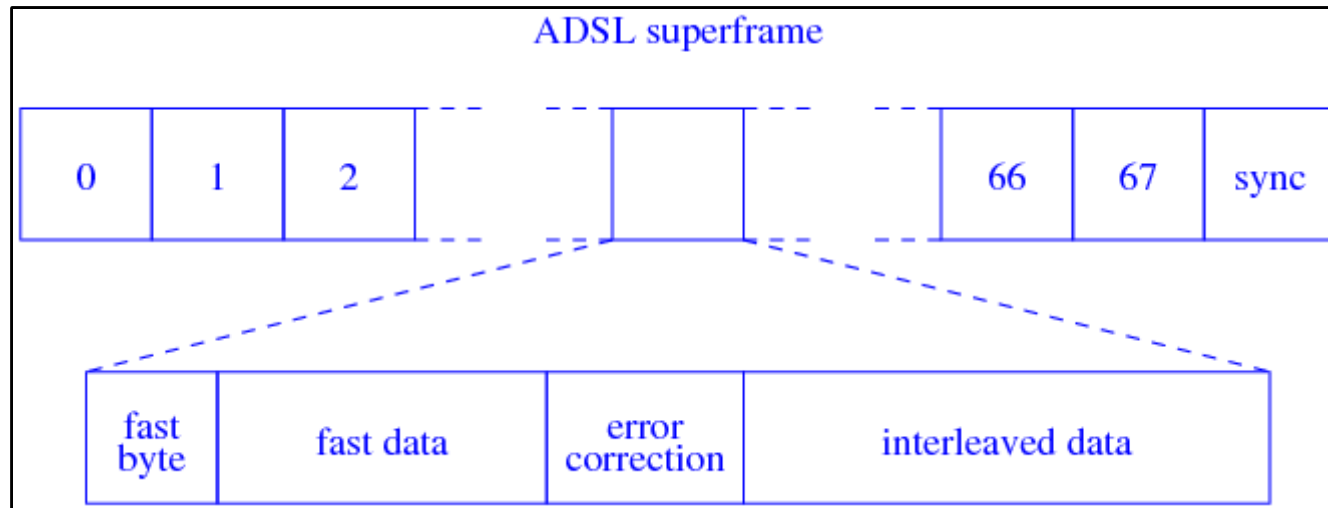
ADSL



- Data is transmitted in superframes containing 69 ADSL frames
- Last is synchronisation; rest are data

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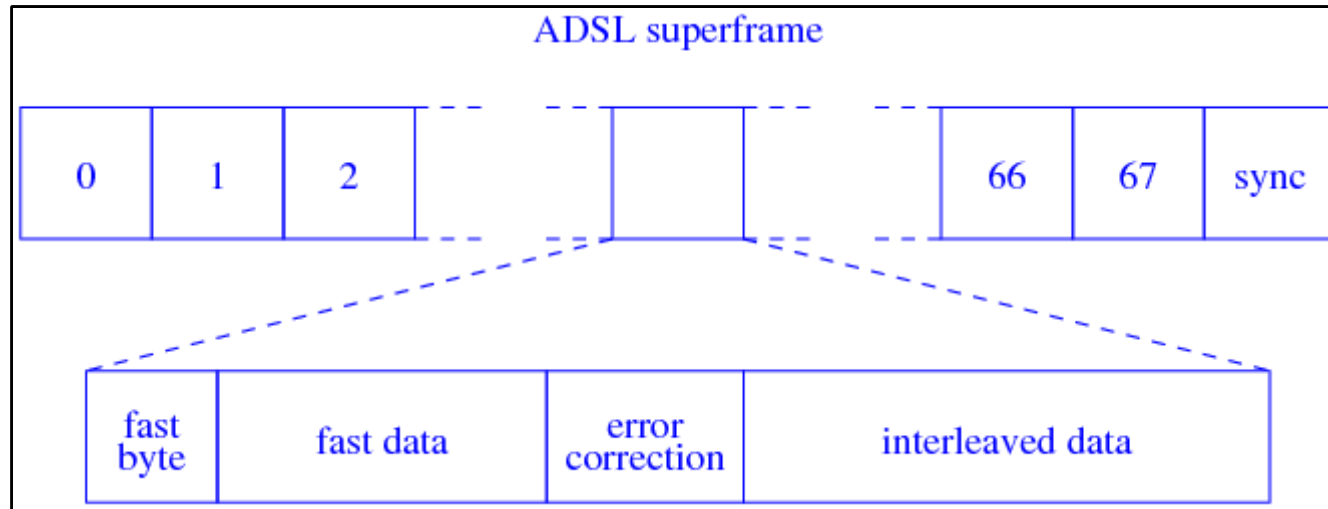
ADSL



- ADSL frames contain
 - Fast data: time sensitive data, such as audio

Going Further

ADSL



- ADSL frames contain
 - Fast byte contains CRCs or administrative flags
 - An error correction field to aid against corruption

Going Further

ADSL

- Many ISPs use ADSL to carry ATM as ATM fits well with their own telephony systems
- At the telephone exchange, several ADSL lines plug into a *Digital Subscriber Line Access Multiplexer* (DSLAM), which converts ADSL into (typically) ATM
- The ATM is then transported alongside other data (voice) in the telephone company's network

Going Further

ADSL

- Typical ADSL allows up to 8Mb/s downstream and 960Kb/s upstream
- A common method of delivery of ADSL to the home is to use a modem that plugs into the USB port on a computer

Then a Web browser will use HTML over HTTP over TCP over IP over PPP over AAL5 over ATM over ADSL over USB over copper!

Going Further

DSL

- ADSL is one of many standards

Going Further

DSL

- ADSL2: upgrade to ADSL providing more bandwidth over longer distances
- ADSL2+: an extension to ADSL2 up to 24Mb/s (over very short distances)
- High Rate DSL (HDSL): symmetric 1.544Mb/s over a pair of cables
- Symmetric DSL (SDSL): symmetric 1.544Mb/s over a single cable

Going Further

DSL

- Very High Rate DSL (VDSL): Up to 26Mb/s downstream, 6.4Mb/s upstream, range 300m
- VDSL2: upgrade to a symmetric 100Mb/s at 350m
- ISDN DSL (IDSL): symmetric 144Kb/s building on ISDN hardware

Going Further

Second Generation DSL

- Also known as *Next Generation DSL*, *Etherloop*, *Ethernet over POTS*
- Combines elements from Ethernet and DSL
- 10Mb/s at 1km; 4Mb/s at 2km; 2.5Kb/s at 2.5km; 2Mb/s at 3.5Km; 1Mb/s at 4.5Km
- Half duplex (ADSL is full duplex) reducing interference and so can be used over lower quality wiring

Going Further

Second Generation DSL

- Transmits in packets, rather than continuously like DSL, thus reducing power
- Is point-to-point, so no collision issues
- Symmetric, so full bandwidth in both directions (but not simultaneously)
- Based on Ethernet so has good compatibility with existing systems and good encapsulation