Chapter 6

Multiple Access Techniques

By: Dr Musaddaq Mahir Abdul Zahra

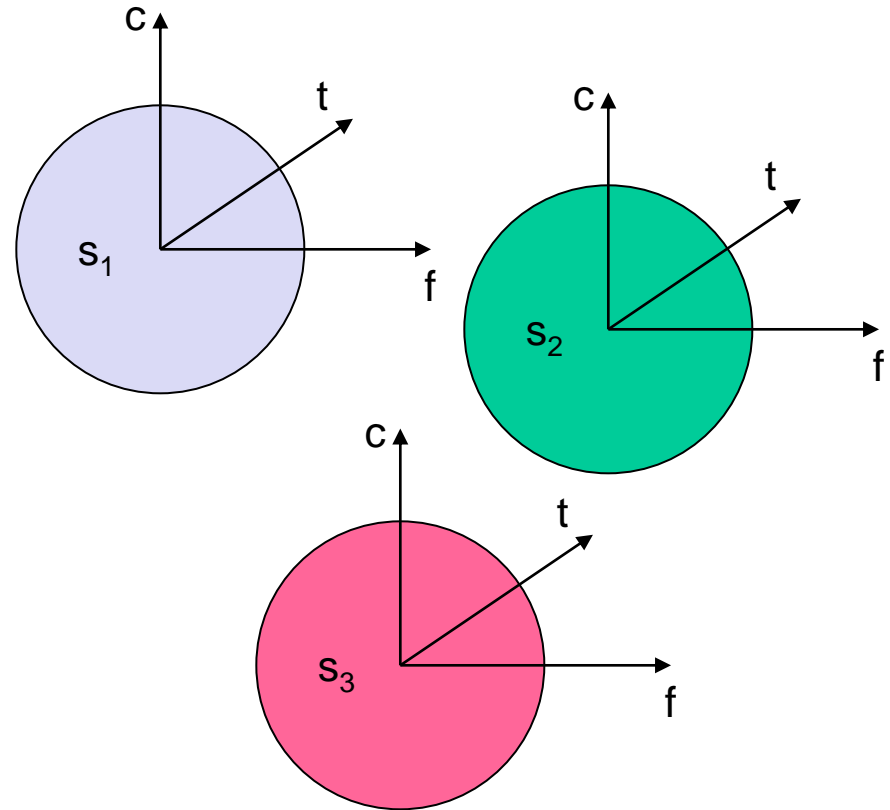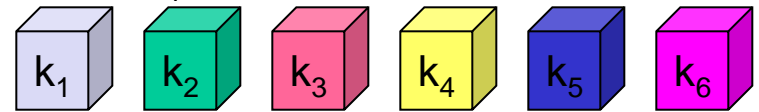# 6.1 Multiplexing

channels k_i

k_1 k_2 k_3 k_4 k_5 k_6

Multiplexing in 4 dimensions

- ❑ space (s_i)
- ❑ time (t)
- ❑ frequency (f)
- ❑ code (c)

Goal: multiple use
of a shared medium

Important: guard spaces needed!

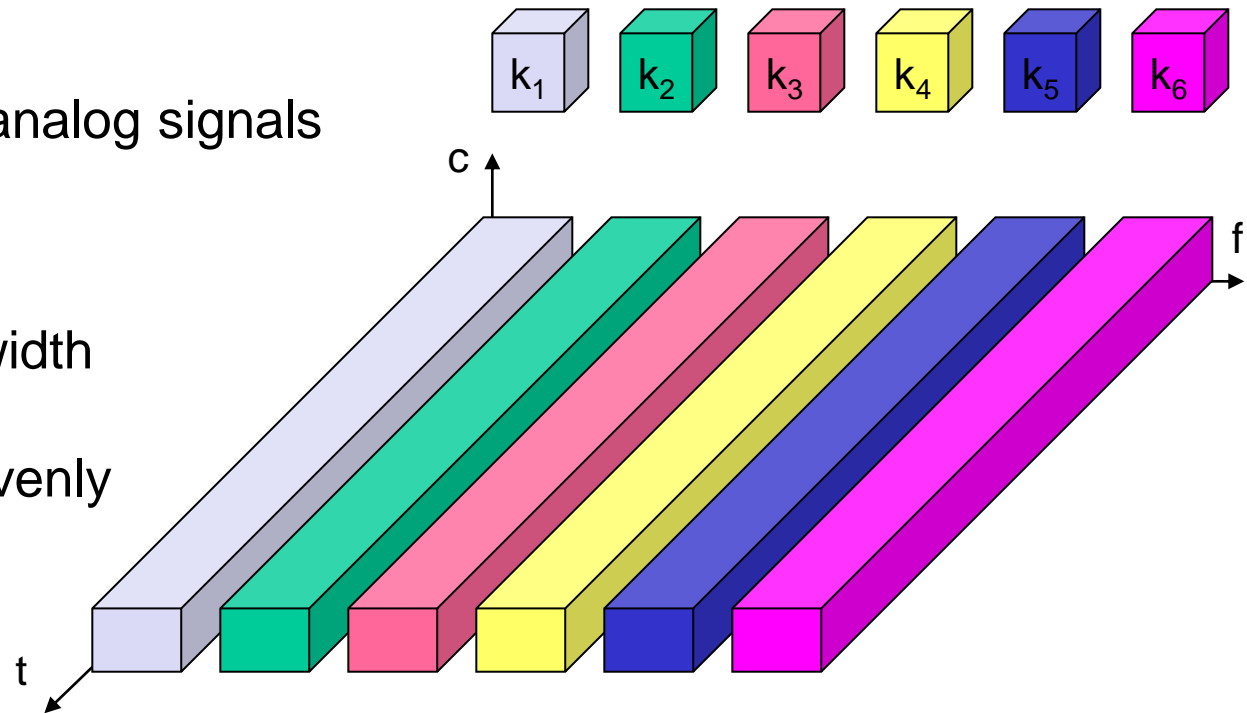Separation of the whole spectrum into smaller frequency bands

A channel gets a certain band of the spectrum for the whole time

Advantages:

- ❑ no dynamic coordination necessary
- ❑ works also for analog signals

Disadvantages:

- ❑ waste of bandwidth if the traffic is distributed unevenly
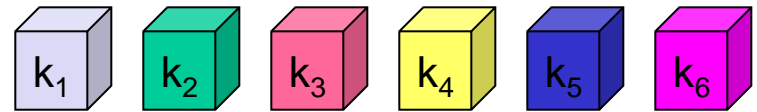- ❑ inflexible
- ❑ guard spaces
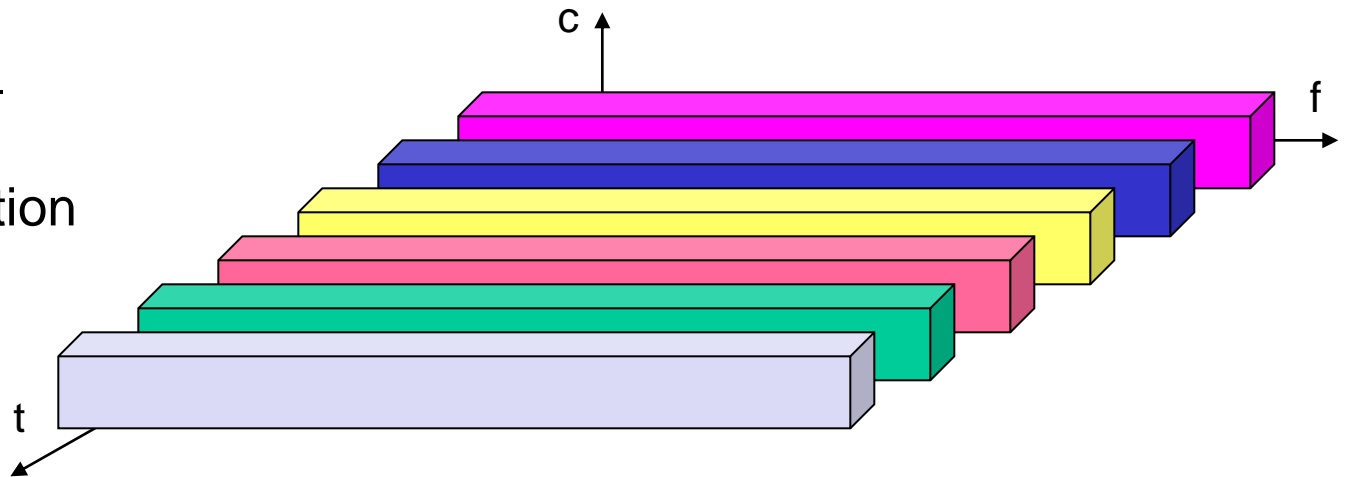
A channel gets the whole spectrum for a certain amount of time

Advantages:

- ❑ only one carrier in the medium at any time
- ❑ throughput high even for many users

Disadvantages:

- ❑ precise synchronization necessary

6.1.3 Time and frequency multiplex
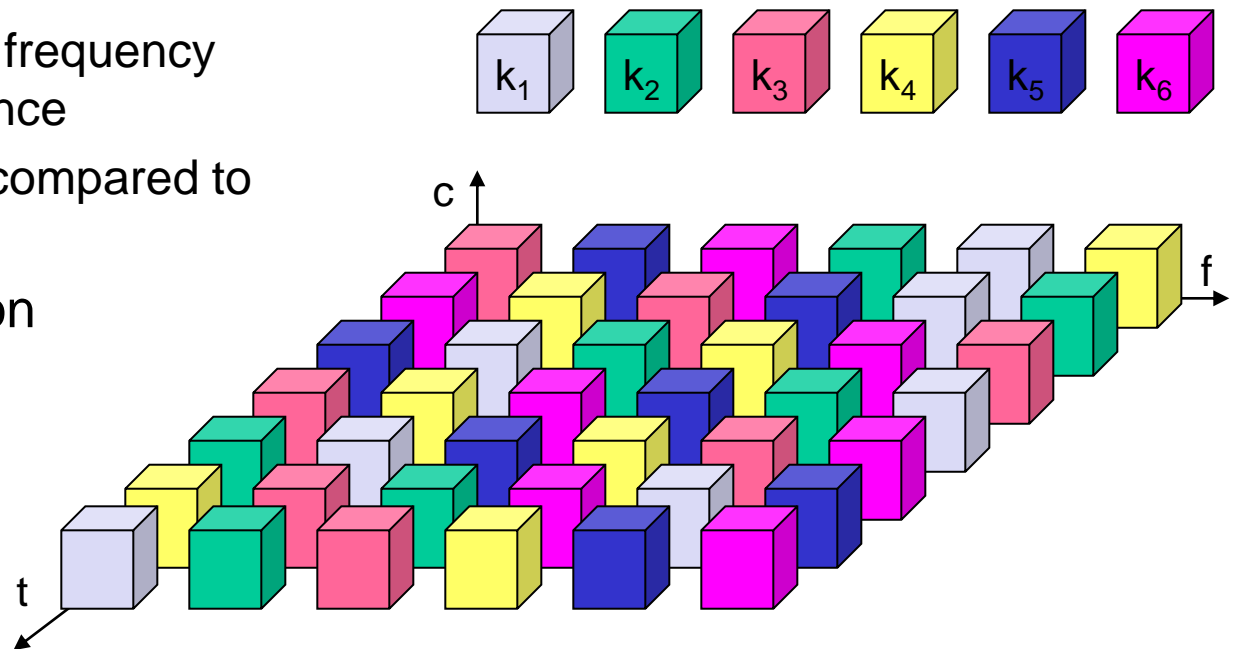
Dr Musaddaq Mahir Abd

Combination of both methods

A channel gets a certain frequency band for a certain amount of time

Example: GSM

Advantages:

- better protection against tapping

- protection against frequency selective interference

- higher data rates compared to code multiplex

but: precise coordination required

Each channel has a unique code
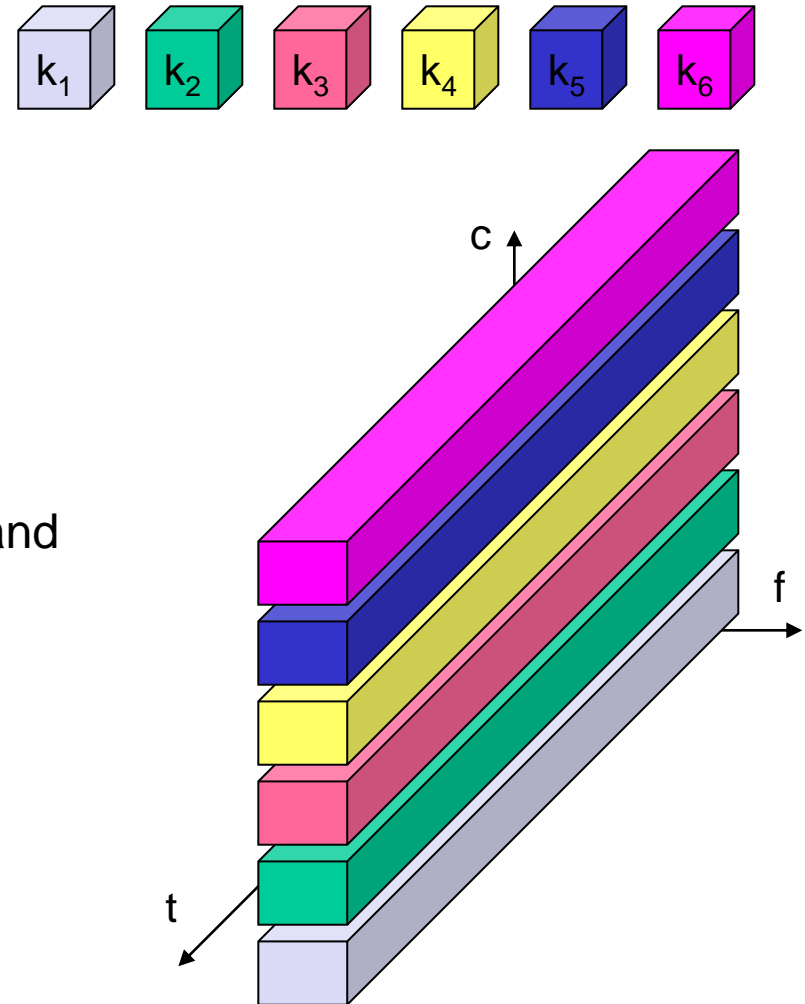
All channels use the same spectrum
at the same time

Advantages:

- ❑ bandwidth efficient
- ❑ no coordination and synchronization necessary
- ❑ good protection against interference and tapping

Disadvantages:

- ❑ lower user data rates
- ❑ more complex signal regeneration

Implemented using spread spectrum technology

6.2 Multiple Division Techniques

To accommodate a number of users, many traffic channels need to be made available.

In principle, there are three basic ways to have many channels within an allocated bandwidth:

- ❑ Frequency Division Multiple Access (FDMA)
- ❑ Time Division Multiple Access (TDMA)
- ❑ Code Division Multiple Access (CDMA)

❖ System employs different carrier frequency – FDMA system.

❖ System uses distinct time – TDMA system.

❖ System uses different code – CDMA system.

❖ In wireless communications, it is necessary to utilize limited frequency bands at the same time, allowing multiple users(MSs) to share radio channel simultaneously.

❖ To provide simultaneous two-way communication (duplex communication) :

   ❑ Frequency division duplexing (FDD)

   ❑ Time Division Duplexing (TDD)

FDMA uses FDD, TDMA & CDMA uses TDD & FDD
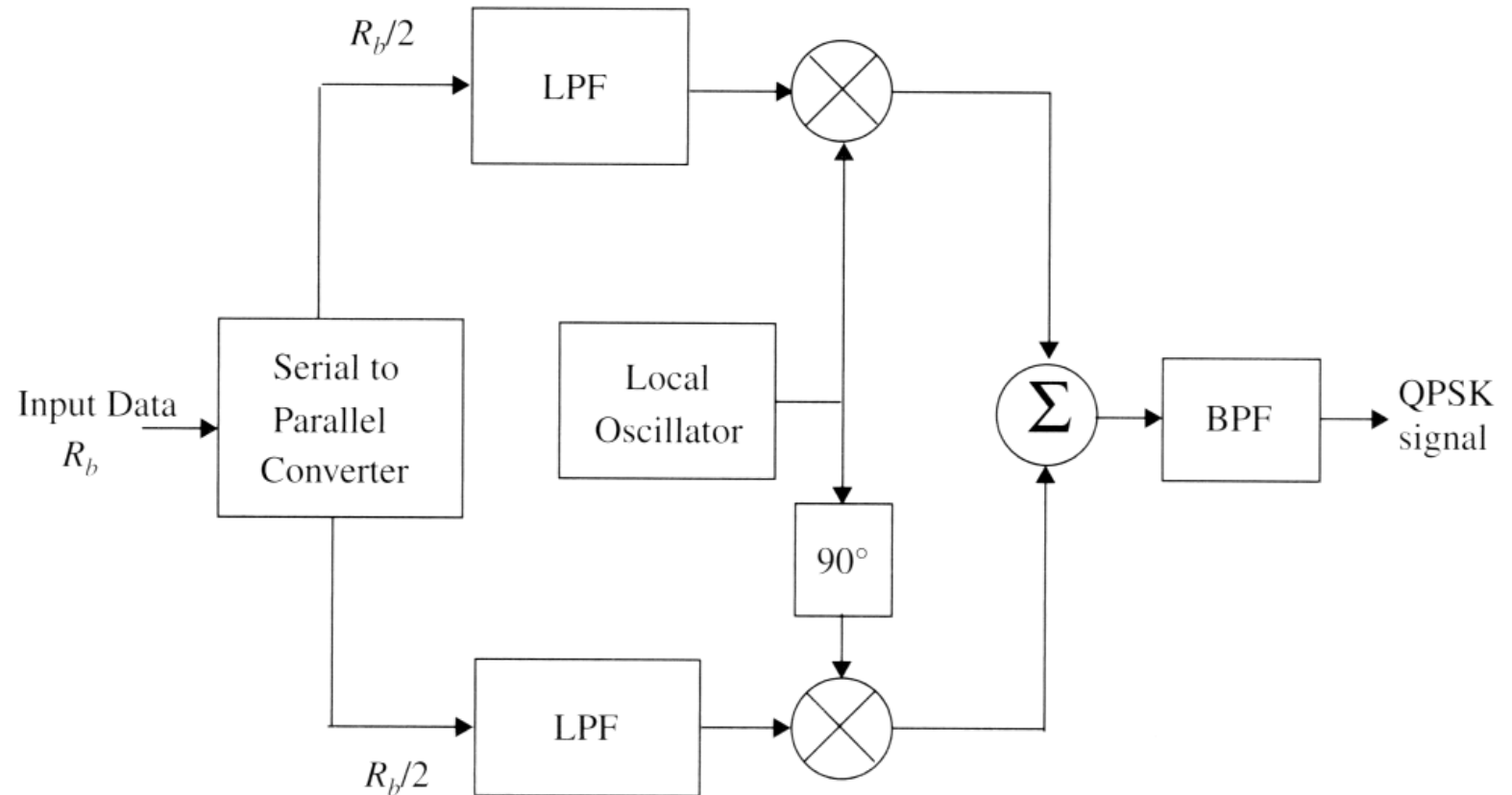
Fig. 7   Block diagram of a QPSK transmitter.