

# Bluetooth

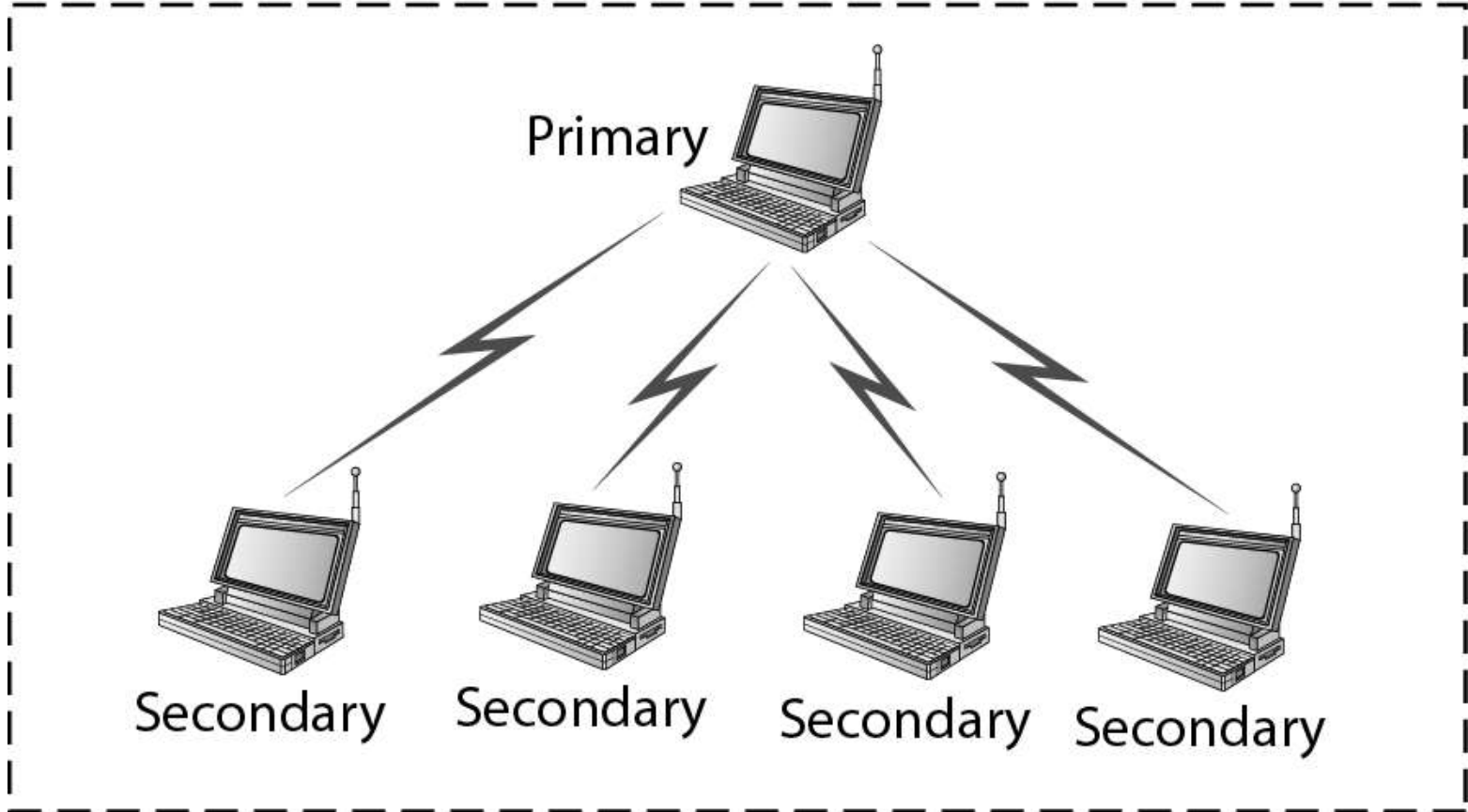
- ▶ *Bluetooth is a wireless LAN technology designed to connect devices of different functions such as telephones, notebooks, computers, cameras, printers, coffee makers, and so on.*
- ▶ *A Bluetooth LAN is an ad hoc network, which means that the network is formed spontaneously.*
- ▶ Bluetooth technology is the implementation of a protocol defined by the IEEE 802.15 standard.
- ▶ The standard defines a wireless personal-area network (PAN) operable in an area the size of a room or a hall.



- ▶ A Bluetooth LAN is an ad hoc network, which means that the network is formed spontaneously; the devices, sometimes called gadgets, find each other and make a network called a piconet. A Bluetooth LAN can even be connected to the Internet if one of the gadgets has this capability.
- ▶ Peripheral devices such as a wireless mouse or keyboard can communicate with the computer through this technology.
- ▶ Monitoring devices can communicate with sensor devices in a small health care center.
- ▶ Home security devices can use this technology to connect different sensors to the main security controller.
- ▶ Conference attendees can synchronize their laptop computers at a conference.

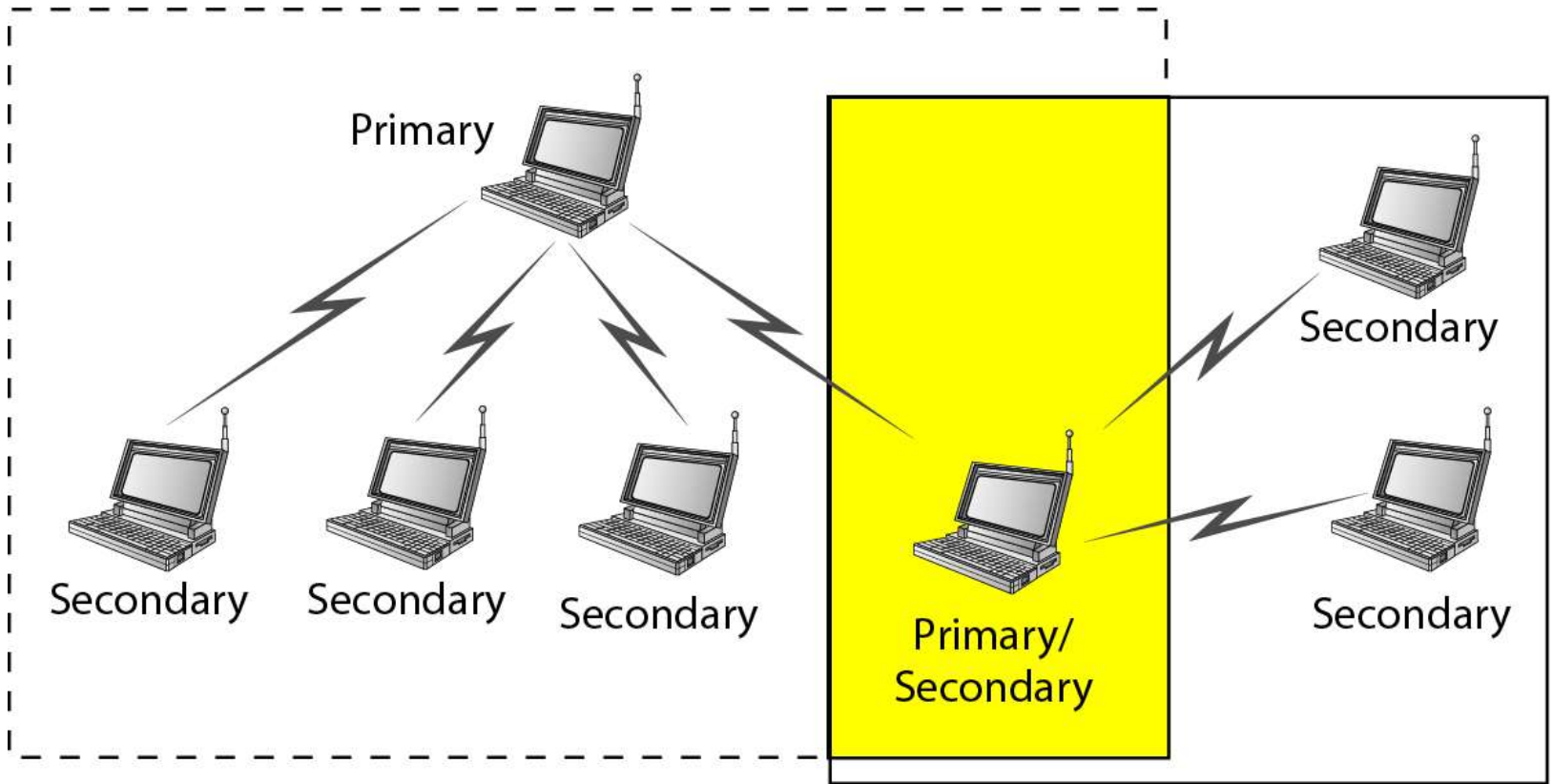
# Piconet

## Piconet



# Scatternet

Piconet



Piconet

# Bluetooth layers

## **Radio Layer**

- ▶ The radio layer is roughly equivalent to the physical layer of the Internet model. Bluetooth devices are low-power and have a range of 10 m.

## **Band**

- ▶ Bluetooth uses a 2.4-GHz ISM band divided into 79 channels of 1 MHz each.
- ▶ The **industrial, scientific, and medical radio band** (ISM band) refers to a group of radio bands or parts of the radio spectrum that are internationally reserved for the use of radio frequency (RF) energy intended for scientific, medical and industrial requirements rather than for communications.

## **Profiles**

- ▶ A Bluetooth profile is a **wireless interface specification for Bluetooth-based communication between devices**, such as the Hands-Free profile. For a mobile device to connect to a wireless headset, both devices must support the Hands-Free profile

## **FHSS**

- ▶ Bluetooth uses the **frequency-hopping spread spectrum (FHSS) method in the physical** layer to avoid interference from other devices or other networks.
- ▶ Bluetooth hops 1600 times per second, which means that each device changes its modulation frequency 1600 times per second

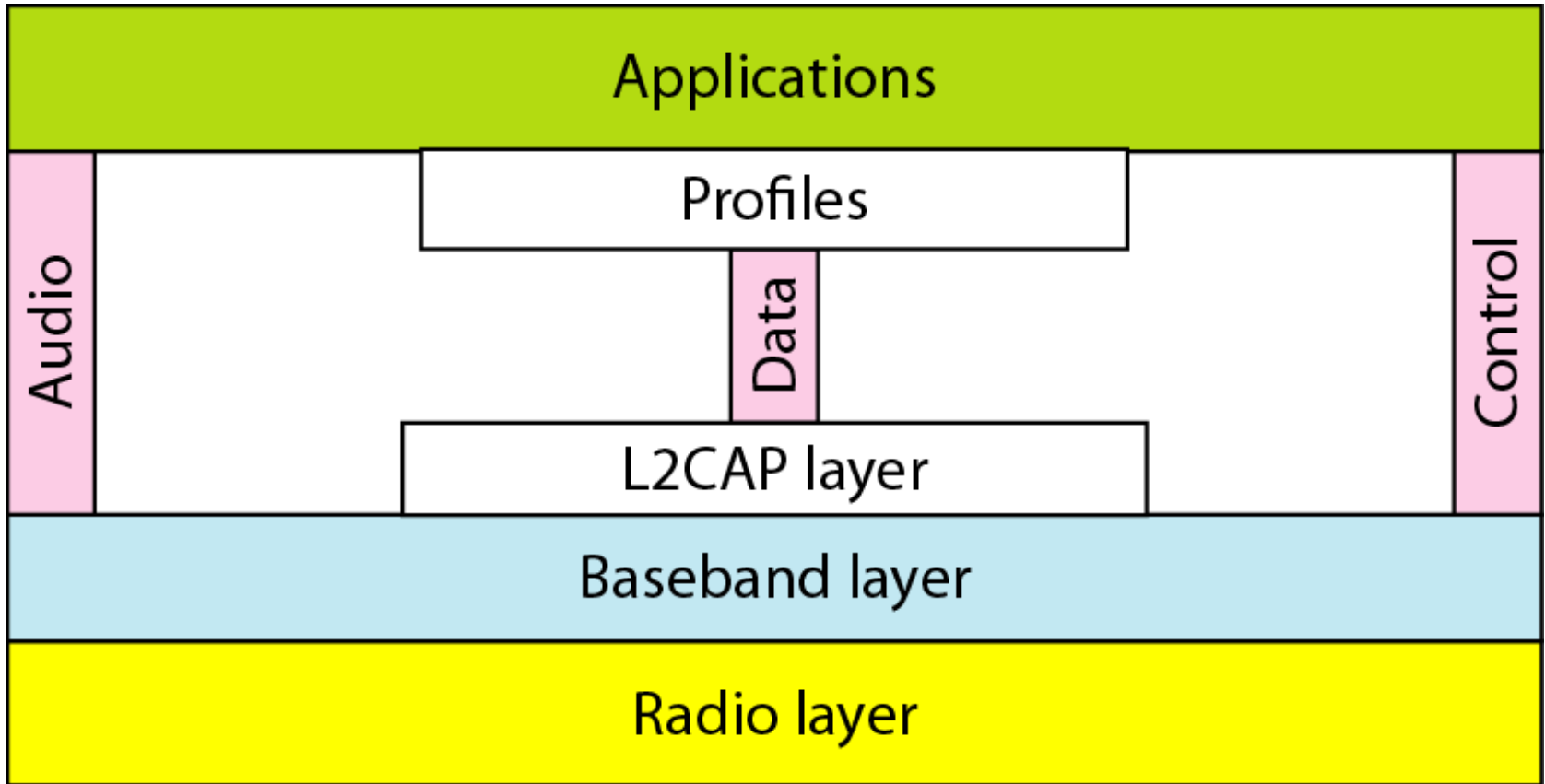
## **Modulation**

- ▶ To transform bits to a signal, Bluetooth uses a sophisticated version of FSK, called GFSK (FSK with Gaussian bandwidth filtering)

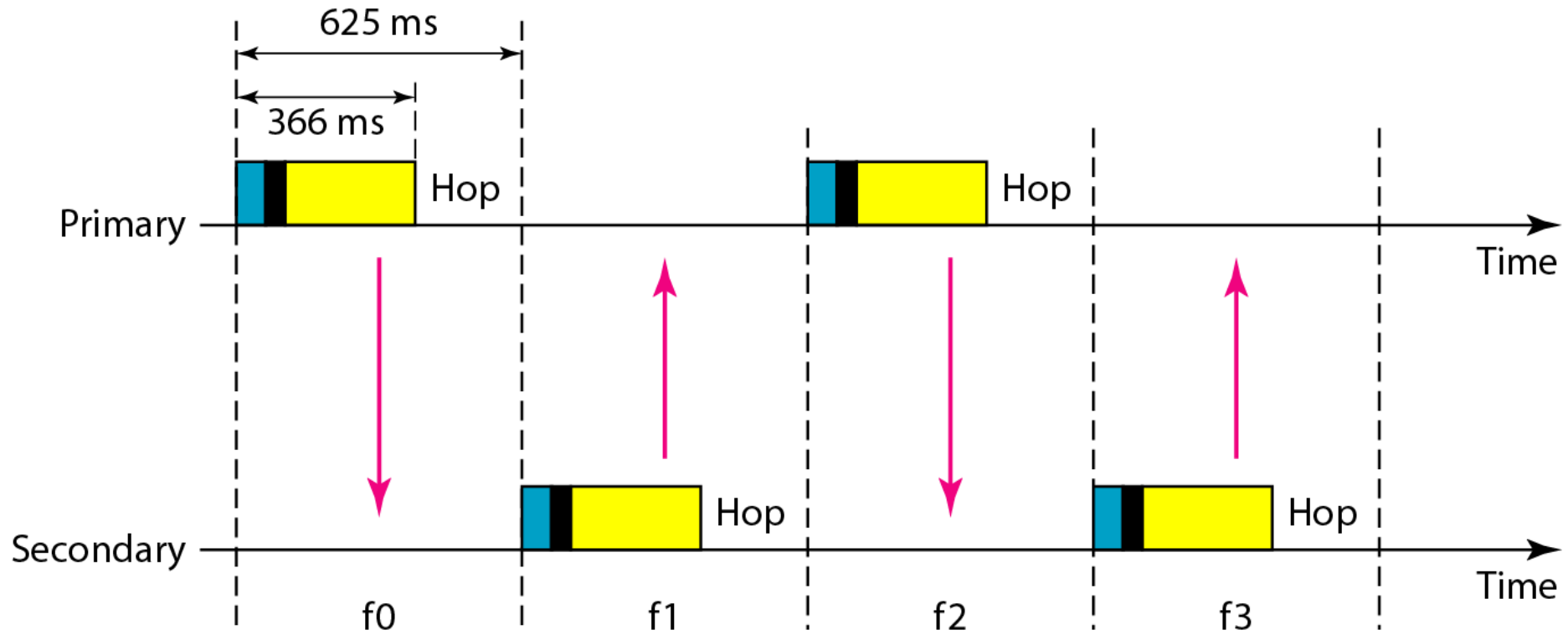
The **Logical Link Control and Adaptation Protocol, or L2CAP (L2 here means LL)**, is roughly equivalent to the LLC sublayer in LANs

- ▶ The L2CAP has specific duties: multiplexing, segmentation and reassembly, quality of service (QoS), and group management.

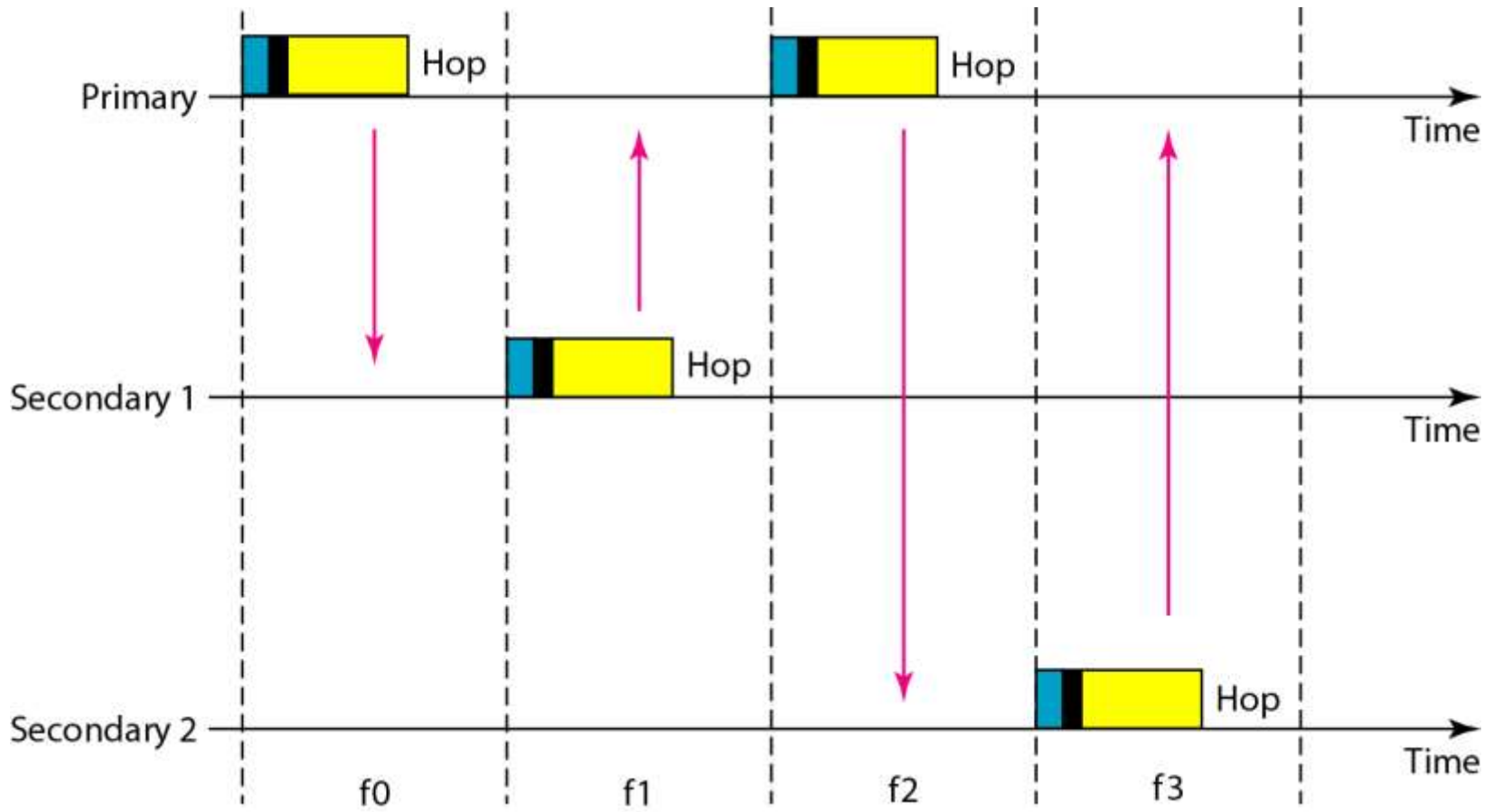
# Bluetooth layers



# Single-secondary communication



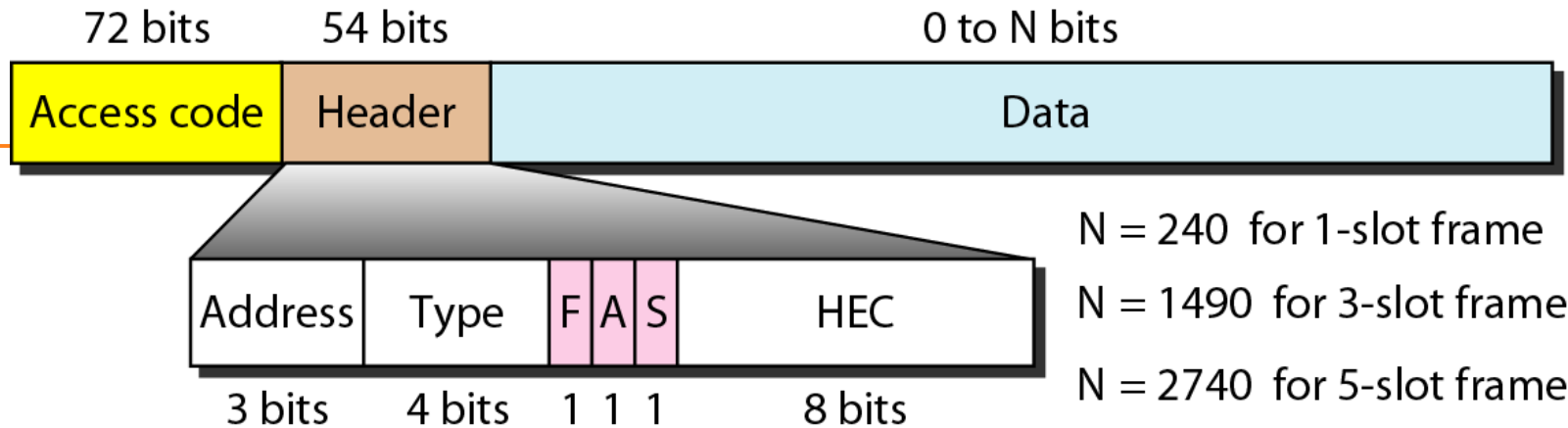
# Multiple-secondary communication





1. In slot 0, the primary sends a frame to secondary 1.
2. In slot 1, only secondary 1 sends a frame to the primary because the previous frame was addressed to secondary 1; other secondary are silent.
3. In slot 2, the primary sends a frame to secondary 2.
4. In slot 3, only secondary 2 sends a frame to the primary because the previous frame was addressed to secondary 2; other secondary are silent.
5. The cycle continues.

We can say that this access method is similar to a poll/select operation with reservations. When the primary selects a secondary, it also polls it. The next time slot is reserved for the polled station to send its frame. If the polled secondary has no frame to send, the channel is silent.



This 18-bit part is repeated 3 times.

Access code: 72-bit field normally contains sync bits and ID of the primary to distinguish the frame of one piconet from another

Address: up to 7 secondaries; 0 means broadcast

Type: defines the type of data coming from the upper layer

F: flow control (1 indicates buffer full); A: ACK (bluetooth uses stop and wait)

S: sequence number for stop and wait

*HEC. The 8-bit header error correction subfield is a checksum to detect errors in header section*

## *L2CAP data packet format*



L2CAP layer roughly equivalent to LLC layer in LANs

Length: length of data coming from upper layers

Channel ID: defines a unique ID for the virtual channel created at this level