



BLE HID Intro

26 Questions

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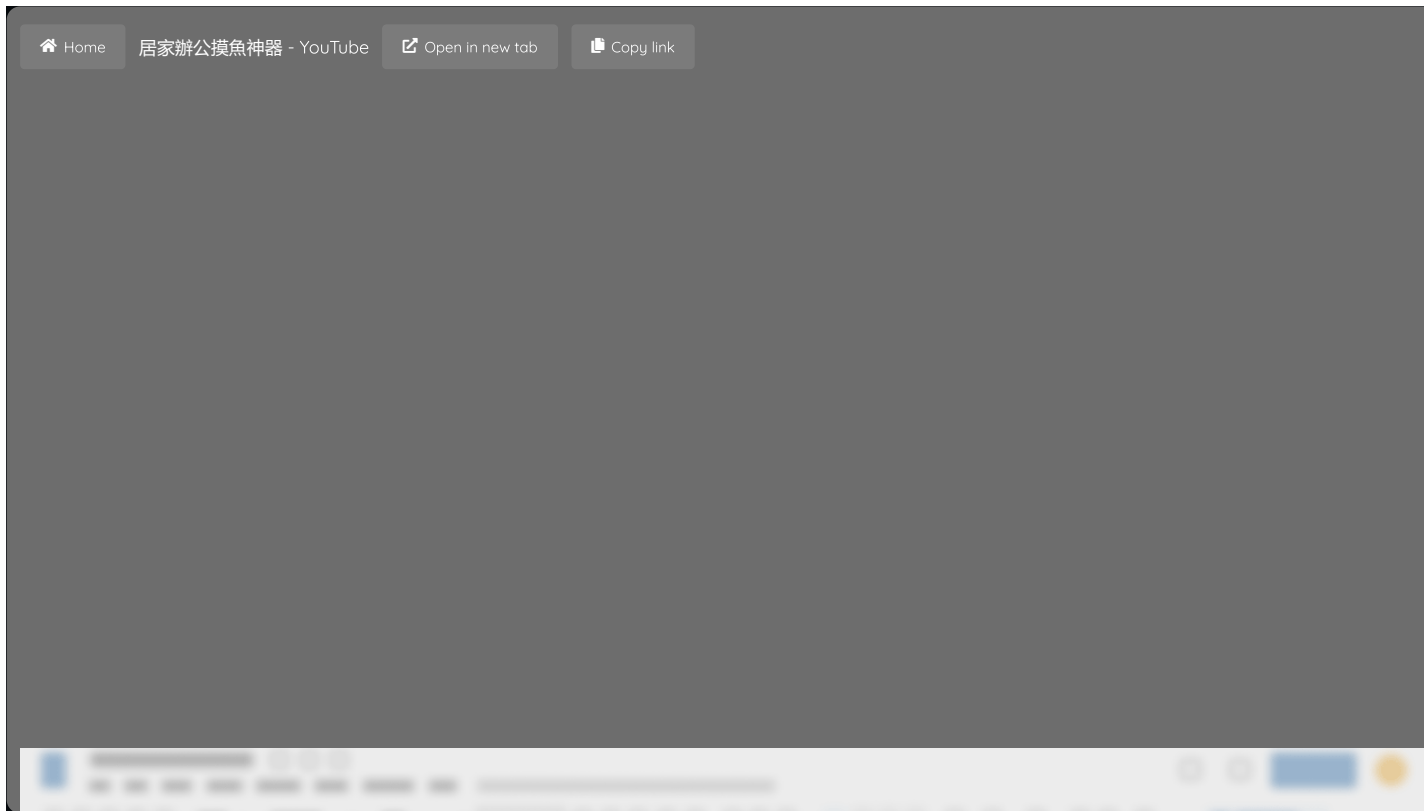
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Agenda

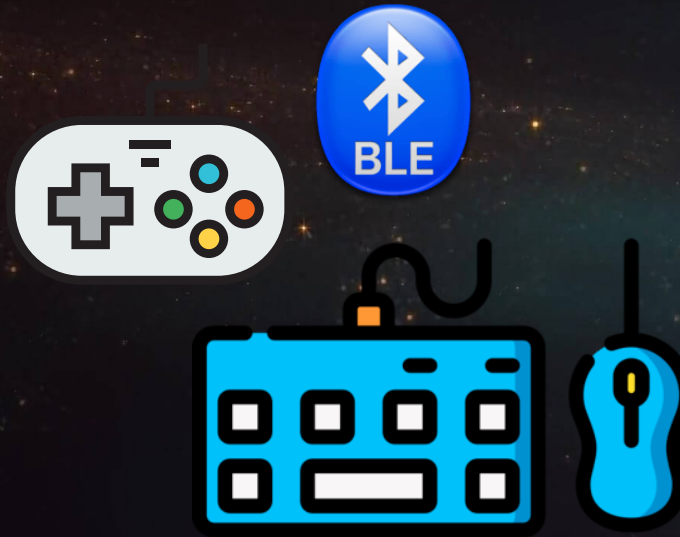
Introduce to HID (USB-HID)?

Introduce to BLE?

- GAP
- GATT

Ameba BLE HID Example Demo

- Mouse
- Keyboard
- Gamepad



4.

Introduce to Human Interface Device (HID) ^[1]

人機接口設備

1. What is a Human Interface Device
2. A standard to Simplify Accessories
3. HID and Applications
4. Types of Human Interface Devices

5.

1. What is a HID

- Human Interface Device (HID) is a **standard** for computing devices that are operated by humans.
 - A device class definition to replace PS/2-style connectors with a generic USB driver
- HID Devices
 - keyboards, mice, game controllers, etc.



PS/2 Connectors

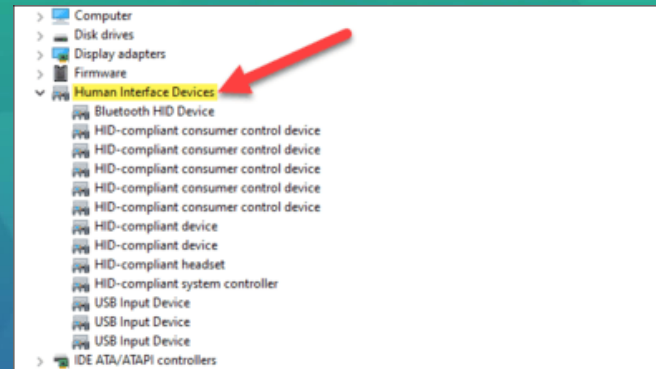
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2.A Standard to Simplify Accessories

Prior to HID, there were several specific protocols for each type of input device.

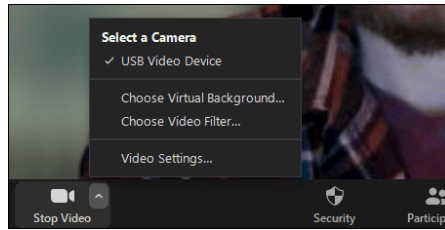
Advantages of HID

- simplify the process of installing input devices
- easier to produce widely compatible accessories



HID in the Windows Device Manager

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3. [HID & Applications](#) How to make sure the accessories work with the apps/software?

8.

4.Types of Human Interface Devices

- USB-HID
 - Keyboards, mice, webcams, trackpads, gaming controller, thermometers, audio instruments etc.
- Bluetooth-HID
 - same USB-HID protocol with slight modifications for Bluetooth
 - Bluetooth Keyboards, mouse etc.



USB-HID



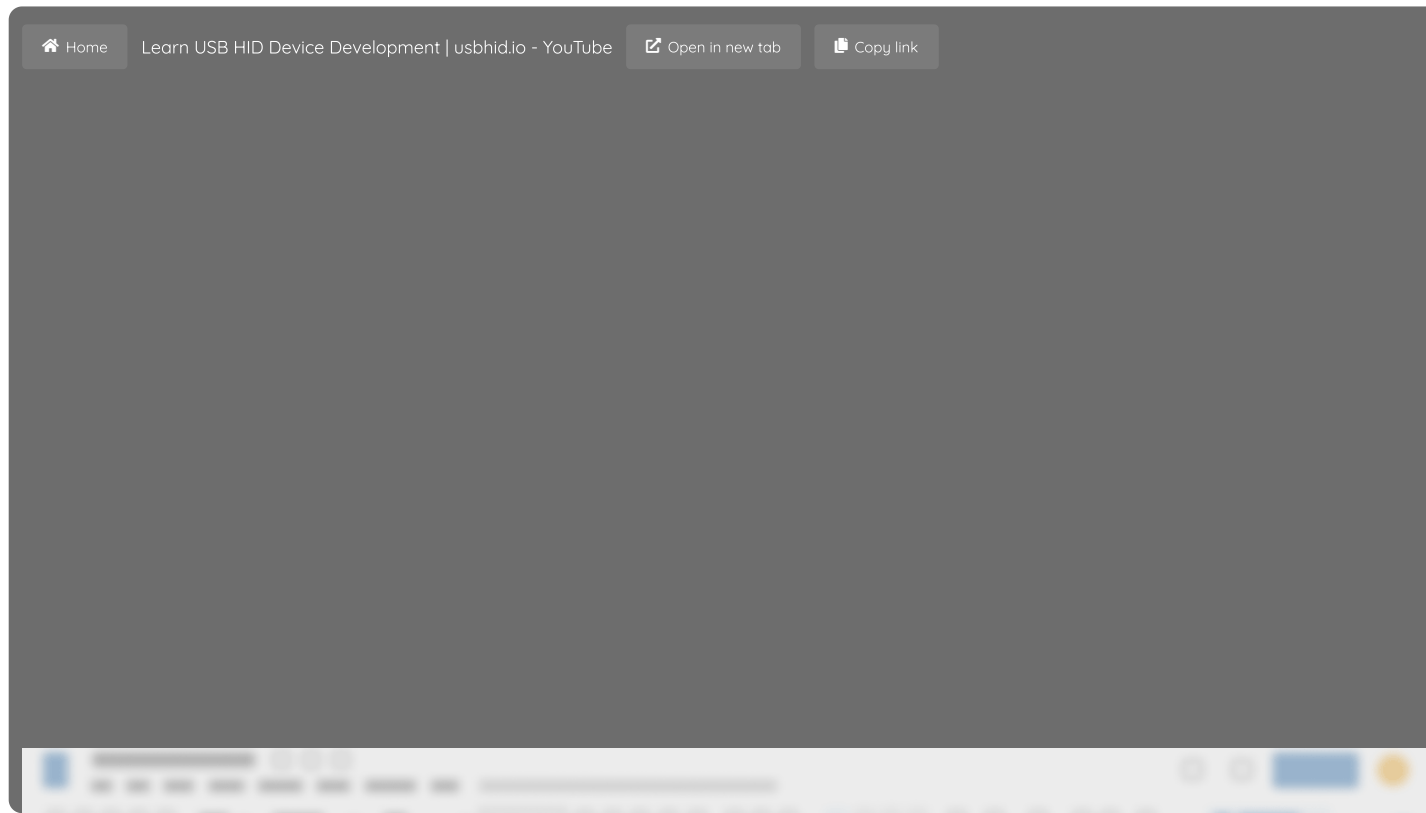
Bluetooth-HID

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Quiz 1 HID 的全稱是?

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Introduce to Bluetooth Low Energy (BLE)

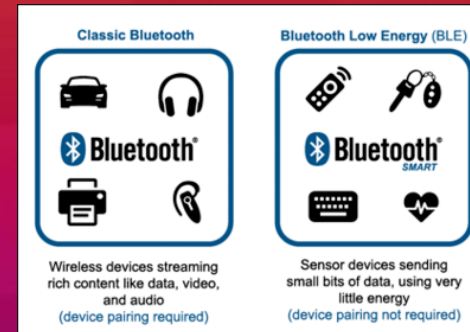
超低功耗藍芽

1. What is BLE and BLE Devices
2. Important Terminology & Concepts
3. GAP vs GATT

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1. Bluetooth Low Energy (BLE)

- Also referred to as "Bluetooth SMART"
- BLE is a wireless communication protocol used by many devices, including mobile devices. [3]
- BLE connections are established based on **GATT**, where GATT is a Bluetooth regulation for TX/RX small data payloads/attributes



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2. Important TERMS & CONCEPTS

Two major concepts to know about are the 2 Modes of BLE devices:^[4]

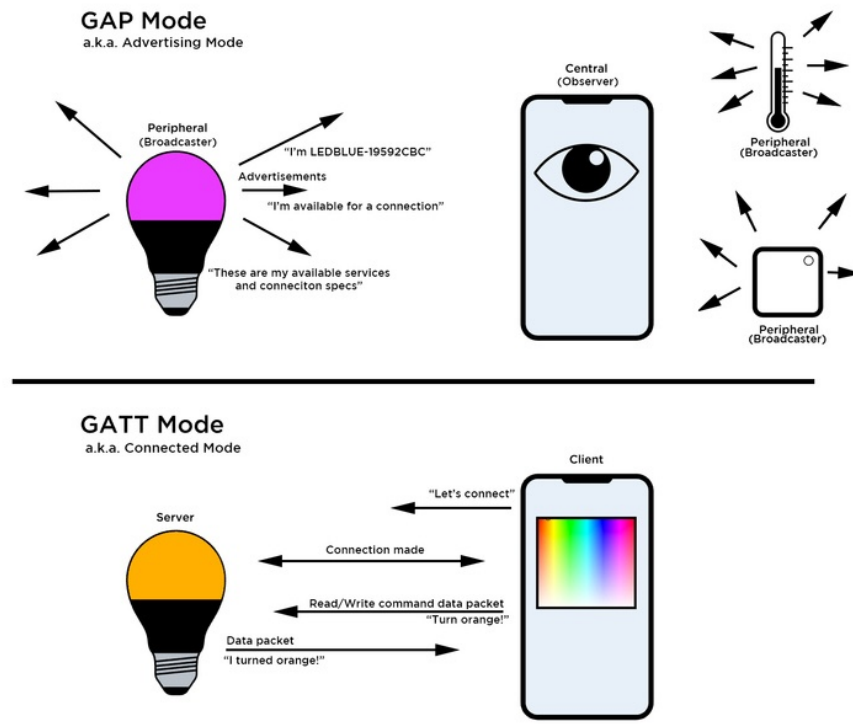
1. Broadcasting Mode
Generic Access Profile (GAP) 一般訪問協議
2. Connected Device Mode
 - a. Generic Attribute Profile (GATT) 普通屬性協議

Terms:

- GAP: Advertising
- GATT: Profile, Service, Characteristic, Packet

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GAP mode deals with broadcasting peripheral advertisements, such as "I'm a device named LEDBlue-19592CBC", as well as advertising information necessary to establish a dedicated device connection if desired. The peripheral may also be advertising available services.



GATT mode deals with communications and attribute transfer between two devices once they are connected, such as between a heart monitor and a phone, or between your CPB and the Magic Light.

GAP vs GATT

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3. GAP Device Roles

Peripheral 外圍設備

- The low-power device that broadcasts advertisements.
- Examples of peripherals include the heart rate monitor, smartwatch, fitness tracker, and iBeacon.

Central 中心設備

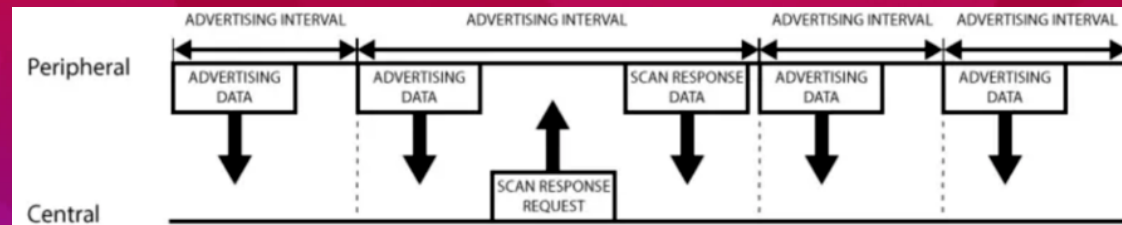
- The host "computer" observes advertisements being broadcast by the Peripherals.
- This is often a mobile device such as a phone, tablet, desktop or laptop.

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GAP Terms

Advertising 廣播

- Two ways of advertising data
 - Advertising Data Payload 廣播數據 (Necessary)
 - Scan Response Data Payload 掃描回復 (Optional)
- Package Size: 31 Byte
- Sequence Diagram



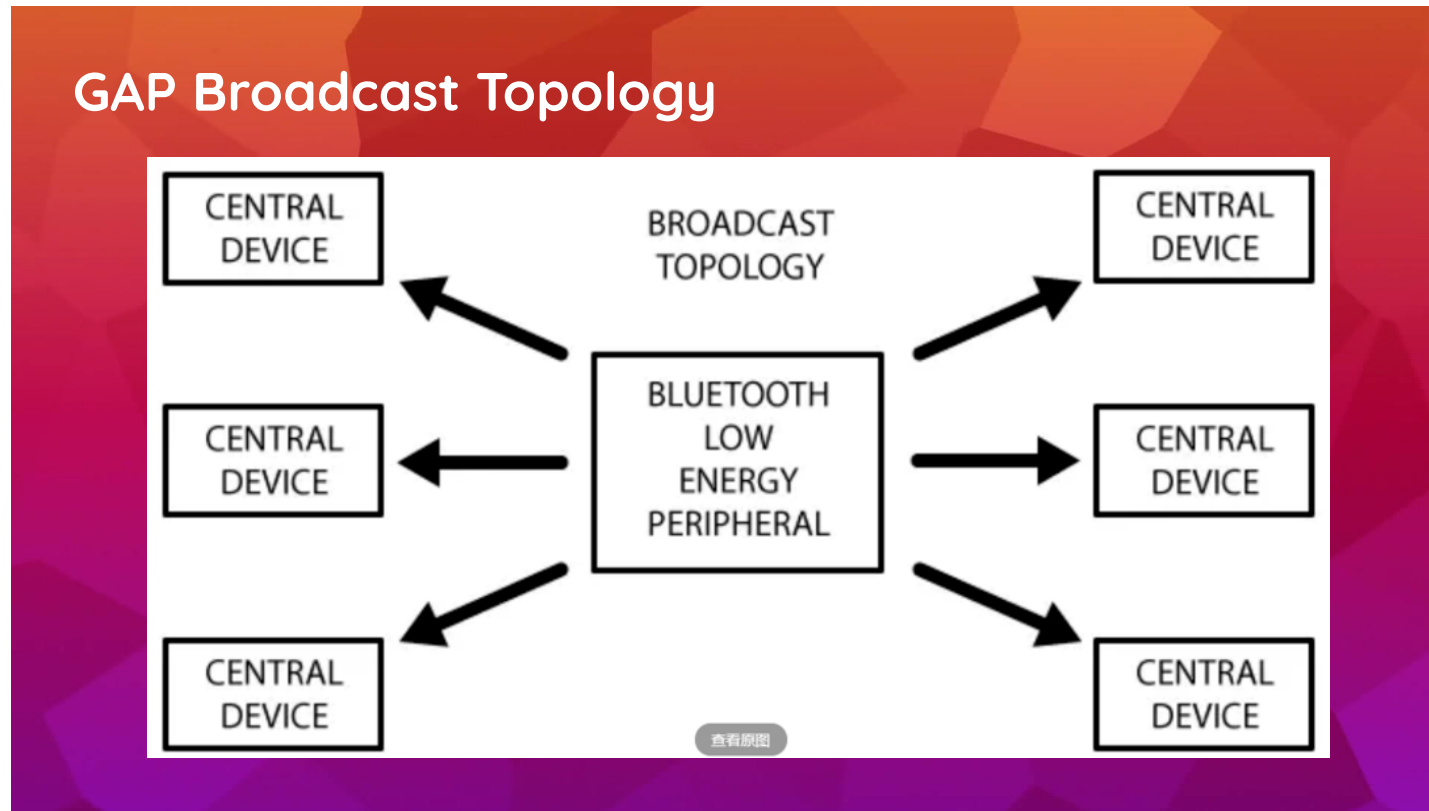
Step 1: peripheral set up interval

Step 2: peripheral advertising

Step 3: Central device send Scan Response Request

Step 4: Peripheral replies Scan Response Data

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18. Quiz 2 【多選題】 GAP Profile 中定義的常見設備角色有？

- a) Master
- b) Central
- c) Peripheral
- d) Slave
- e) Client

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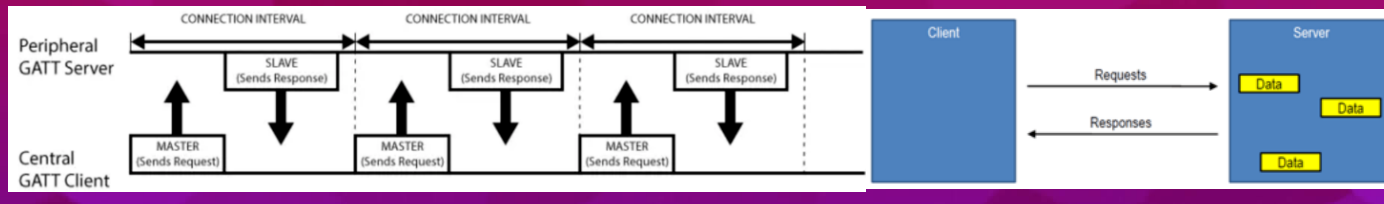
3. GATT Device Roles

Server 服務器

- In connected mode, a device may take on a new role as a **Server**, providing a Service available to clients.
- It can now send and receive data packets as requested by the Client device to which it now has a connection. For example, the Smart Watch

Client 客戶端

- In connected mode, a device may also take on a new role as **Client** that can send requests to one or more of a Server's available Services to send and receive data packets. For example, the mobile phone



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GATT Terms

Service 服務

- A function the **Server** provides.
- For example, a heart rate monitor armband may have separate **Services** for:

Device Information

Battery Service

Heart Rate

- Each Service is comprised of collections of information called **Characteristics**. In the case of the Heart Rate Service, the two Characteristics are:

Heart Rate Measurement and

Body Sensor Location

- The peripheral advertises its services.

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GATT Terms

Characteristic 特徵數據

- A Characteristic is a container for the value, or attribute, of a piece of data along with any associated metadata, such as a human-readable name.
- A characteristic may be readable, writable, or both.
- In the case of the Heart Rate Service, the two **Characteristics** are:
 - Heart Rate Measurement** and **Body Sensor Location**
 - For example, the Heart Rate Measurement Characteristic can be served up to the Client device and will report the heart rate measurement as a number, as well as the unit string "bpm" for beats-per-minute.
- Characteristics each have a Universal Unique Identifier (UUID) which is a 16-bit or 128-bit ID.

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GATT Terms

Packet 數據包

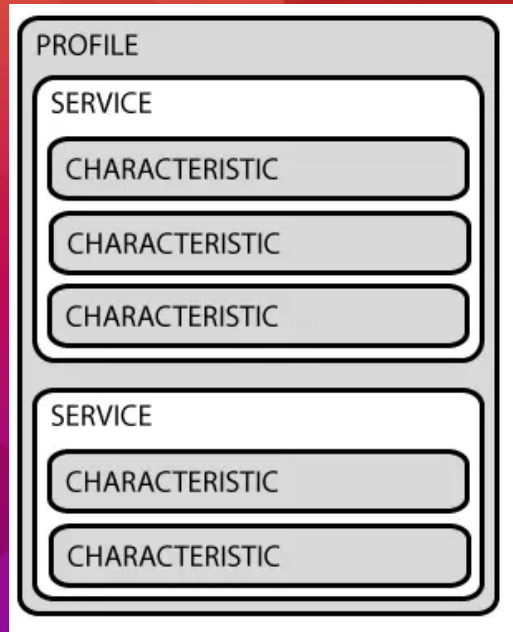
- Data transmitted by a device. BLE devices and host computers transmit and receive data in small bursts called packets.

Profile 數據包

- A pre-defined collection of **Services** that a BLE device can provide.

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Summary

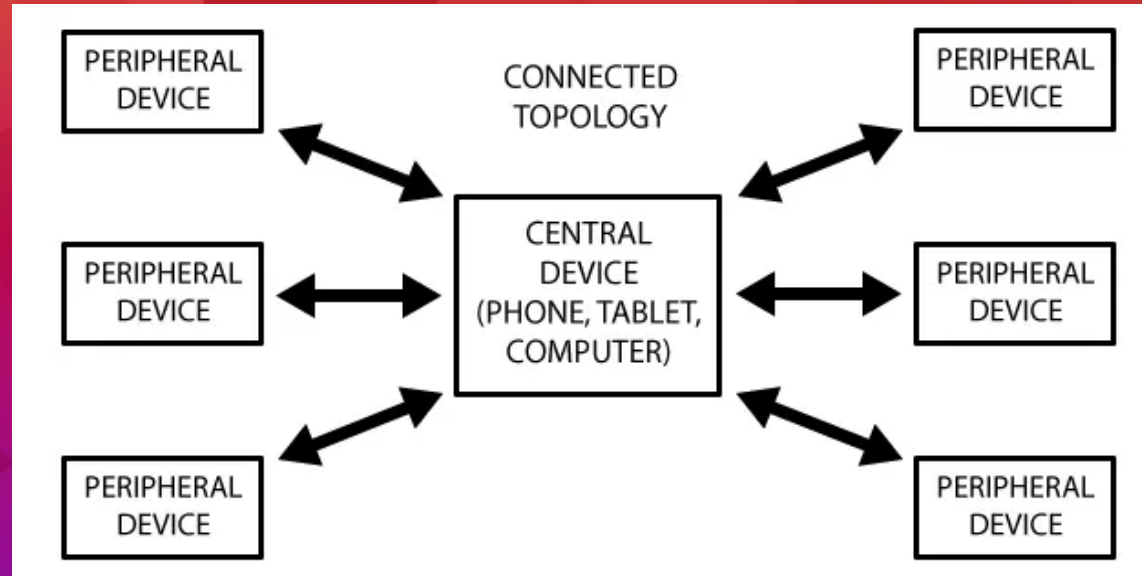


Heart Rate Profile

- Heart Rate Service
 - Heart Rate Measurement Characteristic
 - Body Sensor Location Characteristic
- Device Information Service
- Battery Service

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GATT Broadcast Topology



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Quiz 3 【單選】 下列敘述中正確的有？

- a) GAP的廣播工作流程中廣播時間間隔越長就越省電
- b) GAP的廣播工作流程中廣播時間間隔越長就越容易被掃描到
- c) GATT連接建立之前不需要先經過GAP協議
- d) 一個BLE外設能同時連接多個中心設備，一個中心設備也能同時連接多個外設

26.

References

- [1] Learn USB HID Device Development (<https://bit.ly/3JeYrJu>)
- [2] *What Is a Human Interface Device (HID)? (<https://bit.ly/3munQVQ>)
- [3] *Adafruit - Understanding BLE (<https://bit.ly/3el8ZZj>)
- [4] 藍牙BLE - GATT Profile 簡介 (GATT & GAP) (<https://bit.ly/33SRbCR>)