

An Introduction to BLUETOOTH TECHNOLOGY



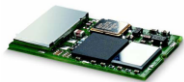
Example : The Networked Home



What is Bluetooth?

- “Bluetooth wireless technology is an open specification for a low-cost, low-power, short-range radio technology for ad-hoc wireless communication of voice and data anywhere in the world.”

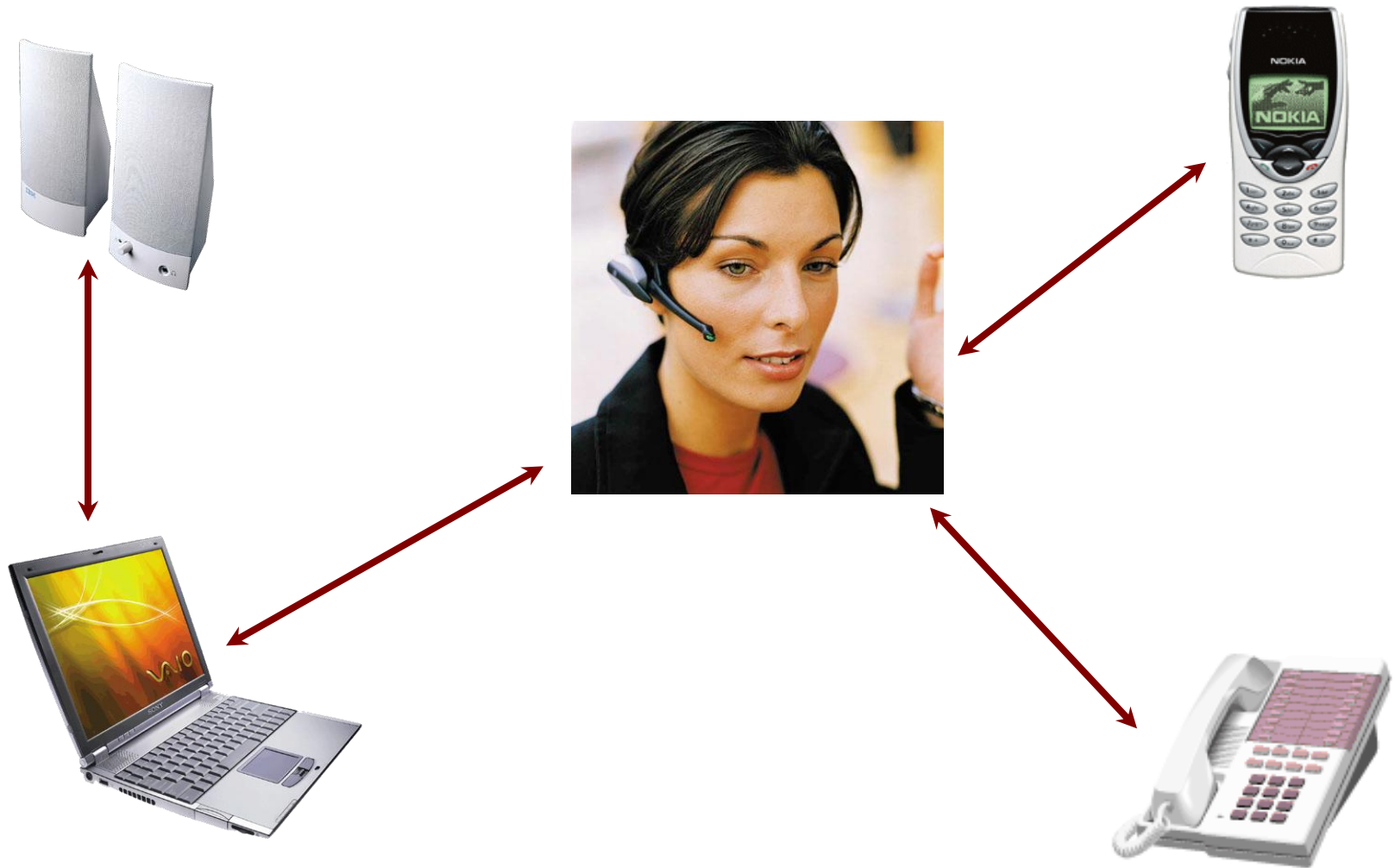
One of the first modules (Ericsson)



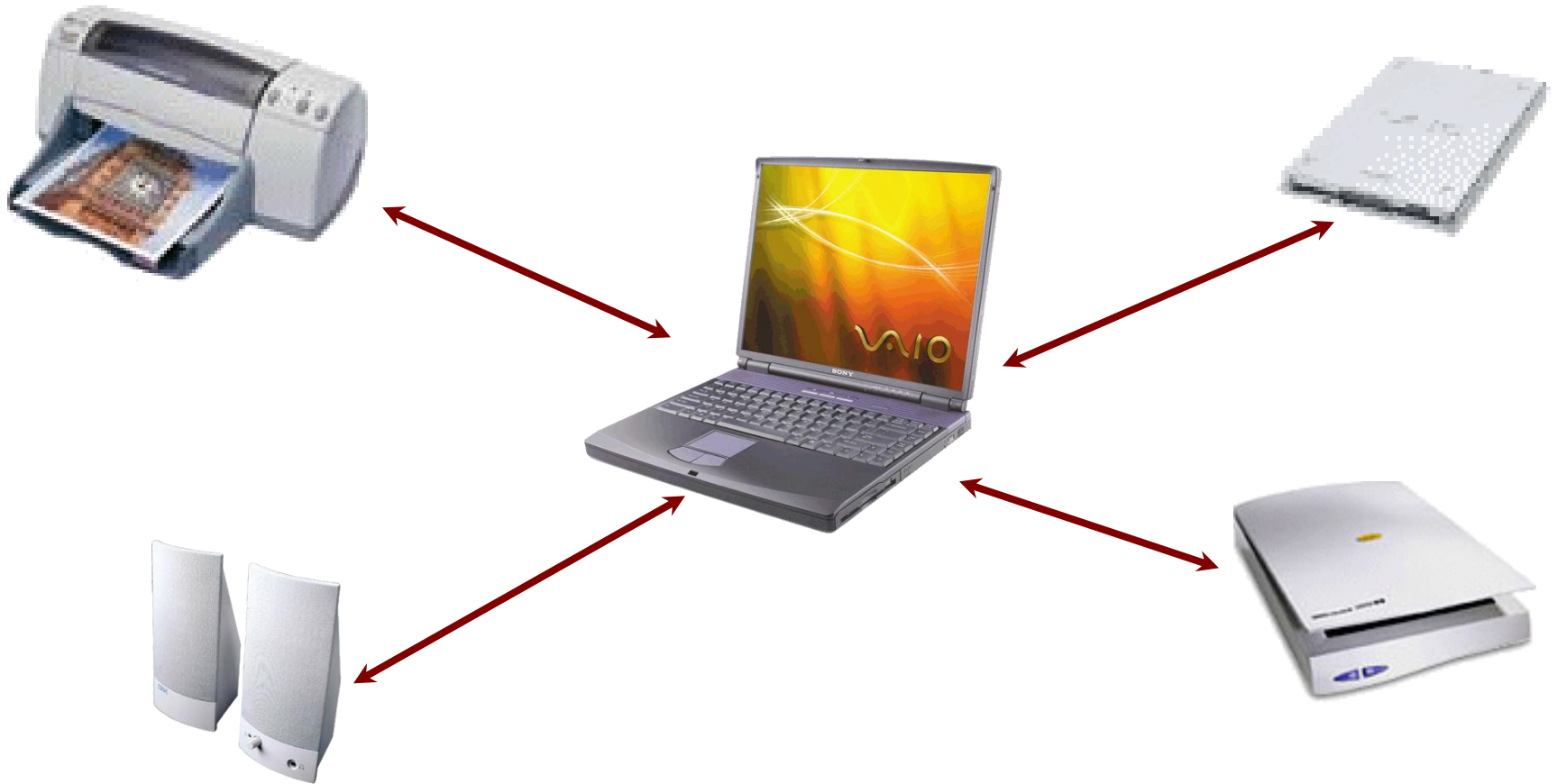
A recent module



Ultimate Headset



Cordless Computer



Bluetooth Goals & Vision

- Originally conceived as a cable replacement technology
- Short-Range Wireless Solutions
- Open Specification
- Voice and Data Capability
- Worldwide Usability
- Other usage models began to develop:
 - **Personal Area Network (PAN)**
 - **Ad-hoc networks**
 - **Data/voice access points**
 - **Wireless telematics**

Overview of Bluetooth History

- What is Bluetooth?
 - **Bluetooth is a short-range wireless communications technology.**
- When does it appear?
 - **1994 – Ericsson study on a wireless technology to link mobile phones & accessories.**
 - **5 companies joined to form the Bluetooth Special Interest Group (SIG) in 1998.**
 - **First specification released in July 1999.**

Timeline

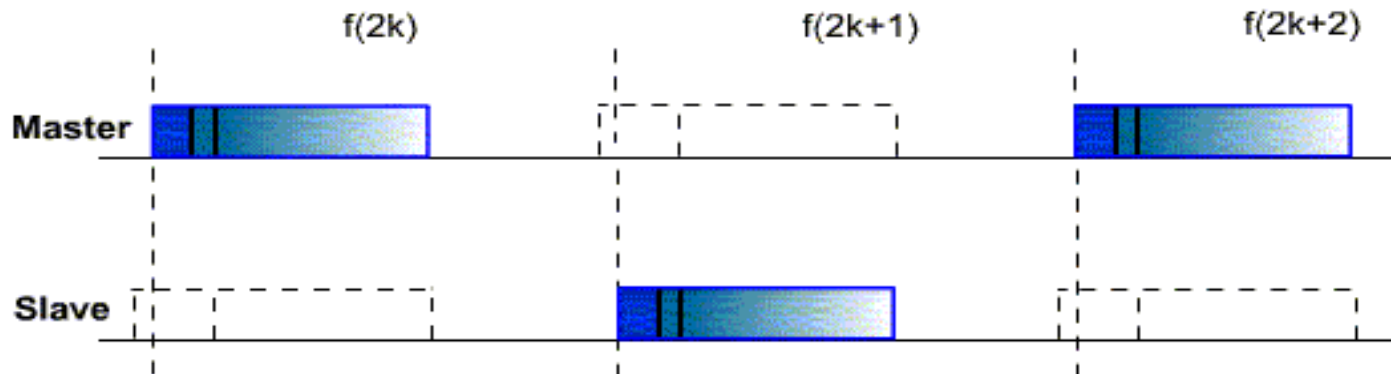
- 1994 : Ericsson study complete / vision
- 1995 : Engineering work begins
- 1997 : Intel agrees to collaborate
- 1998 : Bluetooth SIG formed: Ericsson, Intel, IBM, Nokia & Toshiba
- 1999 : Bluetooth Specification 1.0A SIG promoter group expanded: 3Com, Lucent, Microsoft & Motorola
- 2000 : Bluetooth Specification 1.0B, 2000+ adopters
- 2001 : First retail products released, Specification 1.1
- 2003 : Bluetooth Specification 1.2
- 2005 : Bluetooth Specification 2.0 (?)

Technical features

| | |
|--|---|
| <i>Connection Type</i> | Spread Spectrum (Frequency Hopping) & Time Division Duplex (1600 hops/sec) |
| <i>Spectrum</i> | 2.4 GHz ISM Open Band (79 MHz of spectrum = 79 channels) |
| <i>Modulation</i> | Gaussian Frequency Shift Keying |
| <i>Transmission Power</i> | 1 mw – 100 mw |
| <i>Data Rate</i> | 1 Mbps |
| <i>Range</i> | 30 ft |
| <i>Supported Stations</i> | 8 devices |
| <i>Data Security –Authentication Key</i> | 128 bit key |
| <i>Data Security –Encryption Key</i> | 8-128 bits (configurable) |
| <i>Module size</i> | 9 x 9 mm |

Time-Division Duplex Scheme

- Channel is divided into consecutive slots (each $625\ \mu\text{s}$)
- One packet can be transmitted per slot
- Subsequent slots are alternatively used for transmitting and receiving
 - Strict alternation of slots between the master and the slaves
 - Master can send packets to a slave only in EVEN slots
 - Slave can send packets to the master only in the ODD slots



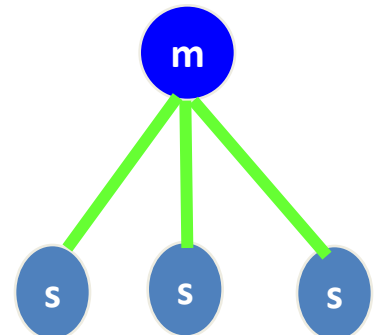
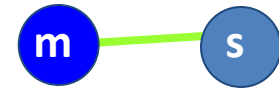
Classification

- **Classification of devices on the basis of Power dissipated & corresponding maximum Range.**

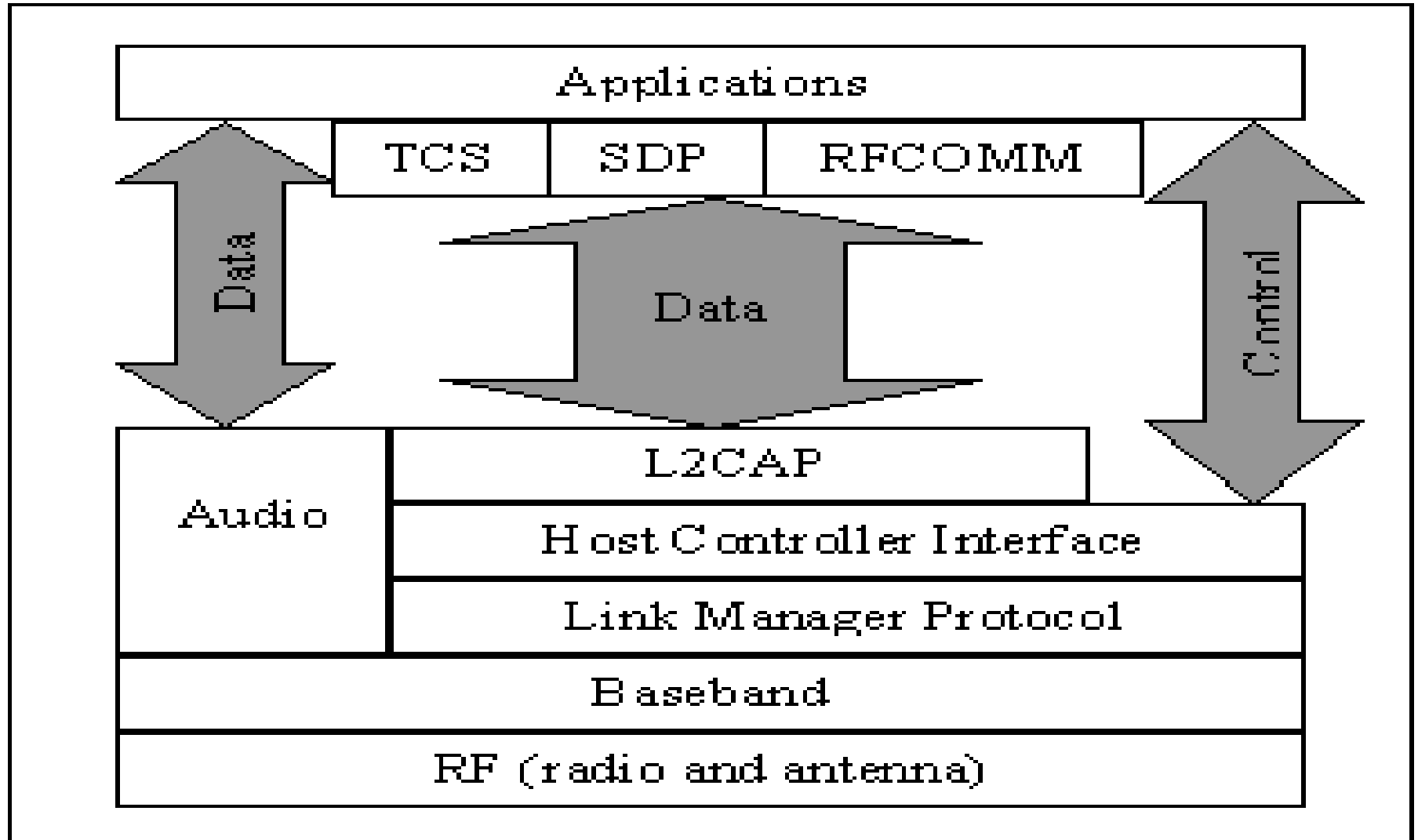
| | POWER | RANGE |
|------------------|----------------|--------------|
| CLASS I | 20 dBm | 100 m |
| CLASS II | 0-4 dBm | 10 m |
| CLASS III | 0 dBm | 1 m |

Typical Bluetooth Scenario

- Bluetooth will support wireless point-to-point and point-to-multipoint (broadcast) between devices in a piconet.
- Point to Point Link
 - **Master - slave relationship**
 - **Bluetooth devices can function as masters or slaves**
- Piconet
 - **It is the network formed by a Master and one or more slaves (max 7)**
 - **Each piconet is defined by a different hopping channel to which users synchronize to**
 - **Each piconet has max capacity (1 Mbps)**



Bluetooth Protocol Stack

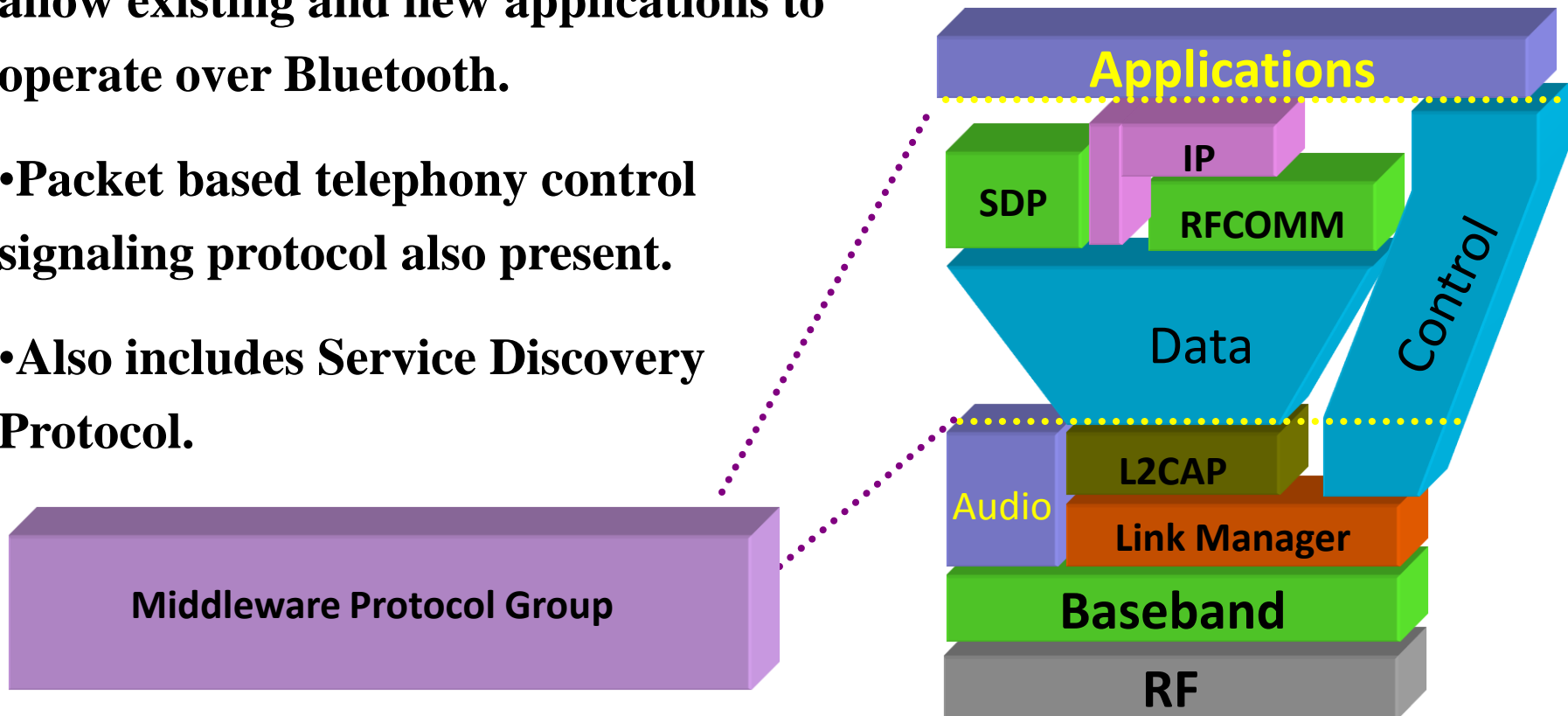


Bluetooth Protocol Stack

- **TCS**(Telephony Control Protocol specification): provides telephony services.
- **SDP**(Service Discovery Protocol): discover that what services other Bluetooth devices support.
- **RFCOMM**: provides as RS 232 link Serial interface.
- **L2CAP**:(logical link control & adaption) it multiplex the data from higher layers & converts the different packet sizes.
- **Link Manager**: It handles the communication between a separate host & bluetooth module.
- **Baseband**: it controls the physical link via the radio ,assembling packet & controlling frequency hoping
- **RADIO**: It modulates & demodulates data for transmission on air.

Middleware Protocol Group

- **Additional transport protocols to allow existing and new applications to operate over Bluetooth.**
- **Packet based telephony control signaling protocol also present.**
- **Also includes Service Discovery Protocol.**



Middleware Protocol Group (contd.)

- Service Discovery Protocol (SDP)
 - Means for applications to discover device info, services and its characteristics.
- TCP/IP
 - Network Protocols for packet data communication, routing.
- RFCOMM
 - Cable replacement protocol, emulation of serial ports over wireless network.

Link Manager Protocol

- The Link Manager carries out link setup, authentication & link configuration.
- Channel Control
 - **All the work related to the channel control is managed by the master**
 - The master uses *polling* process for this
 - **The master is the first device which starts the connection**
 - This roles can change (master-slave role switch)

L2CAP

- Service provided to the higher layer:
 - **L2CAP provides connection-oriented and connectionless data services to upper layer protocols**
 - **Protocol multiplexing and de-multiplexing capabilities**
 - **Segmentation & reassembly of large packets**
 - **L2CAP permits higher level protocols and applications to transmit and receive L2CAP data packets up to 64 kilobytes in length.**

Assignment

- Write a short note on Bluetooth technology.