

Bluetooth[™] Developers Conference

building a world without wires

A large, thin, black oval shape that is slightly tilted, positioned between the words "Developers" and "Conference".

Bluetooth Software Overview

Jon Inouye

Intel Corporation

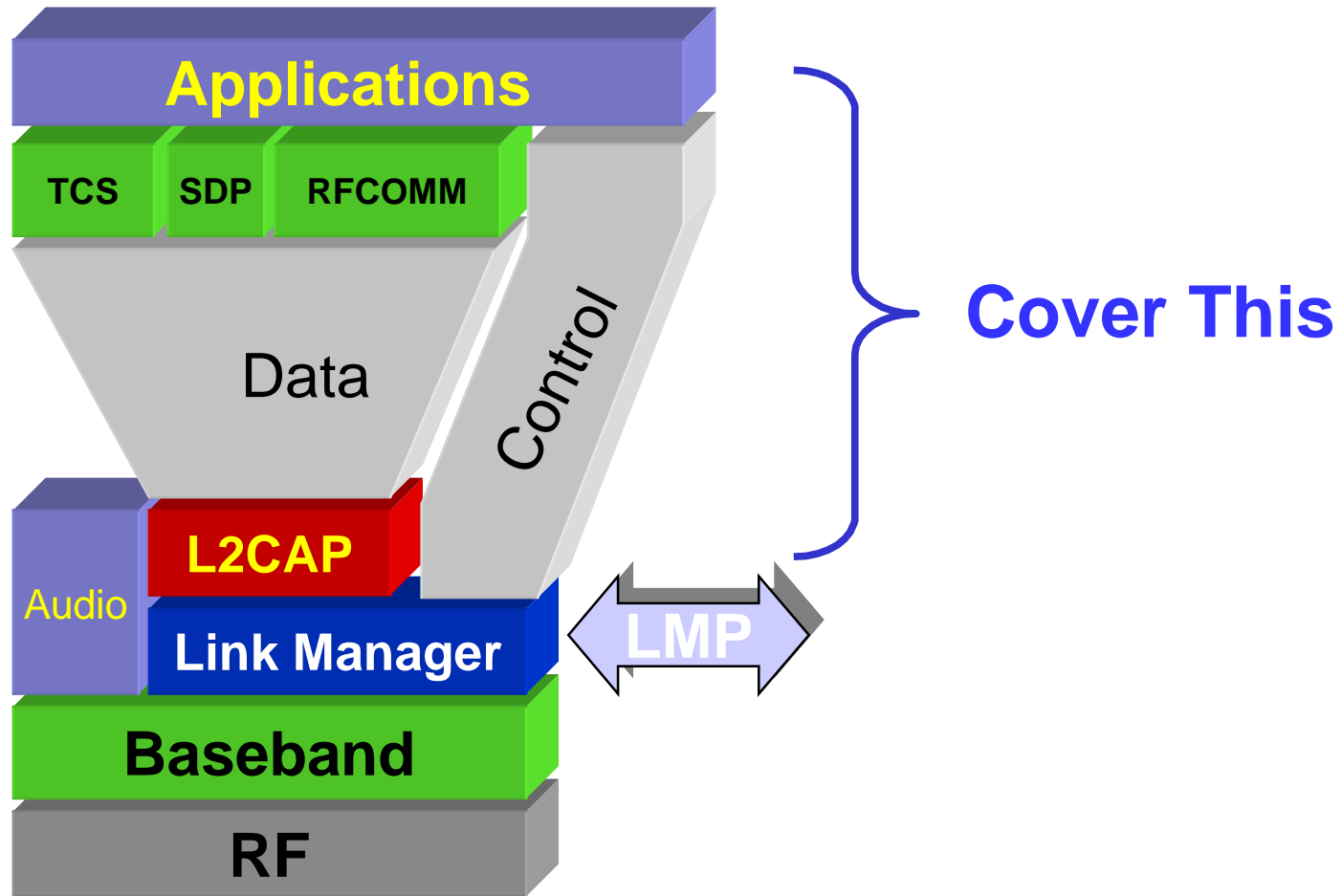
December 6, 1999



Outline

- Software scope and goals
- Protocol Review
- Profile Review
- Summary

Software Architecture



Software Architecture Goals

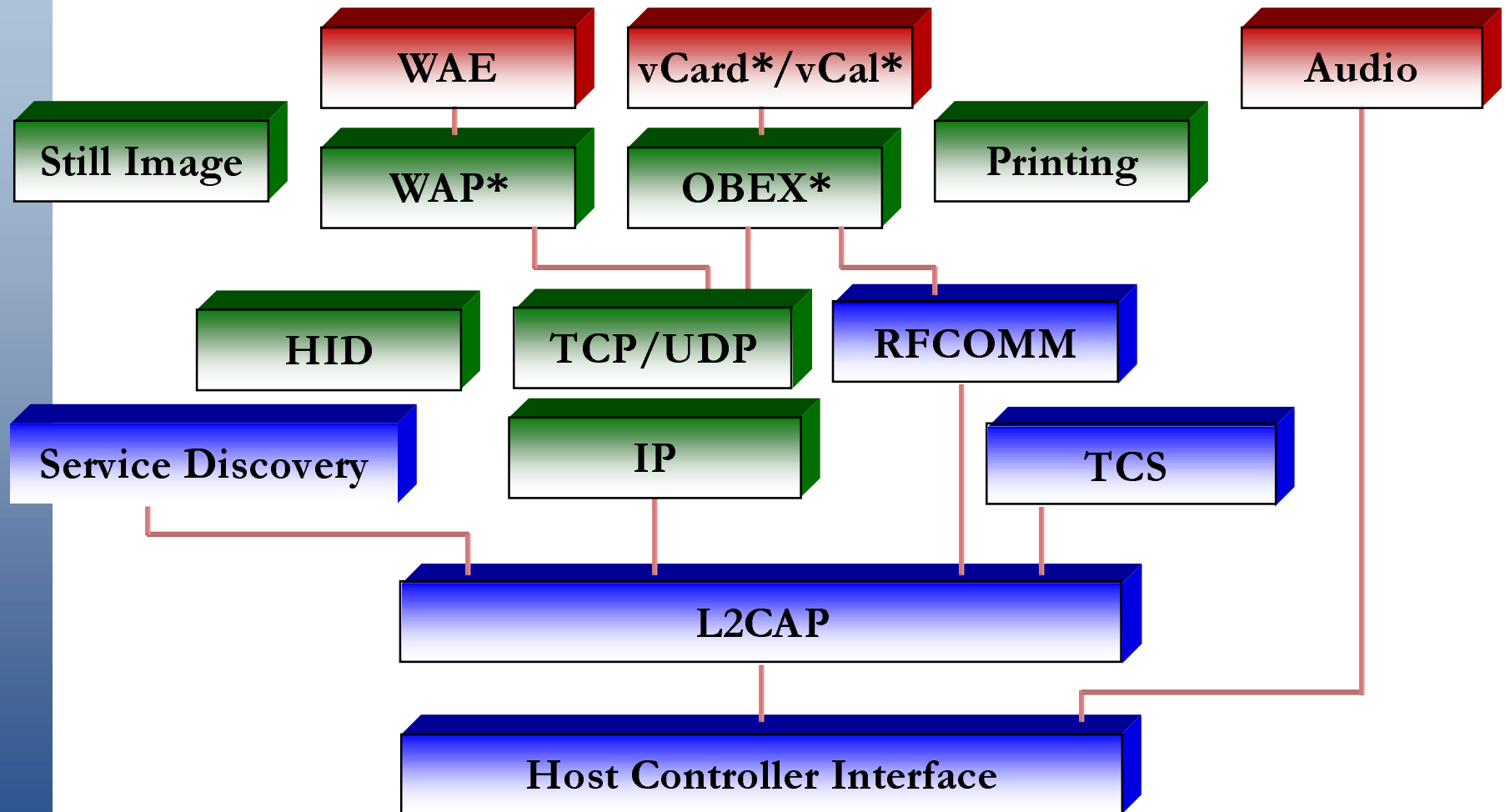
- Support the target usage models
- Support a variety of hardware platforms
- Good out of box user experience
 - Enable legacy applications
 - Utilize existing protocols where possible

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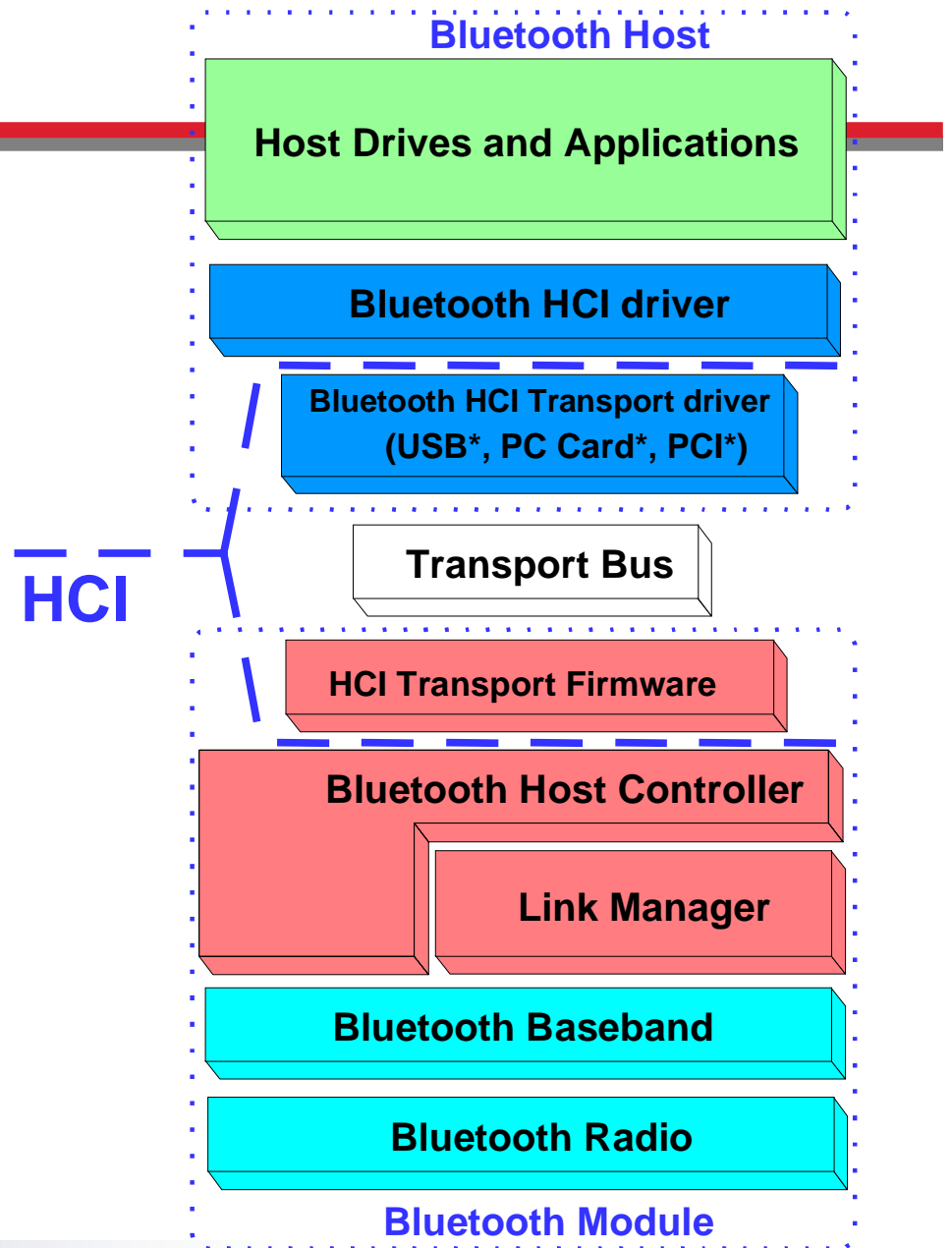
Bluetooth™ Protocols



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HCI

- Host Controller Interface (HCI) provides a common interface between the Bluetooth Host and the Bluetooth Module



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Host Controller Transports

- HCI-USB part of Specification 1.0 A
 - Notebook integration
 - Desktop add-on
- HCI-UART part of Specification 1.0 A
- HCI-RS232 part of Specification 1.0 A
- Others will be defined as needed
 - PCI*, IEEE 1394*, LPC*
- PC Card* uses vendor-specific interface
 - White paper on Web site

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Link Layer Control and Adaptation Protocol (L2CAP)

- Basic data link layer protocol over Baseband
- Support for:
 - Protocol Multiplexing
 - Segmentation and Reassembly (SAR)
 - Quality of Service
 - Groups

L2CAP Architecture

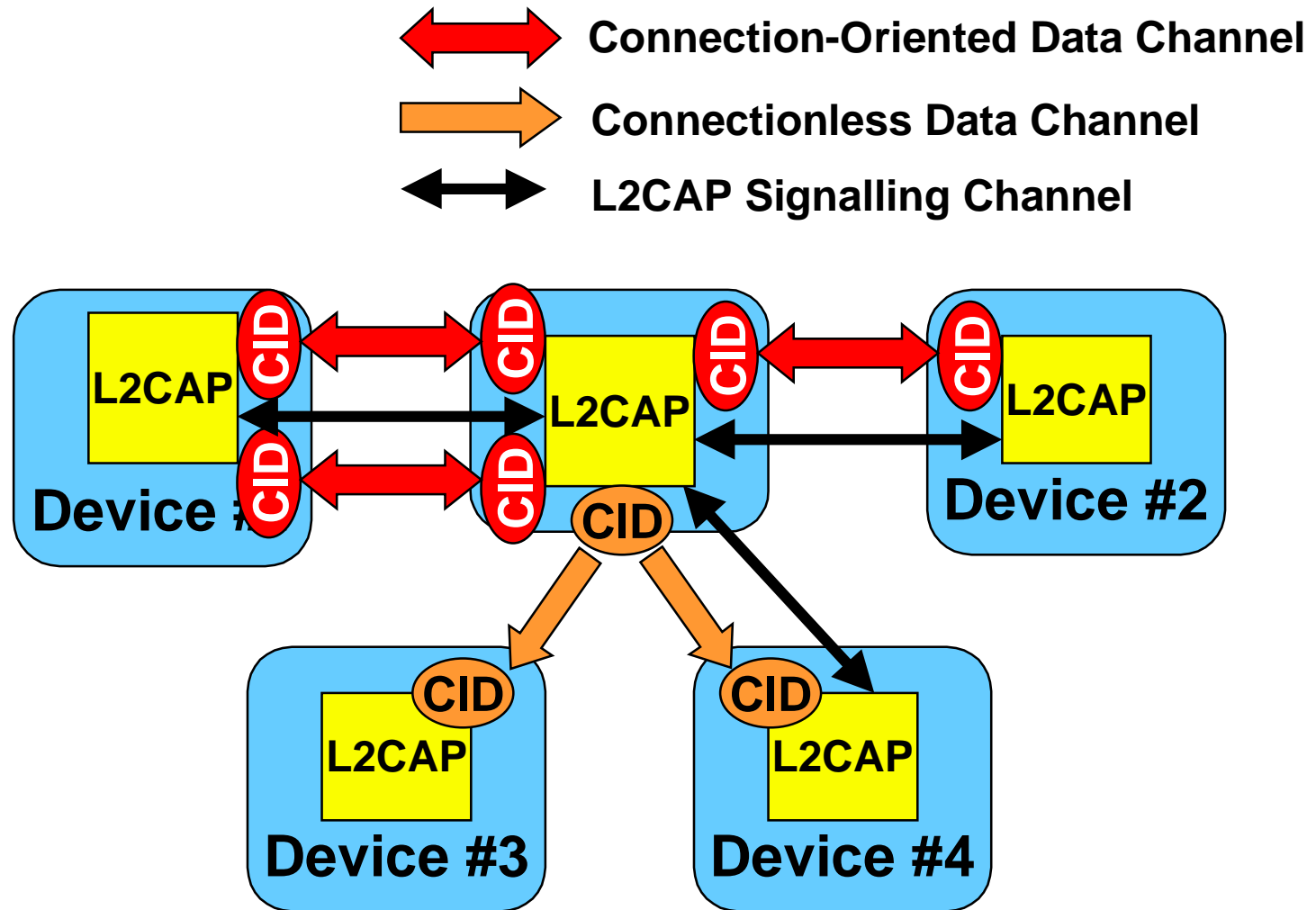
■ Connection-oriented

- Channel identifier (CID) used to label each connection endpoint
- Channels may be uni-directional or bi-directional
- QoS flow specification assigned to each channel direction

■ Connectionless

- Supports group abstraction

L2CAP Channels



L2CAP and Reliability

- Some protocols above L2CAP need reliability
 - RFCOMM, OBEX*
- Some do not
 - TCP
- L2CAP uses Baseband ARQ to ensure reliable connections
- Implications:
 - Reliable channels specify infinite flush timeouts
 - Loss of Baseband link terminates channel

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Service Discovery

■ Two parts

- Service record format
 - Information about service provided by *attributes*
 - Attributes composed of an ID and a value
 - Ids may be universally unique identifiers (UUID)
- Session protocol for enabling discovery
 - Searching for and browsing services

Example SDP Session

- Establish channel to remote device
- Query for services
 - Search for specific class of service, or
 - Browse for services
- Retrieve service attributes
- Close SDP channel
- Establish channel to service

SDP Scope

- Many Service Discovery Protocols
 - Service Location Protocol (SLP), Jini*, Universal Plug and Play (UPnP*), etc.
- Bluetooth SDP focuses on service discovery within Bluetooth environment
- SDP does not compete with other technologies.
- SDP compliments them by enabling their use in Bluetooth environments

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RFCOMM

- Supports a large base of legacy applications using the serial port as the primary communications mechanism.
- Leverage GSM TS 07.10 as an existing standard for multiplexing a single physical channel and V.24 emulation.
- Designed to allow multiple “ports” over a single physical channel between a PC and a GSM handset

Supports two types of devices

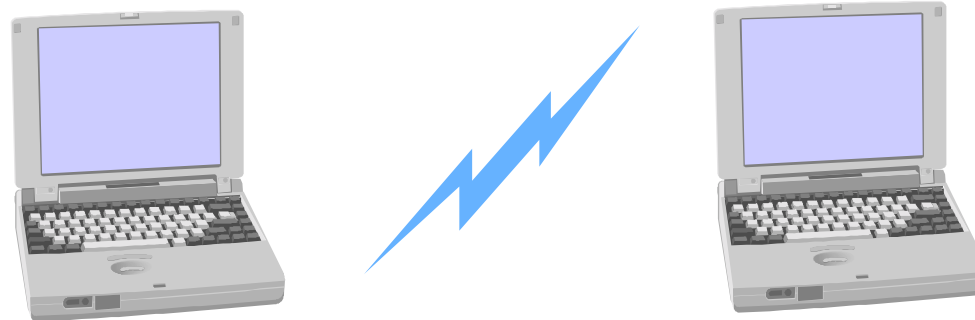


Figure 1: Emulated serial port

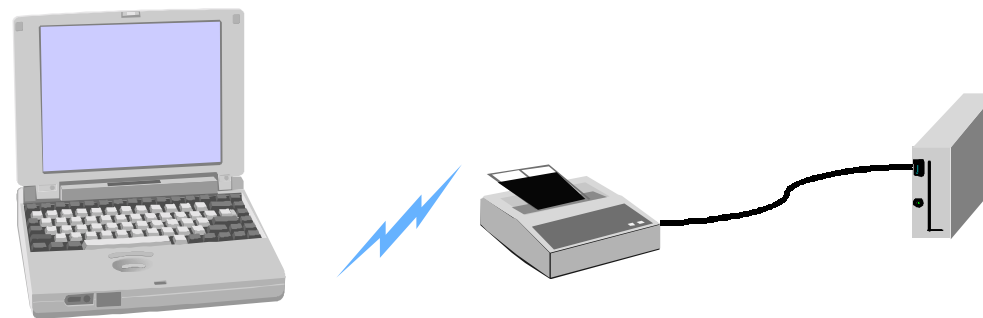


Figure 2: Remote Port Control

RFCOMM dependencies

- Requires reliable, in-sequence delivery of byte stream
 - Requested using L2CAP service parameters
 - Provided by the Baseband Protocol
- Requires multiple concurrent connections to one or more devices
 - Provided by L2CAP and Baseband Protocol

RFCOMM services

- Reliable data stream
- Multiple concurrent connections
- Flow control
- Serial cable line settings and status

RFCOMM impact

- Basic transport protocol for:
 - Dial-up networking
 - FAX
 - Headset control
 - Generic Object Exchange
 - Business card exchange
 - File transfer
 - Synchronization
 - LAN Access

TCS Protocol

Telephony Control Protocol Specification

Call Control

Call setup and release
Symmetrical derivative of
Q.931

Group management

Gateway may serve more
cordless devices
Distributes group information

TCS Impact

■ Cordless Telephony Example

- Phone moves into range of voice access point and establishes link
- Phone link placed into a low power state
- Incoming call is broadcast to all phones
- On answer, a voice (SCO) link is setup

■ Intercom

- Supports direct phone-to-phone communication

Protocol Reuse

- Desire to reuse IrDA applications on cellular phones and PCs
 - Decision to merge with IrDA's OBEX* (Object Exchange) protocol on top of RFCOMM or TCP.

- Interaction with applications on phones
 - Handset manufacturers have agreed on an application framework called WAP*.
 - Bluetooth is treated as a WAP “bearer” in a manner similar to GSM.

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Interoperability

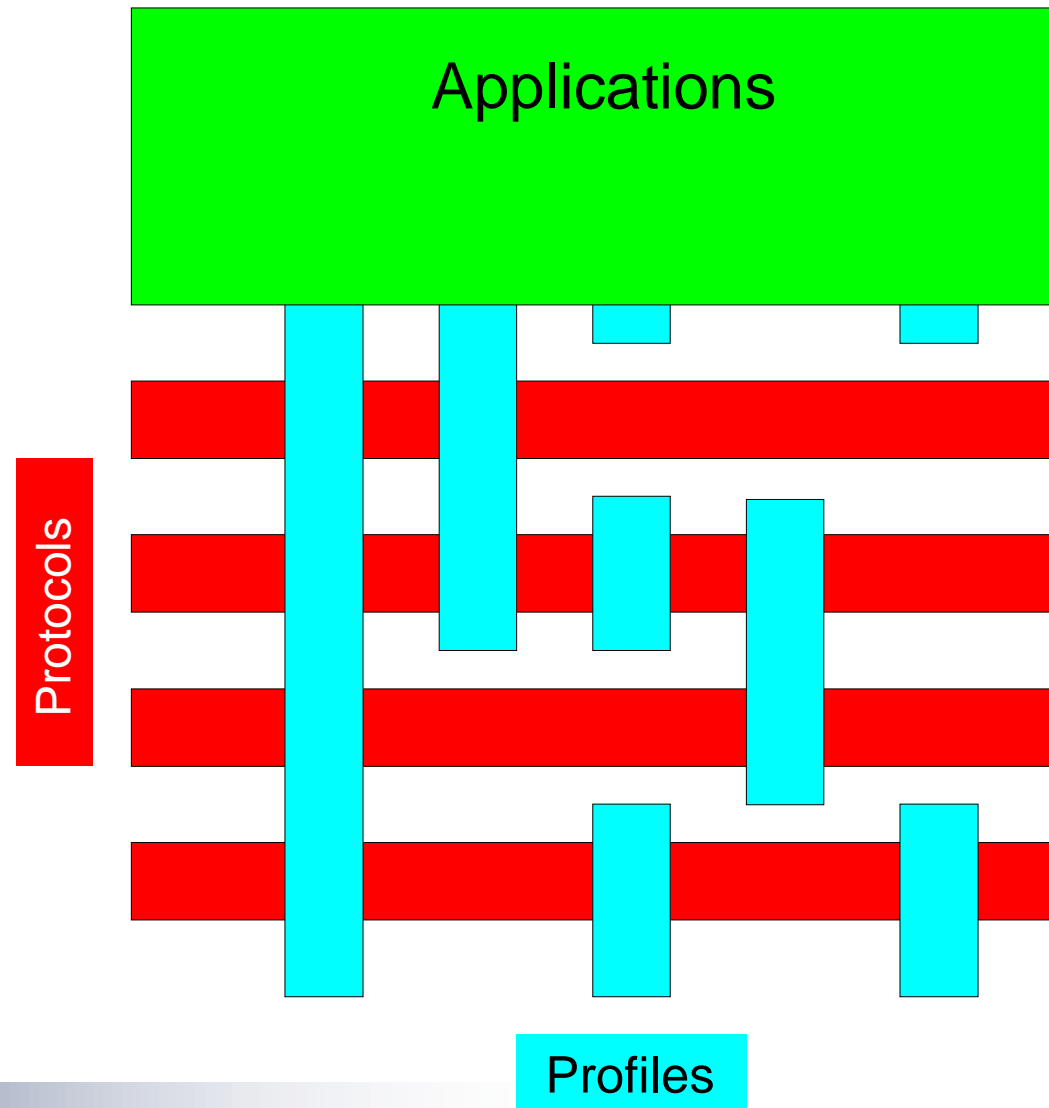
- Protocols define the communication language spoken between devices
- How do you avoid the “Tower of Babel” problem?
- Solution: Mandate the language spoken for a given usage model

Profiles

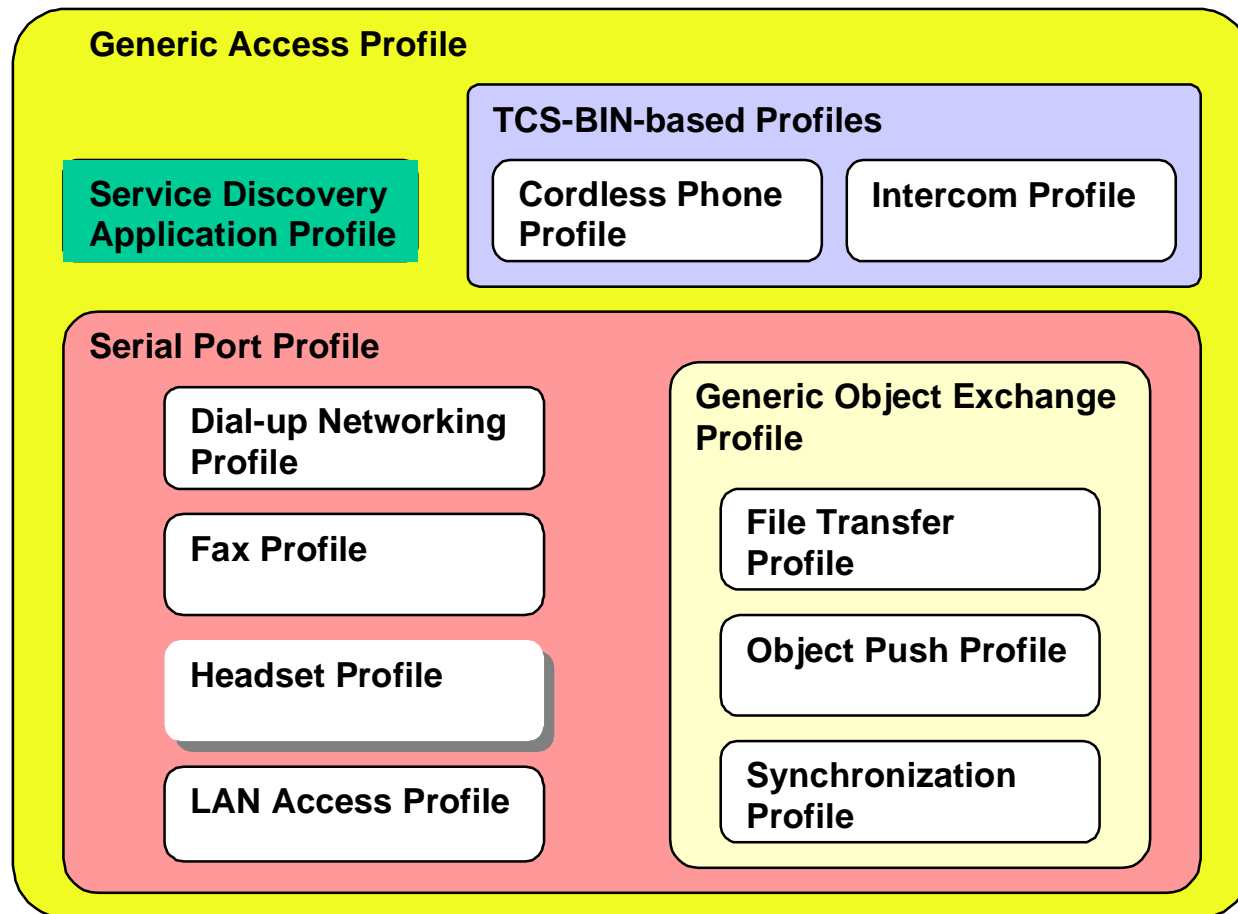
- Represents default solution for usage model
- Vertical slice through the protocol stack
- Basis for interoperability and logo requirements
- Each Bluetooth™ device supports one or more profiles

Protocols and Profiles

Relationship
between
Protocols
and Profiles



Bluetooth™ Profiles



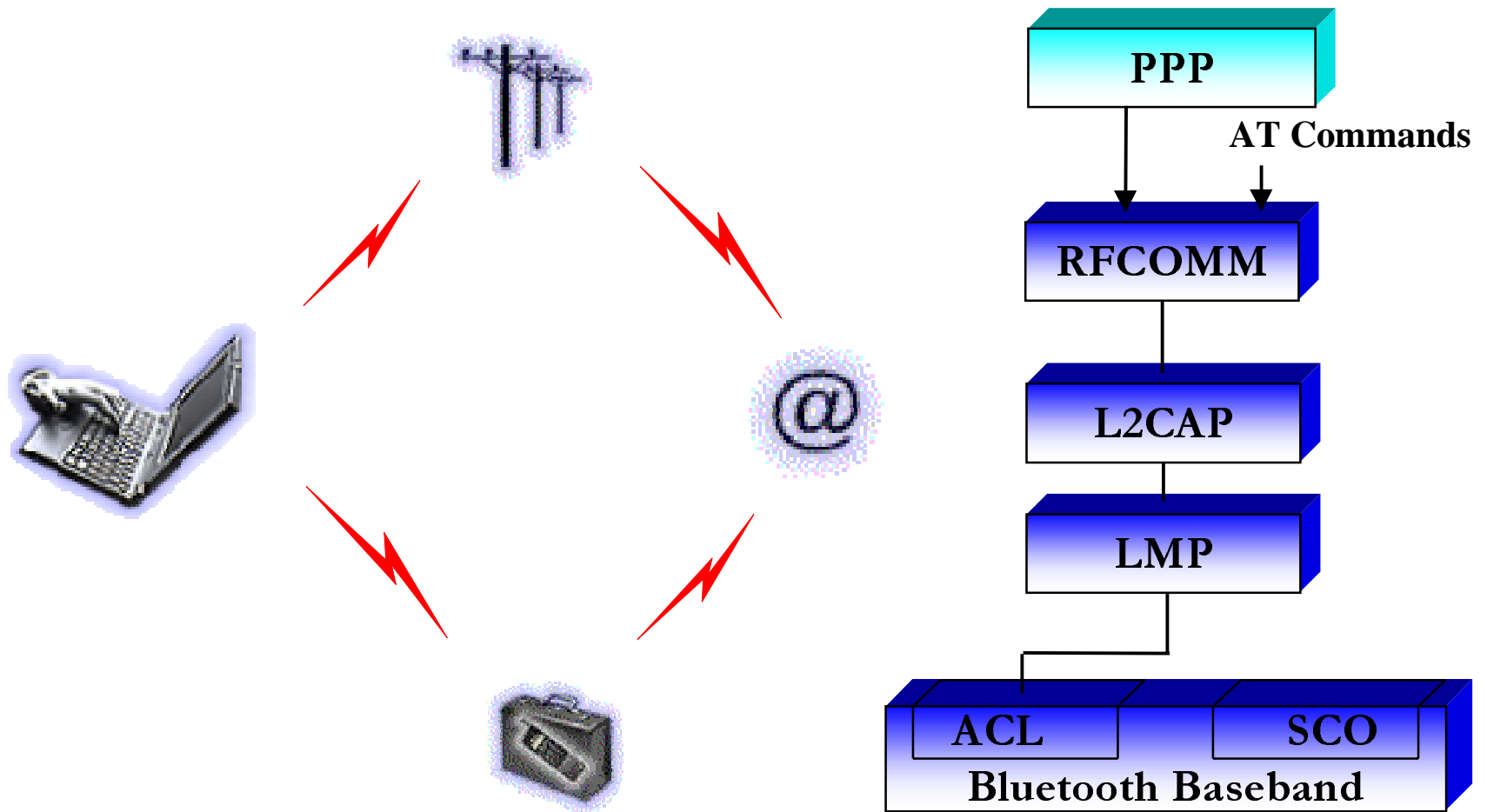
Generic Access Profile

- Addresses common modes and basic operation across all profiles
- Examples include:
 - Service discovery
 - Security architecture

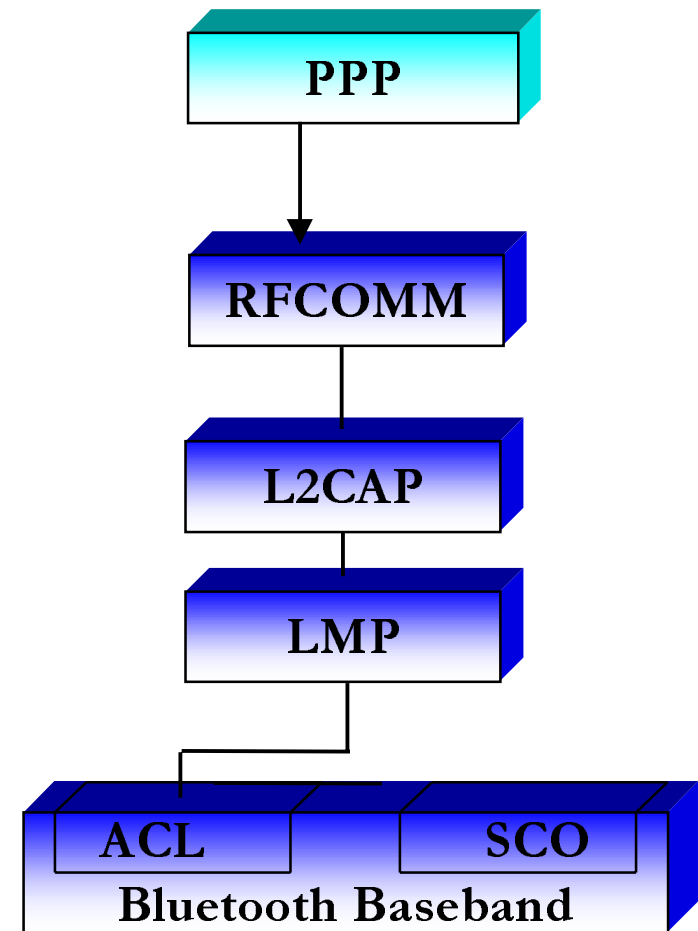
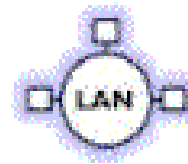
Security Architecture

- Builds on mechanisms in Baseband/LMP
- Defines two classes of devices:
 - Trusted (personal devices)
 - Untrusted (everything else)
- Three security modes
- Mode 2 defines security level for services:
 - Authorization required
 - Authentication required
 - Encryption required
- Implementation dependent and not part of the Specification

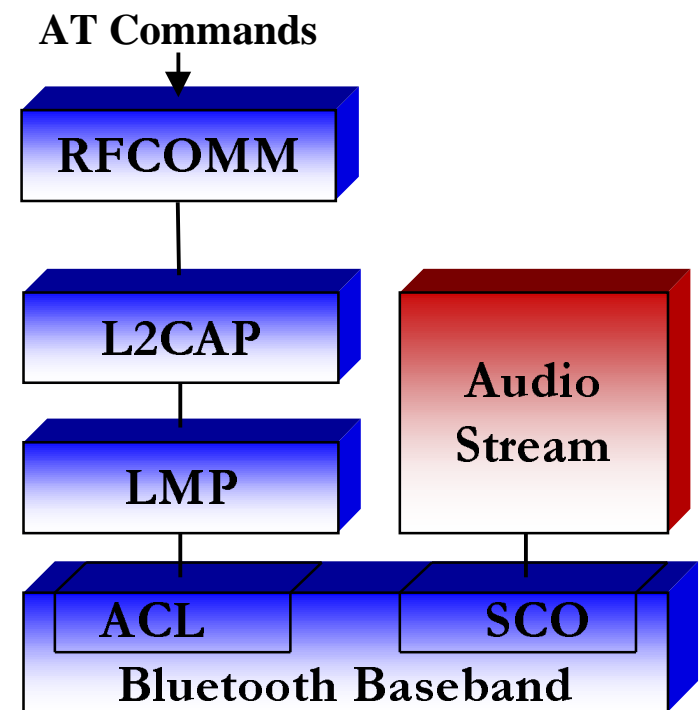
Dialup Networking Profile



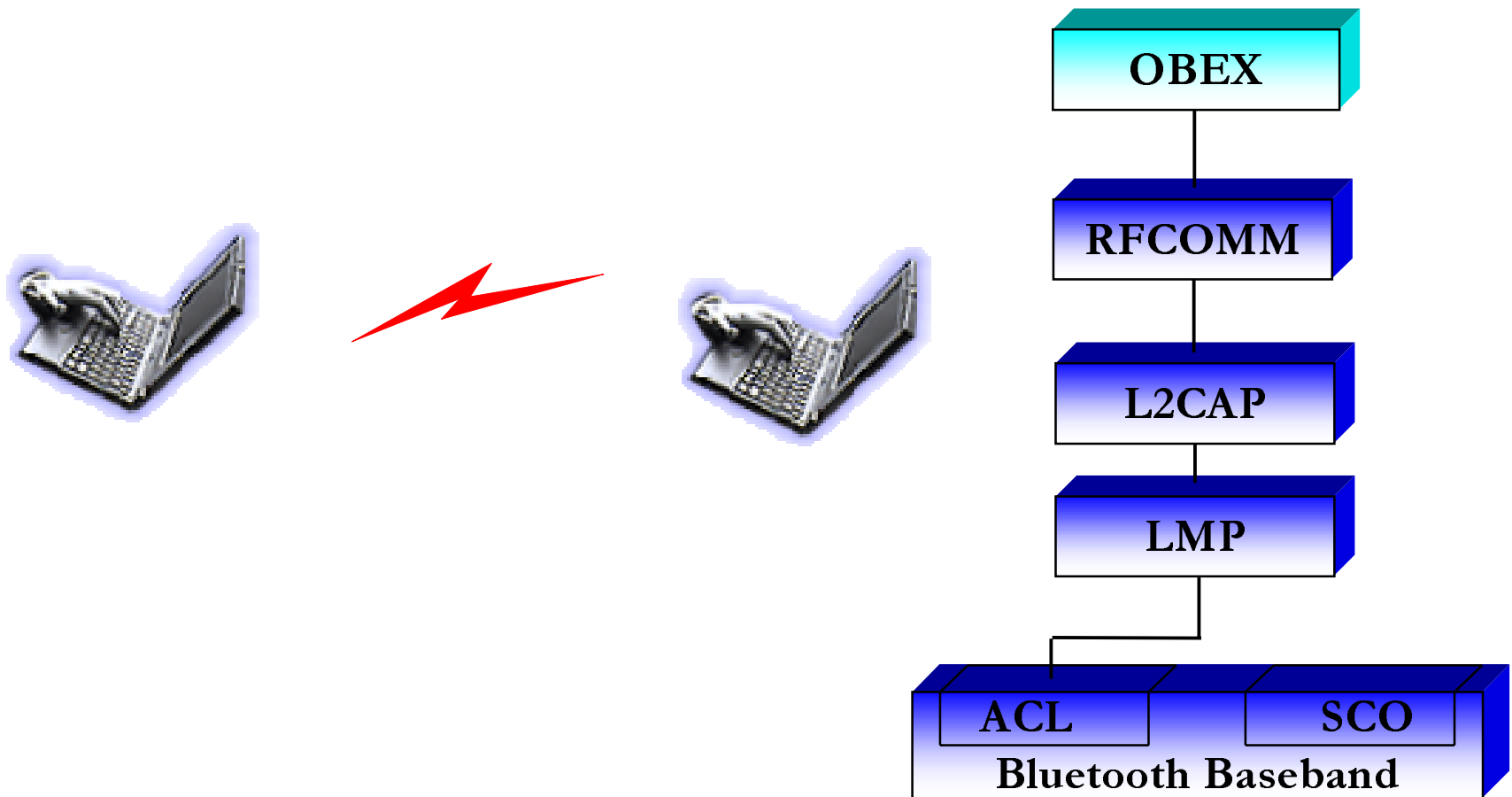
LAN Access Point Profile



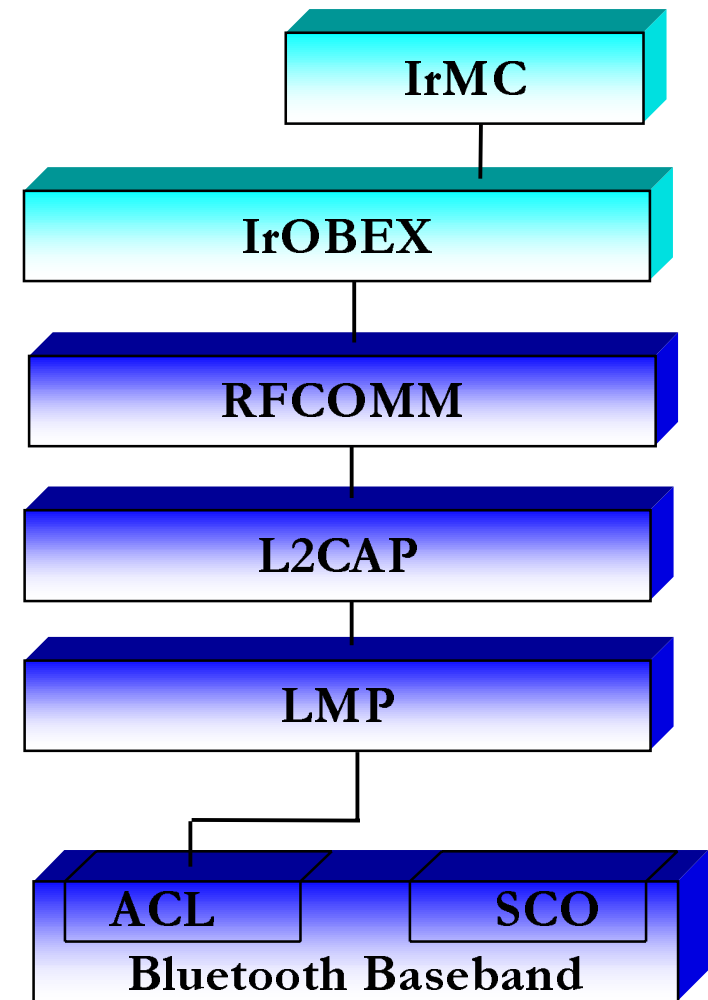
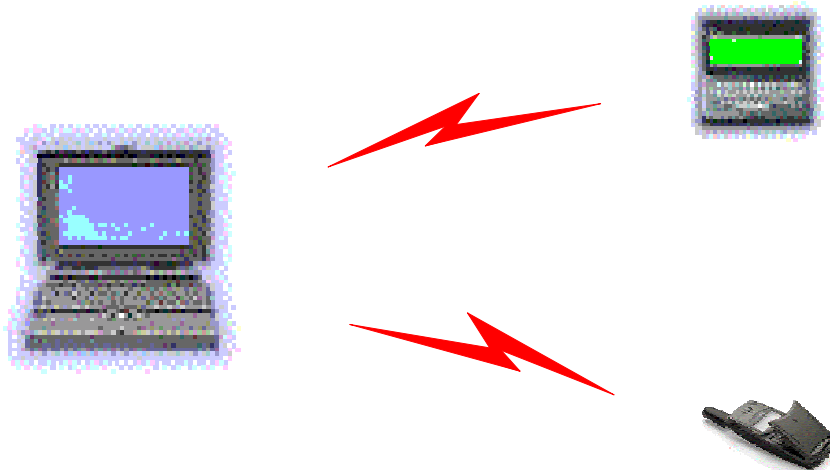
Headset Profile



File Transfer Profile



Synchronization Profile



Briefcase Trick

- Interaction between handset and notebook
 - PC notifications redirected to phone
 - Phone used for remote control of PC
 - Phone sends commands to PC applications
- WAP* browser on phone used for input and display
- WAP* browser communicates with thin server on PC



Summary

- Protocols defined for communication
 - HCI supports common interface to hardware modules
 - L2CAP provides common base for data communication
 - SDP provides basis discovery mechanisms
- Profiles defined to promote interoperability
- Need to test both!