電腦網路 ch2.0

Chapter 2 Link Layer

第二章鏈路層

Problem Statement

問題陳述

To effectively and efficiently transmit data over physical links from one node to one or more nodes,

為了通過物理鏈路從一個節點到一個或多個節點有效地傳輸數據，

there is much more to do than simply modulating or encoding bit stream into signal.

除了將比特流調製或編碼為信號外，還有很多事情要做。

Transmission impairments,

傳輸障礙，

such as crosstalk between two adjacent pairs,

例如兩個相鄰對之間的串擾，

can unexpectedly change transmission signal and thus result in errors.

可能會意外更改傳輸信號，從而導致錯誤。

The transmitter might transmit faster than the receiver can handle. The transmitter has to somehow indicate the destination(s),

發射器的發射速度可能比接收器處理的速度快。發射機必須以某種方式指示目的地，

if on a broadcast link,

如果在廣播鏈接上，

i.e. LAN,

即局域網

and usually needs to name itself to let the receiver know where the source is.

並且通常需要自我命名，以使接收者知道來源在哪裡。

If multiple stations share a LAN,

如果多個站共享一個局域網，

an arbitration mechanism is required to determine who can transmit next.

需要一種仲裁機制來確定誰可以下一步發送。

Beyond all of the above,

除了上述所有之外，

we need to interconnect LANs,

我們需要互連局域網，

i.e. bridging to forward packets between LANs,

即橋接以在局域網之間轉發數據包，

to extend the coverage beyond a single LAN.

將覆蓋範圍擴展到單個局域網之外。

These problems need to be addressed by a set of functions above the physical link.

這些問題需要通過物理鏈路上方的一組功能來解決。

The link layer in the 4-layer Internet architecture,

4層Internet體系結構中的鏈接層，

or the physical layer and the data link layer together in the 7-layer OSI architecture,

或是7層OSI架構中的物理層和數據鏈路層，

manages the physical link to solve these problems.

管理物理鏈接以解決這些問題。

Upper layers are therefore exempt from the duty of controlling parameters in a physical network.

因此，上層免於控制物理網絡中參數的責任。

These services greatly alleviate upper-layer protocol design and make it virtually independent of physical transmission characteristics.

這些服務極大地減輕了上層協議的設計，使其實際上與物理傳輸特性無關。

In this chapter,

在這一章當中，

we present

我們提出

(1) functions or services provided in the link layer,

（1）鏈路層中提供的功能或服務，

(2) real-world popular link protocols,

（2）現實世界中流行的鏈接協議，

and
和
(3) some of their open source software or hardware implementations.
（3）他們的一些開源軟件或硬件實現。
Section 2.1 addresses the general issues in designing link layer functions ranging from framing,
第2.1節解決了設計鏈接層功能時遇到的一般問題，這些問題包括成幀，
addressing,
尋址，
error control,
錯誤控制
flow control,
流量控制，
access control,
訪問控制，
to interfaces with other layers.
與其他層的接口。
Their possible solution alternatives are reviewed.
審查了其可能的解決方案。
Function calls in Linux are used to illustrate the interfaces and sk_buff packet flows with the network adaptor and the upper IP layer,
Linux中的函數調用用於說明與網絡適配器和上層IP層的接口和sk_buff數據包流，
as a zoom-in of a packet life in Section 1.5. To prepare readers with physical background,
作為第1.5節中數據包壽命的放大。為了使讀者俱有實際背景，
Section 2.2 first briefs the wired and wireless medium,
第2.2節首先介紹了有線和無線媒體，
and then their encoding and modulation schemes.
然後是它們的編碼和調製方案。
Given the vast number of real-world links,
鑑於現實世界中的鏈接數量眾多，
it is nearly impossible to describe all of them.
幾乎不可能描述所有這些。
We summarize well-known data-link protocols in Table 2.1. Some are obsolete or fading nowadays,
我們在表2.1中總結了眾所周知的數據鏈路協議。如今有些已經過時或褪色，
some are in the mainstream,
有些是主流，
and still some others are under development.
還有一些正在開發中。
Among the mainstream,
在主流之中
we detail one point-to-point link,
我們詳述了一個點對點鏈接，
i.e. Point-to-Point Protocol (PPP) in Section 2.3 along with an open source package,
即第2.3節中的點對點協議（PPP）以及開源軟件包，
one wired broadcast link,
一條有線廣播鏈接，
i.e. Ethernet in Section 2.4 along with its Verilog hardware implementation,
即第2.4節中的以太網及其Verilog硬件實現，
and one wireless broadcast link,
一條無線廣播鏈接，
i.e. wireless LAN (WLAN) in Section 2.5 plus a brief on Bluetooth and WiMAX.
即2.5節中的無線局域網（WLAN），以及有關藍牙和WiMAX的簡介。
PPP is popularly used in the last-mile dial-up services or routers carrying various network protocols over point-to-point links.
PPP通常用於最後一英里的撥號服務或通過點對點鏈接承載各種網絡協議的路由器。
Ethernet has occupied more than 95 percent of wired LANs.
以太網已經佔據了超過95%的有線LAN。
It is also poised to be ubiquitous in MANs and WANs.
它也有望在城域網和廣域網中無處不在。

In contrast to desktop PCs,
與台式機相比，
which usually use wired links,
通常使用有線鏈接
many devices such as laptop PCs and cellular phones are mobile and prefer wireless links such as WLAN,
許多設備（例如筆記本電腦和蜂窩電話）都可以移動，並且更喜歡無線鏈接（例如WLAN，
Bluetooth,
藍牙，
and WiMAX.
和WiMAX。

Table 2.1 Link protocols.

	PAN/LAN	MAN/WAN
Obsolete or Fading 過時或衰退	Token Bus (802.4) Token Ring (802.5) HIPPI Fiber Channel Isochronous (802.9) Demand Priority (802.12) FDDI ATM HIPERLAN	DQDB (802.6) HDLC X.25 Frame Relay SMDS ISDN B-ISDN
Mainstream or Still active 主流 要么 仍然活躍	Ethernet (802.3) WLAN (802.11) Bluetooth (802.15) Fiber Channel HomeRF HomePlug	Ethernet (802.3) Resilient Packet Ring (802.17) Point-to-Point Protocol (PPP) DOCSIS WiMAX (802.16) ATM

As an independent issue, bridging for LAN interconnection is covered in Section 2.6, along with its open source implementations of two key components, *self learning* and *spanning tree*. At the end, Section 2.7 illustrates the general concepts of Linux device *drivers*. We go deep into the Ethernet driver implementation.

作為一個獨立的問題，第2.6節介紹了LAN互連的橋接以及兩個關鍵組件的開源實現，
自學習和生成樹。
最後，第2.7節說明了Linux設備驅動程序的一般概念。我們深入研究以太網驅動程序的實現。