FIT 1047

Introduction to computer systems, networks and security

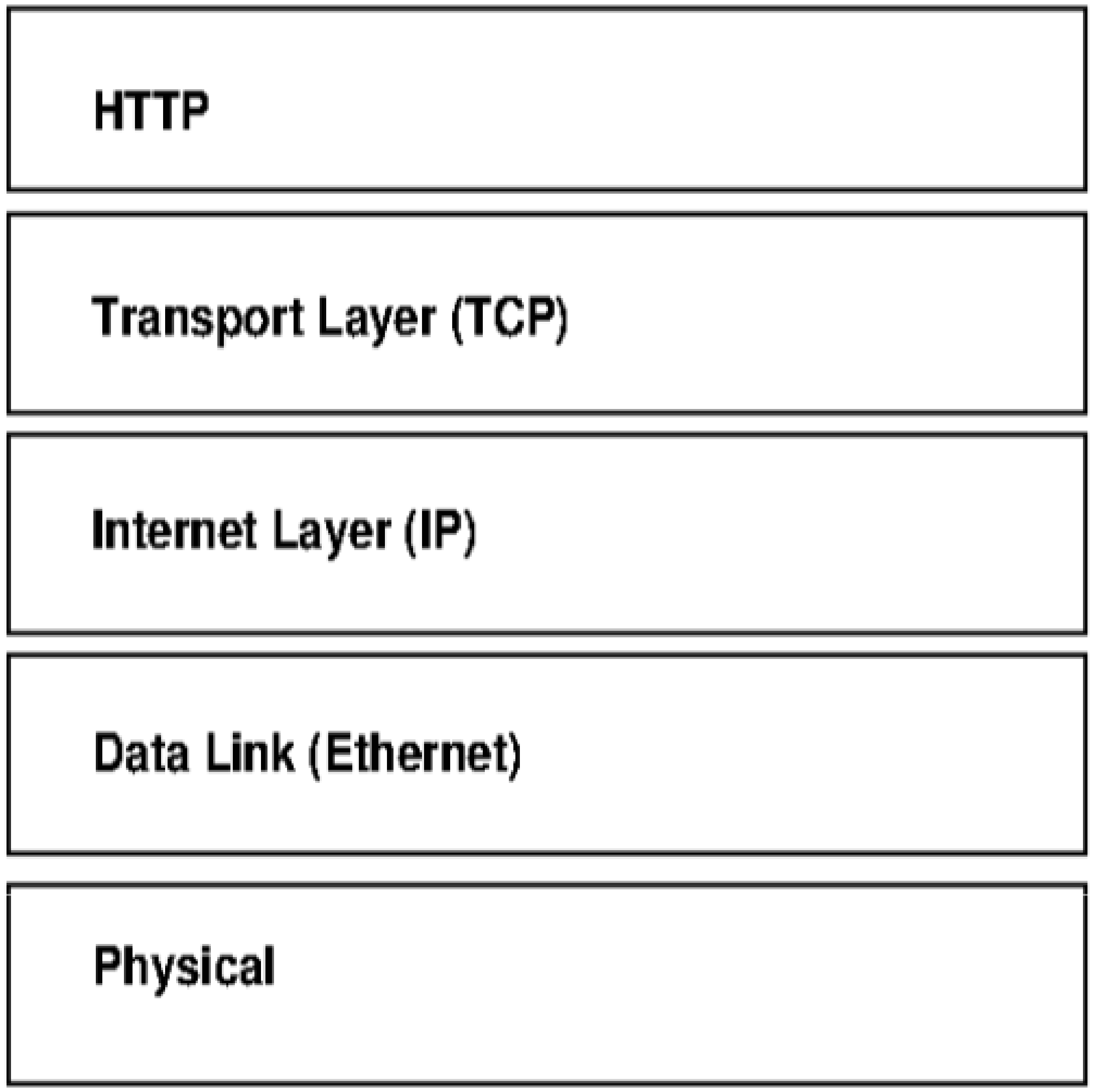
Space	Forward
Right, Down, Page Down	Next slide
Left, Up, Page Up	Previous slide
P	Open presenter console
H	Toggle this help

MONASH University

Security Protocols

Space	Forward
Right, Down, Page Down	Next slide
Left, Up, Page Up	Previous slide
P	Open presenter console
H	Toggle this help

Network Stack with HTTP



HTTP

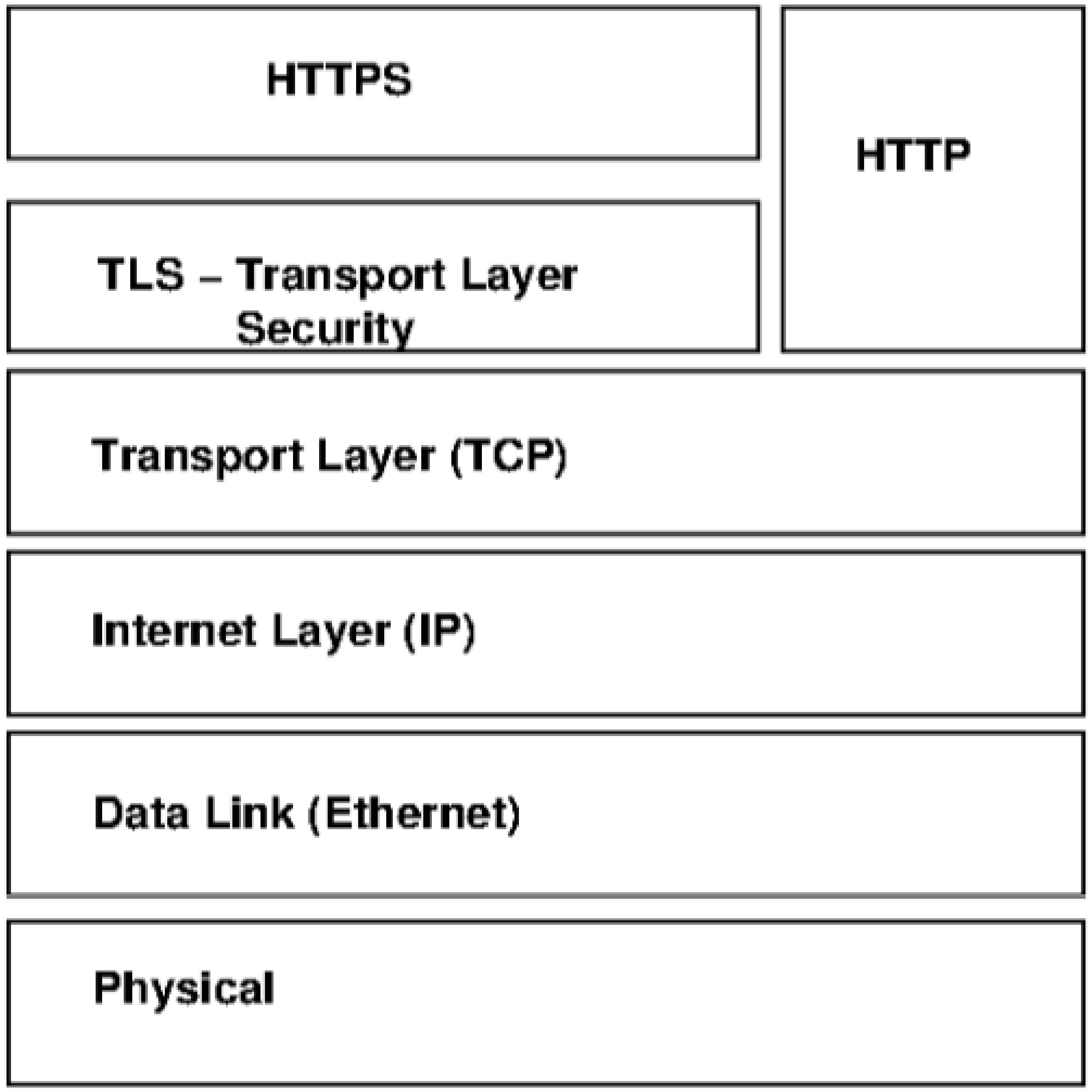
Transport Layer (TCP)

Internet Layer (IP)

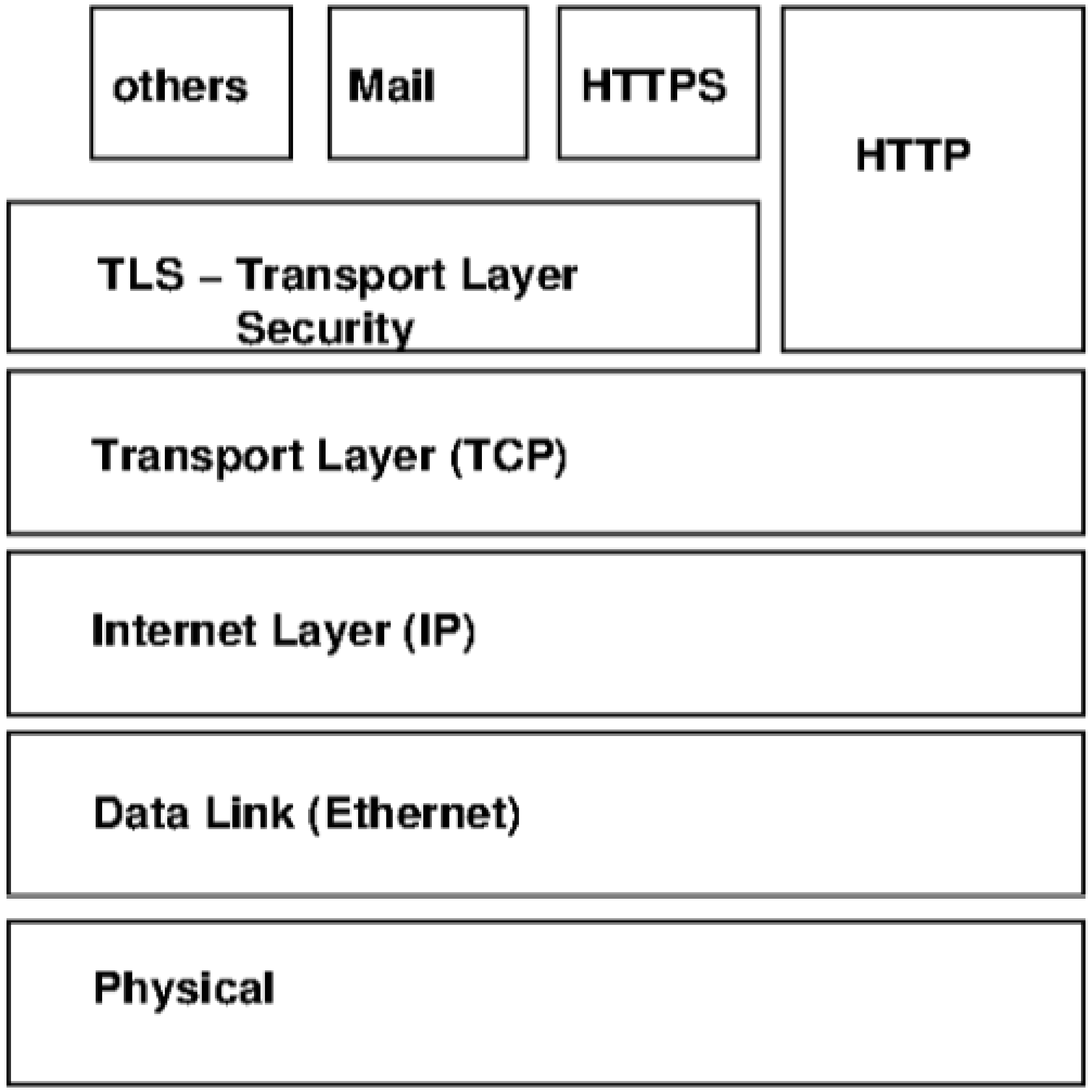
Data Link (Ethernet)

Physical

Security above Transport Layer - TLS



Security above Transport Layer - TLS



others

Mail

HTTPS

HTTP

TLS – Transport Layer Security

Transport Layer (TCP)

Internet Layer (IP)

Data Link (Ethernet)

Physical

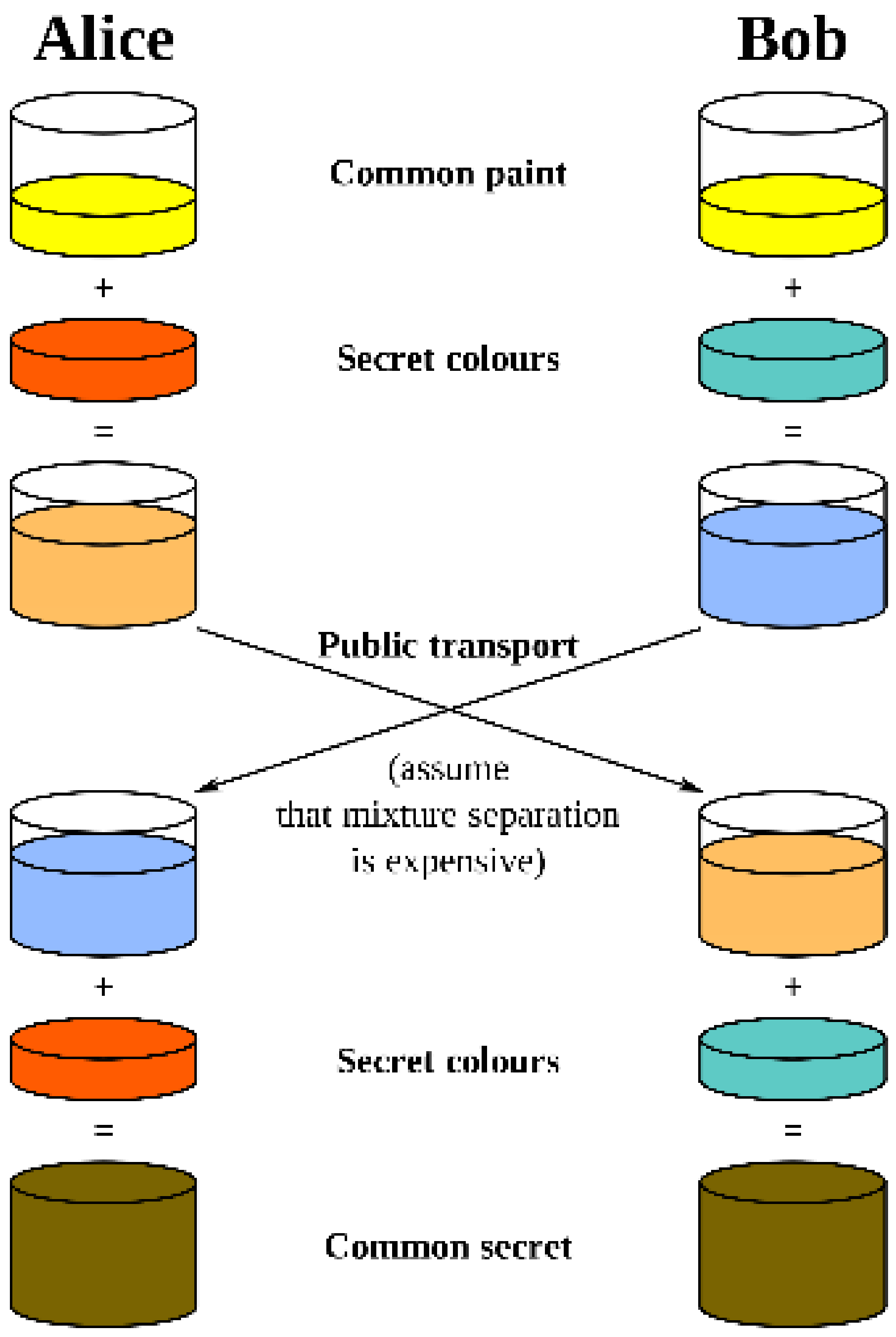
SSL/TLS

- Originally developed by Netscape as Secure Socket Layer SSL
- SSL Version 2.0 in 1995 was quickly replaced by SSL 3.0 in 1996
- IETF (Internet Engineering Taskforce) published successor Transport Layer Security 1.0 as RFC5246 in 1999
- Current version is TSL 1.2 as IETF RFC 5246
- All previous versions should be disabled due to security problems.
-

SSL/TLS

- Main goal is to establish a shared key to protect messages (confidentiality and integrity/authenticity)
- Main sub-protocols are TLS handshake to negotiate parameters, optional authentication, establish shared key
- and TSL record, which is the actual secure transport protocol
- Uses Diffie-Hellman key exchange to create the shared secret

Diffie-Hellman key exchange



(Wikipedia)

Diffie-Hellman key exchange

1. Alice and Bob agree on values g and n (these values are public)

2a. Alice generates random A and $a=g^{A}$ mod n

2b. Bob generates a random B and $b=g^{B}$ mod n

3. They exchange a and b

4. Shared key is $K= b^{A} = g^{BA} = g^{AB} = a^{B}$ mod n

Why does this work?

A and B are secret values.

$a=g^A$ and $b=g^B$ are public

To get A or B, the attacker would need to compute A from g^A

This discrete logarithm is difficult to compute!

TLS Phases

1. TLS Handshake

Can authenticate server and client. In HTTPS mostly only the server is authenticated. Results in a shared key and session ID or session ticket.

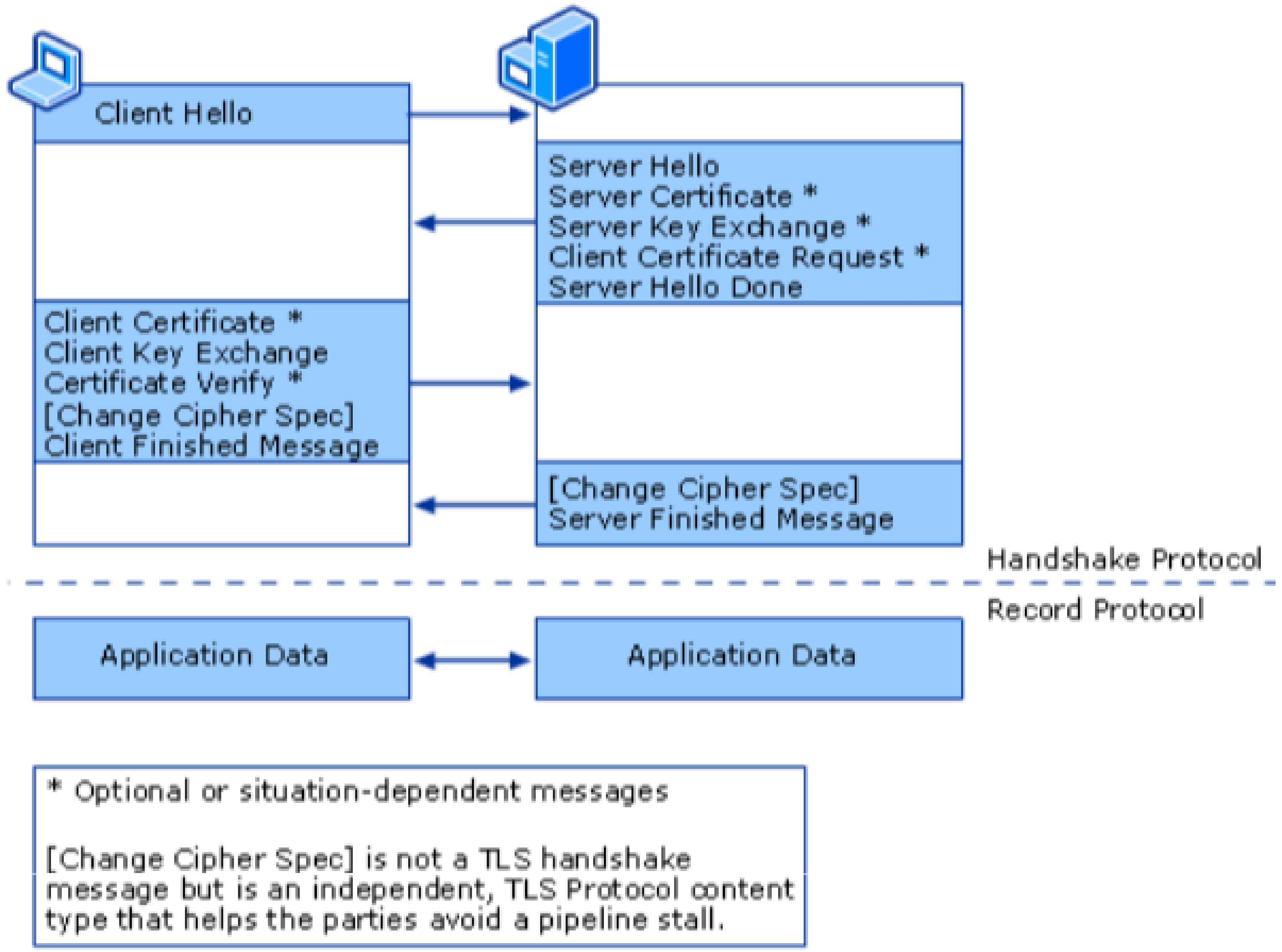
1. TLS Record

After the exchange of ChangeCipherSpec messages, all subsequent traffic is encrypted.

1. TLS Alert

Immediately closes a session

A closer look at TLS Handshake



Client Hello

Server Hello
Server Certificate *
Server Key Exchange *
Client Certificate Request *
Server Hello Done

Client Certificate *
Client Key Exchange
Certificate Verify *
[Change Cipher Spec]
Client Finished Message

[Change Cipher Spec]
Server Finished Message

Handshake Protocol

Record Protocol

Application Data

Application Data

* Optional or situation-dependent messages

[Change Cipher Spec] is not a TLS handshake message but is an independent, TLS Protocol content type that helps the parties avoid a pipeline stall.

(Source: Microsoft)

Authentication with certificates

- A certificate provides additional information for a public key.
- Owner of the matching private key
- Validity (expiration date and time)
- Subject name
- Issuer name
- other parameters
-

Trusted certificates

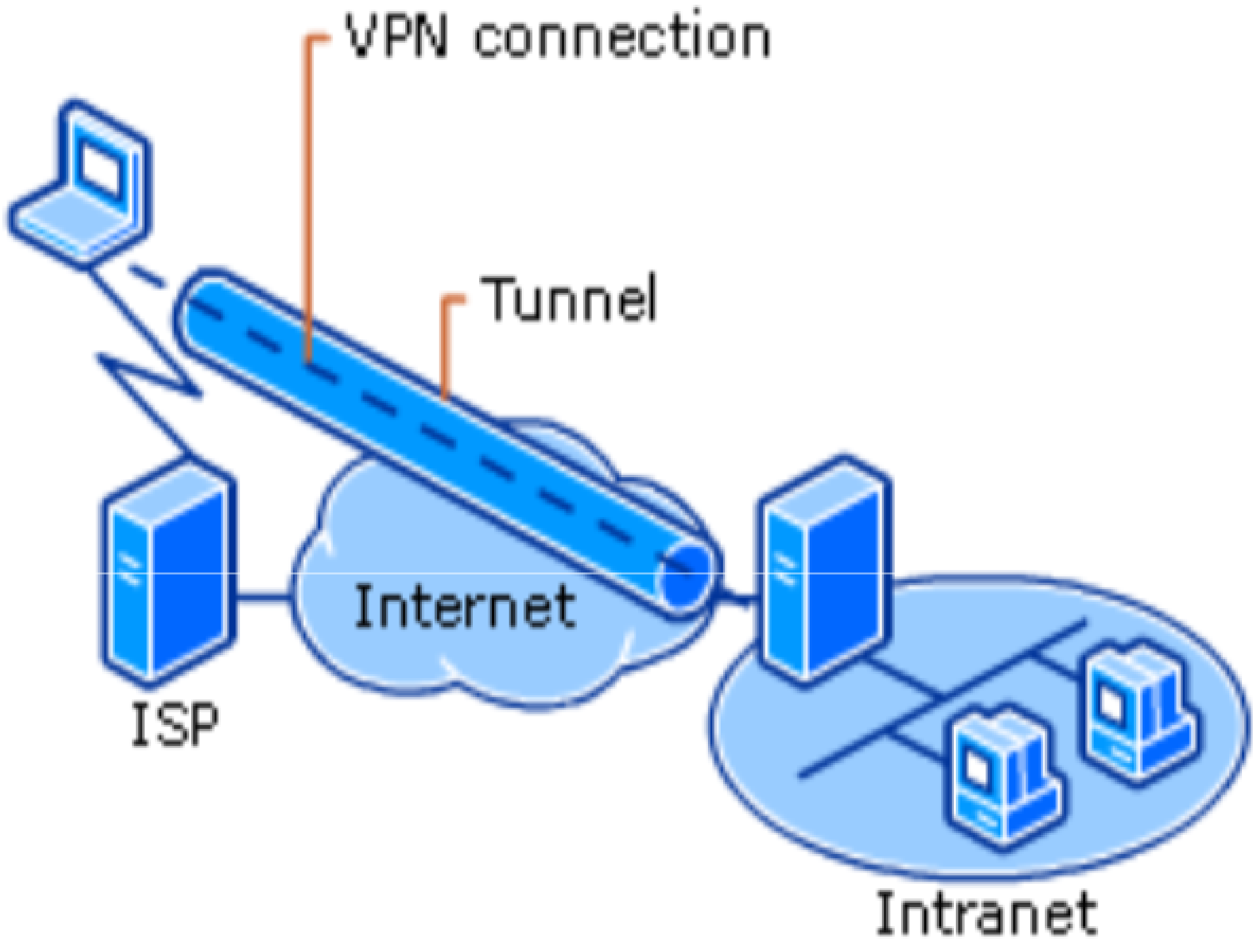
- A trusted certificate is digitally singed by a known certification authority
- Browsers (Chrome, Firefox, IE, Safari, etc.) come with a list of these authorities.

Certificates have problems

- Certificate revocation
- Relation between name and principal
- Users are used to accept certificates with errors
- New policies are stricter (which sometimes is annoying)

VPN - Virtual Private Network

- A VPN logically connects a client (or a network) to a network via an encrypted channel.



(Source: Microsoft)

- A VPN routes packet between different networks.
- Tunnel can be established by TLS, IPSec
- Security only between tunnel endpoints, e.g. VPN client and VPN gateway. Traffic in an internal network is still in clear!

IPSec

A protocol suite on the level of IP packets:

- Can authenticate and encrypt data for each IP packet of a communication
- Transport mode: Payload in IP packets is encrypted, integrity of header is protected. used for example for end-to-end communication between two devices.
- Tunneling mode: Complete IP packets are encrypted and contained in a new IP packet with a new header. Used for VPNs and host-to-host/network-to-network communication.