CCNA: OSI TCP/IP CHEAT SHEET

Open System Interconnect (OSI) Model

It is model to sub-divide the communication system into smaller parts

Layers provide service to upper layers and vice versa

There are seven OSI layers

Layer-1 or Physical Layer: defines the physical and electrical specification for the devices. Data unit is in Bits

Layer-2 or Data Link Layer: provides the functional and procedural means to transfer. The data unit at this layer is called Frames. Also provide the error correction that may occurred at layer-1. Data link layer is subdivided into:

1. Media Access Control (MAC) layer: defines the addressing schemes at layer-2
2. Logical Link Control (LLC): defines the flow control and acknowledgment methods

Layer-3 or Network Layer: defines the (end-to-end) logical address, traffic forwarding and path determination. The data unit at the layer is called Packet.

Layer-4 or Transport Layer: ensures transparent transfer of data between end users by providing reliable (or un-reliable) transfer services. Reliable delivery is ensured by means error correction and flow control. The data unit is called Segment.

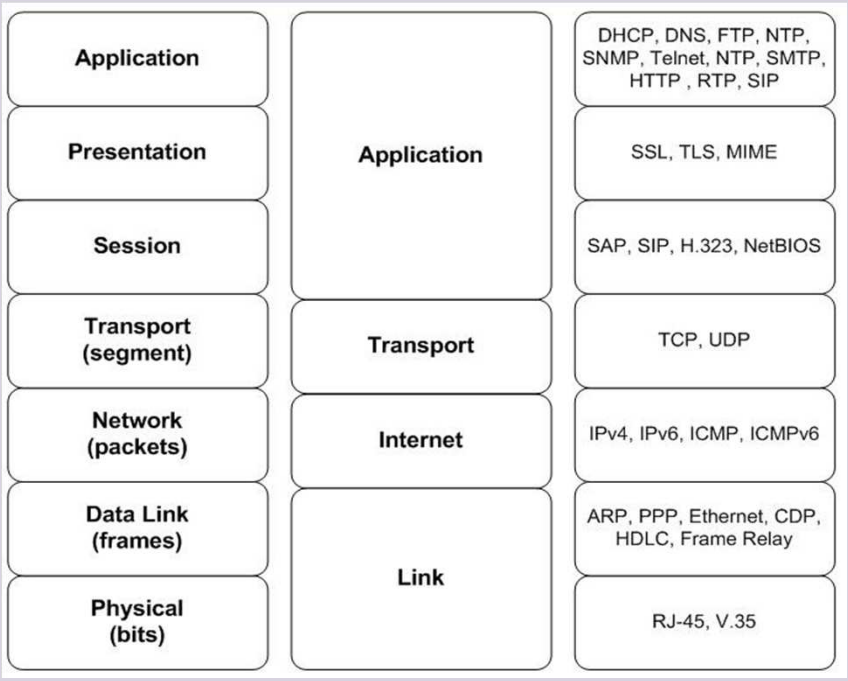
Layer-5 or Session Layer: responsible for connection setup, maintenance and tear down between network entities. Data unit called Datagrams. A session could be:

1. Simplex: data transfer in one direction only
2. Half-Duplex: bi-directional communication but only one network device can transmit in the given time
3. Full-Duplex: bi-directional communication and both devices can transmit at the given time

Layer-6 or Presentation Layer: responsible for inter-host communication. Receives data from application layer and converts to suitable format. For example: character conversion, encryption/decryption, compress and terminal emulation. Data unit called Datagrams

Layer-7 or Application Layer: responsible for application-to-application communication. Data unit called Datagrams

OSI and TCP/IP Model and Protocols



TCP/IP Model

TCP/IP is framework for computer network protocols created by DARPA in 1970s. It has four layers:

Link Layer: is analogous to Data Link layer of the OSI model. TCP/IP was designed to be hardware independent hence implemented on the top of the virtually any hardware networking device

Internet Layer: has two functions

1. Host Addressing and Identification
2. Packet Routing

Transport Layer: responsible for end-to-end delivery of traffic along with error control segmentation, congestion control, flow control and application addressing (in term of port numbers)

Application Layer: It refer to the session, presentation and application layers of the OSI reference model

Troubleshooting

OSI model uses bottom up approach

Layer 1 (physical) problems

- Interface administrative shutdown
- Faulty or broken cables
- Broken or faulty pins/connectors
- No power
- No cable connected or wrong interface
- Failing or damaged interface
- Incorrect cable for the interface

When there is a physical layer problem, the following states are applicable to router interfaces:

1. Administratively down/down – not configured
2. Down/down – L1

Layer 2 (data link) problems

- Incorrect configuration on the interface
- Clock rate missing or incorrect
- Incorrect layer 2 protocol settings
- Faulty network card
- Interface shut down

In case of a layer-2 problem, the following states are applicable to router interface:

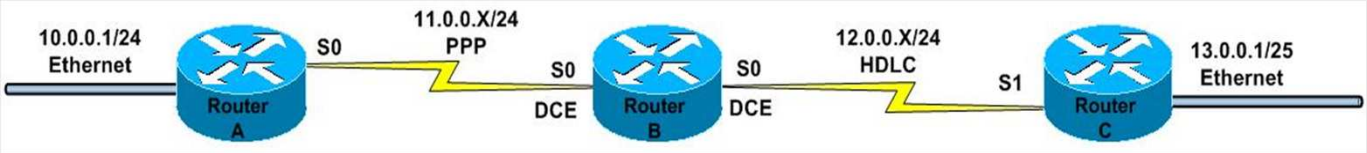
1. Up/Down

Layer 3 (network) problems

- Mis-configured routing protocol
- Incorrect IP/network addressing
- Incorrect subnet masking

Usually both physical and line protocol are in up/up state

Example: Let us consider a simple network running RIP version 2 (as shown figure). The network numbers are 10.0.0.0, 11.0.0.0, 12.0.0.0, and 13.0.0.0. We know that each router should be able to see all of the networks. For Router A, we know that networks 10.0.0.0 and 11.0.0.0 are directly connected to the router. Networks 12.0.0.0, and 13.0.0.0 should be in the routing table as a RIP route. In order for this to happen all of the interfaces connected to the other routers should be up/up and the correct routes should be in the routing table



Rather than checking to see if the cables are attached first check to see if the router can see the other networks

```
RouterA# show ip route | begin Gateway
Gateway of last resort is not set
C     10.0.0.0/24 is directly connected, 10.0.0.1
```

We can see that only the directly connected Ethernet network can be seen. The WAN network is not there. Start at layer 1 and check that the router can see the cable

```
RouterA# show controllers serial 0
HD unit 0, idb = 0x1AE828, driver structure at 0x1B4BA0
buffer size 1524 HD unit 0, V.35 DTE cable
```

So we can see that the cable is attached. It is a DTE cable, so we know we do not need to use the "clock rate" command on this interface. If the cable on the other end was DCE then it should have the "clock rate" command configured on it.
Next we need to check layer 2. The interface has a cable attached but is it showing up/up?

```
RouterA#show ip interface brief
Interface    IP-Address   OK?  Method  Status                Protocol
Serial0      11.0.0.1     YES  unset   administratively      down down
Ethernet0    10.0.0.1     YES  unset   up                    up
```

Troubleshooting

Somebody has neglected to open or “no shutdown” the serial interface. This can easily be corrected with the “no shut” command

```
RouterA#config terminal
RouterA(config)#interface serial 0
RouterA(config-if)#no shutdown
%LINK-3-UPDOWN: Interface Serial0, changed state to up
RouterA(config-if)#end
%LINK-3-UPDOWN: Interface Serial0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed state to down
```

We should now look at the interfaces to see if there is a difference

```
RouterA#show ip interface brief
Interface  IP-Address  OK?  Method  Status  Protocol
Serial0    11.0.0.1    YES  unset   up      down
Ethernet0  10.0.0.1    YES  unset   up      up
```

Okay, so now the interface is administratively up; however, it is showing as up/down. If the serial interface cannot see keepalives from the other interface then it will remain up/ down. We need to examine the configuration on our serial interface and compare it with its neighbor on Router B

```
RouterA#show run interface serial 0
interface Serial0
 ip address 11.0.0.1 255.255.255.0
 no ip directed-broadcast
 encapsulation ppp
```

The encapsulation type is set to PPP that is not the default HDLC. The diagram indicates that this side should be using PPP. On Router B, we would also check to make sure the interfaces are up/up

RouterB#show ip interface brief

Interface	IP-Address	OK?	Method	Status	Protocol
Serial0	11.0.0.2	YES	unset	up	Down
Serial1	12.0.0.1	YES	unset	down	Down
Ethernet0	unassigned	YES	unset	administratively down	Down
Ethernet1	unassigned	YES	unset	administratively down	Down
Bri0	unassigned	YES	unset	administratively down	Down
Bri0:1	unassigned	YES	unset	administratively down	Down
Bri0:2	unassigned	YES	unset	administratively down	Down

We can see that the interface connected to Router A is down down. We can check the configuration on the interface to see what could be wrong

```
RouterB#show run interface serial 0
interface Serial0
 ip address 11.0.0.2 255.255.255.0
 no ip directed-broadcast
 clock rate 128000 « clock rate present
```

We can immediately see a difference between the configurations on Router A and Router B. Router A's serial interface shows that the encapsulation is set to PPP. Router B does not show an encapsulation type because it is left at the default for Cisco which is HDLC

```
RouterB#show interface serial 0
Serial1 is down, line protocol is down
 Hardware is HD64570
 Internet address is 12.0.0.1/24
 MTU 1500 bytes, BW 1544 Kbit, DLY 1000 usec, rely 255/255, load 1/255
 Encapsulation HDLC, loopback not set, keepalive set (10 sec)
```

Troubleshooting

We can now change the encapsulation type (layer 2) to HDLC

```
RouterA#config t
RouterA(config)#interface serial 0
RouterA(config-if)#encapsulation hdlc
RouterA(config-if)#end
%LINK-3-UPDOWN: Interface Serial0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed state to up
%SYS-5-CONFIG_I: Configured from console by console
```

RouterB#show ip interface brief

Interface	IP-Address	OK?	Method	Status	Protocol
Serial0	11.0.0.1	YES	unset	up	Up
Ethernet0	10.0.0.1	YES	unset	up	Up

So now we are satisfied that layers 1 and 2 are now operational. To confirm, we ping Router A from Router B

```
RouterA#ping 11.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 11.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

We can now check the routing table for Router A to see if it can see the rest of the network

```
RouterA#show ip route | begin Gateway
Gateway of last resort is not set
C       10.0.0.0/24 is directly connected, 10.0.0.1
C       11.0.0.0/24 is directly connected, 11.0.0.1
R       12.0.0.0/24 [120/1] via 11.0.0.2, 00:01:33, Serial0
```

This is better than before; however, we still can only see as far as network 12.0.0.0. We could check on Router B, but since network 13.0.0.0 is connected to Router C, we can start there

RouterC#show ip interface brief

Interface	IP-Address	OK?	Method	Status	Protocol
Serial0	12.0.0.2	YES	unset	up	Up
Ethernet0	13.0.0.1	YES	unset	up	Up

Both interfaces are up/up, so we know that the Ethernet interface can see its own network (13.0.0.0) and that the serial interface is capable of advertising the route. Layers 1 and 2 appear fine, so we can check layer 3. We could type in the “show run” command; however, we could be more specific than that

```
RouterC#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 19 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface Send Recv Triggered RIP Key-chain
    Ethernet0 2    2
    Serial0   2    2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    12.0.0.0
    14.0.0.0
  Routing Information Sources:
    Gateway   Distance   Last Update
    12.0.0.1       120   00:00:17
  Distance: (default is 120)
```

Troubleshooting

The problem appears to be that although network 13.0.0.0 is attached to ethernet 0, the router has been configured to advertise network 14.0.0.0. We can easily correct this problem

```
RouterC#configure terminal
RouterC(config)#router rip
RouterC(config)#version 2
RouterC(config-router)#no network 14.0.0.0
RouterC(config-router)#network 13.0.0.0
RouterC(config-router)#^Z
%SYS-5-CONFIG_I: Configured from console by console
```

```
RouterC#show ip protocols
```

```
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 19 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
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    Interface Send Recv Triggered RIP Key-chain
    Ethernet0 2    2
    Serial0   2    2
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    12.0.0.0
    13.0.0.0

  Routing Information Sources:
    Gateway   Distance   Last Update
    12.0.0.1       120   00:00:17
  Distance: (default is 120)
```

We are now advertising the correct networks. We should check that Router C can see all of the networks before we move on

```
RouterC#show ip route
Codes:  C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
        U - per-user static route

Gateway of last resort is not set
C       12.0.0.0/24 is directly connected, 12.0.0.2
C       13.0.0.0/24 is directly connected, 13.0.0.1
R       11.0.0.0/24 [120/1] via 12.0.0.1, 00:07:13, Serial0
R       10.0.0.0/24 [120/2] via 12.0.0.1, 00:06:37, Serial0
```

We can go back to Router A to see if it can see all of the networks

```
RouterA#show ip route
Codes:  C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
        U - per-user static route

Gateway of last resort is not set
C       10.0.0.0/24 is directly connected, 10.0.0.1
C       11.0.0.0/24 is directly connected, 11.0.0.1
R       12.0.0.0/24 [120/1] via 11.0.0.2, 00:04:17, Serial0
R       13.0.0.0/24 [120/2] via 11.0.0.2, 00:04:34, Serial0
```

All the routes are now visible