Let's begin with a 3560 Switch. Please understand that I don't have access to any device and I am configuring this based on my memory, so please excuse the typos if you see one.

There are four MTU values that can be set:
System MTU
Jumbo MTU
System Alternate MTU
Routing MTU

System MTU is set and changed for any Ethernet or FastEthernet interface (10/100).
Jumbo MTU will affect any Gig or TenGig interface/s with the highest value of 9000 Bytes
System MTU routing effects layer three interfaces.

Let's say you have SW1 that needs to establish an OSPF adjacency with a router:

```
SW1(config)#int f0/1
SW1(config-if)#no swi
SW1(config-if)#ip addr 10.1.1.10 255.255.255.0
SW1(config-if)#No shut
```

Let's set the system MTU routing to be 1504:

```
SW1(config)#system mtu routing 1504
```

You will get an error

The reason it doesn't like the command is because system MTU routing is set based on the system MTU. Let's change the system MTU:

```
SW1(config)#system mtu 1998
You need to reload the switch
```

Based on your console message, the switch needs to be reloaded for the changes to take effect, let's save the config and reload the switch. Once the switch is up, we should verify the MTU sizes:

```
SW1#sh system mtu

System MTU size is 1998 bytes
```

System Jumbo MTU size is 1998 bytes
Routing MTU size is 1998 bytes

So we can see that if we need to change the "system MTU routing", since by default it is set based on the "system MTU", we need to change the "system MTU" first, then reload the switch before we can change the "system MTU routing".

Let’s change the "system MTU routing" to 1504.
SW1(config)#system mtu routing 1504
SW1(config)#

Note: We didn’t have to reload the switch to do that.

SW1#sh system mtu

System MTU size is 1998 bytes
System Jumbo MTU size is 1998 bytes
Routing MTU size is 1504 bytes

So we can see that changing "system MTU routing" does not change the "system MTU".
Now let’s configure router (R1) .

R1(config)#int f0/0
R1(config-if)#ip addr 10.1.1.1 255.255.255.0
R1(config-if)#No shut

Let’s test connectivity:

R1#ping 10.1.1.10
This should be successful.

Let’s configure OSPF on both devices:

On R1

R1(config)#router ospf 1
R1(config-router)#netw 0.0.0.0 0.0.0.0 a 0

On SW1:

```
SW1(config)#ip routing
SW1(config)#router ospf 1
SW1(config-router)#netw 0.0.0.0 0.0.0.0 a 0
```

To verify the configuration:

```
R1#sh ip ospf neighbor
```

The neighbor will be in “EXSTART” state.

The reason these devices are not forming adjacency is a mismatch in MTU sizes, let’s change the MTU of the switch:

```
SW1(config)#system mtu routing 1500
```

You should see a console message revealing that the adjacency was formed:

Let’s change the MTU routing on the switch back to 1504, and what if you wanted to change the router’s MTU to 1504?

```
SW1(config)#system mtu routing 1504
```
And clear ip ospf process and enter “Yes”.

```
R1(config)#int f0/0
R1(config-if)#ip mtu ?
1500  MTU
```

Well, we can see that the MTU has a maximum size of 1500, but this is the IP MTU, which sets the maximum MTU size of an IP packets sent out of a given interface. Is there another MTU that we can adjust?

```
R1(config-if)#mtu ?
  1600  MTU
```

The MTU displayed above is the hardware MTU. Hardware MTU specifies the maximum packet length that the interface can support.
This is different to the “IP MTU” which determines whether an egress IP packet needs to be fragmented.

Normally “IP MTU” must be lower or equal to the hardware MTU, and by default they are

equal. Therefore, in order to change the “IP MTU”, the hardware MTU must be changed first, just like what we did on the switch, we had to change the system MTU and then reload the device and then change the system mtu routing. On the routers there is no need to save and reload.

Let’s do that:

R1(config-if)#mtu 1504

You should see that OSPF established its adjacency.

Now let’s test the “IP MTU” and the hardware MTU:

Let’s configure R1 and R2 on the same VLAN and ping:

R1(config-if)#int f0/0
R1(config-if)#ip addr 12.1.1.1 255.255.255.0
R1(config-if)#no shu

R2(config)#int f0/0
R2(config-if)#ip addr 12.1.1.2 255.255.255.0
R2(config-if)#no shu

Switch(config)#interface range f0/1-2
Switch(config-if-range)#swi mode acc
Switch(config-if-range)#swi acc v 12
Switch(config-if-range)#spannin portf
Switch(config-if-range)#no shu

To test:
R1#ping 12.1.1.2
This should be successful.

Let’s ping with packet size of 1500 and the “DF” bit set.

R1#ping 12.1.1.2 size 1500 df-bit
This should not be a problem, meaning that the ping is going to be successful.

No problems, the reason for this demonstration is to say that fragmentation happens on the way out meaning if R1 needs to fragment because its IP MTU is set to something lower, it

will. But the receiving router, in this case R2 will not fragment packets on the ingress if the packet size is higher than set MTU and the packet will be dropped. Let's test this:

R1#ping 12.1.1.2 size 1501 df-bit rep 2
This will NOT be successful

What happened? Fragmentation does not happen on the ingress, it happens on the egress.

R1#sh int f0/0 | i MTU
  MTU 1600

We can see that the MTU on R1 is set to 1600, so we are pinging with a size of 1501 and we are asking R1 not to fragment with the "DF" bit set. In this case R1 does not need to fragment, but R2's MTU is set to 1500, and since it will not fragment on the ingress, it will drop the packets.

R2#sh int f0/0 | i MTU
  MTU 1500

This is all good but what is the "system MTU alternate" on switches?

MAY BE the reason you don't see that on your switch is because they included it starting with 12.2(55)Se (IF I AM NOT WRONG, PLEASE CHECK), you can setup a single alternate MTU and assign it to one or bunch of interfaces. This can be accomplished using the following commands in the global configuration mode:

Switch(config)#System mtu alternate *bytes* ---------- to setup the alternate MTU
Switch(config)#System mtu alternate interface f0/1

Alternate MTU does not affect the routing MTU. If you assign an alternate MTU to an interface and the received packet size is larger than the configured alternate MTU size, the packet will be dropped.

I hope this helped, but this is not something that you read and try to memorize, you need to lab this up and explain it back to yourself as you see the results. I was thinking about 2800 routers and 3560 switches when I wrote this answer.