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Jumbo/Giant Frame Support on Catalyst Switches Configuration Example

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Introduction

This document provides a concise view of the Maximum Transmission Unit (MTU) sizes supported across all of the Cisco Catalyst−series switches on Ethernet−based ports. Interfaces such as Asynchronous Transfer Mode (ATM), Packet over SONET (POS), Token Ring, and so on, are not addressed in this document.

Conventions

- **MTU:** Maximum Transmission Unit

- **jumbo:** the definition of frame size is vendor−dependent, as these are not part of the IEEE standard. Jumbo frames are frames bigger than the standard Ethernet frame size, which is 1518 bytes (including Layer 2 (L2) header and Frame Check Sequence (FCS)).

- **baby giants:** the baby giants feature allows the switch to pass through/forward packets slightly larger than the IEEE Ethernet MTU, rather than declaring those frames oversize and discarding them.

- In all examples below, unless specifically mentioned, all values quoting MTU in bytes omit the 18 bytes for the Ethernet header and FCS.

- For more information on document conventions, see the Cisco Technical Tips Conventions.

Background Theory

In order to transport traffic across switched−networks, care must be taken that transmitted traffic MTU does not exceed that which is supported on the switch platforms. There are various reasons as to why the MTU size of certain frames may be truncated:

- **vendor−specific requirements:** applications and certain Network Interface Cards (NICs) may specify an MTU size outside of the standard 1500 bytes. Much of this drive has been due to studies undertaken, which prove that an increase in the size of an Ethernet frame can increase average throughput.

- **trunking:** in order to carry VLAN−ID information between switches or other network devices, trunking has been employed to augment the standard Ethernet frame. Today, the two most common forms of trunking are Cisco's proprietary InterSwitch Link (ISL) encapsulation and IEEE 802.1q. Refer to the following documents for more information on trunking:

  InterSwitch Link Frame Format

  Basic Characteristics of 802.q Trunking

- **MultiProtocol Label Switching (MPLS):** once enabled on an interface, this will also have the potential for augmenting the frame size of a packet depending on the number of labels in the Label stack for an MPLS−tagged packet. The total size of a label is four bytes; the total size of a label stack is n x 4 bytes. If a label stack is formed, the frames can exceed the MTU. Refer to the following document for more information on MPLS:

  MPLS Technical Tips

Catalyst Supports for Maximum Frame Sizes

The ability of the various Catalyst switches to be able to support various frame sizes depends on many factors, including the hardware and software. Note that certain modules may be able to support larger frame sizes than others, even within the same platform. Additionally, maximum frame size support may also change depending on the software version used.

Catalyst 6000/7600 OSR Series

The Catalyst 6000 series and 7600 Optical Services Router (OSR) platform can support jumbo frame sizes as of release 6.1(1) of CatOS, and 12.1(1)E for Native IOS. However, this is dependent on the type of line cards that are used. There are generally no restrictions in enabling the jumbo frame size feature. This feature can be used with trunking/non−trunking and channeling/non−channeling

The default MTU size is 9216 bytes once jumbo frame support has been enabled on the individual port. However, on the following 10/100−based line cards, an Application Specific Integrated Circuit (ASIC) limitation requires that the MTU size be limited to 8092 bytes. Specifically, the line cards that are affected are as follows:

- WS−X6248−RJ−45
- WS−X6248A−RJ−45
- WS−X6248−TEL
- WS−X6248A−TEL

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- WS−X6348−RJ−45
- WS−X6348−RJ−45V
- WS−X6348−RJ−21

The WS−X6516−GE−TX is also affected at 100 Mbps. At 10/1000 Mbps, up to 9216 bytes can be supported. Note, however, that the WS−X6548−RJ−45 line card is not affected, as it uses newer ASICs.

Note: Jumbo Frame support is available on WS−X6101 ATM modules.

Configuration and Verification in CatOS

```
Cat6509 (enable) set port jumbo
Usage: set port jumbo <mod/port> <enable|disable>
Cat6509> (enable) set port jumbo 1/1 enable
Jumbo frames enabled on port  1/1.
Cat6509> (enable) 2002 May 29 12:34:35 %PAGP-5-PORTFROMSTP:Port 1/1 left bridge port 1/1
2002 May 29 12:34:38 %PAGP-5-PORTTOSTP:Port 1/1 joined bridge port 1/1

Cat6509> (enable) show port jumbo
Jumbo frames MTU size is 9216 bytes.
Jumbo frames enabled on port(s) 1/1,9/1.
```

Configuration and Verification in Native IOS

```
7609(config)#int gigabitEthernet 1/1
7609(config-if)#mtu ?
  <1500-9216>  MTU size in bytes

7609(config-if)#mtu 9216

7609#show interfaces gigabitEthernet 1/1
GigabitEthernet1/1 is up, line protocol is up (connected)
  Hardware is C6k 1000Mb 802.3, address is 0007.0d0e.640a (bia 0007.0d0e.640a)
  MTU 9216 bytes, BW 1000000 Kbit, DLY 10 usec, reliability 255/255, txload 1/255, rxload 1/255
```

The port ASICs on the Catalyst 6000 count as oversized, which are those frames greater than 1548 bytes but less than the configured jumbo MTU. It uses the rxOversizedPkts counter to track these frames in the output from the **show counter** *<mod/port>* command. In this case, you also will see the ifInErrors counter value increment and may equal the number of rxOversizedPkts packets value in the **show counter** *<mod/port>* command output. On a Catalyst 6000 running Cisco Integrated IOS (Native Mode), you may see the input errors counter being incremented along with giant counters on the interface receiving these frames by using the **show interface** *<interface−id>* command.

Note: There is no relationship between the MTU value that you can specify in the VLAN database and the **mtu** command in the interface configuration mode. With the VLAN database setting, the switch checks for an MTU value greater than 1500 and, if detected, puts the VLAN in a non−operational state. Therefore, to support large frames, you only need to change the interface MTU value and not the VLAN database MTU value.

For more information about Jumbo Frame support on the Catalyst 6500, refer to the *Configure Jumbo Frame Support* section of the following document:

- Configuring Interfaces

Catalyst 4000 Series

The Catalyst 4000 series switches can essentially be divided into the following two groups when referring to jumbo or baby giant support:

- **Supervisor I (WS−X4012) and Supervisor 2 (WS−X4013)**

  This includes the WS−C2948G, WS−C2980G, and the WS−C4912G fixed−configuration switches as well. Due to a ASIC limitation, there is no support for baby giants.

Workaround

The only supports these have are in the form of enabling a port for trunking. When a port is enabled for 802.1q trunking (ISL encapsulation is not supported on these platforms), the switch will automatically assume that there will be an extra four bytes of data appended on, incrementing the frame size of the L2 packet. Hence, for implementations that require exactly only one tag to be carried (either 802.1q or MPLS, but not both), it is possible to force the switchport to accept an extra four bytes of data by configuring it as a trunk port.

If the port were to carry multiple VLANs for VLAN−ID tagging or 802.1p prioritization, the port must be configured as a 802.1q trunk. However, even if VLAN tagging is not required, but the increased four−byte support is (for example, to carry one MPLS label), you can configure the port as a 802.1q trunk by changing the Native VLAN to be the one desired to carry the traffic. By doing this, we are now able to accommodate an extra four bytes of data.

- **Supervisor III (WS−X4014) and Supervisor IV (WS−X4515)**

  The Supervisor III and Supervisor IV, which run only Integrated Cisco IOS, currently support baby giants up to 1600 byte−sized frames and jumbo frames. For detailed information on its support, refer to the following document:

  - Understanding Baby Giant and Jumbo Frames Support on Catalyst 4000 and 4500 with Supervisor III and IV

Catalyst 3750 Series

Catalyst 3750 series switches support an MTU of 1546 bytes for all 10/100 interfaces. Jumbo frames up to 9018 bytes are supported on all Gigabit Ethernet interfaces. The MTU cannot be changed on an individual interface, it must be set globally. The switch must be reset afterwards for the MTU change to take effect.

Use the **system mtu** command to change the MTU for all 10/100 interfaces. This command only effects 10/100 interfaces.

```
3750(config)# system mtu 1546
3750(config)# exit
3750# reload
```

Use the **system mtu jumbo** command to change the MTU for all Gigabit Ethernet interfaces. This command only effects Gigabit Ethernet Interfaces.

```
3750(config)# system mtu jumbo 9000
3750(config)# exit
3750# reload
```

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Use the **show system mtu** command to show the mtu sizes after reload.

```
Switch# show system mtu
Sytem MTU size is 1546 bytes
System Jumbo MTU size is 9000 bytes
```

Note: If Gigabit Ethernet interfaces are configured to accept frames greater than the 10/100 interfaces, jumbo frames ingressing on a Gigabit Ethernet interface and egressing on a 10/100 interface are dropped.

Catalyst 3550 Series

The Catalyst 3550 series Layer 3 (L3) switches can also be divided into two major groups, where the Gigabit Ethernet versions support up to 2000 bytes and the Fast Ethernet versions support up to 1546 bytes. The following models support up to 2000 bytes:

- WS–C3550–12G
- WS–C3550–12T

```
3550(config)#system mtu ?
  <1500-2000>  MTU size in bytes

3550(config)#system mtu 2000
Changes to the System MTU will not take effect until the next reload is done.

3550#sh system mtu
System MTU size is 2000 bytes
```

Note: In versions prior to 12.1(9)EA1, an MTU of 2025 was configurable on the above mentioned switches. Due to an ASIC limitation, the configurable MTU has been brought down to 2000 bytes.

The following models support up to 1546 bytes:

- WS–C3550–24
- WS–C3550–24–DC–SMI
- WS–C3550–24–EMI
- WS–C3550–24–SMI
- WS–C3550–48–EMI
- WS–C3550–48–SMI

```
3550(config)#system mtu ?
  <1500-1546>  MTU size in bytes

3550(config)#system mtu 1546
Changes to the System MTU will not take effect until the next reload is done.

3550#sh system mtu
System MTU size is 1546 bytes
```

The MTU size of 1546 does not include the 18 bytes of the standard Ethernet header and FCS. Therefore, these switches actually support Ethernet frames up to 1564 bytes.

Catalyst 2950 Series

The Catalyst 2950 series switches can also be divided into two major groups, where one supports baby giants (up to 1530 bytes), but the other does not. Note also, however, that this is referring to traffic that is

switched through the switch. Packets destined to the management (VLAN) interface will only be capable of supporting 1500 bytes.

The following models of 2950 switches support only 1500 bytes:

- WS–C2950–12
- WS–C2950–24
- WS–C2950–48
- WS–C2950C–24
- WS–C2950T–24

The following models of 2950 switches support up to 1530 bytes:

- WS–C2950G–12–EI
- WS–C2950G–24–EI
- WS–C2950G–24–EI–DC
- WS–C2950G–48
- WS–C2950G–48–EI

For those switches that support up to 1530 bytes, the default is 1500. To change this, a global configuration command is available for versions of software above 12.1(6)EA2. A sample configuration and verification is as follows:

```
2950G(config)#system mtu ?
  <1500-1530>  MTU size in bytes

2950G(config)#system mtu 1530

2950G#sh system mtu
System MTU size is 1530 bytes
```

Catalyst 8500 Series

Jumbo frame support is only available on the two–port enhanced Gigabit Ethernet modules listed below. Additionally, in order to support the jumbo frames, software revision 12.1(7)EY and hardware revision 6.0 is required. Only this hardware revision has a new ASIC to support changing the MTU value.

To identify whether the enhanced two–port Gigabit Ethernet module can support jumbo frames, issue the following command:

show controller <gig–port>

Verify that the following values are in the output:

- Sys Status Register ––> **0x15** – indicates the E–2PGE port supports jumbo frames

- Sys Status Register ––> **0x03** – indicates port does not support jumbo frames

```
8500#show controller g3/0/0
IF Name: GigabitEthernet3/0/0
Port Status UP
FPGA Rev : 0.2
Gigabit Ether Status          : 0xF (Optical Detect,Rx Sync,Link UP)
Mode Parallel Register        : 0x0
Serial Mode Register          : 0x0
```

```
Link Interrupt Enable      : 0x1
Tx Disable                 : 0x0
Internal Reset Trigger Count : 0

Slicer registers
SMDR 0xFF78 SSTR 0x1202 SSMR 0x4002 EVER 0x3001
SIMR 0x0000 MBXW 0x0000 MBXR 0x0000 SPER 0xF000


F000   chan0 chan1 chan2 chan3 sstr 1202
       0006  0006  0006  0006
task0   61    61    61    61
task1  789   789   789   789
task2   61    61    61    61
task3  789   789   789   789

 GCR = 0x4       GICR = 0x2403


MII registers:

Direct Access:
Control Register           (0x0): 0x1140
Status Register            (0x1): 0x16D
Auto Neg. Advt. Register   (0x4): 0x1A0
Auto Neg. Partner Ability Reg (0x5): 0x4020
TR_IPG_TIME Register       (0x10): 0x7
PAUSE_TIME Register 1       (0x11): 0x100
PAUSE_TIME Register 2       (0x12): 0x18
PAUSE_SA1 Register         (0x13): 0x0
PAUSE_SA2 Register         (0x14): 0x0
PAUSE_SA3 Register         (0x15): 0x0
PAUSE_DA1 Register         (0x16): 0x180
PAUSE_DA2 Register         (0x17): 0xC200
PAUSE_DA3 Register         (0x18): 0x1
Pause Upper Watermark Reg.  (0x19): 0x7800
Pause Lower Watermark Reg.  (0x1A): 0x8C00
TX FIFO Watermark Register  (0x1B): 0x40
Memory Address Register     (0x1C): 0xF009
Sync Status Address Register (0x1D): 0x40
Sys Status Register         (0x1E): 0x15
Sys Control Register        (0x1F): 0xFFDA

Indirect Access:
Pause Frame Sent Counter(L)(0xF000): 0x0
```

The model numbers supporting these jumbo frames are as follows:

- C85EGE–2X–16K
- C85EGE–2X–64K
- C85EGE–2X–256K

Additionally, the ATM Router Module 2 (C8540–ARM2) also supports a configurable MTU. The maximum configurable MTU on the ARM 2 is 17976 bytes. A sample configuration and verification of this is as follows:

```
8500(config)#int atm 12/0/0
8500(config-if)#mtu ?
  <64-17976>  MTU size in bytes

8500(config-if)#mtu 17976
```

```
8500#sh int ATM 12/0/0
ATM12/0/0 is up, line protocol is up
  Hardware is arm2_port, address is 0090.2141.b077 (bia 0090.2141.b077)
  SVC idle disconnect time: 300 seconds
  MTU 17976 bytes, sub MTU 17976, BW 1000000 Kbit, DLY 10 usec, reliability 255/255, txload 1/2
```

Catalyst 5000 Series

As of version 6.2(1) of the CatOS software, all ports/modules (with the exceptions stated below), support the default jumbo frame size up to and including 9216 bytes. An example of enabling jumbo frames is as follows:

```
Cat5000> (enable) set port jumbo
Usage: set port jumbo <mod/port> <enable|disable>
Cat5000> (enable) set port jumbo 5/1 enable
Jumbo frames enabled on port 5/1.
Cat5000> (enable) set port jumbo 3/1 enable
Feature not supported on port 3/1.

Cat5000> (enable) show port jumbo ?
Usage: show port jumbo
Cat5000> (enable) show port jumbo
Jumbo frames enabled on port(s) 6/1-2,7/1-8.
```

If the jumbo frame feature can not be enabled on some ports at system startup time, the Command Line Interface (CLI) will display a line telling the user that the system failed to enable the jumbo frame feature on those ports. This means that the feature is user enabled in NonVolatile RAM (NVRAM), but operationally disabled on the line card.

```
Console> (enable) show port jumbo
Jumbo frames enabled on port(s) 6/1-2.
Enabling of jumbo frames failed on port(s) 7/1-8.
```

Other Considerations

- **trunking:** when a port is in `trunking` mode, the jumbo frame feature is automatically enabled on that port. When the port is not in `trunking` mode, the jumbo frame setting on that port will return to the original setting that user has set. If user tries to disable the jumbo frame feature on a trunk port, the port will still pass jumbo frames until trunking is turned off.

- **port channeling:** channeling ports need to have the same jumbo frame setting on each port.

```
Cat5000> (enable) show port jumbo
Jumbo frames enabled on port(s) 6/1-2,7/1-8.
Cat5000> (enable) set port jumbo 6/1 disable
Jumbo frames disabled on port 6/1.
Cat5000> (enable) set port chan 1/1-2 on
Port(s) 1/1-2 are assigned to admin group 9.
Port(s) 1/1-2 channel mode set to on.
Cat5000> (enable) set port jumbo 1/1 enable
Jumbo frames enabled on port 1/1-2.
```

Restrictions

- On 10/100 UTP–based line cards, the maximum frame size supported is only 8092 bytes due to an ASIC limitation.

- The nine−port Gigabit Ethernet line card (WS−X5410) does not support the jumbo frame feature due to an ASIC limitation. To support MPLS−tagged frames, see the Workaround in the Catalyst 4000 section of this document.
- Jumbo frame support is currently not available on ATM modules for the Catalyst 5500 series switches.

Catalyst 2900XL/3500XL Series

The Catalyst 2900XL/3500XL series switches are able to support up to the MTU size of 2018 bytes as of version 12.0(5.2)XU . There is no support for a full jumbo frame. The MTU size is configured on a per−interface basis and can be configured on all 10/100/1000 interfaces. A sample configuration and verification is as follows:

```
3500XL(config)#int fastEthernet 0/3
3500XL(config-if)#mtu ?
  <1500-2018>  MTU size in bytes

3500XL(config-if)#mtu 2018

3500XL#sh interfaces fastEthernet 0/3
FastEthernet0/3 is up, line protocol is up
  Hardware is Fast Ethernet, address is 0007.85b8.6983 (bia 0007.85b8.6983)
  MTU 2018 bytes, BW 0 Kbit, DLY 100 usec, reliability 255/255, txload 1/255, rxload 1/255
```

Note: Currently, the Catalyst 2900LRE−XL switches do no support frame sizes larger than 1536 bytes signaling connection due to limitations on the CPE device.

A Catalyst 2900XL would report oversized frames when a legal max−size Ethernet frame encapsulated or tagged for ISL/802.1Q was received and not forwarded to any other ports. There are many valid reasons for a packet to be received and not forwarded to any other ports. For example, packets received in a port blocked by Spanning Tree Protocol (STP) will not be forwarded. This issue is a cosmetic bug with Bug ID CSCdm34557. Registered users can view additional information about this Bug ID by accessing the Bug Toolkit found on the Tools and Utilities page.

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Catalyst 2948G−L3/4908G−L3 Series

The Catalyst 2948G−L3 and 4908G−L3 series switches do not support a configurable MTU on either 10/100 or 1000. The MTU is therefore the default, which is 1500 bytes.

```
2948G-L3(config)#int gig 49
2948G-L3(config-if)#mtu 2000
% Interface GigabitEthernet49 does not support user settable mtu.

2948G-L3#sh interfaces gigabitEthernet 49
GigabitEthernet49 is up, line protocol is up
  Hardware is xpif_port, address is 0004.6e3b.b507 (bia 0004.6e3b.b507)
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  Full-duplex, 1000Mb/s, 1000Base-SX, Auto-negotiation
```

Catalyst 1900/2820 Series

The Catalyst 1900/2820 series switches' ability to support baby jumbo frames depends on the revision of the switch in question.

The older models of the 1900/2820 series switches that were manufactured with a metal casing can support a larger MTU of 1508 bytes to be passed through. These frames will also be logged as giant frames in the statistics report, as follows:

```
Catalyst 1900 - Port B Statistics Report
    Receive Statistics                    Transmit Statistics
------------------------------------  ------------------------------------
Total good frames              120    Total frames              262767
Total octets                 10041    Total octets            16840696
Broadcast/multicast frames      49    Broadcast/multicast frames  262664
Broadcast/multicast octets    5000    Broadcast/multicast octets 16825351
Good frames forwarded          107    Deferrals                       0
Frames filtered                 13    Single collisions               3
Runt frames                      0    Multiple collisions             0
No buffer discards               0    Excessive collisions            0
                                      Queue full discards             0
Errors:                               Errors:
  FCS errors                     0      Late collisions               0
  Alignment errors               0      Excessive deferrals           0
  Giant frames                   5      Jabber errors                 0
  Address violations             0      Other transmit errors         0
```

The newer models of the 1900/2820 series switches that were manufactured with a plastic casing can only support a maximum MTU of 1500 bytes. Larger frames will be dropped.

Related Information

Related Topics

- **802.1q Trunking Between Catalyst Switches Running CatOS**
- **Configuring ISL Trunking on Catalyst 5000 and 6000 Family Switches**

Additional Documentation

- **LAN Switches Hardware Support**
- **LAN Switches Technology Support**