Configuring LLC2 and SDLC Parameters

You do not need to configure Logical Link Control, type 2 (LLC2) because it is already enabled on Token Ring interfaces. This chapter describes how to modify the default settings of LLC2 parameters as needed.

To support the Synchronous Data Link Control (SDLC) protocol, you must configure the router to act as a primary or secondary SDLC station. You also can change default settings on any SDLC parameters. Configuration examples for both LLC2 and SDLC are given at the end of the chapter.

For a complete description of the LLC2 and SDLC commands mentioned in this chapter, refer to the "LLC2 and SDLC Commands" chapter in the *Bridging and IBM Networking Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

LLC2 Configuration Task List

Because LLC2 is already enabled on a Token Ring, you do not need to enable it on the router. However, you can enhance LLC2 performance by completing the following tasks:

- Control Transmission of I-Frames
- Establish the Polling Level
- Set Up XID Transmissions

To determine which LLC2 parameters need adjustment, you can perform the following task:

- Monitor LLC2 Stations

See LLC2 Configuration Example.

Control Transmission of I-Frames

Control the number of information frames (I-frames) and acknowledgments sent on the LLC2 network by completing the tasks described in the following sections.

- Set the Maximum Number of I-Frames Received before Sending an Acknowledgment
- Set the Maximum Delay for Acknowledgments
- Set the Maximum Number of I-Frames Sent before Requiring Acknowledgment
- Set the Number of Retries Allowed
- Set the Time for Resending I-Frames
- Set the Time for Resending Rejected Frames

Set the Maximum Number of I-Frames Received before Sending an Acknowledgment

You can reduce overhead on the network by increasing the maximum number of frames the Cisco IOS software can receive at once before it must send the sender an acknowledgment. To do so, use the following command in interface configuration mode:

Command	Purpose
llc2 ack-max *packet-count*	Set maximum number of I-frames the router can receive before it sends an acknowledgment.

Set the Maximum Delay for Acknowledgments

You can ensure timely receipt of acknowledgments so that transmission of data is not delayed. Even if the maximum amount of frames has not been reached, you can set a timer forcing the router to send an acknowledgment and reset the maximum amount counter to 0.

To set the maximum delay time, use the following command in interface configuration mode:

Command	Purpose
llc2 ack-delay-time *milliseconds*	Set the I-frame acknowledgment time.

Set the Maximum Number of I-Frames Sent before Requiring Acknowledgment

You can set the maximum number of I-frames that the router sends to an LLC2 station before the software requires an acknowledgment from the receiving end. A higher value reduces overhead on the network. Ensure that the receiving LLC2 station can handle the number of frames set by this value.

To set this value, use the following command in interface configuration mode:

Command	Purpose
llc2 local-window *packet-count*	Set the maximum number of I-frames the router sends before it requires an acknowledgment.

Set the Number of Retries Allowed

You can set the number of times the router will resend a frame when the receiving station does not acknowledge the frame. Once this value is reached, the session is dropped. This value also is used to determine how often the software will retry polling a busy station. Use this command in conjunction with the **llc2 t1-time** command described in the section “Set the Time for Resending I-Frames.”. Using them together ensures that frame transmission is monitored at a reasonable level, while limiting the number of unsuccessful repeated tries.

To set the number of retries, use the following command in interface configuration mode:

Command	Purpose
llc2 n2 *retry-count*	Establish the number of times the router will resend unacknowledged frames or try polling a busy station.

Set the Time for Resending I-Frames

You can set the amount of time the router waits before resending unacknowledged I-frames. This interval is called the *T1 time*. Use this command in conjunction with setting the number of retries and setting the transit poll-frame timer. Using these commands in conjunction with each other provides a balance of network monitoring and performance.

To set the T1 time, use the following command in interface configuration mode:

Command	Purpose
llc2 t1-time *milliseconds*	Control how long the router waits for an acknowledgment of transmitted I-frames.

Note Ensure that you allow enough time for the round trip between the router and its LLC2-speaking stations. Under heavy network loading conditions, resending I-frames every 3000 ms is appropriate.

Set the Time for Resending Rejected Frames

You can set the amount of time that the router will wait for an expected frame before sending a reject command (REJ). Typically, when an LLC2 station sends an I-frame, a sequence number is included in the frame. The LLC2 station that receives these frames will expect to receive them in order. If it does not, it can reject a frame and indicate which frame it is expecting to receive instead. If the correct frame is not sent to the software before the reject timer expires, the software sends a REJ to the remote station and disconnects the LLC2 session.

To set the reject timer, use the following command in interface configuration mode:

Command	Purpose
llc2 trej-time *milliseconds*	Set the time the Cisco IOS software waits for a resend of a rejected frame before sending a reject command to the remote station.

Establish the Polling Level

You can control the amount of polling that occurs on the LLC2 network by completing the tasks described in the following sections:

- Set the Polling Frequency
- Set the Polling Interval
- Set the Transmit-Poll-Frame Timer

Set the Polling Frequency

You can set the optimum interval of time after which the router sends Receiver Ready messages or frames that tell other LLC2 stations that the router is available. These polls occur during periods of idle time on the network.

To set polling frequency, use the following command in interface configuration mode:

Command	Purpose
llc2 idle-time *milliseconds*	Control the polling frequency during idle traffic.

Set the Polling Interval

The amount of time the router waits until repolling a busy station can also be set. Use this command in conjunction with setting the number of retries. Typically, you do not need to use this command unless an LLC2 station has unusually long busy periods before clearing the busy state. In this case, you should increase the value so that the station does not time out.

To set the polling interval, use the following command in interface configuration mode:

Command	Purpose
llc2 tbusy-time *milliseconds*	Set the amount of time the router will wait before repolling a busy station.

Set the Transmit-Poll-Frame Timer

When the router sends a command that must receive a response, a poll bit is sent in the frame. When the software sends the poll bit, it cannot send any other frame with the poll bit set until the receiver replies to that poll frame with a frame containing a final bit set. When the timer expires, the software assumes that it can send another frame with a poll bit.

Set the transmit-poll-frame timer to reduce problems with receiving stations that are faulty and cannot send the frame with the final bit set by using the following command in interface configuration mode:

Command	Purpose
llc2 tpf-time *milliseconds*	Set the amount of time the router waits for a final response to a poll frame before the resending it.

This value should be larger than the T1 time. The T1 time determines how long the software waits for receipt of an acknowledgment before sending the next set of frames. See the section “Set the Time for Resending I-Frames” earlier in this chapter for more information.

Set Up XID Transmissions

You can control the number of frames used for identification on the LLC2 network by completing the tasks described in the following sections:

- Set the Frequency of XID Transmissions
- Set the Time for XID Retries

Set the Frequency of XID Transmissions

Exchange identification (XID) frames identify LLC2 stations at a higher level than the MAC address and contain information about the configuration of the stations.You can set how often the router sends an XID frame by using the following command in interface configuration mode:

Command	Purpose
llc2 xid-neg-val-time *milliseconds*	Set the frequency of XID transmissions.

Caution Do not change the value unless requested by your technical support representative.

Set the Time for XID Retries

You can set the amount of time the router waits for a reply to the XID frames it sends to remote stations. The value should be larger than the T1 time, which indicates how long the software waits for an acknowledgment before dropping the session.

To set the time for XID retries, use the following command in interface configuration mode:

Command	Purpose
llc2 xid-retry-time *milliseconds*	Set how long the router waits for a reply to the XID frames it sends to remote stations.

Monitor LLC2 Stations

You can display the configuration of LLC2 stations to determine which LLC2 parameters need adjustment. Use the following command in EXEC mode:

Command	Purpose
show llc2	Display the configuration of LLC2 stations.

SDLC Configuration Task List

The SDLC tasks described in this section configure the router as an SDLC station. (This is in contrast to a router configured for SDLC Transport, where the device is not an SDLC station, but passes SDLC frames between two SDLC stations across a mixed-media, multiprotocol environment.) The first task is required; you accomplish it with the appropriate set of commands for your network needs. The remaining tasks are optional: you can perform them as necessary to enhance SDLC performance.

- Enable the Router as a Primary or a Secondary SDLC Station
- Enable SDLC Two-Way Simultaneous Mode
- Determine the Use of Frame Rejects
- Set SDLC Timer and Retry Counts
- Set SDLC Frame and Window Sizes
- Control the Buffer Size
- Control Polling of Secondary Stations
- Configure an SDLC Interface for Half-Duplex Mode

- Specify the XID Value
- Specify the SAPs
- Set the Largest SDLC I-Frame Size

To determine which SDLC parameters need adjustment, you can perform the following task:

- Monitor SDLC Stations

See the end of this chapter for SDLC configuration examples.

Enable the Router as a Primary or a Secondary SDLC Station

SDLC defines two types of network nodes: primary and secondary. Primary nodes poll secondary nodes in a predetermined order. Secondaries then transmit if they have outgoing data. When configured as primary and secondary nodes, our devices are established as SDLC stations.

Depending on your particular network needs, perform the tasks in one of the following sections to enable the router as an SDLC station:

- Establish an SDLC Station for Frame Relay Access Support
- Establish an SDLC Station for DLSw+ Support
- Establish an SDLC Station for SDLLC Media Translation

Establish an SDLC Station for Frame Relay Access Support

You can establish the router to be any of the following:

- A primary SDLC station
- A secondary SDLC station
- Either primary or secondary, depending on the role of the end stations or on XID negotiations
- A primary Node Type 2.1 (NT2.1) node

To establish devices as SDLC stations when you plan to configure Frame Relay access support, use the following commands in interface configuration mode:

Step	Command	Purpose
1	**encapsulation sdlc**[1]	Set the encapsulation type of the serial interface to SDLC.
2	**sdlc role** {**none** | **primary** | **secondary** | **prim-xid-poll**}	Establish the role of the interface.

1 For information on the **nrzi-encoding** interface configuration command, refer to the *Configuration Fundamentals Configuration Guide*.

If the interface does not play a role, the router can be either primary or secondary, depending on the end stations. The SDLC end station must be configured as negotiable or primary NT2.1. When the end stations are configured as physical unit (PU) type 2, you can set the role of the interface to primary or secondary. When the end station is configured as secondary NT2.1, you must set the role of the interface to poll the primary XID.

Note Currently, Frame Relay access support does not support the secondary role.

Establish an SDLC Station for DLSw+ Support

To establish devices as SDLC stations when you plan to configure our DLSw+ feature, use the following commands in interface configuration mode:

Step	Command	Purpose
1	**encapsulation sdlc**	Set the encapsulation type of the serial interface to SDLC.
2	**sdlc role** {**none** | **primary** | **secondary** | **prim-xid-poll**}	Establish the role of the interface.
3	**sdlc vmac** *mac-address*	Configure a MAC address for the serial interface.
4	**sdlc partner** *mac-address sdlc-address*	Specify the destination address with which an LLC session is established for the SDLC station.
5	**sdlc dlsw** {*sdlc-address* | **default** | **partner** *mac-address* [**inbound** | **outbound**]}	Attach SDLC addresses to DLSw+.

To configure an SDLC multidrop line downstream, you configure the SDLC role as either **primary** or **prim-xid-poll**. SDLC role **primary** specifies that any PU without the xid-poll parameter in the **sdlc address** command is a PU 2.0 device. SDLC role **prim-xid-poll** specifies that every PU is type 2.1. We recommend that you specify **sdlc role primary** if all SDLC devices are type PU 2.0 or a mix of PU 2.0 and PU 2.1. Specify sdlc role prim-xid-poll if all devices are type PU 2.1

For additional DLSw+ configuration commands, refer to the chapter “Configuring DLSw+.”

Establish an SDLC Station for SDLLC Media Translation

To establish devices as SDLC stations when you plan to configure our SDLLC media translation feature, use the commands in the order listed in the following table. One serial interface can have two or more secondary stations attached to it through a modem sharing device. Each secondary station address must be assigned to the primary station. You must use the following commands in interface configuration mode for the serial interface:

Step	Command	Purpose
1	**encapsulation sdlc-primary**	Establish a router as the primary SDLC station on the serial line.
2	**encapsulation sdlc-secondary**	Establish other routers as secondary SDLC stations.
3	**sdlc address** *hexbyte* [*echo*]	Assign secondary stations to a primary station.

Use the **show interfaces** command to list the configuration of the SDLC serial lines. Use the **no sdlc address** command to remove a secondary address assignment. Addresses are hexadecimal (base 16).

Enable SDLC Two-Way Simultaneous Mode

SDLC two-way simultaneous mode allows a primary SDLC link station to achieve more efficient use of a full-duplex serial line. With two-way simultaneous mode, the primary link station can send data to one secondary link station while there is a poll outstanding. Two-way simultaneous mode works on the SDLC primary side only. On a secondary link station, it responds to a poll from the primary station.

SDLC two-way simultaneous mode operates in either a multidrop link environment or point-to-point link environment.

In a multidrop link environment, a two-way simultaneous primary station is able to poll a secondary station and receive data from the station, and send data (I-frames) to other secondary stations.

In a point-to-point link environment, a two-way simultaneous primary station can send data (I-frames) to the secondary station although there is a poll outstanding, as long as the window limit is not reached.

To enable two-way simultaneous mode, use either of the following commands in interface configuration mode:

Command	Purpose
sdlc simultaneous full-datamode	Enable the primary station to send data to and receive data from the polled secondary station.
or	
sdlc simultaneous half-datamode	Prohibit the primary stations from sending data to the polled secondary station.

Determine the Use of Frame Rejects

You can specify that a secondary station does not send frame reject messages, or reject commands indicating frame errors. If you do so, the router drops an SDLC connection if the system receives an error from the secondary station. To determine handling of frame rejects, use the following command in interface configuration mode:

Command	Purpose
sdlc frmr-disable	Specify that this secondary station does not support frame rejects.

To specify that the secondary station does support frame rejects, use the **no sdlc frmr-disable** command.

Set SDLC Timer and Retry Counts

When an SDLC station sends a frame, it waits for an acknowledgment from the receiver indicating that this frame has been received. You can modify the time the router allows for an acknowledgment before resending the frame. You can also determine the number of times that a software resends a frame before terminating the SDLC session. By controlling these values, you can reduce network overhead while continuing to check transmission of frames.

To set the SDLC timer and retry counts, use one or both of the following commands in interface configuration mode:

Command	Purpose
sdlc t1 *milliseconds*	Control the amount of time the Cisco IOS software waits for a reply.
sdlc n2 *retry-count*	Set the number of times the Cisco IOS software will retry an operation that has timed out.

Set SDLC Frame and Window Sizes

You can set the maximum size of an incoming frame and set the maximum number of I-frames (or window size) the router will receive before sending an acknowledgment to the sender. By using higher values, you can reduce network overhead.

To set SDLC frame and window sizes, use any of the following commands in interface configuration mode:

Command	Purpose
sdlc n1 *bit-count*	Set the maximum size of an incoming frame.
sdlc k *window-size*	Set the local window size of the router.
sdlc poll-limit-value *count*	Set how many times a primary station will poll a secondary station.

Control the Buffer Size

You can control the buffer size on the router. The buffer holds data that is pending transmission to a remote SDLC station. This command is particularly useful in the case of the SDLLC media translator, which allows an LLC2-speaking SNA station on a Token Ring to communicate with an SDLC-speaking SNA station on a serial link. The frame sizes and window sizes on Token Rings are often much larger than those acceptable for serial links, and serial links are often slower than Token Rings.

To control backlogs that can occur during periods of high data transfer from the Token Ring to the serial line, use the following command in interface configuration mode on a per-address basis:

Command	Purpose
sdlc holdq *address queue-size*	Set the maximum number of packets held in queue before transmitting.

Control Polling of Secondary Stations

You can control the intervals at which the router polls secondary stations, the length of time a primary station can send data to a secondary station, and how often the software polls one secondary station before moving on to the next station.

Keep the following points in mind when using these commands:

- Secondary stations cannot transmit data until they are polled by a primary station. Increasing the poll-pause timer increases the response time of the secondary stations. Decreasing the timer can flood the serial link with unneeded polls, requiring secondary stations to spend wasted CPU time processing them.
- Increasing the value of the poll limit allows for smoother transactions between a primary station and a single secondary station, but can delay polling of other secondary stations.

To control polling of secondary stations, use one or more of the following commands in interface configuration mode:

Command	Purpose
sdlc poll-pause-timer *milliseconds*	Set the length of time the router pauses between sending each poll frame to secondary stations on a single serial interface.
sdlc poll-limit-value *count*	Set how many times a primary station will poll a secondary station.

To retrieve default polling values for these operations, use the **no** forms of these commands.

Configure an SDLC Interface for Half-Duplex Mode

By default, SDLC interfaces operate in full-duplex mode. To configure an SDLC interface for half-duplex mode, use the following command in interface configuration mode:

Command	Purpose
half-duplex	Configure an SDLC interface for half-duplex mode.

On an interface that is in half-duplex mode and that has been configured for DCE, you can adjust the delay between the detection of a Request To Send (RTS) signal and the assertion of the Clear To Send (CTS) signal. To do so, use the following command in interface configuration mode:

Command	Purpose
half-duplex timer cts-delay *value*	Delay the assertion of a CTS.

On an interface that is in half-duplex mode and that has been configured for DTE, you can adjust the time the interface waits for the DCE to assert CTS before dropping an RTS. To do so, use the following command in interface configuration mode:

Command	Purpose
half-duplex timer rts-timeout *value*	Adjust the amount of time before interface drops an RTS.

Specify the XID Value

The exchange of identification (XID) value you define on the router must match that of the IDBLK and IDNUM system generation parameters defined in VTAM on the Token Ring host to which the SDLC device will be communicating. To specify the XID value, use the following command in interface configuration mode:

Command	Purpose
sdlc xid *address xid*	Specify the XID value to be associated with the SDLC station.

Specify the SAPs

SAPs are used by the CMCC adapter to establish communication with VTAM on the mainframe and to identify Logical Link Control (LLC) sessions on a CMCC's internal adapter. To configure SAPs in SDLC, use the following command in interface configuration mode:

Command	Purpose
sdlc saps *address ssap dsap*	Sets up SDLC-to-LLC sessions with respect to the SSAP and DSAP on the LAN-connected device (LLC).

Set the Largest SDLC I-Frame Size

Generally, the router and the SDLC device with which it communicates should support the same maximum SDLC I-frame size. The larger this value, the more efficient the line usage, thus increasing performance.

After the SDLC device has been configured to send the largest possible I-frame, you must configure the router to support the same maximum I-frame size. The default is 265 bytes. The maximum value the software can support must be less than the value of the LLC2 largest frame value defined when setting the largest LLC2 I-frame size.

To set the largest SDLC I-frame size, use the following command in interface configuration mode:

Command	Purpose
sdlc sdlc-largest-frame *address size*	Set the largest I-frame size that can be sent or received by the designated SDLC station.

Monitor SDLC Stations

To monitor the configuration of SDLC stations to determine which SDLC parameters need adjustment, use the following command in EXEC mode:

Command	Purpose
show interfaces	Display SDLC station configuration information.

You determine the status of end stations by sending an SDLC test frame to a physical unit via its SDLC address and router interface. You can either send out the default information string or a predefined one. You can send a preset number of test frames a continuous stream that can later be halted. The **sdlc test serial** command pre-check for correct interface and SDLC address of the end station. You can view the results of the test frames after the frames have been sent or a SDLC test frame stop has been executed. To send an SDLC test frame, use the following command in EXEC mode:

Command	Purpose
sdlc test serial *number address* [*iterations* | **continuous** | **stop** | **string** *string*]	Send an SDLC test frame.

Note Only a device configured as primary is allowed to send test frames.

Configuration Examples

The following sections provide LLC2 and SDLC configuration examples:

- LLC2 Configuration Example
- SDLC Two-Way Simultaneous Mode Configuration Example
- SDLC Encapsulation for Frame Relay Access Support Configuration Examples
- SDLC Configuration for DLSw+ Example
- Half-Duplex Configuration Example

LLC2 Configuration Example

You can configure the number of LLC2 frames received before an acknowledgment. For this example, assume that at time 0, two I-frames are received. The maximum amount of three has not been reached, so no acknowledgment for these frames is sent. If a third frame, which would force the router to send an acknowledgment, is not received within 800 ms, an acknowledgment is sent anyway, because the delay timer alarm is activated.

```
interface tokenring 0
 llc2 ack-max 3
 llc2 ack-delay-time 800
```

At this point, because all frames are acknowledged, the counter for the maximum amount of I-frames will be reset to zero.

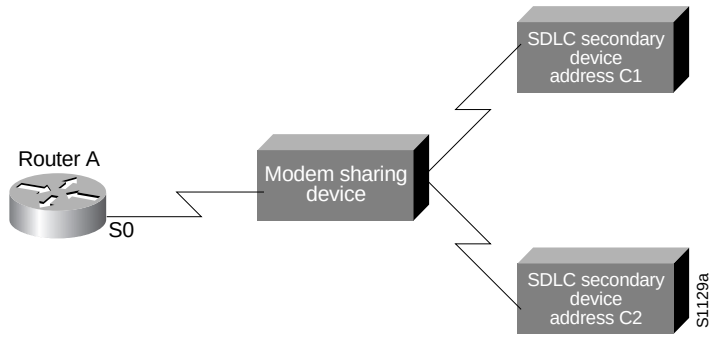
SDLC Two-Way Simultaneous Mode Configuration Example

The following configuration defines serial interface 0 as the primary SDLC station with two SDLC secondary stations, C1 and C2, attached to it through a modem-sharing device. Two-way simultaneous mode is enabled.

```
interface serial 0
 encapsulation sdlc-primary
 sdlc address c1
 sdlc address c2
 sdlc simultaneous full-datamode
```

The network for this configuration is shown in Figure 125.

Figure 125 Two SDLC Secondary Stations Attached to a Single Serial Interface through a Modem-Sharing Device



SDLC Encapsulation for Frame Relay Access Support Configuration Examples

The following examples describe possible SDLC encapsulation configurations if you plan to configure Frame Relay access support.

The following configuration is appropriate if the SDLC station is a negotiable or primary Node Type 2.1 station:

```
interface serial 2/6
 no ip address
 encapsulation sdlc
 clockrate 9600
 fras map sdlc C1 serial 2/0 frame-relay 32 4 4
 sdlc address C1
```

The following configuration is appropriate if the SDLC station is a secondary Node Type 2.1 station:

```
interface serial 2/6
 no ip address
 encapsulation sdlc
 clockrate 9600
 fras map sdlc C1 serial 2/0 frame-relay 32 4 4
 sdlc role prim-xid-poll
 sdlc address C1
```

The following configuration is appropriate if the SDLC station is a secondary PU 2 station:

```
interface serial 2/6
 no ip address
 encapsulation sdlc
 clockrate 9600
 fras map sdlc C1 serial 2/0 frame-relay 32 4 4
 sdlc role primary
 sdlc address C1
 sdlc xid C1 01700001
```

SDLC Configuration for DLSw+ Example

The following example describes an SDLC configuration if you plan to implement DLSw+ support. In this example, 4000.3745.001 is the MAC address of the host. The router serves as the primary station for the remote secondary stations, c1 and c2. Both c1 and c2 are reserved for DLSw+ and cannot be used by any other data link user.

```
interface serial 0
 encapsulation sdlc
 sdlc vmac 4000.3174.0000
 sdlc address c1
 sdlc xid c1 01712345
 sdlc partner 4000.3745.0001 c1
 sdlc address c2
 sdlc xid c2 01767890
 sdlc partner 4000.3745.0001 c2
 sdlc dlsw c1 c2
 sdlc role primary
```

Half-Duplex Configuration Example

In the following example, an SDLC interface has been configured for half-duplex mode:

```
encapsulation sdlc-primary
 half-duplex
```