

Configuring LLC2 and SDLC Parameters

The Logical Link Control, type 2 (LLC2) and Synchronous Data Link Control (SDLC) protocols provide data link-level support for higher-level network protocols and features such as SDLLC and RSRB with Local Acknowledgment. The features that are affected by LLC2 parameter settings are listed in the next section, “LLC2.” The features that require SDLC configuration and use SDLC parameters are listed in the section “SDLC” later in this chapter.

LLC2 and SDLC package data in frames. LLC2 and SDLC stations require *acknowledgments* from receiving stations after a set amount of frames have been sent before sending further data. The tasks described in this chapter modify default settings regarding the *control* field of the data frames. By modifying the control field parameters, you can determine the amount of acknowledgments sent for frames received and the level of polling used to determine available stations. In this manner, you can set the amount of resources used for frame checking and optimize the network load.

LLC2 (IEEE 802.2) provides connection-oriented service and is widely used in LAN environments, particularly among IBM communication systems connected by Token Ring. Our router supports LLC2 connections over Ethernet, Token Ring, and FDDI.

SDLC is used as the primary Systems Network Architecture (SNA) link-layer protocol for wide-area network (WAN) links. 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 routers are established as SDLC *stations*.

Note The SDLC tasks described in this chapter include the configuration commands used to configure our routers as SDLC stations. This is in contrast to a router configured for STUN and SDLC Transport (described in Chapter 22) where our router is not configured as an SDLC station, but *acts as an intermediary*, passing SDLC frames between two SDLC stations across a mixed-media, multiprotocol environment.

This chapter is divided into two sections: “LLC2” and “SDLC.” You do not need to configure LLC2, because it is already enabled on Token Ring interfaces. You can change the default settings of LLC2 parameters as needed. To support SDLC, you will need to configure the router as a primary or secondary SDLC station. You also can change default settings on any of the SDLC parameters listed. Configuration examples for both LLC2 and SDLC are given at the end of the chapter.

For a complete description of the commands mentioned in this chapter, refer to Chapter 23 of the *Router Products Command Reference* publication. For historical background and a technical overview of LLC2 and SDLC, see the *Internetworking Technology Overview* publication.

LLC2

The LLC2 tasks described in this section provide services that support the following features:

- Local Acknowledgment

This feature is used in our implementation of remote source-route bridging (RSRB) as described in Chapter 21.

Because LANs are now connected through remote source-route bridging and WAN backbones, the delays that occur are longer than LLC2 allows for bidirectional communication between hosts. Our Local Acknowledgment feature addresses the problem of delays, retransmissions, and loss of user sessions.

- IBM LAN Network Manager (LNM) support

Routers using 4/16-Mbps Token Ring interfaces configured for SRB support LNM and provide all IBM Bridge Program functions. With LNM, a router appears as an IBM source-route bridge, and can manage or monitor any connected Token Ring interface.

LNM support is described in Chapter 21.

- SDLLC SDLC/LLC2 Media Translation

The SDLLC feature provides media translation between the serial lines running SDLC and Token Rings running LLC2. SDLLC consolidates the IBM SNA networks running SDLC into a LAN-based, multiprotocol, multimedia backbone network.

SDLLC is described in Chapter 24.

- ISO Connection-Mode Network Services (CMNS)

Our CMNS implementation runs X.25 packets over LLC2 so that X.25 can be extended to Ethernet, FDDI, and Token Ring media.

CMNS is described in Chapter 7.

LLC2 Configuration Task List

Since LLC2 is already enabled on Token Rings, you do not need to enable it on the router. However, you can complete the following tasks to enhance LLC2 performance:

- Control transmission of information frames (page 23-2)
- Establish polling levels (page 23-4)
- Set up XID transmissions (page 23-6)

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

- Monitor LLC2 stations (page 23-6)

A sample LLC2 configuration is shown at the end of this chapter.

Control Transmission of Information Frames

You can control the number of information frames and acknowledgments sent on the LLC2 network by completing the tasks described in this section.

Set the Maximum Number of Information Frames Received before Sending an Acknowledgment

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

Task	Command
Set maximum number of information frames the router can receive before it sends an acknowledgment.	llc2 ack-max <i>packet-count</i>

Set the Maximum Delay for Acknowledgments

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

To set the maximum delay time, perform the following task in interface configuration mode:

Task	Command
Set the information frame acknowledgment time.	llc2 ack-delay-time <i>msec</i>

Set the Maximum Number of Information Frames Sent before Requiring Acknowledgment

You can set the maximum number of information frames that the router sends to an LLC2 station before the router 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, perform the following task in interface configuration mode:

Task	Command
Set the maximum number of information frames the router sends before it requires an acknowledgment.	llc2 local-window <i>packet-count</i>

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 router will retry polling a busy station. This task should be done in conjunction with the task for setting the time for resending information frames (described next). Performing 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, perform the following task in interface configuration mode:

Task	Command
Establish number of times the router will resend unacknowledged frames or try polling a busy station.	llc2 n2 <i>retry-count</i>

Set the Time for Resending Information Frames

You can set the amount of time the router will wait before resending unacknowledged information frames. This interval is called the T1 time. Perform this task in conjunction with the tasks of setting the number of retries and setting the transit poll-frame timer. Performing these tasks in conjunction with each other provides a balance of network monitoring and performance.

To set the T1 time, perform the following task in interface configuration mode:

Task	Command
Control how long the router waits for an acknowledgment of transmitted information frames.	llc2 t1-time <i>msec</i>

Note Ensure that you allow enough time to account for the round trip between the router and its LLC2-speaking stations. Under heavy network loading conditions, resending information frames every 3000 msec 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 information 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 router before the reject timer expires, the router sends a REJ to the remote station and disconnects the LLC2 session.

To set the reject timer, perform the following task in interface configuration mode:

Task	Command
Set the time a router waits for a resend of a rejected frame before sending a reject command to the remote station.	llc2 trej-time <i>msec</i>

Establish Polling Level

You can control the amount of polling that occurs on the LLC2 network by completing the tasks described in this section.

Set the Polling Frequency

You can set the optimum interval of time after which the router sends *Receiver Readys*, 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, perform the following task in interface configuration mode:

Task	Command
Control the polling frequency during idle traffic.	llc2 idle-time msec

Set the Polling Interval

The amount of time the router waits until repolling a busy station also can be set. Perform this task in conjunction with setting the number of retries. Typically, you do not need to perform this task 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, perform the following task in interface configuration mode:

Task	Command
Set the amount of time the router will wait before it repolling a busy station.	llc2 tbusy-time msec

Set the Transmit-Poll-Frame Timer

When sending a command that must receive a response, a *poll* bit is sent in the frame. Once the router 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 router 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 performing the following task in interface configuration mode:

Task	Command
Set the amount of time the router waits for a <i>final</i> response to a <i>poll</i> frame before the resending it.	llc2 tpf-time msec

This value should be larger than the T1 time (set with the **llc2 t1-time** command). The T1 time determines how long the router waits for receipt of an acknowledgment before sending the next set of frames. See the task “Set the Time for Resending Information Frames” listed 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 this section.

Set the Frequency of XID Transmissions

Exchange of 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 performing the following task in interface configuration mode:

Task	Command
Set the frequency of XID transmissions	llc2 xid-neg-val-time <i>msec</i>



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 router waits for an acknowledgment before dropping the session.

To set the time for XID retries, perform the following task in interface configuration mode:

Task	Command
Set how long the router waits for a reply to the XID frames it sends to remote stations.	llc2 xid-retry-time <i>msec</i>

Monitor LLC2 Stations

You can display the configuration of LLC2 stations to determine which LLC2 parameters need adjustment. Perform the following task to make this determination:

Task	Command
Display the configuration of LLC2 stations.	show llc2

SDLC

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 (described in Chapter 22) where the router is not an SDLC station, but *passes* SDLC frames between two SDLC stations across a mixed-media, multiprotocol environment.

The tasks described in this section support the following features:

- SDLLC SDLC/LLC2 Media Translation

Our SDLLC feature provides media translation between the serial lines running SDLC and Token Rings running LLC2. SDLLC consolidates the IBM SNA networks running SDLC into a LAN-based, multiprotocol, multimedia backbone network.

SDLLC is described in Chapter 24.

- SDLC Local Acknowledgment

SDLC Local Acknowledgment is used with SDLC Serial Tunneling (STUN). The Transmission Control Protocol/Internet Protocol (TCP/IP) must be enabled. With Local Acknowledgment, STUN SDLC connections can be terminated locally at the router, eliminating the need for acknowledgments to be sent across a wide area network (WAN).

SDLC Local Acknowledgment is described in Chapter 22.

SDLC Configuration Task List

Complete the first two required tasks to enable the router as an SDLC station. Do not complete the remaining tasks unless situations warrant changing default settings or your technical support representative suggests a change:

- Enable router as primary or secondary SDLC station (page 23-7)
- Determine use of frame rejects (page 23-8)
- Set SDLC timer and retry counts (page 23-8)
- Set SDLC frame and window sizes (page 23-9)
- Control the buffer size (page 23-9)
- Control polling of secondary stations (page 23-9)

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

- Monitor SDLC stations (page 23-10)

A sample of SDLC configuration is shown at the end of this chapter.

Enable Router as Primary or 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 routers are established *as SDLC stations*.

In the IBM environment, a Front End Processor (FEP) is the primary station and Establishment Controllers (ECs) are secondary stations. In a typical scenario, an EC may be connected to dumb terminals and to a Token Ring network at a local site. At the remote site, an IBM host connects to an IBM FEP, which can have links to another Token Ring LAN. Typically, the two sites are connected through an SDLC leased line.

If a router is connected to an EC, the router takes over the function of the FEP and must therefore be configured as a primary SDLC station. If the router is connected to a FEP, the router takes the place of the EC and must therefore be configured as a secondary SDLC station.

To establish routers as SDLC stations, complete tasks 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 (MSD). Each secondary station address must be assigned to the primary station. You must perform the following tasks in interface configuration mode for the serial interface:

Task	Command
Step 1 Establish a router as the primary SDLC station on this serial line.	encapsulation sdhc-primary
Step 2 Establish other routers as secondary SDLC stations.	encapsulation sdhc-secondary
Step 3 Assign secondary stations to a primary station.	sdhc address <i>hexbyte</i>

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

Determine Use of Frame Rejects

You can specify that a secondary station does not send Frame Rejects (FRMRs), or reject commands indicating frame errors. If you do so, the router will drop an SDLC connection if it receives an error from the secondary station. To determine handling of FRMRs, perform the following task in interface configuration mode:

Task	Command
Specify that this secondary station does not support Frame Rejects (FRMRs).	sdhc frmr-disable

To specify that the secondary station does support FRMRs, use the **no sdhc frmr-disable** command described in the *Router Products Command Reference* publication.

Set SDLC Timer and Retry Counts

When an SDLC station sends a frame, it waits for an acknowledgment from the receiver saying that this frame has been received. You can modify the time the router allows for an acknowledgment before resending the frame. You also can determine the number of times that a router 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, perform one or both of the following tasks in interface configuration mode:

Task	Command
Control the amount of time the router waits for a reply.	sdhc t1 <i>timeout</i>
Set the number of times a router will retry an operation that has timed out.	sdhc n2 <i>retry-count</i>

Set SDLC Frame and Window Sizes

You can set the maximum size of an incoming frame and set the maximum number of information frames (or *window* size) a 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, perform one or both of the following tasks in interface configuration mode:

Task	Command
Set the maximum size of an incoming frame.	sdlc n1 <i>bit-count</i>
Set the local window size of the router.	sdlc k <i>window-size</i>

Control the Buffer Size

You can control the router's buffer size. The buffer holds data that is pending transmission to a remote SDLC station. This task 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, perform the following task in interface configuration mode on a per-address basis:

Task	Command
Set the maximum number of packets held in queue before transmitting.	sdlc holdq <i>address queue-size</i>

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 router polls one secondary station before moving on to the next station.

Keep the following points in mind when performing these tasks:

- Secondaries 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 and require secondary stations to spend wasted CPU time processing them.
- Increasing the poll timer allows the user terminal screen to be updated more quickly but may increase the amount of time it takes before the user receives data.
- 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, perform one or more of the following tasks in interface configuration mode:

Task	Command
Set the length of time the router pauses between sending each poll frame to secondary stations on a single serial interface.	sdlc poll-pause-timer <i>msec</i>
Set the maximum time that output can be sent to any secondary station before polling for input must begin.	sdlc fair-poll-timer <i>msec</i>
Set how many times a primary station will poll a secondary station.	sdlc poll-limit-value <i>count</i>

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

Monitor SDLC Stations

You can monitor the configuration of SDLC stations to determine which SDLC parameters need adjustment by performing the following task:

Task	Command
Display SDLC station configuration information.	show interfaces

Configuration Examples

This section provides sample configurations that you can use as a guide to configuring your LLC2 and SDLC parameters. It includes examples of the following:

- LLC2 example (page 23-10)
- SDLC example (page 23-11)

LLC2 Example

You can configure the number of LLC2 frames received before an acknowledgment. For this example, assume that at time 0, two information frames are received. The ack-max 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 in 800 milliseconds, an acknowledgment will be sent anyway, because the ack-delay timer alarm will have gone off.

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

At this point, because all frames are acknowledged, the counter for the ack-max purposes will be reset to zero.

SDLC Example

To configure interface serial 0 to have two SDLC secondary stations attached to it through a modem-sharing device (MSD) with addresses C1 and C2, begin your SDLC configuration of this interface with the following:

```
interface serial 0
encapsulation sdhc-primary
sdhc address c1
sdhc address c2
```

The network for this configuration is shown in Figure 1-1.

Figure 1-1 Two SDLC Secondary Stations Attached to a Single Serial Interface through an MSD



