Chapter 7
3512 SDC Operation

Contents

Chapter 7

Introduction

This chapter addresses the **synchronous data compression (SDC)** feature. The chapter provides:

- SDC configuration and operation notes—**differences between the 3512 and 3512 SDC**, especially directed to 3512 users who are adding SDC functions

- Compression notes—**key concepts and measures of efficiency** that you need in order to get maximum compression performance

- Sample system applications—descriptions, diagrams, and parameter settings to a**ddress typical requirements most effectively**

- A sample restoral application—a description, a diagram, and parameter settings to **maintain efficient operation during service interruptions**

Configuring applications requires familiarity with front-panel operation (refer to Chapter 3) and the menu tree structure.

3512 SDC Configuration and Operation Notes

The following items apply to the 3512 SDC *at all times*:

Single-channel operation: In this mode, Port 3 is the only active port. The unit is in a single-channel mode when **DTE Con** (✴MODIFY main menu, MODIFY PORT category) is set to BitSteal, Normal, MPM-BitSteal, or MPS-Bitsteal.

Channel-sharing, with compression disabled–If channel-sharing is configured, it must include all three ports. Refer to **P-to-CH**, in Chapter 4.

Port 3 DTE interface: Port 3 on the 3512 SDC supports only the V.35 interface.

Initiating restoral: DTR-controlled restoral initiation is supported only on Port 3.

The following items apply when operating *in compression mode:*

Point-to-point: Port 3 can operate only in point-to-point applications. However, in a compression application between a master and exactly one slave unit, multipoint muxed **DTE Con** options--MPM Mux and MPS Mux--are allowed (✴MODIFY main menu, MODIFY PORT category).

Data framing: Port 3 transmit and receive *only* synchronous, HDLC-type data.

Channel-sharing: Port 3 cannot be part of a channel-sharing unit.

Transmitting network management data: To transmit network-management data on the digital line, set **DTE Con** to one of the options that provide a non-interruptive network management channel: BitS, Muxed, MPM Mux, and MPS Mux.
NOTE: The Normal option adversely affects compression performance.

Link Problem Determination Aid (LPDA): Port 3 does not support LPDA.

Timing: The unit does not support external DSU timing on Port 3 (✳MODIFY main menu, MODIFY DSU category, **Timing**=Ext.P3).

Timing and Flow Control: When **P3 Data** (✳MODIFY main menu, MODIFY PORT category) is set to Sync Ext or Sync Sta, set **Flow Control** (✳COMPRESSION main menu, COMPRESS CONFIG category) to Off or CTS.

P3 CTS: The available options are Normal and Always On. The RTS option is not available (✳MODIFY main menu, MODIFY PORT category).

P3 CTS and Flow Control: When **P3 CTS**=Always On and **Flow Control**=CTS, **Flow Control** takes precedence: the unit de-asserts CTS when data arrives from the DTE on Port 3 faster than the unit can compress and transmit it.

Inband Signaling: Port 3 does not support RTS, DCD, DTR, and DSR.

Compression and testing: You must disable compression on the remote unit before running a Loop 2 test on Port 3; a Loop 4 test; or a front-panel-initiated RT test. Re-enable remote compression after completing the test. (For other tests, the 3512 SDC automatically disables compression, if necessary, for the duration of the test.)

3512 SDC Application Notes

This section provides information that you may find helpful in understanding data compression, planning applications, and maximizing the 3512 SDC's performance. It addresses the following concepts as they concern compression:

- Data throughput
- Link utilization
- Anti-expansion
- Flow control
- Data delay
- Time-division multiplexing (TDM)
- Network Management

Data Throughput

Throughput is generally understood to be *the rate of information transfer across a communication link*. The throughput improvement attainable with data compression varies among and within application environments from one moment to the next. The characteristics of the data itself strongly affect throughput. Some types of data are very compressible; others are not compressible at all. In a typical user environment, the mix of data types varies from moment to moment. Overall compressibility in these environments ranges from 2:1 to 4:1—significant improvement when compression is added.

The real key to understanding throughput measurement is understanding exactly what is constitutes "*information*," which depends on where, within a protocol stack, the information is measured. Generally, information is *all data (including higher protocol layers' overhead) passed into the layer where the measurement is taken*. The information rate can be measured at any protocol layer (or sub-layer)--typically at the physical, link, or application layer. As the measurement point is moved higher in the protocol stack, the throughput is lower, because more overhead is excluded from the measurement.

An example of a throughput rate measured at the physical layer is a standard data-transparent DSU/CSU operating on a 56 kbps DDS line. Here, "throughput" is 56 kbps, regardless of the actual line utilization.

The **Tx TP** and **Rx TP** parameters indicate the current compressed-data transmit and receive throughput, measured at the link layer. Only HDLC frames are counted as "information" in the calculation; the SDC feature does not distinguish the address, length, checksum, or any other overhead characters from user data. All data except flag characters is considered as user data by the compression algorithms.

You could also measure throughput at the application layer, since this excludes *all* protocol layers' overhead, and yields the "real" file transmit rate. This would be comparable to using a stopwatch to time the transmission of a user file across a communication link, then dividing the file size (in bits) by the elapsed time (in seconds).

Throughput, when measured anywhere above the physical layer, is affected by:

- The performance of the application itself
- The protocol-stack overhead, window and frame sizes
- The data's compressibility
- The communication channel rate

Link Utilization

The **Link Util%** and **Rx (Receive) Link Util%** parameters indicate the current percentage of Port 3's line bandwidth being used for user data. When there is little data, Link Utilization values decrease. One would expect this during *off-peak* periods when few users or applications are active, but if Link Utilization values are consistently low during *peak-traffic* periods, this indicates that there is unused bandwidth, and adjustment of the application environment may be in order.

The most common cause of low link utilization is a small *window size* setting in the application protocol. The window size is the number of packets a protocol transmits before pausing for an acknowledgment from the receiving device. In many environments, the default size is 1, which means that the protocol must receive an acknowledgment for *each* packet before sending the next. With this setting, the 3512 SDC can provide little, if any, performance improvement. The window size for many protocols may be adjusted to allow multiple packets before acknowledgment.

The Novell IPX environment is very sensitive to protocol window size. The default size is 1. The IPX Burst Mode Network Loadable Module (NLM) allows the use of a much bigger window size and results in higher throughput.

NOTE: In some situations, such as a multi-user environment, you might prefer to leave the window size small. This would cause file transfers, or similar functions requiring high bandwidth, to be limited by the window size. The remaining bandwidth, available through SDC, is available to other users, who would otherwise have had a significant performance degradation while the file transfer was in progress.

Anti-Expansion

Typical environments with a mix of data types of varying compressibility, improve significantly when compression is added. However, some data, such as pre-compressed data, is not compressible. The 3512 SDC's *anti-expansion* feature activates automatically when it detects incompressible data.

This feature tracks data compression achieved, and disables the compression algorithm when its use would cause the data to expand. This keeps throughput nearly as high as it would have been without the compression option, and adds error-detection and error-correction benefits.

Flow Control

The *flow control* feature signals a local DTE on the 3512 SDC to temporarily stop transmitting when the SDC's receive buffer is full.

This can occur, for example, when the DTE is transferring at the 3512 SDC's maximum of 256 kbps, and the 3512 SDC, compressing the data at a typical 2:1 to 4:1 ratio, is transmitting it over a 56 kbps link. Despite the compression, the 56 kbps line cannot accept the data at 256 kbps. The 3512 SDC buffers data, but when the buffer is full, the unit can use flow control to signal the DTE to stop transmitting until the unit is ready for more data.

The default **Flow Control** option, Tx Clk, turns off the transmit clock to the DTE when the buffer is full, and turns it back on when ready. This method works in most environments. For DTEs that cannot use clock-stopping, the CTS option de-asserts CTS when the buffer fills. (This requires a DTE that responds correctly to CTS.) For DTEs that cannot use either of these methods, the Off option turns off flow control. With this option, the port rate must be reduced to a level that the 3512 SDC can compress and transmit without filling its buffer, or else there may be data loss.

For example, if the average data compression is between 2:1 and 3:1, you could set the port rate to 112 kbps (on a 56 kbps DDS line). However, some data loss could occur, if a long burst of incompressible data is transferred.

Data Delay

Compared to standard, data-transparent DSU/CSUs, data compression features tend to add delay to user data. Some of this delay is due to the compression algorithms. The compressor must buffer data until it can determine the compressed data representation to transmit across the link.

More delay is added at the receiving end of an SDC circuit. As data is compressed at the transmit end, HDLC frame fragments are sent across the link. Generally, the receiving device must buffer these until an entire frame has arrived, before forwarding to the DTE. This is because the frame fragments' arrival rate cannot be predicted. If the receiving device starts to forward a frame to the DTE before the entire frame has arrived, it may complete this step before it receives the remaining fragments from the line. These data underruns lead to aborted frames and requires the user application to re-transmit the data.

Buffering at the receive end represents the majority of the added delay in the 3512 SDC. The **TpDlyMin (Throughput Delay Minimization**) parameter's Rx (Receive) Clock and Rx Data Delay options provide ways to mitigate it.

Receive Clock, the default, forwards partial frames to the DTE as they are received. To prevent underruns, the receive clock stops temporarily when the unit needs to wait for more data. Most synchronous DTEs operate properly with this arrangement.

For DTEs that do *not* tolerate receive data clock stopping (such as some IBM cluster controllers), or where the DTE is *providing* the receive data clock (a T1 mux port), the Rx Data Delay option monitors frame sizes and uses a statistical algorithm to predict when the unit can safely begin forwarding fragments without causing an underrun. A limitation of this method is that a succession of short frames with an occasional long one interspersed, or a succession of frames of widely varying sizes, may cause occasional underruns.

If these occurrences are too disruptive, it may be appropriate to use the Off option; with this setting, the 3512 SDC buffers whole frames before forwarding to the DTE.

In addition to the features provided for minimizing throughput delay, one of the best ways to further minimize delay is to maximize the port rate. At the transmit end, a high port rate minimizes the time it takes for data to go from the user equipment to the compression function. At the receive end, a high port rate minimizes the time for buffered data to go from the 3512 SDC to the user equipment.

Time-Division Multiplexing (TDM)

SDC & TDM

Some interactive applications, particularly critical legacy applications with stringent response-time requirements, may not function properly with the occasional delays noted thus far. Typically, these applications have low bandwidth requirements. The 3512 SDC's *time-division multiplexing (TDM)* feature enables you to combine these delay-sensitive, interactive applications with higher-bandwidth applications that can benefit from data compression.

Set **DTE Con**=Mux to configure TDM. Use the **Port-to-Channel** and **CHn Rate** parameters to assign part of the bandwidth to Ports 1 and/or 2, for transparent-data applications, and the bulk of the remaining bandwidth to Port 3, for compressed-data applications. The transparent channel offers constant throughput and low delay, and thus is ideal for the lower-bandwidth requirements of interactive applications, and the compression channel serves high-bandwidth data. TDM automatically establishes a network-management channel, using a small part of the available bandwidth.

Network Management

On a 3512 SDC operating with a network management system, the network management feature transmits information either:

- *Interruptively* – during short interruptions in transmission of other data
- *Non-interruptively* – by assigning a very small channel (on a 56.0 kbps line, about 0.8 kbps) to network management information

On the 3512 SDC, the **DTE Con=** Normal option enables interruptive signalling; the Bitsteal and Muxed options enable non-interruptive signalling.

When compression is enabled, the unit establishes a Link Access Procedure for Modems (LAPM) error detection/error correction channel on the link. Using the **Normal** (interruptive) setting conflicts with LAPM, causing errors and retransmission of data, which degrades performance. Avoid such problems by using the **Bitsteal** or **Muxed** (non-interruptive) settings.

3512 SDC System Applications

This section explains how to configure data compression on the 3512 SDC for common application requirements. The application examples include:

Application	Figure
Compression link between two routers	7-1
Compression of multiplexed legacy and router traffic	7-2
Compression with central-site T1 access	7-3
Compression on a restoral link	7-4

Refer to the *3512 SDC DSU/CSU Reference Card*, which shows control key functions and the menu tree, to help you navigate to parameters you want to set.

Follow these steps to configure your 3512 SDC:

1) Complete the procedures in Chapter 1, Introduction, and Chapter 2, Verifying Line Quality, of the *3512 DSU/CSU Quick Start*.

2) On the ✳MODIFY main menu, CONFIGURATIONS category, set **Factory**=Yes, to set all parameters to the default values.

3) Select a configuration, and set parameter options appropriately. You may set parameters from the front panel or from a network management system.

Configuring SDC Primary Applications

Compression Link Between Two Routers

A **digital point-to-point link between two routers** is shown in Figure 7-1. In this example, compression increases throughput between the two routers. Any synchronous HDLC point-to-point data application is a candidate for SDC; for example, the Motorola 6500 Series data concentrator offers an ideal application for SDC over DDS links. Such a configuration allows applications that require fractional T1 throughput of up to 256 kbps to operate over much less-expensive standard 56 kbps DDS leased lines.
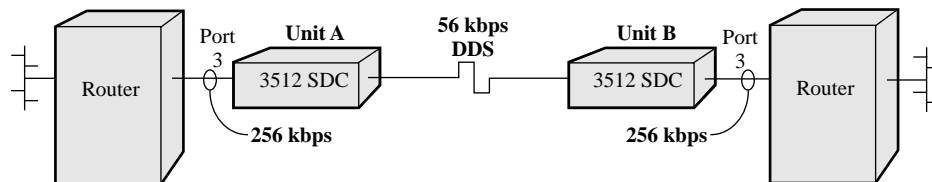

Figure 7-1. SDC Compression Link Between Routers

Parameters *not* specified below may be set to factory default values. (Your configuration may vary.)

Category	Parameter	Unit A	Unit B
MODIFY DSU	Data Rate	56.0	56.0
MODIFY NETWORK	NC Address	001	002
COMPRESS CONFIG	Compress Mode		Ans

Compression of Multiplexed Legacy and Router Traffic

A **digital point-to-point link in a hybrid SNA and LAN environment** is shown in Figure 7-2. The 3512 SDCs combine mission-critical legacy applications and high-throughput LAN applications on common facilities. Through the time-division multiplexing (TDM) feature, the legacy applications can be guaranteed constant bandwidth and the associated rapid response time; the remaining bandwidth is allocated through the compression channel to the LAN-to-LAN connection.
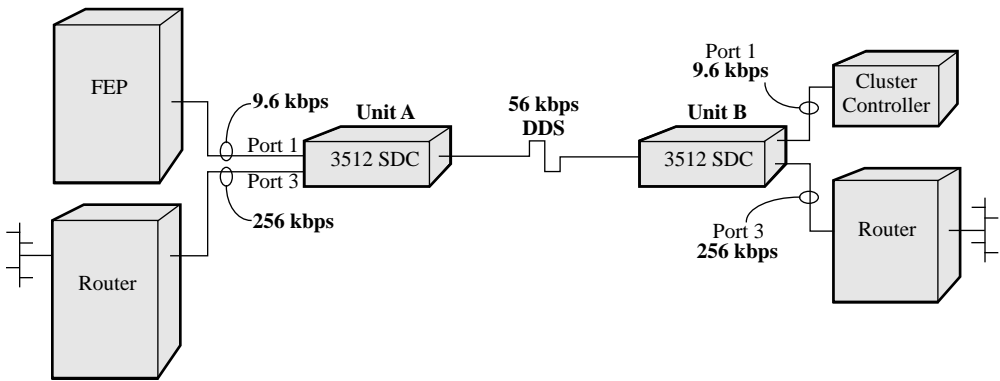

Figure 7-2. Multiplexed Legacy and Router Compressed-Data Traffic

In this example, Port 1 is used for a low-speed 9.6 kbps link. This link is multiplexed with the router channel, which uses the remaining 38.4 kbps; compression maximizes throughput between the routers.

Parameters *not* specified below may be set to factory default values.

Category	Parameter	Unit A	Unit B
MODIFY DSU	Data Rate	56.0	56.0
	CH1 Rate	9.6	9.6
	CH3 Rate	38.4	38.4
MODIFY PORT	DTE Con	Muxed	Muxed
MODIFY NETWORK	NC Address	001	002
COMPRESS CONFIG	Compress Mode		Ans

Compression With Central-Site T1 Access

A **digital point-to-point link with central-site T1 access using SDC** is shown in Figure 7-3. At a site with multiple 56 kbps terminations, it is often cost-efficient to install a T1 link to group lines from the service provider, and split the 56 kbps terminations with an on-site T1 multiplexer or channel bank. With T1 multiplexers that use V.35 serial DCE ports instead of 4-wire DDS-type lines, you can configure the 3512 SDC for V.35-to-V.35 compression (as shown on the right side of Figure 7-3), working with a remote SDC unit on a DDS line.

Here, the 3512 SDC's DDS interface is not used; instead, the local 3512 SDC redirects compressed data through **Port 2**, using the A/B switch feature and a standard restoral cable. The T1 multiplexer's DCE port must provide either:

- A DCD signal, which allows the 3512 SDC to re direct through Port 2
- A CTS signal (set the 3512 SDC's **Restoral Type**=Digital, ✱RESTORAL main menu, DIAL PARAMETERS category)

If the T1 multiplexer's DCE port supports external timing, configure it that way; otherwise, set the 3512 SDC's **Timing**=Ext. P2 Station (DIAL PARAMETERS).

In restoral mode, Unit D is always the answering device, so its **Compress Mode** is not used. Thus Unit C's **Compress Mode** must be Originate (the default).
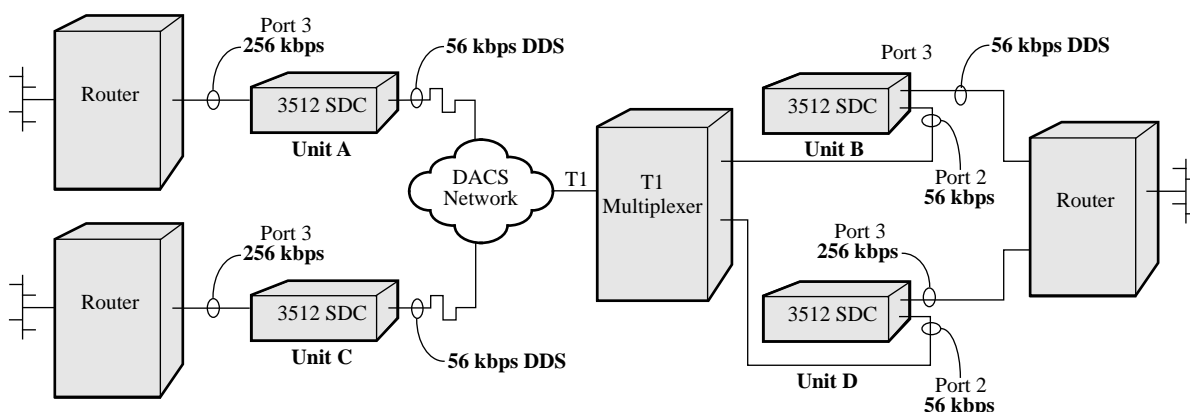

Figure 7-3. Compression Link Using T1 Access to a WAN

Parameters *not* specified below may be set to factory default values.

Category	Parameter	Unit A	Unit B
MODIFY DSU	Data Rate	56.0	56.0
MODIFY PORT	Pn Intfce		V.35
MODIFY NETWORK	NC Address	001	002
AUTO ANSWER	Answer		Enable
RESTORAL CONFIG	Timing		Ext. P2
	Rest Rate		56.0

Configuring SDC Restoral Applications

A primary line (A) and external restoral line (B) setup is an **A/B** configuration. For details on configuring restoral, refer to Chapter 4.

Compression on a Restoral Link
A **digital point-to-point** *restoral* **link using a V.***FAST* **modem on Port 2** is shown in Figure 7-4. When the 3512 SDC detects a service interruption on the primary line, it can automatically redirect data to Port 2. The devices use an alternate public switched telephone network (PSTN) line, through a modem or a switched-56 device.

Since the restoral circuit may not support as high a line rate as the primary line, you can configure an alternate rate for restoral. In this case, you might assign reduced bandwidth to less-critical applications, or drop them altogether, to allow critical applications to continue in restoral.
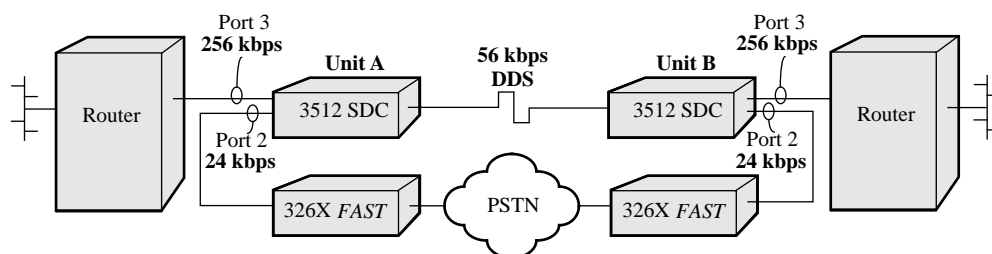

Figure 7-4. Compression Restoral Link

Parameters *not* specified below may be set to factory default values.

Category	Parameter	Unit A	Unit B
MODIFY DSU	Data Rate	56.0	56.0
MODIFY NETWORK	NC Address	001	002
COMPRESS CONFIG	Compress Mode		Answer
DIAL PARAMETERS	DDS To Dial	Auto	Auto
	From DDS		60 Sec
INIT PARAMETERS	DDS Alarms	On	On
	Idles	On	On
	Link Down	On	On
AUTO ANSWER	Answer	Enable	Enable
RESTORAL CONFIG	Timing		Ext. P2
	Restoral Rate	24.0	24.0