ARCH6648

CONTROL DATA NETWORK ARCHITECTURE (CDNA)

CDCNET STATISTICS MANAGER (CSM)

EXTERNAL REFERENCE SPECIFICATION

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Version 1

CONTROL DATA PRIVATE

REVISION RECORD

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A	Preliminary version	RW	10/01/84
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1.0 INTRODUCTION

Statistics provide a very powerful tool to determine a wide variety of things about data communications catenets. It can help determine if the catenet is behaving the way it is designed and identify potential or real bottlenecks and failures. It can provide a much needed input for the design of future networks and network software. Statistics can also provide useful input to define and use a model to analyze network behavior.

Statistics in CDCNET systems are collected for the following kinds of enties.

network solution - statistics about data traffic on directly connected networks.

communication line - statistics concerning usage of lines served by terminal interface packages (TIPs).

software component - statistics about the operation of particular software components such as Directory M-E and Routing M-E.

1.1 PURPOSE

CDCNET Statistics Manager (CSM) exists in all DIs and provides program interfaces for DCNS software components and command processors in order to report and control the collection and reporting of statistics. Individual software components collect the statistics and interface to CSM using Statistics Data Structures (SDSs). Running as a low priority task, CSM performs the following functions:

1) Controls the reporting of statistics; At specified time intervals, software component supplied procedures are called to generate and issue log messages containing statistics.

2) Manages the sampling and reporting of statistics which involves keeping track of which statistics are to be

collected and reported and how often.

3) Maintains data structures which eliminates the need for the statistics command processors to directly interface the components collecting the statistics; SDSs can be located using statistics type and group and element name.

1.2 REFERENCES

1. CDNA GDS by J H Hart (ARH4243)
2. CDCNET Statistics Solution DAP by B S Sekhon (ARH6541)

2.0 FEATURE/SERVICE OVERVIEW

2.1 FEATURES/SERVICES

The CDCNET Statistics Manager (CSM) is a collection of program interface procedures and commands concerned with collecting and reporting CDCNET statistics. In general, software components concerned with statistics create Statistics Data Structures (SDSs) and open SAPs to CSM. By defining SDSs, CSM is forcing all software components to use consistent data structures to support the collection and reporting of statistics. The software components do the actual collection of statistics into the SDS record.

Commands are provided to control the collection and reporting of statistics. CSM coordinates the commands with the SDSs provided by the software components which open statistics SAPs. CSM sets a flag in the SDS directing the software component whether to collect statistics. The software component may decide to always collect statistics if more overhead is required to check this flag than to collect statistics.

CSM controls statistics reporting by calling log message procedures (supplied by software components) as specified by CSM commands whenever statistics are to be reported. Log message procedures generate log messages containing collected statistics and call the Log Support Application to issue them.

The services performed by CSM are listed below

SAP Management - Statistics SAPs can be opened and closed and SAP entries found: In general the SAP management service helps create a dynamic association among CSM, command processors and software components.

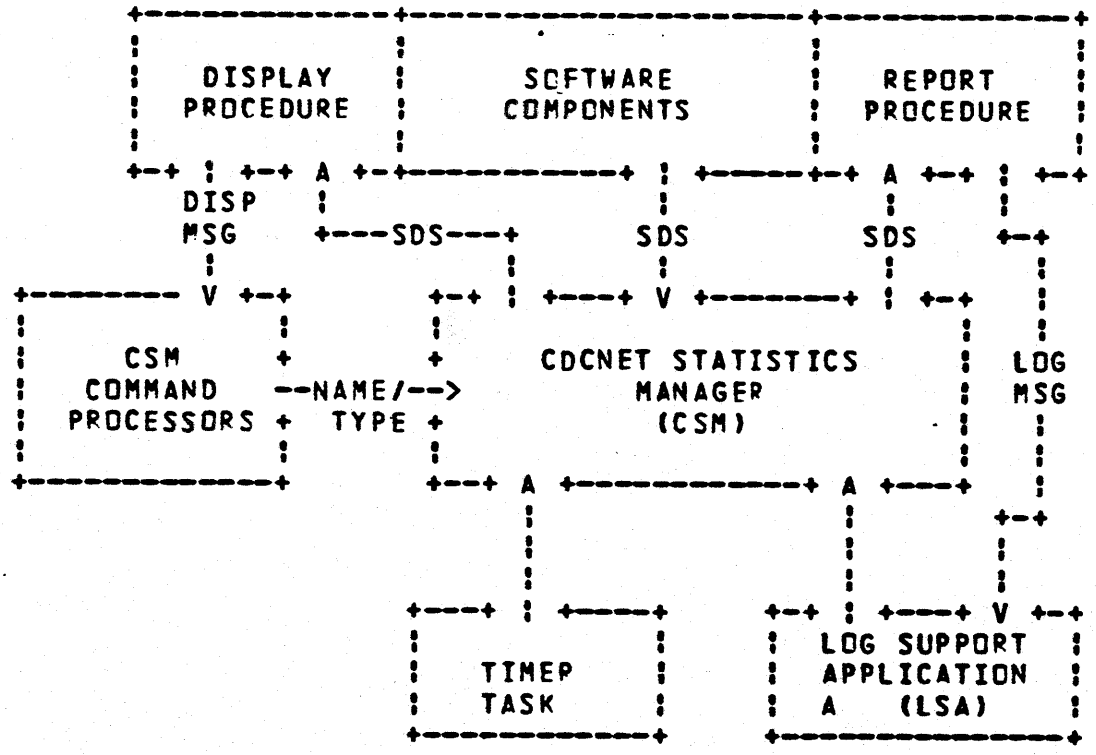
Statistics Control - Turning on and off the collection and reporting of CSM statistics while specifying a report/collection interval. This allows commands to control the collection and reporting of statistics without interfacing with the particular software components which manage them or being aware of the associated data structures.

2.0 FEATURE/SERVICE OVERVIEW
2.1 FEATURES/SERVICES

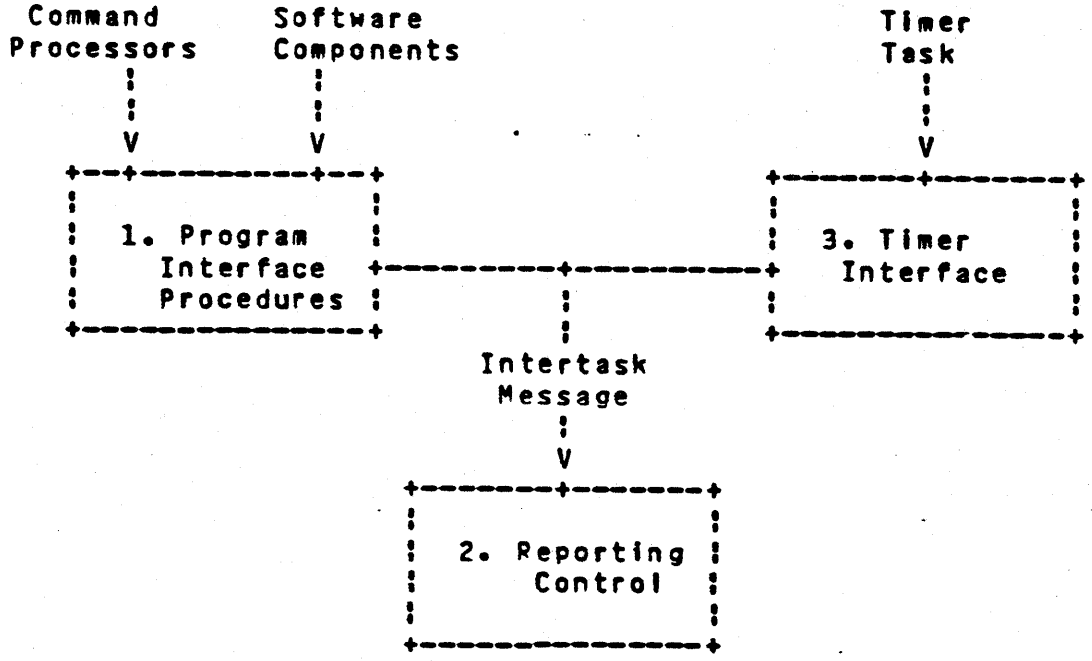
Statistics Reporting - Statistics are reported periodically according to time intervals specified by CSM commands. They are also reported when the corresponding statistics are started or stopped or when the Statistics SAP is closed. Report procedures supplied by the software components are called to generate and issue the log messages containing the statistics.

Display Command - The display command causes the specified statistics to be displayed using the display procedure supplied by the software component.

2.2 FUNCTIONAL RELATIONSHIPS



In the diagram above, software components use SDS records to pass collected statistics to CSM. The SDS record specifies a Report Procedure which formats the log message containing the statistics data and calls the Log Support Application to issue it. CSM calls this procedure whenever a particular statistics is to be reported. An interface from LSA indicates to CSM if a particular log message is enabled. SDS records also specify Display Procedures that format display messages containing statistics for CSM Display Command Processors. These command processors are provided to control the collection and reporting of statistics. Via program interface procedures, they request CSM to start and stop the collection and reporting of statistics. In order to control the reporting of statistics on time, CSM sets up calls from the Timer Task for whenever particular statistics are to be reported.



CSM is made up of three parts:

1. The program interface procedures for commands and software components manage SAPs and control the collection and reporting of statistics. They run as part of the callers task.

2. Reporting Control runs as a low priority task and is issued intertask messages whenever particular statistics are to be reported.

3. The 'Timer_task' interface procedure is called when statistics are to be reported and runs as part of the 'Timer_Task'. However, it issues intertask messages to Reporting Control to do the reporting.

2.3 UTILIZED EXTERNAL INTERFACES

Most the interfaces to Exec and Common routines such as buffer management are not included here.

2.3.1 LOG SUPPORT APPLICATION

Log message generator procedures supplied by software components issue log messages containing the reported statistics to the Log Support Application (LSA) to report statistics. An interface is provided by LSA to indicate if a particular log message is enabled in order that the command selecting statistics reporting knows if the associated log message will be processed.

2.3.2 TIMER TASK

Statistics for particular software components are reported periodically at specified time intervals. This is accomplished by setting up calls from the Timer Task using the common routine 'Call_periodic'. One timer task call exists for each active Statistics SAP.

3.0 FEATURE DESCRIPTIONS

The CDCNET Statistics Manager (CSM) is composed of program interface procedures and command processors.

Software components use program interface procedures to open and close Statistics SAPs and to force reporting of a statistics when data fields are near overflow. SAP entries point to SDS records which are used for collecting statistics.

Command processors control the collection and reporting of statistics using program interface calls. Statistics SAP entries can be located using statistics type (network solution, communication line, or software component) and element names supplied by the command processors. A linked list of one or more SDS header records is pointed to by each SAP entry. Each SDS header is defined by a statistics group type. Possible values for statistics group are:

summary - normal process statistics
expanded - statistics beyond normal processing
debug - statistics for debugging

Fields in the SAP and SDS header records are set to indicate whether to collect and report particular statistics.

CSM controls the reporting of statistics by calling report procedures provided by the software components which collect statistics. These procedures generate the log message containing the statistics and issue it to the Log Support Application. The timing of reporting is specified by commands. CSM sets the desired interval in the SDS record and calls the report procedures according to it.

3.0 FEATURE DESCRIPTIONS
3.1 SAP MANAGEMENT

3.1 SAP_MANAGEMENT

3.1.1 DESCRIPTION

This feature allows software components to create and release Statistics SAP entries. Also, it locates SAP entries for command processors making it possible for them to control the collection and reporting of statistics. CSM uses SAP entries as a focus for reporting the statistics.

3.1.2 COMMAND INTERFACES

None

3.1.3 PROGRAM INTERFACES

The following program interface procedures allow software components to open and close CSM SAPs and command processors to find SAP entries.

3.1.3.1 Open_Statistics_SAP

This procedure allows a software component which is collecting statistics to make itself know to CSM. The combination of "element_type" and "element_name" defines a SAP entry. The "sds_header_ptr" points to a chain of one or more sds_headers. Each sds_header specifies a different "group". The format of the call is shown below:

```
PROCEDURE [XREF] open_statistics_sap ( {
      element_type: statistics_type; { INPUT
      element_name: string ( * ); { INPUT
      sds_header_ptr: ^sds_header; { INPUT
      report_interval: 1 .. 60*60*24; { INPUT: Secs (24 hrs max)
  VAR sap_id: 0 .. 0ffff(16); { OUTPUT: Assigned SAP ID
  VAR status: open_statistics_status); { OUTPUT
```

```
TYPE
  open_statistics_status = (statistics_sap_opened,
    statistics_sap_entry_exists, sds_header_not_included);
```

3.1.3.2 Close_Statistics_SAP

This procedure allows a software component to close a previously opened statistics SAP. Note that the statistics for this SAP are reported if statistics reporting was selected in a previous START_METRICS call. The format of the call is shown below:

```
PROCEDURE [XREF] close_statistics_sap ( {
      sap_id: 0 .. 0ffff(16); { INPUT
      element_type: statistics_type; { INPUT
      element_name: string ( * ); { INPUT
  VAR status: close_statistics_status); { OUTPUT

TYPE
  close_statistics_status = (statistics_sap_closed,
    statistics_sap_entry_not_found, mismatch_statistics_sap);
```

3.1.3.3 Obtain_SDS_Address

This procedure is used by the statistics control command processor to request CSM to check if the specified element has an open statistics SAP and if so, to return the address of the first corresponding SDS header. The format of the call is shown below:

```
PROCEDURE [XREF] obtain_sds_address ( {
      element_type: statistics_type; { INPUT
      element_name: string ( * ); { INPUT
  VAR sap_open: boolean; { OUTPUT
  VAR sds_header_ptr: ^sds_header); { OUTPUT
```

3.2 STATISTICS REPORTING AND DISPLAYING

3.2.1 DESCRIPTION

Statistics reporting and displaying is controlled internally by CSM. To control reporting, calls from the Timer Task are set up using the common routine 'Call_periodic'. Also, reporting occurs when a statistics SAP is closed or reporting is started or stopped. Statistics are displayed when requested by Display commands.

3.2.2 COMMAND INTERFACES

None

3.2.3 PROGRAM INTERFACES

3.2.3.1 Software Supplied Procedures

3.2.3.1.1 REPORT_STATISTICS

A procedure, as defined procedure pointer below, is supplied for each SDS header by software components whenever a statistics SAP is opened (see SDS header record definition in section 8.2.1). This procedure is called whenever statistics are to be reported for the specified group. If the 'report' parameter is TRUE, a statistics log message is generated and issued to the log support application. The collection fields are cleared reguardless of the 'report' parameter.

LSA

```
TYPE
  report_procedure = ^PROCEDURE
        sds_hdr_ptr: ^sds_header; { INPUT
        report: boolean; { INPUT: If TRUE, issue report
        reason: statistics_reason_type; { INPUT
        time: report_time_type); {INPUT
```

3.2.3.1.2 DISPLAY_STATISTICS

A procedure, as defined by the procedure pointer below is supplied by software components for each SDS header whenever a statistics SAP is opened (see SDS header record definition in section 8.2.1). This procedure is called by a Display command processor whenever statistics are to be dislayed.

```
  TYPE
    display_procedure = ^PROCEDURE ( { generates display message
          sds_hdr_ptr: ^sds_header; { INPUT
          time: report_time_type; { INPUT
      VAR disp_msg: buf_ptr); { OUTPUT
```

3.2.3.2 Build_Statistics_Msg_Header

The following procedure is provided by CSM to build the Statistics report header. The user supplied report procedure calls this interface to build the log message header when reporting statistics.

```
  PROCEDURE [XREF] build_statistics_msg_hdr ( {
        sds_header_ptr: ^sds_header; { INPUT
        time: report_time_type; { INPUT
        reason: statistics_reason_type; { INPUT
    VAR log_msg: buf_ptr); { OUTPUT: partially build log message

{
{  CDCNET Statistics Reason for Report
{

  TYPE
    statistics_reason_type = (periodic_report, start_reporting,
                              stop_reporting, close_sap);
```

3.3 COLLECTION/REPORTING CONTROL SERVICES

3.3.1 DESCRIPTION

This feature provides the ability to control the collection and reporting of CDCNET statistics via commands. The software components do the actual collection of statistics, but fields in SDSs set by the command processors specify if the statistics are to be collected. In some cases, statistics are collected regardless of this selection since it is less "expensive" to collect the statistics than to check the field.

Note that separate start/stop commands are provided for networks, lines and processes (software elements).

3.3.2 COMMAND INTERFACES

3.3.2.1 START NETWORK METRICS / STANM

This command starts the collection and optionally reporting of statistics for the specified network solution(s) and group(s). The 'collecting' field in each related SDS header record is set TRUE, and the reporting field in the SAP entry is set to the value specified in the command. Note that if statistics are already enabled for these networks, they are immediately reported and the timer that controls reporting restarted for the items selected. The new selection may specify different names, groups and/or reporting interval.

For each specified network name, a response message is displayed specifying whether that network's statistics are started and which groups are enabled.

3.0 FEATURE DESCRIPTIONS
3.3.2.1 START_NETWORK_METRICS ! STANM

```
PDT stanm_pdt (
    name,n      : list of name = $REQUIRED
    group,g     : list of key summary, expanded, debug, all = all
    report,r    : boolean  = TRUE
    interval,i  : integer 1..60*60*24 = $REQUIRED)
```

name - name(s) of network solution(s)

group - statistics group(s)

reporting - whether to generate report message

interval - reporting interval in seconds (maximum 24 hrs.)

Some or all of the following response messages are possible

Metrics started for groups <gr name(s)> on network <nw name>

No statistics entry exist for network <nw name>

log message <message number> not enabled

3.3.2.2 STOP_NETWORK_METRICS ! STONM

This command stops the collection and reporting of statistics for the specified network solution(s) and groups(s). If a value for the group parameter is specified, metrics collection and reporting is stopped only for the specified groups (others remain enabled). Otherwise it is stopped for all groups for the specified network solution. The 'collecting' field in each related SDS header record is set FALSE. If no SDS header entries for the specified SAP remain enabled, the reporting field in the SAP entry is set to FALSE. Statistics are immediately reported for the stopped networks.

For each specified network name, a response message is displayed specifying whether that network's statistics are stopped and for which groups.

```
PDT stonm_pdt (
    name,n  : list of name = $REQUIRED
    group,g : list of key  summary, expanded, debug, all = all)

    name,n - name(s) of network solution(s)

    group,g - statistics group(s)
```

Some or all of the following response messages are possible

```
    Metrics stopped for groups <gr name(s)> on network <nw name>

    No statistics entry exist for network <nw name>
```

3.3.2.3 START_LINE_METRICS ! STALM

This command starts the collection and optionally reporting of statistics for the specified communication line(s) and groups(s). The 'collecting' field in each related SDS header record is set TRUE, and the reporting field in the SAP entry is set to the value specified in the command. Note that if statistics are already enabled for these lines, they are immediately reported and the timer that controls reporting restarted for the items selected. The new selection may specify different names, groups and/or reporting interval.

For each specified line name, a response message is displayed specifying whether that line's statistics are started and which groups are enabled.

```
PDT stalm_pdt (
    name,n     : list of name = $REQUIRED
    group,g    : list of key summary, expanded, debug, all = all
    report,r   : boolean  = TRUE
    interval,i : integer 1..60*60*24 = $REQUIRED)

    name - name(s) of communication line(s)

    group - statistics group(s)

    reporting - whether to generate report message

    interval - reporting interval in seconds (maximum 24 hrs.)
```

Some or all of the following response messages are possible

Metrics started for groups <gr name(s)> on line <line name>

No statistics entry exist for line <line name>

log message <message number> not enabled

3.3.2.4 STOP_LINE_METRICS ! STOLM

This command stops the collection and reporting of statistics for the specified communication line(s) and groups(s). If a value for the group parameter is specified, metrics collection and reporting is stopped only for the specified groups (others remain enabled). Otherwise it is stopped for all groups for the specified line solution. The 'collecting' field in each related SDS header record is set FALSE. If no SDS header entries for the specified SAP remain enabled, the reporting field in the SAP entry is set to FALSE. Statistics are immediately reported for the stopped lines.

For each specified line name, a response message is displayed specifying whether that line's statistics are stopped and for which groups.

```
PDT stolm_pdt (
    name,n  : list of name = $REQUIRED
    group,g : list of key  summary, expanded, debug, all = all)
```

name - name(s) of communication line(s)

group,g - statistics group(s)

Some or all of the following response messages are possible

Metrics stopped for groups <gr name(s)> on line <line name>

No statistics entry exist for line <line name>

3.3.2.5 START_PROCESS_METRICS ! STAPM

This command starts the collection and optionally reporting of statistics for the specified software element(s) and groups(s). The 'collecting' field in each related SDS header record is set TRUE, and the reporting field in the SAP entry is set to the value specified in the command. Note that if statistics are already enabled for these software elements, they are immediately reported and the timer that controls reporting restarted for the items selected. The new selection may specify different names, groups and/or reporting interval.

For each specified software element name, a response message is displayed specifying whether that software element's statistics are started and which groups are enabled.

```
PDT stapm_pdt (
    name,n      : list of name = $REQUIRED
    group,g     : list of key summary, expanded, debug, all = all
    report,r    : boolean  = TRUE
    interval,i : integer 1..60*60*24 = $REQUIRED)
```

name - name(s) of software element(s)

group - statistics group(s)

reporting - whether to generate report message

interval - reporting interval in seconds (maximum 24 hrs.)

Some or all of the following response messages are possible

Metrics started for groups <gr name(s)> on sw element <se name>

No statistics entry exist for software element <se name>

log message <message number> not enabled

3.3.2.6 STOP_PROCESS_METRICS ! STOPM

This command stops the collection and reporting of statistics for the specified software element(s) and groups(s). If a value for the group parameter is specified, metrics collection and reporting is stopped only for the specified groups (others

remain enabled). Otherwise it is stopped for all groups for the specified software element. The 'collecting' field in each related SDS header record is set FALSE. If no SDS header entries for the specified SAP remain enabled, the reporting field in the SAP entry is set to FALSE. Statistics are immediately reported for the stopped software elements.

For each specified software element name, a response message is displayed specifying whether that software element's statistics are stopped and for which groups.

```
PDT stopm_pdt (
    name,n  : list of name = $REQUIRED
    group,g : list of key  summary, expanded, debug, all = all)

    name - name(s) of software element(s)

    group,g - statistics group(s)
```

Some or all of the following response messages are possible

Metrics stopped for groups <gr name(s)> on sw element <se name>

No statistics entry exist for software element <se name>

3.3.2.7 SYNCHRONIZE_MEIRICS ! SYNM

This command synchronizes the reporting of all statistics. Note that all statistics already collected are immediately reported and their report periods restarted. There are no parameters for this command. Only one response is possible.

```
synchronize_metrics ! snym
```

Response to the synchronize command is

Metrics snchronize

3.3.3 PROGRAM INTERFACES

3.3.3.1 Start_Metrics

This procedure is used by the statistics reporting command processor to request CSM to start periodic reporting of statistics. If reporting is already in progress, statistics are immediately reported and the report period restarted. The format of the call is shown below:

```
PROCEDURE [XREF] start_metrics ( {
      element_type: statistics_type; { INPUT
      element_name: string ( * ); { INPUT
      group: statistics_group_set; { INPUT
      reporting: boolean; { INPUT: Whether to issue log msg
      report_interval: 1 .. 60*60*24; { INPUT: Secs (24 hrs max)
  VAR status: metrics_status); { OUTPUT

TYPE
  metrics_status = record
    CASE started: boolean of
    = TRUE =
      group: statistics_group_set,
    CASEND,
  recend;
```

3.3.3.2 Stop_Metrics

This procedure is used by the statistics reporting command processor to request CSM to stop periodic reporting of statistics. Statistics so far collected are reported. The format of the call is shown below:

```
PROCEDURE [XREF] stop_metrics ( {
      element_type: statistics_type; { INPUT
      element_name: string ( * ); { INPUT
      group: statistics_group_set; { INPUT
  VAR status: metrics_status); { OUTPUT
```

3.4 DISPLAY PROCESSING

3.4.1 DESCRIPTION

Commands are provided to display the statistics currently in the reporting SDS data record. The accompanying display procedure is supplied by the software component collecting the statistics. Also, the responses for these commands are documented in the related functional ERS for the particular component.

Note that separate display commands are provided for networks, lines and processes (software elements).

3.4.2 COMMAND INTERFACES

3.4.2.1 DISPLAY_NETWORK_METRICS / DISNM

This command displays the network solution statistics for for the specified network(s) and groups(s).

The command response for each network specified is the display message (described in the particular feature ERS) or the message listed below (if corresponding SAP entry not found).

```
PDT disnm_pdt (
    name,n      : list of name = $REQUIRED
    group,g     : list of key summary, expanded, debug, all = all)

    name - name(s) of network solution(s)

    group - statistics group(s)
```

The following error response is possible

No statistics entry exist for network <nw name>

3.4.2.2 DISPLAY_LINE_METRICS ! DISPM

This command displays statistics for the specified communication line(s).

The command response for each line specified is the display message (described in the particular feature ERS) or the message listed below (if corresponding SAP entry not found).

```
PDT dislm_pdt (
    name,n      : list of name = $REQUIRED
    group,g     : list of key summary, expanded, debug, all = all)
```

name - name(s) of communication line(s)

group - statistics group(s)

The following error response is possible

No statistics entry exist for line <line name>

3.4.2.3 DISPLAY_PROCESS_METRICS ! DISPM

This command displays statistics for the specified software element(s).

The command response for each software element specified is the display message (described in the particular feature ERS) or the message listed below (if corresponding SAP entry not found).

```
PDT dispm_pdt (
    name,n      : list of name = $REQUIRED
    group,g     : list of key summary, expanded, debug, all = all)
```

name - name(s) of software element(s)

group - statistics group(s)

The following error response is possible

No statistics entry exist for software element <se name>

3.4.3 PROGRAM INTERFACES

None.

4.0 PERFORMANCE

The performance of Statistics Management is not critical to the performance of the DI system. However, since statistics reporting is a low priority function, the CSM tasks run a the lowest priority in order not to interfere with CDCNET performance.

The following targets for table size, code size and performance are provided:

- SAP entry size - 10 byte + element_name
- SDS header size - 30 bytes
- SDS data control - 10 bytes
- SAP and SDS table space (20 SAPs/40 SDSs) - 2000 bytes
- CSM code space
  - program i/f - 1000(16)
  - commands - 2000(16)
- instruction count for:
  - open SAP - 1000
  - close SAP - 600
  - obtain SDS address - 300
  - start metrics - 500
  - stop metrics - 500
  - issue a report - 500

5.0 FINITE STATE MACHINE

Since CSM does not have any external protocol, a finite state machine is not required.

6.0 LOG MESSAGES

6.1 STATISTICS REPORT LOG MESSAGE

CDCNET statistics are reported via log messages. However, these log messages are formatted and reported by the software components that are collecting the statistics. Therefore, they are described in the corresponding ERSs.

6.0 LOG MESSAGES
6.2 NO SAP ON CLOSE

6.2 NO_SAP_ON_CLOSE

Whenever the SAP entry cannot be found for a close Statistics SAP call, the following log message is generated:

LOG_MESSAGE_ID

sme_no_sap_on_close

DESCRIPTIVE_MESSAGE

Statistics SAP entry not found for SAP ID

MASK		LOG_MSG_BUFFER		
MASK		LOG_MESSAGE_BUFFER_PTR^ (variable part)		
fixed text	type	value	description	
sap_id =	bin_octet	1..ffff(16)	SAP ID to close	
element_type =	bin_octet	0..2	element type for entry to close	
element_name =	char_octet	1-31 chars	element name for entry to close	

Operator_Display_Format_Example

```
--ERROR-- system_name system_address 83/08/04 11.00.35 30401
Statistics SAP entry not found for SAP ID 0023 corresponding
     to element_type = 1 and element_name = ESCI_NW_45
```

NOTE: The date, time and originating system address are taken from the PDU header.

6.3 NO_SAP_FOR_TIMER

Whenever the SAP entry cannot be found for a Timer Task call, the following log message is generated:

LOG_MESSAGE_ID

sme_no_for_timer

DESCRIPTIVE_MESSAGE

Statistics SAP entry not found for SAP ID

MASK		LOG_MSG_BUFFER			
MASK		LOG_MESSAGE_BUFFER_PTR^ (variable part)			
fixed text		type	value	description	
sap_id =		bin_octet	1..ffff(16)	SAP ID not found	

Operator_Display_Format_Example

```
--ERROR-- system_name system_address 83/08/04 11.00.35 30402
Statistics SAP entry not found for SAP ID 0023 specified by
timer task call
```

NOTE: The date, time and originating system address are taken from the PDU header.

6.4 UNKNOWN_INTERTASK_MSG

Whenever an unknown intertask message is received by the Issue Statistics task, the following log message is generated:

LOG_MESSAGE_ID

sme_unknown_intertask_msg

DESCRIPTIVE_MESSAGE

Unknown intertask message message received by Statistics Manager

MASK	LOG_MSG_BUFFER			
MASK	LOG_MESSAGE_BUFFER_PTR^ (variable part)			
fixed text	type	value	description	
message =	bin_octet	8 bytes	The intertask msg	

Operator_Display_Format_Example

```
--ERROR-- system_name system_address 83/08/04 11.00.35 30403
Unknown intertask message received by Statistics Manager
     message = 02134576
```

NOTE: The date, time and originating system address are taken from the PDU header.

7.0 INITIALIZATION

7.0 INITIALIZATION

1) The Reporting Control task is started to receive intertask messages to report statistics.

2) Miscellaneous variables are preset to initial values.

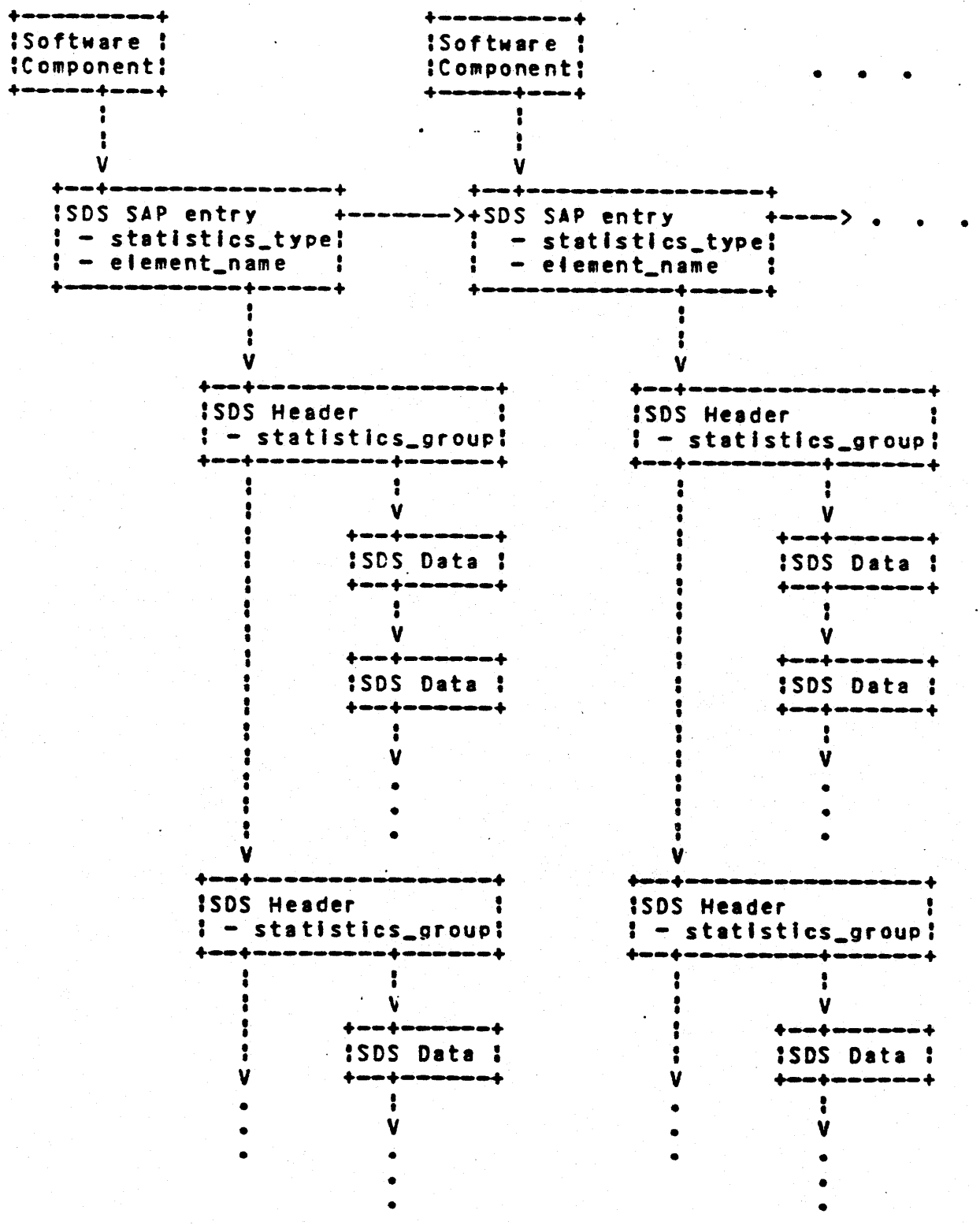
8.0 NEW DATA TYPES

8.0 NEW DATA TYPES

Each software component (or task) that is collecting statistics opens a SAP to CSM specifying statistics_type (comm_line, nw_solution or sw_component) and element name and a pointer to one or more SDS headers. Each SDS header represents a particular statistics_group of that software component. If the software component is collecting statistics for more than one occurrence of one statistics_group (eg: several connections) there will be one SDS data record for each occurrence. Thus, the command processor program interface procedures can locate a particular SDS header by specifying the statistics_type, element_name and statistics group. The SAP entry is found from the statistics_type and element name, and the particular SDS isolated using the statistics_group. The relationship of SAP entries and SDS records is shown in the following diagram:

summary, expanded, debug

8.0 NEW DATA TYPES



8.0 NEW DATA TYPES
8.1 SDS SAP TABLE

8.1 SDS_SAP_TABLE

The SDS SAP Table keeps track of SAPS opened by software components. Its format is shown below:

```
TYPE
  sds_sap_entry = record
    sap_id: 0 .. 0ffff(16),
    element_type: statistics_type,
    element_name: ^string ( * <= 31 ),
    sds_header_ptr: ^sds_header,
    timer_id: ^timer,
    sap_report_interval: 1 .. 60*60*24, { Secs (24 hrs max)
    report_interval: 1 .. 60*60*24, { Secs (24 hrs max)
    reporting: boolean,
    next_reporting: boolean,
    report_in_progress: 0 .. 0ffff(16), { To lock SAP entry
    report_time: report_time_type,
    next_entry: ^sds_sap_entry,
  recend,

  statistics_type = (comm_line, nw_solution, sw_component);
```

8.2 STATISTICS_DATA_STRUCTURE_SDS

The Statistics Data Structure (SDS) consists two parts: the Statistics Data Structure Header (SDS Header) and the SDS Data. One or more (one for each statistics_group) are created by a software component and a pointer to the first passed to CSM when an Statistics SAP is opened.

8.2.1 SDS HEADER

The format of the SDS Header is identical for all statistics data structure. One SDS Header exists for each statistics group being collected. Its format is shown below:

```
   TYPE
     sds_header = record
{ NOTE!!! The first 7 fields (sds_buf1_ptr -> next_header
{         are initialized by the Software Component
       sds_buf1_ptr: ^cell, { User defined collection buffers
       sds_buf2_ptr: ^cell,
       group: statistics_group_type,
       log_msg_number: 0 .. 0ffff(16),
       log_template_id: template_id_type,
       report_proc: report_procedure,
       display_proc: display_procedure,
       next_header: ^sds_header,
{ WARNING!!! The following fields are maintained by CSM
{             and should not be changed by Software Component
       collecting: boolean, { Collecting statistics & next reporting
       reporting: boolean, { Reporting statistics
       collecting_buf1: boolean, { TRUE=buffer1 FALSE= buffer2
     recend;

     statistics_group = (summary, expanded, debug),

     report_time_type = record
       start:  ost$hms_time, { HH:MM:SS }
       ending:  ost$hms_time, { HH:MM:SS }
     recend;
```

8.2.2 SDS DATA

Since software components collect and report the statistics concerning their processes, design of the related SDS data buffers is left to the software component developers. Two buffers are to be provided for each SDS data item in order that one can be collecting while the other is reporting. For each SDS header, there may be multiple entities such as multiple Transport connections. In these cases, the developer may choose to provided one SDS data item for each connection. Note that data buffer pointers are provided in the SDS header record which the software component may or may not use.

9.0 GLOSSARY

CSM: CDCNET Statistics Manager; The name of the software product described in this ERS.

SDS: Statistics Data Structure; The data structure consisting of an SDS header and SDS data record (described in section 8.2) that coordinates the collection and reporting of CDCNET statistics.

10.0 ABORTS AND ERROR RECOVERY

10.0 ABORTS_AND_ERROR_RECOVERY

No special error recover is provided. The chances for aborts is minimized by carefully checking all parameters passed in program interface calls.