APPENDIX D

CEDRIC CARTESIAN FILE DESCRIPTION

SPRINT uses the CEDRIC file structure for its gridded-volume output. Instead of having a physical record structure, this disk file consists of an unblocked, continuous stream of bytes. It is written using the standard C input-output libraries. Information at the beginning of the file reveals how many logical volumes are contained in the file and what their starting byte addresses are relative to the beginning of the file. CEDRIC files are meant to be portable to most machines in use in the scientific community. The basic requirements are that the machine have C on it and that it represent integers using 2's complement. Several words at the beginning of the file indicate the byte ordering convention used by the machine that wrote the file. The machine reading the file will do any byte swapping necessary.

Below is a very brief description of the structure of CEDRIC files. It is not intended that this information be detailed enough that any routines can be written to read and write CEDRIC volumes. We can provide either guidance in that regard or an input-output software package. Associated with the file and logical volumes are headers described on the following pages.

FILE—a file consists of 1 or more VOLUMEs. At the beginning of the file is information about the number of VOLUMEs in the file, their byte addresses, and other descriptive information.

VOLUME—each volume contains a 3-dimensional set of radar FIELDs mapped to an ordered (X,Y,Z), (X,Y,C) or (X,Y,E) coordinate system. Volumes are associated with a fixed time of day and may contain a field with temporal information corresponding to each individual location. VOLUMEs are preceded by a 510-word logical record containing header information describing the characteristics of the volume. Within a VOLUME, the data corresponding to each radar FIELD is organized in LEVELs associated with either a constant height (Z), constant coplane angle (C), or constant elevation angle (E).

LEVEL—A constant Z-, C-, or E-level contains the data from each FIELD at that height or angle. LEVELs are preceded by a 10-word logical record containing header information describing the characteristics of the LEVEL. FIELD order is indicated in the VOLUME header. Within a LEVEL, the data from each field is contiguous; that is, all the data from Field 1 followed by all the data from Field 2 and so forth.

FIELD—Each field contains the information for a single parameter such as radial velocity, reflectivity, U-component, V-component, and so forth. Within a LEVEL, the data from each radar FIELD is organized as a two- dimensional FORTRAN array such that the lower left corner corresponds to the (1,1) element and the upper right corner corresponds to the (M,N) element; where M increases along the X-axis and N increases along the Y-axis. Each element of a FIELD is a 16-bit integer word.

ILLUSTRATION OF FILE STRUCTURE

```
FILE ...
  ·    VOLUME 1...
  ·         ·        LEVEL 1...
  ·         ·             ·       FIELD 1...
  ·         ·             ·           .
  ·         ·             ·           .
  ·         ·             ·           .
  ·         ·             ·           .
  ·         ·             ·           .
  ·         ·             ·           .
  ·         ·             ·       FIELD last
  ·         ·        LEVEL last
  ·         ·
  ·    VOLUME last
END of FILE
```

CEDRIC FILE HEADER

At the beginning of the file is a 1540-byte header which is followed by as many as 25 separate logical volumes. The file header contains a description of the separate logical volumes and items 3, 5-29, and 30-54 are updated each time a logical volume (items 61 onward) is appended to an existing output file. Those file, volume and level header words that are generated (or updated) during interpolations using SPRINT are listed as "SP"; those that are updated by CEDRIC are listed as "CD."

ITEMS	BYTES	TOTAL LENGTH	UPDATES	DESCRIPTION OF CONTENTS
1	1-4	4 chars	SP	ASCII character string "CED1"
2	5-8	32-bit word	SP	Indicates byte ordering convention of integers in the file (0 - Big Endian such as used by Sun Sparc and CRAY machines) (1 - Little Endian such as used by DEC and PC machines) **Note:** This word is always checked by SPRINT and CEDRIC and neither program allows new volumes to be appended to an existing file written on a machine with a different byte-ordering.
3	9-12	4 bytes	SP,CD	Contains the size in bytes of the entire CEDRIC file
4	13-16	4 bytes		Reserved for future use
5-29	17-116	25 32-bit words	SP,CD	Integer addresses that contain starting byte locations of the respective 25 logical volumes within the disk file. These addresses are all relative to the beginning of the disk file. If there are fewer than 25 logical volumes in the file, the unused byte-addresses will be filled with zeroes.
30-54	117-1516	25 56-char strings	SP,CD	Each character string will say something about its corresponding logical volume.
55-60	1517-1540	6 32-bit words		Reserved for future use.
61-85	$\geq$1541	$\leq$25 logical volumes	SP,CD	Contains a 510-word volume header followed by the data for that logical volume. The contents of individual volume headers are described below. Note that the output file contains only the actual number of volumes written. Thus, if only one CEDRIC logical volume is present, item 61 would be the highest one in the file.

CEDRIC VOLUME HEADER

The header for CEDRIC volumes consists of 510, 16-bit words that are to be interpreted as either two ASCII alphanumeric characters (A) or as signed integers (2's complement). Several of the integer values are scaled so that their true representation will be their integer value times or divided by this scaling factor. The two general scaling factors are: CF for angle scaling (a value of 64) and SF for general scaling (a value of 100). In the case of constant coplane- or elevation-angle interpolations, words 170-171 and 173 have the same meaning as constant-Z interpolations; however, the grid spacing (word 173) is the difference between the first two levels. Those volume header words that are updated by CEDRIC are listed as "CD;" those that are generated during interpolations using SPRINT are listed as "SP."

WORDS	TYPE	SCALING	UPDATES	DESCRIPTION OF CONTENTS
001-004	A		SP,CD	Tape catalogue number (6 char) or disk file name (8 char, 2 per word)
005-006	A		SP,CD	Program name (4 char, 2 per word)
007	A		SP,CD	Program version (2 char, 2 per word)
008-009	A		SP,CD	Project name (4 char, 2 per word)
010-012	A		SP,CD	Scientist name (6 char, 2 per word)
013-015	A		SP	Radar station or data origin (6 char, 2 per word)
016-017	A		SP	Output coordinate system (CRT, ELEV, CPL, LLE, LLZ) (4 char, 2 per word)
018-020	A		SP	Tape catalogue number (6 char, 2 per word); depends on computer installation
021-023	I	None	SP	Beginning date of radar volume (YYMMDD)
024-026	I	None	SP	Beginning time of radar volume (HHMMSS)
027-029	I	None	SP	Ending date of radar volume (YYMMDD)
030-032	I	None	SP	Ending time of radar volume (HHMMSS)
033-034	I	None	SP,CD	Coordinate origin: Latitude (DEG-MIN)
035	I	(*SF)	SP,CD	Coordinate origin: Latitude (SEC)
036-037	I	None	SP,CD	Coordinate origin: Longitude (DEG-MIN)
038	I	(*SF)	SP,CD	Coordinate origin: Longitude (SEC)
039	I	None	SP,CD	Z-coordinate of the origin: Height in meters (MSL); always 0.0
040	I	(*CF)	SP,CD	Degrees clockwise from North to positive X-axis
041-042	I	(*SF)	SP,CD	X,Y-coordinates of the origin (km)
043-044	A		SP,CD	Time zone (4 char,2 per word)
045-047	A		SP,CD	Job identification number (6 char, 2 per word)
048-050	A		SP,CD	Submitter's name (6 char, 2 per word)
051-054	A		SP,CD	Date of program run (MMDDYY); (8 char, 2 per word)
055-058	A		SP,CD	Time of program run (HHMMSS); (8 char, 2 per word)
059		Unused		
060	I	None		Tape edition number (Incremented by Edit2D)
061	I	None	SP,CD	Length of header record (always 510)
062	A		SP,CD	Computer installation (2 char, 2 per word)
063	I	None	SP,CD	Number of bits per data value (always 16)
064	I	None	SP,CD	Blocking mode (always 2)
065	I	None	SP,CD	Block size or physical record length (always 3200)
066	A		SP	Data set: subsectioned = "SU" or original = "OR"
067	I	None	SP,CD	Missing data flag (always -32768)
068	I	None	SP,CD	General scaling factor: SF = 100
069	I	None	SP,CD	Angle scaling factor: CF = 64
070		Unused		

CEDRIC VOLUME HEADER (cont'd)

WORDS	TYPE	SCALING	UPDATES	DESCRIPTION OF CONTENTS
071-074	A		SP	Input file label 1 (8 char, 2 per word)
075-078	A		SP	Input file label 2 (8 char, 2 per word)
079-082	A		SP	Input file label 3 (8 char, 2 per word)
083-086	A		SP	Input file label 4 (8 char, 2 per word)
087-090	A		SP	Input file label 5 (8 char, 2 per word)
091-094	A		SP	Input file label 6 (8 char, 2 per word)
095		Unused		
096	I	None	SP,CD	Number of data records per field per plane
097	I	None	SP,CD	Number of data records per plane
098	I	None	SP,CD	Number of data records per volume, excluding all headers
099	I	None	SP,CD	Total number of records per volume, including all headers
100	I	None	SP,CD	Total number of records per volume, excluding level headers
101-104	A		SP,CD	Volume scan designation (8 char, 2 per word)
105		Unused		
106	I	None	SP,CD	Number of planes in volume scan
107	I	(/SF)	SP	Volume scanned (km^3)
108	I	(/SF)	SP	Total number of sampling points
109	I	(*SF)	SP	Average sampling density (sample point per km^3)
110	I	None	SP	Number of samples integrated in time series
111	I	None	SP,CD	Physical volume number within disk file
112-115		Unused		
116-118	I	None	CD	Beginning date of the volume (YYMMDD)
119-121	I	None	CD	Beginning time of the volume (HHMMSS)
122-124	I	None	CD	Ending date of the volume (YYMMDD)
125-127	I	None	CD	Ending time of the volume (HHMMSS)
128	I	None		Volume Time (Sec)
129	I	None		Index Number-time (4)
130-131		Unused		
132-133	I	(*SF)		Minimum and maximum ranges of the volume scanned (km)
134	I	None	SP	Average number of gates per beam
135	I	None	SP	Average spacing of gates (m)
136-137	I	None	SP	Minimum and maximum number of gates
138		Unused		
139	I	None	SP	Index number for range (always 1)
140-141		Unused		
142-143	I	(*CF)		Clockwise minimum and maximum azimuths of the sweep (deg)
144	I	None		Average number of beams per scanned sweep
145	I	(*CF)		Average increment between beams per sweep (deg)
146-147	I	None		Minimum and maximum number of beams per sweep
148	I	None		Number of steps per beam (average over scanned volume)
149	I	None		Index number for azimuth angle (always 2)
150		Unused		

CEDRIC VOLUME HEADER (cont'd)

WORDS	TYPE	SCALING	UPDATES	DESCRIPTION OF CONTENTS
151	A		SP	Coplane (CO) or ppi (sector scan) (PP) flag
152-153	I	(*CF)	SP	Minimum and maximum elevation angle of the volume scanned (deg)
154	I	None	SP	Number of elevation angles scanned
155	I	(*CF)	SP	Average elevation angle between sweeps (deg)
156	I	(*CF)	SP	Average elevation angle (deg)
157	I	None	SP	Scan-direction indicator (+1 = from lowest to highest elevation angle)
158	I	(*CF)	SP	Baseline angle (CW from true North, coplane only)
159	I	None	SP	Index number for the angle scanned, either coplane or elevation (always 3)
160-161	I	(*SF)	SP,CD	X- or Longitude-coordinate: minimum and maximum values (km or deg)
162	I	None	SP,CD	X- or Longitude-coordinate: number of grid points
163	I	None	SP,CD	X- or Longitude-coordinate: grid spacing (m or 1000*deg)
164	I	None	SP,CD	X- or Longitude-coordinate: index number (0,1,2,3,4)
165-166	I	(*SF)	SP,CD	Y- or Latitude-coordinate: minimum and maximum values (km or deg)
167	I	None	SP,CD	Y- or Latitude-coordinate: number of grid points
168	I	None	SP,CD	Y- or Latitude-coordinate: grid spacing (m or 1000*deg)
169	I	None	SP,CD	Y- or Latitude-coordinate: index number (0,1,2,3,4)
170-171	I	(*SF)	SP,CD	Z-, C-, or E-coordinate; minimum and maximum values (m, deg, or deg)
172	I	None	SP,CD	Z-, C-, or E-coordinate: number of grid points
173	I	None	SP,CD	Z-, C-, or E-coordinate: quasi-vertical grid spacing. Internal values with units of km or deg are multiplied by 1000 before writing this word. CEDRIC divides this parameter by 1000 for use internally. In the case of constant coplane (C) or elevation (E) angle interpolations, which can be unevenly spaced, this word is the difference between the first two levels. The actual coordinates are contained in word 4 of the level header.
174	I	None	SP,CD	Z-, C-, or E-coordinate: index number (0,1,2,3,4)
175	I	None	SP,CD	Number of fields (Maximum of 25)
176-179	A		SP,CD	Name of first field (8 char, 2 per word)
180	I	None	SP,CD	Scaling factor for first field, actual value = value in file divided by scaling factor
181-184	A		SP,CD	Name of second field (8 char, 2 per word)
185	I	None	SP,CD	Scaling factor for second field, actual value = value in file divided by scaling factor
186-295	I	none	SP,CD	Scaling factors for remaining fields
296-299	A		SP,CD	Name of 25th field (8 char, 2 per word)
300	I	None	SP,CD	Scaling factor for 25th field, actual value = value in file divided by scaling factor

CEDRIC VOLUME HEADER (cont'd)

WORDS	TYPE	SCALING	UPDATES	DESCRIPTION OF CONTENTS
301	I	None	SP,CD	Number of grid points per field per plane
302	I	None	SP,CD	Number of landmarks
303	I	None	SP,CD	Number of radars
304	I	(*SF)	SP,CD	Nyquist velocity (if word 303 = 1)
305	I	(*SF)	SP,CD	Radar constant (if word 303 = 1)
306-308	A		SP,CD	Name of landmark #1, must be "ORIGIN" (6 char, 2 per word)
309-310	I	(*SF)	SP,CD	Landmark #1: (X,Y) coordinates (km), always (0,0)
311	I	None	SP,CD	Landmark #1: Z-coordinate (m), always (0)
312-314	A		SP,CD	Name of landmark #2; name of radar if word 303 = 1 (6 char, 2 per word)
315-316	I	(*SF)	SP,CD	Landmark #2 (X,Y) coordinates (km)
317	I	None	SP,CD	Landmark #2: Z-coordinate (m)
318-320	A		SP,CD	Name of landmark #3; name of 2nd radar if word 303 > 1 (6 char, 2 per word)
321-322	I	(*SF)	SP,CD	Landmark #3 (X,Y) coordinates (km)
323	I	None	SP,CD	Landmark #3: Z-coordinate (m)
324-395	A,I	See above	SP,CD	Information for remaining landmarks in the above order: [Name (three words) and XYZ (one word each)] for a maximum of 15 landmarks
396-510				—RESERVED FOR PROGRAM USE—

CEDRIC LEVEL HEADER

The header for CEDRIC levels consists of 10, 16-bit words that are to be interpreted as either two ASCII alphanumeric characters (A) or as signed integers (2's complement). Several of the integer values are scaled so that their true representation will be their integer value times or divided by this scaling factor. The general scaling factor is SF for general scaling (a value of 100). Header words that are updated by CEDRIC are listed as "CD"; those that are generated during interpolation using SPRINT are listed as "SP". Since interpolations to constant coplane angles (C deg) or constant elevation surfaces (E deg) may not be equally spaced, the current level information is always obtained from word 4 in the level header rather than from words 170-173 of the Volume Header. Constant E-level interpolations can only be organized in successive XY- or Longitude-Latitude planes of data at E-levels. Constant C-level interpolations are organized in successive XY-planes only. The Nyquist velocity for WSR88D radars changes as the elevation angle increases so the current E-level Nyquist is placed in word 010 of the CEDRIC LEVEL HEADER.

WORDS	TYPE	SCALING	UPDATES	DESCRIPTION OF CONTENTS
001	A		SP,CD	Always = "LE"
002	A		SP,CD	Always = "VE"
003	A		SP,CD	Always = "L "
004	I	(*1000)	SP,CD	For CRT or LLZ output: height coordinate of the plane or level (Z m)
		(*1000)	SP,CD	For CPL or ELEV output: only angular coordinate C or E deg is allowed
005	I	None	SP,CD	Plane (or level) number within the volume
006	I	None	SP,CD	Number of fields
007	I	None	SP,CD	Number of grid points per plane (or level)
008	I	None	SP,CD	Number of records per field
009	I	None	SP,CD	Number of records per plane
010	I	(*SF)	SP,CD	Nyquist velocity (used for NEXRADs)

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