PROJECT DOCUMENTATION

POLAR DATA HEADER FORMAT

Improvement Radar Data Quality

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PRINCE2

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Product Descriptions History

Document Location

This document is only valid on the day it was printed.
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Revision History

Date of this revision: 7th June 2010
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Revision date	Previous revision date	Summary of Changes	Changes marked
05/06/2001	-	First issue	No
05/04/2002	05/06/2001	Produced following changes made in Cyclops 5.0	No
31/03/2003	05/04/2002	Corrections in paragraph 1 of Derivations & minor format changes	No
04/06/2004	31/03/2003	Added info about what is coded in which Cyclops and file name changes in version 6.	No
24/09/04	04/06/2004	Reviewed prior to release to DRS	No
08/10/04	24/09/04	Following review by DRS	YES in yellow
12/10/04	8/10/04	Suggested modifications to DRS proposal coordinated by M Kitchen (v2.1)	No
13/10/04	12/10/04	V 2.2 Corrections and new data type definitions (by M R A Edwards).	No
10/11/04	13/10/04	V2.21 further corrections to incorporate corrections to v1.3 received from Micah Epps (DRS) and outcomes of discussions with Bob Stafford (DRS)	No
15/11/04	10/11/04	V2.3 following further internal discussion	No
16/12/04	15/11/04	V2.4 following further corrections from Micah Epps at DRS	No
09/02/05	16/12/04	V2.5 further corrections	Yes
03/03/05	09/02/05	V2.51 Include change of Zdr coding offset and increment	Yes
10/03/05	03/03/05	V2.52 further corrections	Yes
4/04/04	10/03/05	V2.6: Change to increase the resolution of some data types.	
28/10/05	04/04/05	V2.61: change the order of the parameters for data type 2211	

Revision date	Previous revision date	Summary of Changes	Changes marked
08/11/05	28/10/05	V2.62: change the resolution of parameter located in offset 4 of the ray header.	
17/01/06	08/11/05	V2.63: add offset 158 and 160 to volume header table	
31/01/06	17/01/06	V2.7: major update to include polar format used on Radarnet4 as well as Cyclops and Edge	No
06/04/06	31/04/06	V2.8: Include change to accommodate refractivity measurements	
11/05/06	06/04/06	V2.9: include Radarnet name for each header field for decoding purposes	
24/05/06	11/05/06	V3.0: Add entries to the single parameter data type (table 8)	
06/12/06	24/05/06	Version 3.1: one addition to the flag list (Table 9), and the file naming convention (Table 1).	
02/01/07	06/12/06	Version 3.2: additions to the data type list (Table 8).	
02/03/07	02/01/07	Version 3.3: modify the flag list (Table 9)	
25/04/07	02/03/07	Version 3.4: add header entries for ZDR calibration values.	
27/06/2007	25/04/2007	Version 3.5: add header entries for the receiver and transmitter characteristics	
14/08/2007	27/08/2007	Version 3.6: modify entries to the volume header for the noise measurements. Also include new multi-parameters data type numerology.	
11/06/2009	14/08/2007	Version 3.7: modify entries to the ray header for the noise measurements. Change Augmented Counts info in Table 7.	
04/09/2009	11/06/2009	Version 3.8: modify scan header entries relating to noise info	
07/06/2010	04/09/2009	Version 3.9: i) Modify scan header to include NCO frequency. ii) Include multi-parameter type, CPA iii) Include multi-paramter type, PR	
02/07/2010	07/06/2010	Version 3.91: Correction of table 7 / Augmented Refractivity / std.dev of phase offset from -60dB to -40dB	
08/11/2010	02/07/2010	Version 3.92: Further explanation on correct lat/lon encoding rules	
07/12/2010	08/11/2010	Version 3.93: Correction to Scan header calibration_offset description	
12/07/2011	07/12/2010	Version 3.94: Table 7 correction to Ci physical increment, point to Table 7a.	
25/01/13	12/07/2011	Version 3.95: Update to include coding of polarized noise in ray headers and add LDR2 and Zdr2 products.	
30/4/13	25/01/13	Version 3.96 : Update Ray header to correctly define coding as Hundredths rather than hundreds.	
10/10/13	30/04/13	Version 3.97: Clarify radial velocity direction convention	

30/04/14	10/10/13	Version 3.98: Correct description of the augmented refractivity SDP quantity	

Distribution

This document has been distributed to

Name	Title	Date of Issue	Version
Met Office Radar team		05/04/02	1.0
Met Office Radar team	-	31/03/03	1.1
Met Office Radar team	-	04/06/04	1.2
Met Office Radar team, DRS and Reading University	-	24/09/04	1.3
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Radar Team (Met Office) and Reading University		04/09/2009	3.7
Radar Team (Met Office)		07/06/2010	3.9
Radar Team (Met Office)		07/06/2010	3.91
Radar Team (Met Office)		08/11/2010	3.92
Radar Team (Met Office)		07/12/2010	3.93
Radar Team (Met Office)		07/12/2010	3.94
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Radar Team (Met Office)		10/10/13	3.97
Radar Team (Met Office)		30/04/13	3.98

Product Description

Relevant systems:

Cyclops	Single polarisation radar site processor (version 4.3 to 6.0)
Cyclops-D	Single polarisation Doppler site processor
Edge	Dual polarisation site processor by EEC
Radarnet IV	Central radar data processor

This document refers to the file format for polar reflectivity, velocity moments and dual polarisation parameters collected by the processing systems at radar sites around the UK, and the single parameters data files created by the central processing system at the UK Met Office headquarters.

File Naming Convention

All files produced using version 5 of Cyclops (and previous versions) are named RADXXpolar_YYYYMMDDhhmmB.dat, where XX is the local radar site number, B is the elevation number and YYYYMMDDhhmm is the time stamp of the data rounded down to the nearest one minute for the time that collection of each elevation finished. By convention Cyclops runs on a five minute cycle where highest elevations are collected first and the lowest elevation is designated scan 0 and timed to coincide with a five minute time stamp. For example, RAD03polar_2004060410340.dat is the data for site 03 and scan 0 for 4th June 2004 collected at 1034 UTC.

For version 6 of Cyclops and later versions, the file name was changed to reflect the Nimrod naming convention. It is recommended that the naming convention used in version 6 is maintained for future network radars. This name format is YYYYMMDDhhmm_polar_pl_radarXXbB_reflectivity, where YYYYMMDDhhmm is the date and time strings as described above, XX is the site no and B is the elevation number. For example 200406041044_polar_pl_radar11b1_reflectivity, contains scan 1 data collected at 1044 on 4th June for site 11. The data type is defined in the filename with the subscript "reflectivity". In order to accommodate for data collected at different pulse mode, an additional subscript is tagged at the end of the file to define the pulse mode. The subscript should be altered for each data types and pulse mode, as follows:

Table 1 : File name format for different multiparameter data types

Data Type	Pulse mode	Subscript	Name format
2108	Undefined	augcount	YYYYMMDDhhmm_polar_pl_radarXXbB_count
2111	Undefined	reflectivity	YYYYMMDDhhmm_polar_pl_radarXXbB_reflectivity
2122	Undefined	augdoppler	YYYYMMDDhhmm_polar_pl_radarXXbB_augdoppler
2141	Undefined	refractivity	YYYYMMDDhhmm_polar_pl_radarXXbB_refractivity
2211	Long pulse	augsidpol_lp	YYYYMMDDhhmm_polar_pl_radarXXbB_augsidpol_lp
2211	Short pulse	augsidpol_sp	YYYYMMDDhhmm_polar_pl_radarXXbB_augsidpol_sp
2212	Long pulse	augldr_lp	YYYYMMDDhhmm_polar_pl_radarXXbB_augldr_lp
2212	Short pulse	augldr_sp	YYYYMMDDhhmm_polar_pl_radarXXbB_augldr_sp
2213	Long pulse	augsidpol_lp	YYYYMMDDhhmm_polar_pl_radarXXbB_augzdr_lp
2213	Short pulse	augsidpol_sp	YYYYMMDDhhmm_polar_pl_radarXXbB_augzdr_sp
2214	Long pulse	augldr_lp	YYYYMMDDhhmm_polar_pl_radarXXbB_augldr_lp
2214	Short pulse	augldr_sp	YYYYMMDDhhmm_polar_pl_radarXXbB_augldr_sp
2154	Undefined	reflectivityCPA	YYYYMMDDhhmm_polar_pl_radarXXbB_reflectivityCPA
2126	Undefined	reflectivityPR	YYYYMMDDhhmm_polar_pl_radarXXbB_reflectivityPR

Derivation

The radar data format has three hierarchical levels of structure: Volume, Scan and Ray. A Ray is the lowest level of aggregation and consists of all the data for all the individual range bins collected for a single pointing direction. A Scan is a collection of Rays, which will normally be contiguous in either azimuth (a PPI or Plan Position Indicator scan) or elevation (a RHI or Range Height Indicator scan). A Volume is a collection of Scans, which normally form a sequence in azimuth or elevation. For example, for current network operations, a Volume would consist of the 4 PPI Scans at decreasing elevations, each of which was composed of 360 rays of 340 data bins. However, it is also possible for a Volume to consist of but a single Scan and a single Ray.

Each level of structure is preceded by a header record giving information, which describes all the Scans contained within that Volume. An example of the way in which these different levels of structure are organised is shown in Table 2 for a Volume consisting of 2 Scans each composed of 2 Rays.

Table 2 : Outline of Basic Structure
Volume Header
Scan Header, Scan 0
Ray Header, Scan 0, Ray 0
data for Scan 0, Ray 0
Ray Header, Scan 0, Ray 1
data for Scan 0, Ray 1
Scan Header, Scan 1
Ray Header, Scan 1, Ray 0
data for Scan 1, Ray 0
Ray Header, Scan 1, Ray 1
data for Scan 1, Ray 1

The requirement that the header information at one level should be applicable to all lower levels will necessarily impose some restrictions on what can be regarded as constituting a Volume. One example might be where a radar is configured to repeat a series of PPI scans e, with the lower elevation Scans used primarily for precipitation measurement, and the higher elevation Scans used to obtain wind measurements. To provide for these two functions, the PRF might be raised at higher elevations or a secondary PRF might be employed. In this case, the two sets of Scans would be regarded as two separate Volumes, this having some merit in that the change in PRF or other parameters would impact on the quality and interpretation of quantities such as reflectivity or radial velocity.

While it is intended that the format should provide sufficient flexibility to accommodate both current and likely future developments, a balance has to be struck between this needless redundancy or over-complication. The following is a list of the principal restrictions or limitations on application:

- For archiving purposes and standard use, each Volume is stored as a separate file. However, this does not preclude the storage of multiple Volumes within a single file where this might be more convenient (e.g. a playback sequence for a particular event).
- All the data contained within a Volume is for a single radar site, of a single data type and for a single set of configuration parameters (e.g. pulse length and frequency, processing options). All the Scans comprising a Volume will be of the same type (PPI, RHI or unstructured).
- All the data contained within a Volume or a Scan is for a single, contiguous time period. Rays

cannot be interspersed between different Volumes or Scans.
- ☐ Within a Ray, data for each bin will be stored in order of its range from the radar, with the Data Element for the bin closest to the radar immediately following the Ray header.

The majority of header information is stored as one or more unsigned 16 bit integers, this making translation between different machine architectures relatively straightforward. The first two fields in the Volume Header have fixed values and can be used both to identify the file type and to confirm bit and byte ordering. Each Volume is preceded by a 256 byte Volume Header. Because of the amount of information applying at this level, related header elements are grouped into seven Sections as indicated in Table 3 below. Tables 3a to 3g detail what information is included in each Section.

Each Scan is preceded by a 64 byte Scan Header, as described in Table 4. This gives the following information:

- ☐ The index of the Scan within the Volume.
- ☐ The start and stop, azimuth and elevation requested for the Scan.
- ☐ The start and stop times for the Scan. It is assumed that data collection is continuous within a Scan, and that the time for each Ray of data can be estimated from its position within a Scan.
- ☐ The number of rays in the Scan, the number of Bins per ray, and the range to the first Bin within each Ray.

Each Ray is preceded by a 10 byte Ray Header as described in Table 5. This gives the following information:

- ☐ the index of the Ray within the Scan.
- ☐ the azimuth and elevation angle for the ray as actually reported by the radar control unit.
- ☐ the number of bytes of data following the Ray Header. This is intended primarily to support the use of run-length compression.

Volume and Scan Headers contain a number of fields which are currently unused and reserved for future use. These will be set to zero.

Byte Orientation: The format accommodates both little endian and big endian byte orientation of 16 bit data values. The complete set of data can be stored in either one representation or the other but not mixed at the same time. By checking the magic number and/or the bit and byte ordering bytes fields in the volume header the byte orientation of the data can be determined.

The radial velocity direction convention is NAPT : negative away, positive towards. Note that this is the opposite of the ODIM/H5 convention.

Table 3 : Volume Header Overview

Offset	No. Bytes	Section Name	Functional Description	Refer To
0	48	Identification	Provides basic information for identifying the file, including the nominal start and stop times for the volume.	Table 3a

48	24	Site Information	Provides information about the location of the radar site.	Table 3b
72	36	Hardware Configuration	Provides information about the radar hardware and capabilities.	Table 3c
108	36	Processor Configuration	Provides information about the way in which the scan has been configured.	Table 3d
144	24	Data Processing	Provides information about the data processing options and how the data has been stored.	Table 3e
168	24	Data Storage	Provides information about the type and way in which information has been stored.	Table 3f
192	64	Diagnostics	Used to report back the radar status and any problems encountered.	Table 3g

Format and Presentation - Storage of data

The data stored for each bin is stored as a Data Element. This might be a Single Parameter (e.g. the reflectivity) or Multiparameter (e.g. reflectivity, radial velocity and spectral width for Doppler measurements). The structure and interpretation of each Data Element is found by reference to a number of pre-defined Data Types.

Multiparameter Data Types are defined in Table 7. These represent cases where two or more values might be stored for each bin, either to minimise redundancy, to support the use of bitpacking or because this is the form in which data is output from a site processor.

- ☐ The bits used to represent individual parameters within a multiparameter data element will be permitted to cross byte boundaries. However, the total space occupied by a single data element should ideally be some multiple of 8 bits.
- ☐ As with single parameter data types, missing or bad values will be represented by setting all the bits representing that parameter to 1. Any or all of the parameters forming a multiparameter data element can be coded as missing data.

Single Parameter Data Types are defined in Table 8. These represent cases where there is only a single value per bin, where the information in a file has been derived from a Multiparameter Data Type.

- ☐ Single parameter data types are present in 4, 8, 12 and 16-bit resolutions.
- ☐ In all cases, missing or bad data will be represented by 299.
- ☐ A flag table is tagged at the end of the file by radarnet4, defined in Table 9. Each flag is a 8-bit integer and correspond to a single parameter bin gate (starting from 0 range and 0 degree, and increasing in range for each degree).

Table 3a : Volume Header, Identification (48 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
0	4x1	magic_number_1 magic_number_2 magic_number_3 magic_number_4	A sequence of four bytes with fixed values serving as a file type identifier. When read, the ASCII character codes for the string should be “RADF”.	Cyclops 5
4	2x2	byte_order_1 byte_order_2	A sequence of two 16 bit integer values serving as a check for byte ordering. If the first integer reads 0x8003 and the second reads 0xC001, then no endian swap is necessary. However, if the first integer reads 0x0380 and the second reads 0x01c0 then an endian swap is necessary. If endian swap is necessary, then all 16 bit values in the file will need to be swapped prior to use.	Cyclops 5
8	2	version_number	The version number of the processing software.	Cyclops 6
10	2	mode_of_operation	Code defining the type of data collection to distinguish between different operational scan patterns, and other types of data collection (e.g. clutter map collection, research). Used to determine what subsequent processing is applied (i.e. to distinguish between Volumes employed for precipitation measurement and Volumes employed for wind profiling). Valid codes are defined as: 0 : Non-standard mode of operation. 1 : Operational rainfall product generation. 2 : Operational wind profiling measurements	Cyclops 5
12	6 x 2	file_creation_year file_creation_month file_creation_day file_creation_hour file_creation_minute file_creation_second	Six 16 bit integer values giving the file creation time and date. These will be in the order Year (e.g. 2000), Month (1 – 12), Day (range 1-31), Hour (0 – 23), Minute (0 – 59) and Second (0 – 59).	Cyclops 5
24	6 x 2	volume_start_year volume_start_month volume_start_day volume_start_hour volume_start_minute volume_start_second	Six 16 bit integer values giving the time and date for which the first ray of data was collected. These will be in the order: Year (e.g. 2000), Month (1–12), Day (range 1-31), Hour (0–23), Minute (0–59) and Second (0–59).	Cyclops 5
36	6 x 2	volume_stop_year volume_stop_month volume_stop_day volume_stop_hour volume_stop_minute volume_stop_second	Six 16 bit integer values giving the time and date for which the last ray of data was collected. These will be in the order: Year (e.g. 2000), Month (1–12), Day (range 1-31), Hour (0–23), Minute (0–59) and Second (0–59).	Cyclops 5

Table 3b :Volume Header, Site Information (24 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
48	2	WMO_country_code	A single 16 bit integer value giving the WMO block number for the radar site. For example, this would be 3 for the UK and Ireland, and 7 for France.	Edge
50	2	WMO_site_number	A single 16 bit integer giving the three digit WMO site number (i.e. excluding the country code). For example, this would be 953 for Clee Hill.	Edge
52	3 x 2	radar_site_longitude_degrees radar_site_longitude_minutes radar_site_longitude_seconds	Three 16 bit signed integer values giving the longitude of the radar site in the order degrees (-180 to +180, with positive value representing east longitude), minutes (-59 to +59) and seconds (-59 to +59). The convention used is that the Greenwich meridian is 0 degrees longitude. NB. Sign convention must be applied to each part of longitude. e.g. 1°30'20" W , is equivalent to -1, -30 and -20.	Cyclops 6
58	3 x 2	radar_site_latitude_degrees radar_site_latitude_minutes radar_site_latitude_seconds	Three 16 bit signed integer values giving the latitude of the radar site in the order degrees (-90 to +90), minutes (-59 to +59) and seconds (-59 to +59). The convention used is that the equator is 0 degrees, latitudes to the north are positive, to the south negative. NB. Sign convention must be applied to each part of latitude. e.g. 1°30'20" S , is equivalent to -1, -30 and -20.	Cyclops 6
64	2	local_site_number	A single 16 bit integer value used to hold any site number in local use. For example, within the current UK network, Clee Hill is referred to as Site No. 3 and this would be the value stored.	Cyclops 5
66	2	local_grid_easting	A single 16 bit signed integer value giving the local grid reference easting in tenths of a kilometre. Local grid is assumed to be UKNG.	Cyclops 5

68	2	local_grid_northing	A single 16 bit signed integer value giving the local grid reference northing in tenths of a kilometre. Local grid is assumed to be UKNG.	Cyclops 5
70	2	sensor_height	A single 16 bit integer value giving the height of the antennae in metres above mean sea level.	Cyclops 5

Table 3c : Volume Header, Hardware Configuration (36 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
72	2	hardware_type	A 16 bit integer value defining the type of radar hardware. Valid codes are defined as: 0: Unknown 1: Plessey Type 45C 2: Plessey Type 46C 3: ECC (to be defined)	Cyclops 5
Table 3c (continue): Volume Header, Hardware Configuration (36 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
74	2	software_type	A 16 bit integer value defining the type of operating software. Valid codes are defined as: 0: Unknown 1: Cyclops Site Processor 2: Cyclops-D Processor 3: Edge with EDRP9 Processor	Cyclops 5
76	2	number_of_channels	A 16 bit integer value defining the type of radar system, particularly with reference to the reason for a secondary transmit-receive channel. Valid codes are: 0: Single-Channel. 1: Dual Polarisation (Two Channels). 2: Dual Frequency (Two Channels).	Cyclops 5
78	2	null1	Reserved for future use and set to 0.	-
80	2	channel_1_polarisation_mode	A 16 bit integer value giving a code defining what type of polarisation has been used for Channel 1. 0: Non-standard polarisation. 1: Linear, Vertical (0^o) 2: Linear, Forwards Slant ($+45^o$) 3: Linear, Horizontal (90^o) 4: Linear, Backwards Slant (-45^o) 5: Circular, Lefthand 6: Circular, Righthand For the single polaristion operational hardware configuration (e.g. Cyclops), this would be set to 1. Default setting to 3.	Cyclops 5
82	2	channel_2_polarisation_mode	As for Channel 1, but used where there is a second transmit/receive channel. Otherwise set to 0. Default setting to 1.	Cyclops 5
84	2	channel_1_radar_constant	A 16 bit integer value giving either the measured or estimated radar constant for Channel 1 in units of 0.1 dBZ.	Cyclops 5

86	2	channel_2_radar_constant	As for Channel 1, but used where there is a second transmit/receive channel. Otherwise set to 0.	Cyclops 5
88	2	channel_1_wavelength	A single 16 bit integer value giving the radar wavelength in millimetres. For current systems this would be 0053.	Cyclops 5
90	2	channel_2_wavelength	As for Channel 1, but used where there is a second transmit/receive channel. Otherwise set to 0.	Cyclops 5
92	2	channel_1_beam_width	A single 16 bit integer value giving the nominal, half-power (or 3 dB) beam width in hundredths of a degree. For current systems this would be 100.	Cyclops 5
94	2	channel_2_beam_width	As for Channel 1, but used where there is a second transmit/receive channel. Otherwise set to 0.	Cyclops 5
96	6 x2	null2[6]	Reserved for future use and set to 0.	-

Table 3d : Volume Header, Processor Configuration (36 bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
108	2	Type_of_scan	A single 16 bit integer value giving a code indicating the type of scan. These codes will be : 0: indicating an unstructured scan where neither the azimuth or elevation angles are fixed (e.g. helical scanning). 1: indicating a PPI scan where the requested elevation angle is fixed and the azimuth varies from ray to ray. 2: indicating an RHI scan where the requested azimuth angle is fixed and the elevation angle varies from ray to ray.	Cyclops 5
110	2	number_of_scans_in_volume	A single 16 bit integer value giving the number of separate scans comprising the volume. For example, for the current operational scan configuration (Cyclops 6.0) this would be the value 4, indicating four separate PPI scans at different elevations.	Cyclops 5
112	2	number_of_rays_per_scan	A single 16 bit integer value giving the number of rays comprising each scan, where this is fixed. For example, for the current operational scan configuration (Cyclops 6.0), this would be the value 360, indicating that each of the four scans comprised 360 rays. This will be set to 0 if the number of Rays can vary from Scan to Scan.	Cyclops 5

114	2	number_of_bins_per_ray	A single 16 bit integer value giving the number of bins comprising each ray. For example, this would be 340 for the current operational scan configuration (Cyclops 6.0). This will be set to 0 if the number of Bins per Ray can vary from Scan to Scan.	Cyclops 5
116	2	processed_range_bin_length	A single 16 bit integer value giving the bin length in metres. Note that this is the bin length as output from the signal processor and following any averaging in range. For the current operational scan configuration (Cyclops 6.0), this would be 750.	Cyclops 5
118	2	pulse_length	A single 16 bit integer value giving the pulse length in nanoseconds. For current systems this would be 2000.	Cyclops 5
120	2	antennae_rotation_rate	A single 16 bit integer value giving the requested antennae azimuthal rotation rate in degrees per minute. For example, this would be 396 for 1.1 rpm.	Cyclops 5

Table 3d (continue): Volume Header, Processor Configuration (36 bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
122	2	number_of_samples	A single 16 bit integer value giving the average number of azimuthal samples averaged for each bin output from the signal processor. (e.g. 40 or so at 1.2 rpm is a typical value for the UK network)	Cyclops 5
124	2	primary_PRF	A single 16 bit integer value giving the sole or higher Pulse Repetition Frequency used in Hertz. For the current operational scan configuration this would be 300.	Cyclops 5
126	2	secondary_PRF	A single 16 bit integer value giving the lower Pulse Repetition Frequency used in Hertz. Where only a single Pulse Repetition Frequency is employed, this should be set to 0.	Cyclops 5
128	2	unambiguous_range	A single 16 bit integer value giving the unambiguous range in steps of 0.1 km. This will include the effects of any unfolding done in the signal processor through the use of techniques such as random phase processing. Where two PRFs are employed, this should be the unambiguous range for the lowest or secondary PRF.	Cyclops D
130	2	unambiguous_velocity	A single 16 bit integer value giving the unambiguous velocity in steps of 0.01 ms^{-1}. This will include the effects of any unfolding done in the signal processor through the use of dual or staggered PRF techniques but excludes any subsequent unfolding that might be done in product generation. This value is used to translate phase measurements.	Cyclops D
132	6 x 2	null3[6]	Reserved for future use and set to 0.	-

Table 3e : Volume Header, Data Processing (24 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
144	2	processor_flags	A single 16 bit integer value used to store a bitflag array identifying what data quality options have been employed during signal processing. Individual bits will be allocated as follows: 0: Information is available. 1: Noise threshold employed. 2: Clutter power threshold employed. 3: SQI threshold employed. 4: Speckle filter employed. 5: Range normalisation applied. 6: Gaseous attenuation correction applied. 7: Precipitation attenuation correction applied. Unallocated bits will be set to 0.	Cyclops 5

Table 3e : Volume Header, Data Processing (24 bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
146	2	clutter_filter_type	A single 16 bit integer value giving a code for the clutter removal or suppression method used during signal processing at site. These codes will be: 0: No clutter removal or suppression employed. 1: Static clutter map employed. 2: Dynamic clutter map employed. 3: Statistical clutter filter employed 4: Doppler pulse-pair clutter filter employed 5: Doppler FFT clutter filter employed.	Cyclops 5
148	2	clutter_filter_response	For systems using clutter suppression, a single 16 bit integer value used to store a number indicating the filter response setting. For example, for a pulse pair processor this would indicate the set of coefficients defining the depth and width of the filter stop band. Set to 0 for systems, which do not employ clutter suppression.	Cyclops 5
150	2	clutter_power_threshold	For systems using clutter suppression, a single 16 bit integer value giving the clutter power threshold in tenths of a decibel, at which the values for individual bins are rejected. The clutter power is the difference in decibels between the reflectivity estimates before and after clutter suppression. Set to 0 for systems, which do not employ clutter suppression.	Cyclops 5

152	2	noise_threshold	A single 16 bit integer value giving the threshold in tenths of a decibel at which the values for individual bins will be rejected on the basis of a poor Signal To Noise Ratio (SNR). The SNR is defined as the difference in decibels between the measured reflectivity and the noise level.	Edge
154	2	SQI_threshold	For Doppler systems, the threshold in thousandths at which the values for individual bins are rejected on the basis of a poor Signal Quality Index (SQI), (i.e. 0 corresponds with an uncorrelated signal and 1000 is a coherent signal). The SQI is a test of signal coherency calculated as the ratio between the first and second autocorrelation lags. Set to 0 for non-Doppler systems.	Cyclops 5
156	2	flags_exit	A single 16 bit integer value used to indicate if the flag table (defined in table 9) has been set.	Radarnet 4
158	2	marshall_palmers_a	A single 16 bit integer value used to store the default Marshall Palmers A	Radarnet 4
160	2	marshall_palmers_b	A single 16 bit integer value used to store the default Marshall Palmers B multiplied by 100	Radarnet 4
162	2	zenith_mean_offset_zdr	A single 16 bit integer value used to store the mean ZDR offset (multiplied by 100 with an offset of 800 i.e. offset ranging from -8.00 to +8.00dB), calibrated using measurement collected at vertical incidence.	Radarnet 4
164	2	zenith_stdev_offset_zdr	A single 16 bit integer value used to store the standard deviation of the mean ZDR offset stored in offset 162.	Radarnet 4
166	1 x 2	null4[1]	Reserved for future use and set to 0.	

Table 3f : Volume Header, Data Storage (24 bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
168	2	derived_data_type	A single 16 bit integer value, giving the code for the type of data actually stored. Lists of valid codes for single and multiparameter data types are given in Tables 8 and 7 respectively.	Cyclops 5
170	2	source_data_type	A single 16 bit integer value, used to store the source data type in instances where a single parameter has been derived from a multiparameter data type. This will be set to 0 where there is no source data type.	Cyclops 5

172	2	number_of_bytes_per_element	A single 16 bit integer value giving the number of bytes of data stored for each bin. At present, this will always be 1 for single parameter data types. For multiparameter data types, this is defined in Table 7.	Cyclops 5
174	2	number_of_values_per_element	A single 16 bit integer value giving the number of separate parameters stored for each bin. Naturally, this will always be 1 for single parameter data types. For multiparameter data types, this is defined in Table 7.	Cyclops 5
176	2	compression	A single 16 bit integer value used to indicate whether compression has been employed. This will be set to 1 if run length encoding has been employed or 0 if the data is uncompressed.	Cyclops 5
178	2	accumulation_counts	A single 16 bit integer value used to indicate the number of scan used for deriving single parameter data types 1124, 1125, 1126, and 1610.	Radarnet 4
180	2	accumulation_period	A single 16 bit integer value used to indicate the time interval between 2 scans i.e. 5 mins .	NU
182	5 x 2	null5[5]	Reserved for future use and set to 0.	-

Table 3g : Volume Header, Diagnostics Section (64 bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
192	2	diagnostic_flags_1 diagnostic_flags_2	Bitflag array indicating whether particular problems have been detected (e.g. EHT Resets, FIFO Overflow). To be defined.	Cyclops 5
194	31 x 2	null6[31]	Reserved for future use and set to 0.	-

Table 4: Scan Header Structure (64 Bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
0	2	scan_index	A single 16 bit integer value giving the index of the scan within each volume. The first scan will have the value 0.	Cyclops 5
2	2	number_of_rays_in_scan	A single 16 bit integer giving the number of rays comprising each scan, where this is fixed. For example, for the current operational scan configuration (Cyclops 6.0), this would be the value 360, indicating that each of the four scans comprised 360 rays. Note that for RHI scans this value would be set to 1.	Cyclops 5

4	2	number_of_bins_in_ray	A single 16 bit integer value giving the number of bins comprising each ray. For example, this would be 340 for the current operational scan configuration (Cyclops 6.0).	Cyclops 5
6	2	range_to_first_bin	A single 16 bit integer value giving the range to the start of the first bin in metres. This would be 0 for the current operational scan configuration.	Cyclops 5
8	2	scan_start_seconds	16 bit integer value giving the time is seconds from the volume start time and date recorded for the first ray of data comprising the scan. Note that this will normally be slightly later than the stop time recorded for any previous scan.	Cyclops 5
10	2	scan_stop_seconds	16 bit integer value giving the time is seconds from the volume start time and date recorded for the last ray of data comprising the scan. Since data collection will be continuous within a scan, the time for each individual ray can be estimated from its position within the scan.	Cyclops 5
12	2	scan_start_azimuth	16 bit integer value representing the requested starting azimuth angle for the scan. Tenths of a degree from North; range 0-3600. Note that the requested azimuth will not necessarily be the same as the actual azimuth of the first ray as reported by the radar control unit.	Cyclops 6

Table 4 (continue): Scan Header Structure (64 Bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
14	2	scan_stop_azimuth	16 bit integer value representing the requested ending azimuth angle for the scan. Tenths of a degree clockwise from North; range 0-3600	Cyclops 6
16	2	scan_start_elevation	16 bit integer value giving the elevation requested for a scan. Tenths of a degree above the horizontal; range 0-900	Cyclops 6
18	2	scan_stop_elevation	16 bit integer value giving the average elevation measured during a scan. Tenths of a degree above the horizontal; range 0-900	Cyclops 6
20	2	beam_number.	16 bit integer value giving the scan number, used for Cyclops systems. For PPI volume scans, the scan number for the lowest elevation is set to 0, the preceding scan is set to 1, and so on. Similarly, for RHI volume scans, the scan number of the lower azimuth should be set to 0.	Cyclops 5

22	2	number_of_elevation_in_scan	A single 16 bit integer value giving the number of elevation comprising each scan. This information is for the purpose of a RHI scan. For example, a scan from 0 to 60 degree elevation every 0.5 degrees would comprise 120 elevations per scan	Cyclops D
24	2	rhi_start_elevation	16 bit integer value giving the starting elevation for an RHI scan. Tenths of a degree above the horizon range 0-900.	Cyclops D
26	2	rhi_stop_elevation	16 bit integer value giving the ending elevation for an RHI scan. Tenths of a degree above the horizon range 0-900.	Cyclops D
28	4	transmitting_frequency	16 bit integer value giving the measure of the frequency at the start of each scan, in Hz minus 5GHz	Cyclops D
32	2	channel_1_noise_sample	16 bit integer value giving the noise sample value (in A/D count) which is subtracted to the signal (varying with elevation, and channel).	Edge
34	2	channel_2_noise_sample	16 bit integer value giving the noise sample value (in A/D count) which is subtracted to the signal (varying with elevation, and channel).	Edge

Table 4 (continue): Scan Header Structure (64 Bytes)

Offset	Size	Radarnet Field name	Description of Field	First coded in:
36	2	channel_1_ambient_noise	16 bit unsigned integer value giving the equivalent ambient noise value, in hundreds of dBc units with an offset of 3200.	Cyclops-D2
38	2	channel_2_ambient_noise	16 bit unsigned integer value giving the equivalent ambient noise value taken at 1 km, in hundreds of dBc units with an offset of 3200.	Cyclops-D2
40	2	channel_1_rx_calibration_offset	16 bit signed integer value giving the offset of the calibration response of the receiver. The values are in tens of dBm units.	Cyclops-D2
42	2	channel_2_rx_calibration_offset	16 bit signed integer value giving the offset of the calibration response of the receiver. The values are in tens of dBm units.	Cyclops-D2
44	2	channel_1_receiver_saturation	16 bit integer value giving the receiver saturation level value in hundreds of dBc units.	Cyclops-D2

46	2	channel_2_receiver_saturation	16 bit integer value giving the receiver saturation level value in hundreds of dBc units.	Cyclops-D2
48	2	channel_1_injected_noise_power	16 bit integer value giving the pulse noise value in hundredths of dBc units used to derive the receiver noise.	
50	2	channel_2_injected_noise_power	16 bit integer value giving the pulse noise value in hundredths of dBc units used to derive the receiver noise.	
52	2	channel_1_receiver_noise_power [noise figure]	16 bit integer value giving the noise figure in hundredths of dB units which corresponds to the receiver noise introduced to the signal.	
54	2	channel_2_receiver_noise_power [noise figure]	16 bit integer value giving the noise figure in hundredths of dB units which corresponds to the receiver noise introduced to the signal.	
56	2	transmitter_pulse_power	16 bit integer value giving the transmitter pulse power in hundredths dBm units as measured at Cyclops.	Cyclops-D2
58	2	radar_constant	16 bit integer value giving the radar constant in tenth of dB – default value is 729.	Cyclops D2
60	4	NCOFreq	32 bit integer value giving the NCO frequency in units of Hz.	

Table 5 : Ray Header Structure (10 Bytes)				
Offset	Size	Radarnet Field name	Description of Field	First coded in:
0	2	difference_to_start_of_scan_ transmitted_frequency Or Standard Deviation of Noise Or V Channel Noise	A single 16 bit integer value giving the difference between the actual transmitted frequency for this ray and the transmitted frequency recording at the beginning of the scan (stored in scan header offset 28) Or A single 16 bit integer value giving the standard deviation of noise (calculated over all available gates beyond 255 km), in thousandths of dBc. Or A single 16 bit integer value giving the equivalent ambient horizontally polarized noise (averaged over all available gates beyond 255km) in hunderdths of dBc units with an offset of 3200.	Cyclops D Cyclops D2.1 Cyclops-D4-rc4
2	2	azimuth_centre_angle	A single 16 bit integer giving the average antennae azimuth for the ray as reported by the dsp card. Hundredths of degrees; range 0-36000, measured clockwise from UK National grid North.	Cyclops 5
4	2	elevation_angle	A single 16 bit integer giving the average antennae elevation angle above the horizon for the ray (as reported by the dsp card for Cyclops). tenths of degrees; range 0-900 or A single 16 bit integer giving the zdr azimuth offset in hundredths of dB with an offset of 800.	Cyclops 5 Radarnet4 for data type 2211 only

6	2	number_of_bytes_of_data Or Noise Value Or H Channel Noise	A single 16 bit integer value giving the number of bytes occupied by the data for the ray subsequent to any run-length compression. Where no compression has been employed this will be equivalent to the number of bins per ray x data element size in bytes. Or A single 16 bit integer value giving the equivalent ambient noise value, in hundreds of dBc units with an offset of 3200. Or A single 16 bit integer value giving the equivalent ambient horizontally polarized noise (averaged over all available gates beyond 255km) in hunderdths of dBc units with an offset of 3200.	Cyclops 5 Cyclops D2 Cyclops D2.1 Cyclops-D4-rc4
8	2	number_of_rays_per_degree	A single 16 bit integer value giving the number of rays used in the averaging process, as reported by the dsp card in Cyclops. In the current scheme (Cyclops 6.0) this value (42 at 1.2 rpm) will have to be multiplied by 2.5 to represent 750m x 1 degree resolution bin.	Cyclops 5

Table 7: MultiParameter Data Types – Polar Output by Site Processor							
Data Type	Multi-parameter	No. of Bytes	No. of Elements	Bits Used	Parameter Name	Physical Offset	Physical Increment
2111	Augmented Reflectivity	2	2	0 - 11	Reflectivity (V)	-32 dBZ	0.1 dBZ
				12 - 15	Ci	None	see table 7a
2108	Augmented counts	2	2	0 - 11	Count (V)	-32 dBc	0.05 dBc
				12 - 15	Ci	None	see table 7a
2122	Augmented Doppler	4	4	0 - 11	Reflectivity (V)	-32 dBZ	0.1 dBZ
				12 - 15	Ci	None	see table 7a
				16 - 27	Radial Velocity	-π	$^{\pi}/_{2^{11}}$
				28 - 31	SQI	0	$^{1}/_{2^{4}}$
2141	Augmented Refractivity	4	4	0 - 11	Reflectivity (V)	-32 dBZ	0.1 dBZ
				12 - 15	Ci	None	see table 7a
				16 - 25	Absolute phase - V	0	$^{2\pi}/_{1024}$
				26 - 31	SDP: the power normalized, quadrature sum of the standard deviation of I and Q, expressed as a dB value	-40 dB	0.625 dB
2211	Augmented Zdr	10	10	0 - 11	Reflectivity (H)	-32 dBZ	0.1 dBZ
				12 - 15	reserved	-	-
				16 - 27	Radial Velocity	-π	$^{\pi}/_{2^{11}}$
				28 - 31	reserved	-	-
				32 - 39	Spectral Width	0	$^{\pi}/_{256}$
				40 - 47	ZDR	- 8.0 dB	0.0625 dB
				48 - 55	KDP	-10	0.07812
				56 - 63	Rho HV	-0.2	0.005
				64 - 75	Phi DP	-π	$^{\pi}/_{2048}$
				76 - 79	reserved	-	-

(Continue next page …)

Note that the offset is applied to the data first, and the increment second. For example :
-31.9 dBZ = 1 aug reflectivity

Table 7 (continue): MultiParameter Data Types – Polar Output by Site Processor

Data Type	Multi-parameter	No. of Bytes	No. of Elements	Bits Used	Parameter Name	Physical Offset	Physical Increment
2212	Augmented LDR	8	8	0 - 11	Reflectivity (H)	-32 dBZ	0.1 dBZ
				12 - 15	CI	NONE	See Table
				16 - 27	Radial Velocity	-π	$^{\pi}/_{211}$
				28 - 31	SQI	-	-
				32 - 39	Spectral Width	0	$^{\pi}/_{256}$
				40 - 47	LDR	-40 dB	0.2 dB
				48 - 59	Absolute phase - V	-π	$^{\pi}/_{2048}$
				60 - 63	reserved	-	-
2213	Augmented Zdr2	10	10	0 - 11	Reflectivity (H)	-32 dBZ	0.1 dBZ
				12 - 15	CI	NONE	See Table
				16 - 27	Radial Velocity	-π	$^{\pi}/_{211}$
				28 - 31	SQI	-	-
				32 - 39	Spectral Width	0	$^{\pi}/_{256}$
				40 - 47	ZDR	- 8.0 dB	0.0625 dB
				48 - 63	Rho HV	-0.2	0.00002
				64 - 75	Phi DP	-π	$^{\pi}/_{2048}$
				76 - 79	reserved	-	-
2214	Augmented LDR2	8	8	0 - 11	Reflectivity (H)	-32 dBZ	0.1 dBZ
				12 - 15	CI	NONE	See Table
				16 - 27	Radial Velocity	-π	$^{\pi}/_{211}$
				28 - 31	SQI	-	-
				32 - 39	Spectral Width	0	$^{\pi}/_{256}$
				40 - 47	LDR	-46 dB	0.2 dB
				48 - 59	Absolute phase - V	-π	$^{\pi}/_{2048}$
				60 - 63	reserved	-	-
2154	Reflectivity CPA	2	2	0-9	Reflectivity	-32.0 dBZ	0.1 dBZ
				10-15	CPA	0	$^{1}/_{26}$
2126	Reflectivity PR	2	2	0-9	Reflectivity	-32.0 dBZ	0.1 dBZ
				10-15	PR	0	$^{1}/_{26}$

Table 7a: Lookup table to decode CI data produced by Cyclops version 5 and above	
Coded CI	CI, in dB
0	0.0
1	1.5
2	2.0
3	2.5
4	2.75
5	3.0
6	3.25
7	3.5
8	3.75
9	4.0
10	4.25
11	4.5
12	5.0
13	5.5
14	6.0
15	7.0

Table 8 : Single Parameter Data Types – Radarnet4			
Data Type	No. of Bytes (and type)	Parameter Name	Parameter Description
Reflectivity parameters			
1810	4 (float)	FP_ZN	Measure of the calibrated (but no range correction or noise subtraction) of the radar signal, in Z, also corrected with a site sensitivity factor of 2.96 for radars running Cyclops.
1811	4 (float)	FP_Z	Measure of the calibrated and range corrected radar signal, in Z, corrected with a site sensitivity factor of 2.96 for radars running Cyclops.
1114	4 (float)	FP_DBZ	Measure of the calibrated and range corrected radar signal, in dBZ, corrected with a site sensitivity factor of 2.96 for radars running Cyclops.
1113	4 (float)	FP_CI	Measure, in dB, of the pulse-to-pulse variation of power. CI stands for clutter indicator - this value is used to identify clutter for radar running Cyclops version 5 and above.
Doppler Parameters			
1812	4 (float)	FP_V	Radial wind:- Measure, in m/s, of radial winds.
1813	4 (float)	FP_W	Spectral width:- Measure, in m/s, of spectral width.
1814	4 (float)	FP_REFRACTIVE_INDEX	Measure of the refracting index.
1815	4 (float)	FP_RELATIVE_HUMIDITY	Measure of the relative humidity derived from the refractive index (data type 1814)
1816	4 (float)	FP_SQI	Measure of the Doppler Signal Coherence
Dual polarisation parameters			
1511	4 (float)	FP_ZDR	Measure, in dB, of the differential reflectivity corrected for zero offset.
1512	4 (float)	FP_KDP	Measure, in ^{o}/km, of the specific differential phase. This value is derived from the differential phase (data type 1513).
1513	4 (float)	FP_PHIDP	Measure, in degree, of the differential phase, corrected for hardware offset
1514	4 (float)	FP_RHOHV	Measure of the correlation coefficient between the time series of power received in H and V channel.
1515	4 (float)	FP_LDR	Measure, in dB, of the linear depolarisation ratio between the cross-polar return in the V channel for a horizontally polarised transmission.
Dual polarisation products			
1521	2 (unsigned int)	FP_MARSHALL_PALMER_A	An estimate of Marshall Palmer parameter A (default value in the volume header offset 154) – derived using Thompson et al (2005) algorithm.
Outputs from the VPR Correction			

1611	4 (float)	FP_RAINFALL_RATE	Measure of the rainfall rate, in mm/hr, derived by the VPR for the lowest usable scan for each polar pixel.
1115	1 (unsigned int)	LUS_MAP	LUS map:- Map of the Lowest Usable scan, derived by the VPR of each polar pixel.
1127	1 (unsigned int)	UNCERTAINTY	Measure of the uncertainty of the surface rainfall rate for each polar pixel.

Table 8 (continue) : Single Parameter Data Types – Radarnet4

Data Type	No. of Bytes (and type)	Parameter Name	Parameter Description
Outputs from the VPR Correction (continue)			
1116	1 (float)	ARC	Class the area of radar coverage according to: 1) rain detected; 2) radar could have detected rain but no rain present; 3) the radar could not have detected rain (e.g. SNR too high or blockage).
1400	2 (int)	QI	Measure of a quality indicator.
1500	2 (int)	WEIGHTS	Measure of a weight for each polar pixel based on its distance from the radar (produced for NWP).
Maps derived from auxiliary observation network or models			
1117	4 (int)	GROUND_HEIGHT	Ground height:- Measure of the ground height above sea level over the radar coverage.
1118	4 (int)	FP_OROGRAPHY	Orographic Enhancement:- Measure of the Orographic enhancement derived to the reflectivity.
1119	4 (int)	FP_CTOP	Measure of the cloud top height derived from satellite images.
1911	4 (int)	ALPHAS	Probability of precipitation derived from MSG data synoptic observations.
1122	4 (int)	FP_FREEZING_LEV	Freezing Level:- Measure of the Freezing level height, derived Nimrod.
Accumulation files			
1610	4 (float)	FP_RAINFALL_ACC	Accumulation of the rainfall rate product.
1124	4 (float)	FP_DBZ_ACC	Accumulation of the reflectivity in dBZ.
1125	4 (float)	FP_SQDBZ_ACC	Accumulation of the square of the reflectivity in dBZ – used to identify stable targets to monitor the stability of the signal.
1126	4 (unsigned int)	INT_COUNT_ACC	Daily measure of the number of returns detected for each pixel - used to derived the 3-monthly and 6-monthly FOD maps (data types 1711 and 1712 respectively).
1524	4 (float)	AZIM_ACCUM_RHOHV	As 1520 but for the co-polar correlation coefficient.

1525	4 (float)	AZIM_ACCUM_LDR	As 1520 but for the linear depolarisation ratio in linear unit.

Table 8 (continue) : Single Parameter Data Types – Radarnet4			
Data Type	No. of Bytes (and type)	Parameter Name	Parameter Description
Azimuth dependencies monitoring accumulation files			
1519	4 (float)	AZIM_ZDR_OFFSET	Offset to be subtracted to ZDR measurements to compensate for the interference of the radome joints.
1520	4 (float)	AZIM_ACCUM_Z	Accumulation for each azimuth of the reflectivity in linear unit. Only applied for liquid phase backscatters.
1521	4 (float)	AZIM_ACCUM_ZDR	As 1520 but for the differential reflectivity in linear unit.
1523	4 (float)	AZIM_ACCUM_PHIDP	As 1520 but for the differential phase in degree.
Azimuth dependencies monitoring accumulation files (continue)			
1530	4 (float)	AZIM_ACCUM_SQZ	Accumulation for each azimuth of the square reflectivity in linear unit. Only applied for liquid phase backscatters.
1531	4 (float)	AZIM_ACCUM_SQZDR	As 1530 but for the square differential reflectivity in linear unit.
1533	4 (float)	AZIM_ACCUM_SQPHIDP	As 1530 but for the square differential phase in degree.
1534	4 (float)	AZIM_ACCUM_SQRHOHV	As 1530 but for the square co-polar correlation coefficient.
1535	4 (float)	AZIM_ACCUM_SQLDR	As 1530 but for the square linear depolarisation ratio in linear unit.
Maps derived from accumulation files			
1120	1 (unsigned int)	OCCULTATION_MAP	Map derived monthly using a 6-monthly frequency of detection map (data type 1712), and an horizon map.
3333	2 (int)	POD_DIFFERENCE	Map indicating which polar pixels have a high probably of sea clutter returns – derived from the 6-monthly FOD map (data type 1712).
1128	1(unsigned int)	POD Or INT_POD	Probability of detection, also referred to as dynamic clutter map, derived from the 3-monthly FOD map (data type 1711)
1711	4 (unsigned int)	FOD3	FOD3:- 3-monthly Frequency of detection map, derived from the last 3 months worth of daily accumulation of returns for each pixel (data type 1126).

1712	4 (unsigned int)	FOD6	FOD6:- 6-monthly Frequency of detection map, derived from the last 6 months worth of daily accumulation of returns for each pixel (data type 1126).

Table 9 : Single Parameter Data Flag – set by Radarnet4 Odd number – Invalid pixels : if not 0 then correction needs to be applied Even number – Valid pixels: if not 0 then correction has been applied 1 byte per gate		
Value	Flag Name	Flag Descriptions
INVALID DATA FLAGS		
1	IFLAG_INVALIDE_DATA 1	Invalid data.
3	IFLAG_PROBABLE_NOISE 11	Data below the pre-defined noise threshold.
5	IFLAG_PROBABLE_CI_CLUTTER_AP 101	Data most likely affected by clutter/anaprop as identified using CI and climatological statistics.
9	IFLAG_PROBABLE_SPECKLE 1001	Isolated data point, most likely plane or last remaining clutter pixel.
17	IFLAG_PROBABLE_PROBABLE_ALPHA_AP 1 0001	Data most likely affected by anaprop. Identified using a probability of precipitation field derived by nimrod.
33	IFLAG_PROBABLE_MAJOR_OCCLUSION 10 0001	Data most likely located in a major occlusion zone based on climatological statistics.
65	IFLAG_PROBABLE_DP_NONPP_ECHO 100 0001	Data most likely affected by clutter/anaprop as identified using dual polarisation parameters and climatological statistics.
129	IFLAG_INDEFINE2 1000 0001	
VALID DATA FLAGS		
0	IFLAG_VALIDE_DATA 0	Valid data.
2	IFLAG_CONV_ATTENUATION_CORR_CAP 10	Pixel corrected with the maximum attenuation factor.
4	IFLAG_ABOVE_MODEL_FLH 100	Lower edge of the radar beam at this pixel location is above the freezing level height as reported by model field data.
8	IFLAG_BELOW_BRIGHT_BAND 1000	Higher edge of the radar beam at this pixel location is below the bright band as define to be 500m below the freezing level height reported by model field data.
16	IFLAG_GRAUPEL_FLAG_SET 1 0000	Graupel flag set as define by the vertical profile of reflectivity.
32	IFLAG_MINOR_OCCLUSION_CORRECTED 10 0000	Data corrected for minor occlusion not larger than 1 degree, using extrapolation between adjacent rays.
64	IFLAG_RX_SATURATION_REACHED 100 0000	Data power level has reached the saturation level of the radar receiver and is therefore most likely to be underestimated.
128	IFLAG_INDEFINE1 10000 0000	