Fisheries Technology Committee

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Report of the

Planning Group on the HAC Data Exchange Format

Bergen, Norway
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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 OPENING OF THE MEETING

The meeting was Chaired by D. Reid, (UK, Scotland) who also acted as rapporteur. A full list of participants is attached as Annex 1.

2 BACKGROUND

The terms of reference for PGHAC as agreed at the FAST meeting (Montpellier, France, June 2002) and approved at the ICES Annual Conference, Copenhagen, Denmark, September 2002 were:

a) continue to work on the HAC format in order to adapt it to the latest versions of equipment and to improve it;
b) provide information on the changes in the format and its evolution;
c) share information between manufacturers and users on the way acoustic data are processed and stored
d) agree on the definition of two new tuples for the use of attitude sensors on towed bodies.

The planning group reported to the June 2003 meeting of WGFAST (Bergen, Norway, June 2002) and to the Fishing Technology Committee at the 2003 Annual Science Conference

3 INTRODUCTION

In 1999 the FAST WG (meeting in St. John's, Newfoundland) adopted the ***HAC*** standard data format for raw and edited hydroacoustic data (Simard *et al*. 1997, 1999) as the common format for exchanging fisheries acoustics data and for comparing processing algorithms within the ICES community (ICES CM 1999/B:2: Section 10.3, p. 12). A group of experts including FAST members and representatives of hardware and software manufacturers was assigned the responsibility of coordinating the development of the format. This included the examination of proposals to introduce new information in the ***HAC*** environment and the definition of a generic set of tuples for echosounders that were not covered by the already defined tuples[*] of this upgradable format. At the WGFAST in Haarlem, Netherlands, it was agreed that this was a major issue of importance to all members of the fisheries acoustic community and that a more permanent group should be set up. This was proposed at the ASC in Bruges, Belgium (September 2000) and was formally incorporated as an ICES Planning Group (PGHAC, ICES Annual Report for 2000. Part 3. p. 256).

4 SUBJECTS ADDRESSED

The PG discussed the following main issues:

- New Tuples added to the existing set:
  - Independent platform attitude tuples (42 and 10142)
  - SIMRAD EK60 Tuples
  - Speed through the water and vessel log tuples (30 and 31)
- Single documentation correction issues
  - Tuple 2001 had the wrong specified size
  - Missing field in documentation of tuple 10140
  - Problems with stated "unavailable" value in some fields
- Calculation of range field in tuple 10090
- Allocation of development tuples for SIMRAD multibeam sonar
- Inclusion of "edited" in attribute field to signify non "raw" data

[*] Tuple: a labelled group of bytes encapsulating special type of information in the ***HAC*** format, which forms the basic structure of this format and that gives the format its upgradability and versatility property. Tuples belongs to tuple families or classes that groups the information by themes. Unique numbers, varying from 0 to 65535, identify each tuple. The ***HAC*** co-ordinating committee has to allocate these numbers to prevent any "collision" in the tuple usage by various groups around the world and to agree on the definition of the various fields of information they contain.

- Description of negative values in angle data tuples

- Problems with the application of new variable length tuples

- Completion of remark fields – pad or terminate

- HAC for Acoustic Seabed Classification data collection

- HAC for recording of Multi-beam sonar data

- New HAC standard document

- Data exchange using HAC

The new tuples and changes to existing tuples are detailed in the annex and are only described briefly here. For more detail please see Annex 2

5 NEW TUPLES ADDED TO THE EXISTING SET

Three new sets of tuples were proposed for inclusion in the format.

- Independent platform attitude tuples (42 and 10142)
- SIMRAD EK60 Tuples
- Speed through the water and vessel log tuples (30 and 31)

5.1 Independent platform attitude tuples (42 and 10142)

These new tuples were proposed and written by IFREMER to allow the recording of the attitude and relative position of an independent platform e.g. a towed body or sounder mounted on a fishing net. The tuples needed to describe the set up for such a platform and its attitude recording systems (tuple 42) and a ping style tuple for recording continuous data (tuple 10142). The specifications proposed by IFREMER were accepted with a few small changes. Namely:

- Platform offsets should be described with reference to vessel "heading" and not to vessel "track".

- The term "transducer channel **number**" in tuple 41 should be changed to match the term "transducer channel **identifier**" now used in tuple 42.

The new tuples were accepted on the standard 2 months approval. The tuple descriptions are provided in tables 2 and 3 in Annex 2.

5.2 New Tuples for use with the SIMRAD EK60 Echosounder.

Outline proposals for new sounder and channel tuples for the EK60 were presented at the 2002 meeting. Revised versions of these were presented at this meeting. In general the tuples appeared to meet the requirements of the format (Simard *et al*. 1997, 1999). However, there were some problems that required correction before acceptance, and some agreements on approach.

- SIMRAD questioned the need for a specific EK60 tuple, and suggested using the generic sounder tuple. This was rejected by the group, as it was felt that there were sufficient unique elements to the EK60 to merit a specific tuple.

- The subject of floating points was revisited following the last presentation of the EK60 tuples. The group agreed that floating point variables lacked precision and that continuous variables should always be coded as LONG or ULONG and to 4 decimal places.

- The comment field in the sounder tuple was being used extensively for information on the system. The group agreed that this should be moved to specified fields.

- In some cases the design used blank spaces for "unavailable" This should be avoided. The following is reprinted from the last report: ***Where possible, "unavailable/not known" will generally use the maximum permissible value for unsigned fields and the minimum permissible value for signed fields.***

- SIMRAD requested that they be able to use the U16 tuples 10030 for power data and 10031 for angle data. These tuples are not currently used by any software, and so this was agreed. In addition these will now be adopted into the standard.

Subject to the changes detailed above and bearing in mind the commercial development timetable at SIMRAD, the PG agreed that these tuples would be accepted on a six month approval. The finalised tuples will be circulated to the members and comments invited. The final versions will be reviewed at the 2004 meeting of PGHAC, in Poland April, 2004, and included in the 2004 report.

Draft versions of the EK60 sounder and channel tuples (210 and 2100) are attached to this report (tables 4 and 5 in Annex 2). They are presented here for reference only and may be subject to further alteration prior to approval.

5.3 Speed through the water and vessel log tuples (30 and 31)

At the 2002 meeting of PGHAC IFREMER requested and were assigned two tuples (30 and 31) to develop for the recording of speed of the vessel through the water and for vessel log pulses. It was concluded that tuple 30 was useable in its current form and that 31 was not needed at all. Therefore, no changes to the format were made.

6 SINGLE DOCUMENTATION CORRECTION ISSUES

6.1 Tuple 2001 had the wrong specified size

In the last documentation from the 2002 meeting, tuple 2001 (EK500 channel tuple) was given as having a length of 112 bytes (data size of 102 bytes). This should actually read 116 bytes (data size of 106 bytes). Investigation suggests that CH1 and Movies both use the correct size and it is assumed that Echoview does so also. The documentation has been changed accordingly and the new correct tuple description included in this report. For full tuple format see table 7.

6.2 Missing field in documentation of tuple 10140

There is an error in the documentation for the Attitude sensor tuple 10140. There should be a 2-byte space field after the Yaw field. However, the total number of bytes is correct in the description. DFO has collected some data with the missing space field and this may cause problems when reading by other software. DFO have implemented a "bypass" in CH2 to detect the error, and CH1 now saves the tuple correctly. DFO will also implement a "plugin" to correct the error for future data exchange. For full tuple format see table 7.

6.3 Problems with stated "unavailable" value in some fields

There is also an error in the documentation for the "not available" values in tuple 10140. In the 2002 report the unavailable value was specified as the highest possible value, rather than the lowest possible value i.e. + rather than -. The format specifies the lowest possible value for signed fields. This oversight may also occur in the documentation of other tuples. Therefore, programmers should pay particular attention to this issue. For full tuple format see table 7.

7 CALCULATION OF RANGE FIELD IN TUPLE 10090

The SIMRAD acquisition software produces the DEPTH of a detected single target, whereas in most cases the users would prefer the RANGE to that target. It appears that the SIMRAD software calculates the depth from the range and angle, so this value is a calculated rather than "raw" value. PGHAC would like manufacturers to provide the range to the target in any future applications. In addition, it was agreed that SIMRAD would make the algorithm for calculating depth from range available to the general user. This would allow the back calculation for range. When this is made available it will be included in the format text as a footnote.

8 ALLOCATION OF DEVELOPMENT TUPLES FOR SIMRAD MULTIBEAM SONAR

SIMRAD are currently developing a new multi-beam "sounder" for fisheries purposes. Due to their special interest in this IFREMER requested allocation of a sounder and a channel tuple for development for this system. The PG agreed to allocate tuple 220 (sounder) and 2200 (channel) to IFREMER for this purpose.

9 INCLUSION OF "EDITED" IN ATTRIBUTE FIELD TO SIGNIFY NON "RAW" DATA

The basic concept of the HAC format is that the data should be in its rawest possible form, and that all information for post processing should be included. However, there are many cases where "semi-processed" data are required. This is most common when the data are to be exchanged between users of different software. Examples might include incorporation of motion sensor data or redrawing of the seabed. It was agreed, therefore, to include the possibility of an "edited" value in the attribute for any tuple which has been altered, however little. This can act as a warning to the user. The onus is then on the user to find out what has been changed if required.

10 DESCRIPTION OF NEGATIVE VALUES IN ANGLE DATA TUPLES

There are two accepted ways of storing negative values. These are either as "Two's complement" or as "sign + magnitude". The format as it currently exists does not specify which method should be used to store negative numbers. "Two's complement" has been used by some developers and "sign + magnitude" by others in the angle data tuples. It was agreed that the format should recognise this and also that "Two's complement" is the general standard in software. It was therefore, decided that "Two's complement" be used from now on for storing all negative numbers, and that programmers should implement code to allow for both in angle data tuples.

11 PROBLEMS WITH THE APPLICATION OF NEW VARIABLE LENGTH TUPLES

In the 2002 report PGHAC decided that all future tuples should have a variable length, to allow modification without the use of "patch" tuples. However, the PG had also decided in 2001 to allow the use of variable length remark fields. The combination results in tuples which are not easily readable by most software. This has generated some data problems with tuples 901 and 9001 (generic sounder and channel) and also in 2002 (the patch tuple for the EK500 channel). There was some confusion about the best solution to this problem. For the time being it was decided to leave tuples 901 and 9001 with variable length remarks, and use the "patch" tuple approach to fix any future problems. For tuple 2002, remark size will now be considered as fixed at 20 bytes – see table 8 for the full description. This topic will be reconsidered at the next meeting of PGHAC.

12 COMPLETION OF REMARK FIELDS – PAD OR TERMINATE

The use of fixed length remarks means that there will be unused space in the field. This raised the question of whether the space should be filled with some sort of padding character, or whether the remark should be explicitly terminated. It was agreed that the best solution was to terminate any remark with a "null" character, and leave the rest of the field untouched.

13 HAC FOR ACOUSTIC SEABED CLASSIFICATION (ASC) DATA COLLECTION

Following the 2002 meeting an approach was made by Quester-Tangent of Canada about the potential for the use of the HAC format to store sea bed classification data. This issue has become more topical with the formation of the Acoustic Seabed Classification Study Group within FAST. It was agreed that to a great extent the data specifications and quality required by HAC was also required for input to ASC post processing. To that extent, the existing HAC format would be appropriate. The output data is relatively straightforward and is also highly processed, as in such a form it is no longer easily transferable to another analysis system, the need for a HAC tuple description was unclear. It was agreed that Quester Tangent would study the existing format, and determine if all the requisite data fields were available. If not they will propose modifications which can be examined by the PG at its 2004 meeting.

14 HAC FOR RECORDING OF MULTI-BEAM SONAR DATA

In principle the HAC format should allow the recording and exchange of data from multi-beam systems. Multi-beam analysis applications are being developed by IFREMER, SonarData and Quester Tangent. Historically, DFO developed HAC for their own purposes, the format was then adopted by the community as an exchange standard and PGHAC was set up to administer and document changes to the format in an international context. To a great extent this has been carried out successfully (see section 16 below). As multi-beam is generally seen as the next major area of development in fisheries acoustics, it was felt by PGHAC that it should have a major role in providing format and ensuring compatibility across analysis systems. It was agreed that PGHAC would monitor developments in this field and review any proposed tuple construction.

15 NEW HAC STANDARD DOCUMENT

The HAC format was originally published in 1997 (Simard *et al* 1997). Since then PGHAC has been responsible for generally improving and expanding the format, and providing a review forum for new components. New tuples and changes to existing tuples have been published individually as appendices to the reports of PGHAC since 2000. As a result there is no comprehensive single document to provide all the details of the format as it currently exists. Developers and users have to consult both the original format AND all the PGHAC reports since that time.

It was agreed that a new document giving the latest version of the format would be very useful. However, it was also recognized that this involved a substantial amount of work, and that it was not possible for a single organisation to make such resources available. It was therefore agreed that DFO would investigate carrying out this task in house, and that other interested parties (research organisations and commercial companies) would provide financial support for this.

Progress on this new standard document will be reported at the next meeting of PGHAC in Poland in 2004.

16 DEVELOPMENTS IN THE USE OF HAC AS A DATA EXCHANGE FORMAT

As given above, the stated aim of adopting HAC as the standard for acoustic data acquisition and archiving was to allow easy exchange of data between research groups using different hardware and software. This was initially proposed in relation to the work of the ICES Study Group on Echo Trace Classification (Reid *et al* 2001). Theoretically, once the HAC format was used by the principal hardware and software developers (e.g. SIMRAD, SonarData, IFREMER and DFO), it should be possible to exchange and analyse raw data independent of platform. In reality, this had not been attempted in anger prior to 2002. In that year, a group comprised of DFO, IFREMER, IMR and SonarData, set out to demonstrate that this was possible and make any appropriate modifications required. To date, this exercise has been largely successful. The group have successfully transferred data from BI500, CH2 and Echoview to MOVIES+ and back. The final step will be to confirm that exchange between the other packages also works.

PGHAC recognises that this is a major step forward, and would like to encourage the group to complete the work and report back at the 2004 meeting in Poland.

17 TUPLE ALLOCATION RULES

The following is reprinted from the last report and is included here for the guidance of users and developers.

The rules for allocating tuple numbers and accepting new tuple definitions: the basic tuples and the optional tuples of the common data format

*To ease the use of the **HAC** format by various software developers requiring the addition of new tuples, and to facilitate the work of the coordinating Committee, the tuple classes were divided in two groups. A first group is the basic tuples classes for which any tuple addition will require a thorough examination and a unanimous agreement by the coordinating committee. Tuple numbers will be allocated temporarily to the applicants during their definition and debugging period for a maximum of 14 months, after which they will be retired if the committee has not accepted their description. (See below; the Committee will meet annually to resolve outstanding issues). A second group is the optional tuple classes that concern auxiliary information or secondary level of data analysis. For these classes, the committee will allocate tuple numbers at the request of the users, on presentation of a short justification and objectives of the tuple by the applicant. In addition there is a need to define the minimum tuples required to define the minimum needs of a **HAC** compliant file.*

***The Basic tuple classes are:** Position tuples, Navigation tuples, Platform attitude tuples, Echosounder tuples, Channel tuples, Ping tuples, Threshold tuples, Environmental tuples for sound speed profiles, Opening and closing file tuples, End of file tuples and the HAC signature tuple.*

***The Optional tuple classes are:** Mission and project tuples, Event marker tuples, Edition tuples, Classification tuples, Environmental tuples except sound speed profiles, Private tuples, and Index tuples.*

The minimum tuples in a HAC file are: *Position tuples, an Echosounder tuple, a Channel tuple, Ping tuples, a Threshold tuple, an End of file tuple and the **HAC** signature tuple.*

18 NEW OR RECENTLY ADDED TUPLE NUMBERS

The following is presented as a summary of changes made at this meeting of PGHAC and includes a list of the tuples added since the initial definition of the ***HAC*** version 1.0.

18.1 List of added tuples since HAC version 1.0

The following tuple numbers have been added to the list of defined tuples or in use:

39, **41,** 210, 300, 301, 901, 1001, 2001, 2100, 3000, 3001, **4000**, 5000, 5001, 9001, 10011, 10039, **10090**, 10119, **10140,** 12000, 12005, 12010, 12050, 12051, 12052, 12053, 12100, 13000, 13500, 14000, 65397, 65406.

Numbers in bold represent those tuples added at the 2002 meeting.

18.2 Temporary tuples assigned for development at 2002 meeting – progress :

- 30 Tuple for vessel speed through the water – no change by developers
- 31 Tuple for recording vessel log pulse – not needed – number is unused
- 4010 Complex data parameter sub-channel tuple – still under development
- 10002 Complex data ping data – still under development
- **42 Towed body position sub channel tuple – complete and added on 2 month approval**
- **10142 Ping style tuple for towed body position data– complete and added on 2 month approval**

Tuples 42 and 10142 will now be considered as part of the format after 2 months

18.3 Tuples modified at the 2003 meeting:

- 901 Remark field set 100 bytes fixed length (table 5)
- 9001 Remark field set 40 bytes fixed length (table 6)
- 2001 Change in attribute filed to recognise patch 2002.(table 2)
- 2002 Remark field set 20 bytes fixed length (table 4)
- 10140 2 bytes space added after “Yaw” field

  “Not available” attribute specified as lowest possible value, rather than the highest as previously stated. (table 3)

18.4 New tuples included at the 2003 meeting

- 220 Sounder tuple for new SIMRAD multi-beam echosounder (temporary – for development by IFREMER)
- 2200 Channel tuple for new SIMRAD multi-beam echosounder (temporary – for development by IFREMER)

19 *HAC* COMPLIANCE AND *HAC* COMPATIBILITY

A data file is defined as ***HAC*** compliant if it conforms to the ***HAC*** syntax rules, contains the minimum required ***HAC*** tuples described above using the exact tuple format described (Simard *et al* 1997 or subsequent updates).

A software application tool is defined as ***HAC*** compatible if it can read and/or write, and use a minimum number of commonly used basic tuples, in the little endian format used by PC platforms.

In the 2002 PGHAC report the list of tuples required for HAC compatibility was defined as:

- 20 Geographic and time reference tuple
- 100 BioSonics Echosounder Tuple
- 200 SIMRAD EK500 Echosounder Tuple
- 901 Generic Echosounder Tuple – replaced previous version tuple 900
- 1000 BioSonics Channel Tuple
- 2000 SIMRAD EK500 Channel Tuple - original
- 2001 SIMRAD EK500 Channel Tuple - revised: 1) add Surface Blanking range 2) Save 2 dec. for angle offsets and 3dB beamwidth
- **2002 SIMRAD EK500 Channel Tuple patch tuple - Addition of both Sv and TS transducer gains**
- 9001 Generic Channel Tuple– replaced previous version tuple 9000
- 10000 Standard Ping U32 – Time-series of data samples Uncompressed 32-bit sample format range
- 10001 Ping U-32-16-angles Time-series of split-beam off-axis angle sample data. Uncompressed 32-bit sample format range
- 10010 Ping C32 - Time-series of samples. Compressed 32-bit sample format range
- 10011 Ping C-32-16-angles Time-series of compressed split-beam off-axis angle sample data. Compressed 32-bit sample format range
- **10040 Ping C-16. Time-series of samples. Compressed 16-bit sample format range:**
- 10100 General threshold - Constant and time-varied threshold
- 65534 End of file
- 65535 HAC signature

Tuples 2002 and 10040 were added to the standard in 2002.

Two further tuples were added to the standard at this meeting of PGHAC 2003:
- **10030 Ping U-16 - Time series of data samples. Uncompressed 16-bit sample format range**
- **10031 Ping U-16-angles Time series of split-beam off-axis angle sample data. Uncompressed 16-bit sample format**

The following table represents the ability of some of the currently available data acquisition software to read and write the above list of tuples and therefore their HAC compatibility

	Data Acquisition/Processing Software			
Tuple number	**CH1(ver. 3.5)**	**CH2(ver 2.9)**	**Echoview (ver 3.1)**	**Movies+ (ver. 4.1)**
20	W	R	RW	RW
100	W	R	R*	
200	W	R	R	RW
901	N/A	R*W*	RW	RW
1000	W	R	R*	
2000	W	R	R	R
2001	W	R	R*	RW
2002	W	R		RW
9001	N/A	R*W*	RW	RW
10000	W	R	RW	R
10001	W	R	RW	
10010	W	RW		R
10011	W	RW	RW	
10040	W	R		RW
10100	WW	R	W*	RW
65534	W	R	RW	RW
65535		R	RW	RW

* Represents implementation planned for 2002/2003 – **Bold** represents new to standard

20 RECOMMENDATIONS

It was agreed that the group should meet again at the same time as the FAST meeting in April 2004 under the Chairship of D. Reid. Proposed Terms of Reference are:

The **Planning Group on the HAC Data Exchange Format** [PGHAC] (Chair: D. Reid, UK) will meet in Gdynia, Poland on 17 April 2004 to:

a) coordinate the development of the HAC standard data exchange format;
b) provide information on the changes in the format and its evolution;
c) share information between manufacturers and users on the way acoustic data are processed and stored.
d) Co-ordinate production on new collated HAC specification manual
e) Review modifications to HAC compatible software to allow full data exchange

PGHAC will make its report available to WGFAST and will report by 15 June 2004 for the attention of the Fisheries Technology Committee.

21 REFERENCES

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ANNEX 2: MODIFICATIONS TO EXISTING TUPLES AND PROPOSED NEW TUPLES

The following tables have been adopted as a standard component of this report and are designed outline any changes to existing tuples and define new provisional tuples. Where a tuple has been modified by the PG the changes are in **bold** and only those fields which have been changed are included, all other fields remain as previously described. The new tuples are provisional and will be reviewed by PGHAC in 2003 for acceptance into the standard. Software developers are reminded that these should not be shipped in any new software prior to this approval. The specification of the attribute field to include patch tuples is given in table 9.

Table 1. Definitions

Data Type	Size	Range
DOUBLE	64 bit	Floating point
FLOAT	32 bit	Floating point
LONG	32 bit	Integer -2147483647 to 2147483647
ULONG	32 bit	Integer 0 to 4294967295
SHORT	16 bit	Integer -32767 to 32767
USHORT	16 bit	Integer 0 to 65535
CHAR	7 bit	Microsoft ASCII table for PC

Integer values are used to represent the encoded units presented in the tables.

Table 2 Dynamic platform position sub channel tuple for offset calculation parameters and time varied transducer position

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 60 bytes	byte	60
4	Tuple type	2	USHORT	Tuple type code: **42**.	unitless	42
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform position reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range : [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform position was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967296 s] (up to year 2106)
12	Dependent distance sensor identifier	2	USHORT	Unique identifier of the dependent sensor to which all distances (X and Y in tuple 10142) are referenced	unitless	[0 - 65535]
14	Dependent depth sensor identifier	2	USHORT	Unique identifier of the dependent sensor to which all depths (Z in tuple 10142) are referenced.	unitless	[0 - 65535]
16	Transceiver channel identifier	2	USHORT	Transceiver channel identifier from the parent channel tuple to which these parameters refer	unitless	[0 - 65535]
18	Platform type	2	USHORT	Platform type in which the transducer/echosounder is installed: 0 = ship 1 = towed body 1 2 = towed body 2 3 = AUV 4 = ROV 5 = Pelagic trawl 6 = Bottom trawl…	unitless	[0 - 65535] Presently: [0; 1; 2; 3; 4; 5; 6]
20	Distance sensor type	2	USHORT	Distance sensor type: 0 = acoustic positioning 1 = cable length 2 = combining cable length and angle measurement 3 = other	unitless	[0 - 65535] Presently: [0; 1; 2; 3]
22	Depth sensor type	2	USHORT	Position sensor type: 0 = acoustic positioning (phase measurement) 1 = pressure sensor 2 = acoustic depth measurement 3 = acoustic bottom altitude measurement (including pinger) 4 = other	unitless	[0 - 65535] Presently: [0; 1; 2; 3; 4]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
24	Alonship Offset	2	SHORT	Distance between the position sensor and the attitude sensor in the fore and aft direction. Negative values are on the aft side of the reference point of the attitude sensor. -327.68 = not available	0.01 m	[-327.68 to 327.67 m]
26	Athwartship Offset	2	SHORT	Distance between the position sensor and the attitude sensor in the starboard and port direction. Negative values are on the port side of the reference point of the attitude sensor. -327.68 = not available	0.01 m	[-327.68 to 327.67 m]
28	Vertical offset	2	SHORT	Distance between the sea surface and the attitude sensor in the vertical direction. Negative values are below the surface. -327.68 = not available	0.01 m	[-327.68 to 327.67 m]
30	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the sensor type and serial number.	ASCII char.	30 characters
60	Tuple attribute	4	LONG	Attribute of the tuple: **0 =** original tuple, e.g. nothing special to mention **1** = edited tuple	unitless	[-2147483648 to +2147483647]
64	Backlink	4	ULONG	Tuple size: bytes	byte	

Table 3 Platform position tuple

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 26 bytes	byte	26
4	Tuple type	2	USHORT	Tuple type code: **10142**.	unitless	10142
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform position reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range : [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform position was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967296 s] (up to year 2106)
12	Distance sensor identifier	2	USHORT	Unique identifier of the distance sensor providing the X and Y position information	unitless	[0 - 65535]
14	Depth sensor identifier	2	USHORT	Unique identifier of the depth sensor providing the Z position information	unitless	[0 - 65535]
16	Alongship distance (X)	4	LONG	Alongship distance between platform and reference point on vessel; negative values are on the aft side of the reference point. -214748.3648 : not available	0.0001 m	[-214748.3648 to 214748.3647 m]
20	Athwartship distance (Y)	4	LONG	Athwartship distance between platform and reference point on vessel; negative values are on port side of the reference point. -214748.3648 : not available	0.0001 m	[-214748.3648 to 214748.3647 m]
24	Depth (Z)	4	LONG	Platform depth, referred to sea surface -214748.3648 : not available	0.0001 m	[-214748.3648 to 214748.3647 m]
28	Tuple attribute	4	LONG	Attribute of the tuple: **0 =** original tuple, e.g. nothing special to mention **1** = edited tuple	unitless	[-2147483648 to +2147483647]
32	Backlink	4	ULONG	Tuple size: 36 bytes	byte	36

Table 4 EK60 Echo sounder tuple 210– new tuple for adoption in 2003.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 58 bytes	Byte	58
4	Tuple type	2	USHORT	Tuple type code: **210.** Tuple type code for the Simrad EK 60	Unitless	210
6	Number of SW channels	2	USHORT	Number of software channels associated with this sounder	Unitless	[1 to 65535]
8	Echo sounder document identifier	4	ULONG	Unique identification number for the echosounder document (i.e. the group of channels).	Unitless	[0 to 4294967295]
12	Sound speed	2	USHORT	Mean speed of sound. 0.0 = Profile used, 6553.5 = Not available	0.1 m/s	[1400.0 to 1700.0 m/s]
14	Ping interval	2	USHORT	0.0 = not known or variable	0.01 s	[0.00 to 655.35 s]
16	Trigger mode	2	USHORT	1 = normal, 2 = external, 65535 = not available	unitless	[0 to 65535]
18	Space	2	USHORT		unitless	
20	Remarks	40	CHAR	SW version (example: "1.2.34.5678")	ASCII	40 characters
60	Tuple attribute	4	LONG	Attribute of the tuple	Unitless	[-2147483648 to 2147483647]
64	Backlink	4	ULONG	Tuple size: 68 bytes	Byte	68

Table 5 EK60 Echo channel tuple 2001 – new tuple for adoption in 2003.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 258 bytes	Byte	258
4	Tuple type	2	USHORT	Tuple type code: **2100.** Tuple type code for the Simrad EK 60	Unitless	2100
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel	Unitless	[0 to 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document	Unitless	[0 to 4294967295]
12	Frequency channel name	50	CHAR	Example: "GPT 38 kHz 0090720171d3 1 ES38B"	ASCII	50 characters
62	Transceiver software version	30	CHAR	Example: "020221"	ASCII	30 characters
92	Data type	2	USHORT	Type of data sampled: 0 = Electrical phase angles [Units: 180/128 degree] 1 = Electrical power [Units: dB re 1W] 2 = Sv [Volume backscattering strength in dB] 3 = TS [point target strength in dB] 4 = Complex voltage [Complex voltage from quadrants in split beam. Units: V]	Unitless	[0 to 65535]
94	Transmission mode	2	USHORT	0=active, 1=passive, 2=test signal	Unitless	[0 to 65535]
96	Acoustic frequency	4	ULONG	Acoustic frequency	Hz	[1000 to 1000000 Hz]
100	Absorption coefficient	4	ULONG	Absorption of sound in the propagation medium	0.0001 dB/km	[0.0000 to 300.0000 dB/km]
104	Transmission power	4	ULONG	Transmit power referred to the transducer terminals	W	[0 to 10000 W]
108	Pulse duration	4	ULONG	Duration of transmitted pulse	us	[0 to 65536 us]
112	Bandwidth	4	ULONG	Transceiver bandwidth	Hz	[100 to 100000 Hz]
116	Time sample interval	4	ULONG	Time between each sample	us	[1 to 65536 us]
120	Start sample	4	ULONG	Number of samples offset from transducer face . 0=no offset	Unitless	[0 to 4294967295]
124	Transducer name	30	CHAR	Example: "ES38B"	ASCII	30 characters
154	Transducer beam type	2	USHORT	0=single, 1=split	Unitless	[0 to 65535]
156	Transducer installation depth	4	ULONG	Installation depth of transducer relative the sea surface	0.0001 m	[0.0000 to 10000.0000 m]
160	Transducer rotation angle	4	LONG	Mechanical angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor co-ordinate system. Negative angles are clockwise rotation.	0.0001 deg	[-180.0000 to +180.0000 deg]
164	Transducer face alongship angle offset	4	LONG	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane. Negative is below the horizontal. 0.0000 = fore direction.	0.0001 deg	[-180.0000 to +180.0000 deg]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
168	Transducer face athwartship angle offset	4	LONG	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane. Negative is below the horizontal. 0.0000 = starboard direction.	0.0001 deg	[-180.0000 to +180.0000 deg]
172	Transducer main beam axis alongship angle offset	4	LONG	Mechanical offset angle of the transducer main beam axis relative to the vertical in the alongship plane. Negative is in the aft direction. 0.0000 = perpendicular to the transducer face	0.0001 deg	[-180.0000 to +180.0000 deg]
176	Transducer main beam axis athwartship angle offset	4	LONG	Mechanical offset angle of the transducer main beam axis relative to the vertical in the athwartship plane. Negative is in the port direction. 0.0000 = perpendicular to the transducer face	0.0001 deg	[-180.0000 to +180.0000 deg]
180	Transducer alongship angle sensitivity	4	ULONG	Electrical phase angle in degrees for one mechanical angle in the alongship (fore-aft) direction.	0.0001 El./mec. deg	[0.0000 to 100.0000]
188	Transducer alongship 3 dB beam width	4	ULONG	Half power (3dB) beam width of the transducer in the alongship direction.	0.0001 deg	[1.0000 to 99.9999 deg]
192	Transducer athwartship 3 dB beam width	4	ULONG	Half power (3dB) beam width of the transducer in the athwartship direction.	0.0001 deg	[1.0000 to 99.9999 deg]
196	Transducer equivalent two-way beam angle	4	LONG	Equivalent two way beam opening solid angle. MacLennan and Simmonds, "Fisheries Acoustics"1992, section 2.3.	0.0001 dB	[-100.0000 to 0.0000 dB]
200	Transducer gain	4	ULONG	Transducer gain used in power budget calculations for calculation of TS.	0.0001 dB	[0.0000 to 99.9999 dB]
204	Transducer sA correction	4	LONG	Correction to transducer gain to obtain transducer gain used in power budget calculations for calculation of Sv (and sA). Transducer Sv gain = Transducer gain + Transducer sA correction.	0.0001 dB	[-10.0000 to +10.0000 dB]
208	Bottom detection minimum depth	4	ULONG	Minimum depth required for bottom detection.	0.0001 m	[0.0000 to 15000.0000 m]
212	Bottom detection maximum depth	4	ULONG	Maximum depth required for bottom detection.	0.0001 m	[0.0000 to 15000.0000 m]
216	Bottom detection minimum level	4	LONG	Bottom detection minimum level used in the bottom detector function. Ref. EK60 manual	0.0001 dB	[-80.0000 to 0.0000 dB]
220	Remarks	40	CHAR	Character string used for any comments to this channel.	ASCII	40 characters
260	Tuple attribute	4	LONG	Attribute of the tuple	Unitless	[-2147483648 to 2147483647]
264	Backlink	4	ULONG	Tuple size: 268	Byte	268

Table 6 Channel tuple Simrad EK500 (tuple 2001). Changes in byte count at offset 0. Changes in offsets for last 3 fields in tuple.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
0	Tuple size	4	ULONG	Tuple data size: ~~102~~ **106** bytes.	byte	~~102~~ **106**
4	Tuple type	2	USHORT	Tuple type code: **2001**. This is the tuple type code for the Simrad EK500 raw data. (Tuples 2000 – 2999 are reserved for Simrad echosounders).	unitless	2001
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel This identifier must be unique for the whole file in order to associate the pings to their proper parent channel N.B. This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
16	Sampling interval	4	ULONG	Sampling interval for this channel. The nominal sampling rate can be derived from this field and the mean sound speed. 4294.967294 = not applicable 4294.967295 = not available	0.000001 m	[0 – 4294.967295 m]
16	Type of data sample	2	USHORT	Type of data sample: 0 = off-axis angles from the split-beam analysis 1 = power (raw Sv before the TVG) 2 = S_v (volume backscattering strength in dB) 3 = TS (point target strength in dB)	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
18	Transceiver channel number	2	USHORT	EK500 transceiver (1, 2 or 3).	unitless	[0 – 65535] Presently: [1, 2, 3]
20	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 –1000000 Hz]
24	Installation depth of transducer.	4	ULONG	Installation depth of transducer relative to the sea surface. 42949672.94 = dynamic platform 42949672.95 = not available	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 9999.99 m]
28	Blanking range	4	ULONG	Blanking range from the transducer face up to which the receiver output is blanked to zero or the range at which the data started to be collected. 429496.7294 = not applicable 429496.7295 = not available	0.0001 m	[0.0000 – 429496.7295m]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
32	Platform identifier	2	USHORT	Unique identifier of the installation platform of the transducer 65535 = unavailable	unitless	[0 – 65535]
34	Transducer shape	2	USHORT	0= other 1= oval (which includes circular transducer) 2= rectangular 3= cross array 4= ring … 65535= not available	unitless	[0 – 65535] Presently: [0 – 4]
36	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane. Negative is below the horizontal and 0 degree is in the fore direction. -3276.7 = not available	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-180.0 to 180.0 degree]
38	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane. Negative is below the horizontal and 0 degree is in the starboard direction. -3276.7 = not available	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-180.0 to 180.0 degree]
40	Rotation angle of transducer	2	SHORT	Mechanical angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor co-ordinate system. Negative angles are clockwise rotation. -327.68 = not available.	0.01 degree	[-327.68 to 327.67 degree] Working range: [-180.00 to 180.00 degree]
42	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam of the transducer relative to the vertical in the alongship plane. Negative is in the aft direction. 0 = perpendicular to the transducer face -327.67 = not available	0.01 degree	[-327.68 to 327.67 degree] EK500 range: [-20.00 to 20.00 degree]
44	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam of the transducer relative to the vertical in the athwartship direction. Negative is in the port direction. 0 = perpendicular to the transducer face -327.67 = not available	0.01 degree	[-327.68 to 327.67 degree] EK500 range: [-20.00 to 20.00 degree]
46	Absorption of sound	2	USHORT	Absorption of sound (alpha) in the propagation medium used for TVG compensation. 655.35 = not available	0.01 dB km^{-1}	[0.00 – 655.35 dB km^{-1}] Practical range: [0.00 - 300.00 dB km^{-1}]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
48	Pulse length mode	2	USHORT	This field indicates the selected transceiver specific duration of the transmitted pulse: 0 = short 1 = medium 2 = long	unitless	[0 – 65535] EK500 options: [0;1; 2]
50	Bandwidth mode	2	USHORT	This field indicates the selected transceiver specific bandwidth: 0 = narrow 1 = wide N.B. Auto: this mode is not coded because the choice (narrow or wide) made by the EK500 is indicated in the EK500 telegram that the acquisition program reads.	unitless	[0 – 65535] EK500 options: [0;1]
52	Maximum power	2	USHORT	Transmit power referred to the transducer terminals.	watt	[0 – 65535] EK500 range: [1 watt – 10000 watt]
54	Alongship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the fore-and-aft direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	0.1	[0.0 – 6553.5] EK500 range: [0.0 – 100.0]
56	Athwartship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the starboard-and-port direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	0.1	[0.0 – 6553.5] EK500 range: [0.0 – 100.0]
58	Alongship 3 dB beamwidth of the transducer	2	USHORT	Half power (3dB) beamwidth of the transducer in the alongship plane.	0.01 degree	[0.00 – 655.35 degree] EK500 range: [0.00 to 99.90 degree]
60	Athwartship 3 dB beamwidth of the transducer	2	USHORT	Half power (3dB) beamwidth off the transducer in the athwartship plane.	0.01 degree	[0.00 – 655.35 degree] EK500 range: [0.00 to 99.90 degree]
62	Two-way beam angle	2	SHORT	Equivalent two way beam opening solid angle: [=10 log (($ß_1$*$ß_2$)/ 5800)], where $ß_1$ and $ß_2$ are the longitudinal and transversal beamwidth (degrees), respectively. N.B.: Directivity index in dB: DI = 10 log (2.5/(sin($ß_1$/2) * sin($ß_2$/2))). (see EK500 user manual).	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-99.90 to 0.00 dB]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
64	Calibration transducer gain	2	USHORT	Peak transducer gain used during computation of the data sample corresponding to the above-selected "type of data sample" (either Sv or TS) (see EK500 user manual).	0.01 dB	[0.00 dB – 655.35 dB] EK500 range: [0.00 to 99.90 dB]
66	Bottom detection minimum level	2	SHORT	Volume backscattering level for the bottom detector`s back search function. -327.68 = not available	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-80.00 to 0.00 dB]
68	Bottom window minimum depth	4	ULONG	Minimum depth for bottom detection window. 42949672.95 = not available	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 9999.90 m]
72	Bottom window maximum depth	4	ULONG	Maximum depth for bottom detection window. 42949672.95 = not available	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 12000.00 m]
76	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the transducer serial number.	ASCII char.	30 characters
~~96~~ **106**	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	Unitless	0
~~104~~ **108**	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g. nothing special to mention 1 = edited tuple Other attributes could be labelled by a code (e.g. tuple data quality). Negative codes should be used for special cases.	Unitless	[-2147483648 to 2147483647]
~~108~~ **112**	Backlink	4	ULONG	Tuple size: ~~112~~ **116** bytes.	Byte	~~112~~ **116**

Table 7 Attitude sensor tuple (tuple 10140). Changed content at offsets 14, 16, 18 and 20. Spacer of 2 bytes added at offset 22.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
0	Tuple size	4	ULONG	Tuple data size: 22 bytes	Byte	22
4	Tuple type	2	USHORT	Tuple type code: **10140**	Unitless	10140
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform attitude reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform attitude reading was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	S	[0 – 4294967295 s] (= up to year 2106)
12	Attitude sensor identifier	2	USHORT	Unique identifier for the attitude sensor providing the attitude information	Unitless	[0 – 65535]
14	Pitch	2	SHORT	Inclination of the platform relative to the horizontal plane in the fore-and-aft direction. Negative angles are below the horizontal and positive above. **-3276.8** = unavailable	0.1 degree	[-3276.8 to 3276.7 degree] Practical range: [-90.0 to 90.0 degree]
16	Roll	2	SHORT	Inclination of the platform relative to the horizontal plane in the starboard-and-port direction. Negative angles are below the horizontal and positive above. **-3276.8** = unavailable	0.1 degree	[-3276.8 to 3276.7 degree] Practical range: [-90.0 to 90.0 degree]
18	Heave	2	SHORT	Heave of the platform Positive heave is upwards and negative heave is downwards. **-327.68** = unavailable	0.01 m	[-327.68 to 327.67 m]
20	Yaw	2	SHORT	Yaw of the platform. Negative yaw angles are clockwise (to starboard) and positive angles are counter-clockwise (to port). **-3276.8** = unavailable	0.1 degree	[-3276.8 to 3276.7 degree] Practical range: [-180.0 to 180.0 degree]
22	**Space**	**2**	**USHORT**	**Space to allow the next field to be aligned on an address that is a multiple of 4.**	**Unitless**	**0**
24	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g. nothing special to mention 1 = edited tuple … Negative codes should be used for special cases.	Unitless	[-2147483648 to 2147483647]
28	Backlink	4	ULONG	Tuple size: 32 bytes	Byte	32

Table 8 Patch for the channel tuple for the SIMRAD model EK-500 (Tuple 2002): Changed at offset 16 (remarks) and then offsets thereafter

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[... – 4 giga]
4	Tuple type	2	USHORT	Tuple type code: 2002.	unitless	2002
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel This identifier must be unique for the whole file in order to associate the pings to their proper parent channel N.B. This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sv transducer gain	2	USHORT	Peak transducer gain used during computation of the Sv data sample.	0.01 dB	[0.00 dB – 655.35 dB] EK500 range: [0.00 to 99.90 dB]
14	TS transducer gain	2	USHORT	Peak transducer gain used during computation of the TS data sample.	0.01 dB	[0.00 dB – 655.35 dB] EK500 range: [0.00 to 99.90 dB]
16	Remarks	~~X4~~ **20**	CHAR	Character string comment. The string must be space filled to the 4 byte boundary. The Remarks field can be missing if there are no comments.	ASCII char.	variable
36	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g. nothing special to mention 1 = edited tuple 2 = temporary Other attributes could be labelled by a code (e.g. tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
40	Backlink	4	ULONG	Tuple size: variable	byte	[... – 4 giga]

Table 9 Specification of attribute field to include patch tuples

Tuple attribute (ULONG)																																	
Content	Undefined																													Patched	Temporary	Edited	Value
Bit	b31	b30	b29	b28	b27	b26	b25	b24	b23	b22	b21	b20	b19	b18	b17	b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Code
Original	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Temporary + Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
Patched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
Patched + Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
…																																	…
b0 (1)	Tuple has been edited (0 = original tuple)																																
b1 (2)	Temporary tuple (unofficial).																																
b2 (4)	Tuple has been patched. Therefore another tuple must refer to this tuple																																
b3 (8)	Undefined																																
…	…																																
b31 (2147483648)	Undefined																																