

Navico (Lowrance, Simrad, B&G) Atlas Type 5 (AT5) File Format

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2018-01-01

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Navico Atlas Type 5 (AT5) File Format

Filename extension *.lcm (older, "Lowrance Chart Map") and *.at5

This documentation is based on own research and the sources listed in the references section.

Basic data types

All values are serialized in little-endian byte order (least significant byte first).

Type	Length	Description
byte	1	8 bit unsigned integer (range 0 .. 255)
ushort	2	16 bit unsigned integer (range 0 .. 65535)
uint	4	32 bit unsigned integer (range 0 .. 4294967295)
short	2	16 bit signed integer (range -32768 .. 32767)
int	4	32 bit signed integer (range -2147483648 .. 2147483647)

General file structure

Header 1
Header 2
Space for Sections, and their Subsections. The sections are usually in ascending order, with their subsections immediately following the Section.

Header 1

Type	Content
uint	Signature = 0x0005AA55 0x0005 is probably the „5“ from „Atlas Type 5“
ushort	Major version Known versions: <ul style="list-style-type: none"> with filename extension *.lcm: 4 and 7 with filename extension *.at5: 4, 6, 10, 12 and 13
ushort	Minor version, always =0
uint	Zero = 0x00000000
uint	Length of data after Header 1
uint	If filename extension is *.lcm or format version is 4: Complement of checksum over data after Header 1 (sum over all Bytes) else Complement of the total file length
uint	Header 2 size
ushort	Complement of checksum over all Header 1 bytes except this field
only if format version 6, 7, 10, 12 and 13:	
ushort	16-bit CRC over Header 2 (using "ARC" parameters, see [3])
16 x byte	Probably some kind of hash (MD4 or MD5? Maybe "salted" with a prefix?) over some parts of the file. At least it contains the Header 2, because the value changes even when only the Header 2 changes. And it does not cover all of the file, since changes to some parts at the end do not lead to a change here.

Header 2

Type	Content
ATString	Original file name, including filename extension (may be empty)
ATString	Date e.g. „Thursday, July 03, 2014“
ATString	Description (sometimes “Blank”)
Map bounds in Mercator meters, see [4].	
int	West
int	South
int	East
int	North
ATRef	Section 0 Displays
ATRef	Section 1 Types
ATRef	Section 2 Icons
ATRef	Section 3 Primitives If format version 6, 7, 10, 12 or 13: The offset in this reference has to be decremented by one to get the correct value!
ATRef	Section 4 Roads
ATRef	Section 5 Road index
ATRef	Section 6
ATRef	Section 7 Cities/countries
ATRef	Section 8
ATRef	Section 9
ATRef	Section 10 Streets
ATRef	Section 11
only if format version 6, 7, 10, 12 and 13:	
uint	Unknown6. Values seen: 1000, 2000, 2050, 2060, 2070, 2080, 2090, 2100 and 10000
ATRef	Section 12
ATRef	Section 13 Acknowledgements
only if format version 7:	
uint	?
uint	?
only if format version 10, 12 and 13:	
ATRef	Section 14

Section 0 Displays

Type	Content
ATUint	Number of displays, usually 1 or 5
Number of displays times:	
ushort	X resolution
ushort	Y resolution
byte	Type 0: mono, 1: color
ushort	Number of grey shades / colors

Values always seen:

640x480, 64 colors / 320x240, 64 colors / 480x350, 4 mono / 120x160, 4 mono / 240x240, 4 mono

Section 1 Types

FeatureList - contains names of object types and some unknown information.

Contains list of map layers with its names and links to map feature list for each display.

Type	Content
only if format version 12 or 13:	
uint	? Unknown7. Values seen: 13, 15, 18, 19, 21, 22, 23, 24, 26 and 28
byte	Usually 1 or 5. A set of flags? Or a ATUint with value 0 or 2?
uint	Number of types
Number of types times:	
ATString	? Some are readable, some look like garbage. Maybe there is something encoded within the latter strings. Seems the second char is always "!" then.
uint	Number of Subsections (must be number of Displays in Section 0)
Number of Subsections times:	
ATRe f	Subsection m of type n

Section 1, Subsection m of type n

Type	Content
ushort	Geometry type 1: point 2: line 3: area 4: empty (in this case the following fields are 0 / empty string) 6: 3D data
ATString	Major category
ATString	Minor category
uint	? Unknown10 Seen values: 0x00000000, 0x0006F93E, 0x00071904, 0x00063C30, 000D4AC8, 0x00065B6A, 0x0000EE08, 0x0000F244, 0x0000EF6D, ...
uint	? Unknown11 Seen values: 0 and 0x00005943 "CY"
ushort	? Unknown12 Seems to be ascending (weakly increasing) within the same category. Seen values: 0, 1, 2, 11, 50, 91, 132, 171, 190, 201, 203, 260, 300, 360, 370, 400, 405, 410, 420
ushort	? Unknown13, most of the times it is the same as Unknown12 Is different for *.lcm Seen value: 30
ushort	? Unknown14 Seen values: 3000, 3010, 3020, 3100, 3900, 5360, 5565, 5750, 7000, 7020
byte	? Unknown15 Seen values: 0x00, 0x01, 0x02 and 0x03
byte	? Unknown15b Seen values: 0x00, 0x02, 0x03, 0x06 and 0x0E
if format version >4:	
byte	? Unknown16 Seen value: 0 and 10
If Geometry type != 4:	
byte	? Unknown17 Seen values: 0, 4, 5, 8, 9, 11, 16, 17, 19, 32, 33, 40, 49, 50, 80, 100, 176, 226 and 228
byte	? Unknown18 Seen values: 0, 1, 3, 4, 8, 9, 12 and 16
ushort	? Unknown19 Seen values: 0
byte	? Unknown20 Seen values: 4, 6, 7, 12, 16, 20, 47, 48 and 49
byte	? Unknown21 Seen values: 0, 8 and 12
ushort	? Unknown22 Seen values: 0

	ATString	? The presence of this string depends on an yet unknown condition!
	Only if Unknown15 bit 0 set:	
	byte	? Unknown23 Seen values: 0
	uint	? Unknown24 Seen value: 15
	uint	? Unknown25 often same value as Unknown10
	uint	? Unknown26 Seen value: 0
	byte	? Unknown27 Seen value: 0
	uint	? Unknown28 Seen value: 0
	uint	? Unknown29 Seen value: 3
	?	? Typically 11 bytes are left.

Section 2 Icons

List of map icons with its names and links to icon list.

Each icon has an image for each display.

Type	Content
only if format version 12 or 13:	
uint	? some counter
byte	Usually 1 or 5. A set of flags? Or a ATUint with value 0 or 2?
uint	Number of icons
Number of icons times:	
ATString	?
uint	Number of images (must be number of Displays in Section 0)
Number of images times:	
ATRef	Subsection icon n, image for display m

Section 2, Subsection icon n, image for display m

Type	Content
byte	Type 0x80: color, else mono
ushort	Width
ushort	Height
ushort	HotX
ushort	HotY
byte	? Usually 1
Width * Height bytes	pattern data

Section 3 Primitives

Zoom levels, blocks and features.

Type	Content
ATUint	Number of primitives
Number of primitives times:	
If format version 4, 6, 7, 10 or 12:	
ATRef-Var2	Subsection Primitive n
else (if format version 13):	

ATRef-Var1	Subsection Primitive n
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Section 3, Subsection primitive n

Type	Content
byte	? Unknown 1. Seen value: 1 and 16 If this is 16, there is an additional byte following, seen value 5, and Unknown 5 is missing instead (everything is shifted by 1 byte).
byte	? Unknown 2. Seen value: 0, 1, 2 and 3
byte	? Unknown 3. Seen value: 0, 1, 2 and 3
only if format version 12 or 13:	
byte	? Unknown 4: Seen value: 0 and 1 If 1, one byte=0 seems to follow here
uint	X0
uint	Y0
uint	X1
uint	Y1
ushort	Scale factor. Seen values: 1, 3, 16, 25, 50, 60, 80, 100, 160 and 1725
byte	? Unknown 5. Seen value: 0
ATUint	Number of additional data
Number of additional data times:	
ATRef	Pointer to additional data
ATUint	Table data length
ATUint	? Unknown length
ATUint	Bounding polygon, number of bound nodes
Number of bound nodes times:	
uint	X
uint	Y

Section 3, Subsection primitive n, additional data m

Type	Content
uint	? Unknown1. Seen value: 0x00005943 "CY", 0x0000ee00 and 0x0000ee08
uint	? Unknown2. Seen value: 0x00005943 "CY", 0x0000ee00 and 0x0000ee08
uint	? Unknown3. Seen value: 0, 0x00005943 "CY"
uint	? Unknown4. Seen value: 0, 0x00005943 "CY"
ATUint	Number of entries
Number of entries times:	
byte	?
byte	?
byte	?

Section 3, after Subsection primitive n, additional data m

Type	Content
tbid	22 Byte: 0x00 0xB4 0xE2 0xFF uint X 0x00 0xF2 0x2B 0x00 uint Y 0xC0 0x5D 0x00 0x00 uint = 24000 0xC0 0x5D 0x00 0x00 uint = 24000 0x14 0x00 ushort Rows 0x14 0x00 ushort Columns 0x42 0x06 – maybe a ATUInt counter 0x190 = 400 = Rows x Columns afterwards probably a long list of ATUInts (400?)

Section 4 Roads

List of roads

Type	Content
ATUInt	Number of roads
Number of roads times:	
ATString	Name
ushort	?
ATUInt	? some counter
?	the remaining length is about 6 x counter bytes long, but not always

Section 5 Road index

Index table of offsets from previous section

Type	Content
ATUInt	Number of roads
Number of roads times:	
uint	Offset of road n within Section 4

Section 6

Type	Content
ATUInt	Number of ?
Number of ? times:	
ATString	Major category
ATString	Minor category
ATUInt	Number of values
Number of values times:	
ushort	Value
ATRefVar2	Pointer to additional Data
Space for additional data. Usually in order and immediately following each other.	

Section 6, Additional data

Type	Content
ATUInt	Some size or counter. It is not the number of subentries, but it is proportional to it.
for each subentry:	

	ushort	? These are the Values from above
	ushort	?
	ushort	?
	only if format version 10, 12 or 13:	
	ATString	contains unknown binary information

Section 7

Cities names/countries

Type	Content
ATUInt	Number of cities
Number of cities times:	
uint	Offset to city (relative to the end of this array of offsets)
Space for cities (usually contiguous, ascending order)	

Section 7, Subsection city

Type	Content
ATString	District of city (optional, may be empty)
ATString	City
ATString	State
ATString	Country
only if format version 4:	
3 x uint8	? seems to be <>0 if and only if District is non-empty

Section 8

Type	Content
ATUInt	Number of ?
Number of ? times:	
byte	?
byte	?
byte	?
byte	?
byte	?
byte	?

Section 9 Table of ? strings

Type	Content
ATUInt	Number of ?
Number of ? times:	
uint	Offset of string ? relative to end of table, within this section
Space for strings, usually in ascending order with no gaps n x ATString	

Section 10 Table of street names

Type	Content
ATUInt	Number of street names
Number of street names times:	

	uint	Offset of street name relative to end of table, within this section
Space for street names, usually in ascending order with no gaps n x ATString		

Section 11

Type	Content
ATUint	Number of lists of points
Number of lists of points times:	
	uint
	Offset of list of points relative to end of table, within this section
Space for lists of points	

Section 11, List of points

Type	Content
ATUint	?
ATUint	Number of points
Number of points times:	
	uint
	X
	uint
	Y

Section 12

Type	Content
Repeat until Nr = 0	
	byte
	Nr (1,2,3,.., 0)
	ATString
	ATString
	uint
	? =0
	uint
	? =0
	uint
	? =0
20 x byte	? =0

Section 13 Acknowledgements

Type	Content
ATUint	Number of acknowledgements
Number of acknowledgements times:	
	ushort
	? Unknown1. Seen value: 0
	ATString
	Acknowledgement message

Section 14

Type	Content

ATUint

An unsigned integer in a variable-sized encoding

Using 1 byte:

	7	6	5	4	3	2	1	0
0	6	5	4	3	2	1	0	= 1

Contains 7 bit. Used for numbers in the range 0-0x7F.

Using 2 bytes:

	7	6	5	4	3	2	1	0
0	5	4	3	2	1	0	= 1	= 0

	7	6	5	4	3	2	1	0
1	13	12	11	10	9	8	7	6

Contains 14 bit. Used for numbers in the range 0x0080-0x3FFF.

Using 3 bytes:

	7	6	5	4	3	2	1	0
0	4	3	2	1	0	= 1	= 0	= 0

	7	6	5	4	3	2	1	0
1	12	11	10	9	8	7	6	5

	7	6	5	4	3	2	1	0
2	20	19	18	17	16	15	14	13

Contains 21 bit. Used for numbers in the range 0x004000-0x1FFFFF.

Using 4 bytes (containing 29 bit):

	7	6	5	4	3	2	1	0
0	4	3	2	1	0	= 0	= 0	= 0

	7	6	5	4	3	2	1	0
1	12	11	10	9	8	7	6	5

	7	6	5	4	3	2	1	0
2	20	19	18	17	16	15	14	13

	7	6	5	4	3	2	1	0
3	28	27	26	25	24	23	22	21

Contains 29 bit. Used for numbers in the range 0x00200000-0x1FFFFFFF.

ATString

Type	Content
byte	string length (in byte), may be 0
char	<p>Characters of the string. There is no string terminator at the end. Usually, the string consists of chars according to the Windows 1252 character set. If the string contains backslash characters, the string contains Unicode characters. These are encoded as UTF-8 bytes which are then encoded in octal representation preceded by a backslash.</p> <p>Example: "Konoba Koroma\304\215na" → "Konoba Koromačna"</p> <p>Some strings have a length restriction. Note that when Unicode characters are contained, the restriction is applied <u>after</u> the encoding to the Windows 1252 string. Thus the string might end right in the middle of a Unicode char encoding.</p>

ATRef

Type	Content
uint	Offset relative to the end of the current object (Header2 or Section or Subsection)
uint	Length in byte

ATRefVar1

Type	Content
uint	Offset relative to the end of the current table (sometimes after the Section, sometimes still within the section)
ATUint	Length in byte

ATRefVar2

Type	Content
ATUint	Offset relative to the end of the current table (sometimes after the Section, sometimes still within the section)
ATUint	Length in byte

References

Used sources of information

- [1] GPSMapEdit partial source code <http://www.geopainting.com/en/src.html>,
http://www.geopainting.com/download/mapedit_src_1_0_61_1.zip
- [2] <https://github.com/OpenSeaMap/at5-chart>
- [3] Catalogue of parametrised CRC algorithms <http://reveng.sourceforge.net/crc-catalogue/all.htm>
- [4] <https://gis.stackexchange.com/questions/114765/convert-mercator-meters-without-utm-zone>

Sources of sample files

- [5] <http://waterways.cz/lowrance.php>
- [6] <http://www.anglingcharts.com/downloadanglingchartsskinfile.html>
- [7] <http://www.sorvik.ru/karty>
- [8] <http://in-touch-with-adventure.de/downloads/NMCSample.rar>
- [9] <http://www.bassanglers.co.za/map-giveaway>
- [10] <http://www.sportfiskekartor.se/gratis-djupkarta/demodata-for-plotter/>
- [11] <http://www.dybdekart.no/Map/Featured>
- [12] <http://offbeat-flyfishing.de/index.php/downloads/maps/lowrance/viewcategory/11-lowrance>
- [13] https://wiki.openstreetmap.org/wiki/AT5-OpenSeaMap-Chart_for_Lowrance_Simrad_B&G
- [14] <http://www.wosoft-ware.de/digitale-binnenkarten/>