

APLICOM D PROTOCOL

**Protocol Version 2.0
Specification rev. 6.1.0**

Data Protocol

Order code S100300

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ISO 9001

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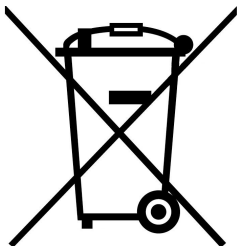
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REVISION HISTORY

Rev.	Date	Editor	Description
1.0	01.02.07	LRe	Original
1.1	05.04.07	LRe	Modified description of "max speed" field.
1.2	04.05.07	LRe	Updated event IDs.
1.3	08.05.07	LRe	Removed duplicate "max speed" variable from table.
1.4	11.05.07	LRe	Re-ordered field max speed and heading.
1.5	15.05.07	JKa	Added IButton triggered snapshot clarification to packet payload table. Added example.
1.6	24.05.07	LRe	Fixed defects after review.
1.7	28.05.07	LRe	Fixed switched values of fix status field.
1.8	06.06.07	THä	Editorial changes
1.9	11.06.07	LRe	Added max speed description.
1.10	26.06.07	THä	Added tacho and CAN events.
1.11	27.06.07	JKa	Modified tacho and can events and EIDs
1.12	20.09.07	JKa	Added events.
1.13	21.09.07	THä	Editorial changes
1.14	03.12.07	JKa	Added GPS STATUS CHANGED event
1.15	19.12.07	JKa	Added FLAG CHANGED event, and note of TCP connection
2.0	18.03.08	JKa	Review changes
2.1	17.04.08	JKa	Removed IMEI calculation appendix
2.2	13.05.08	JKa	Added DLKP
2.3	14.05.08	JKa	Added selection mask
2.4	15.05.08	JKa	Selection mask changes
2.5	15.05.08	JKa	GPS movement events added
2.6	20.05.08	JKa	Desk check
2.7	27.05.08	JKa	Added AD thresholds A,B and C
2.8	03.05.08	JKa	Pre-review changes
2.9	06.06.08	JKa	Review changes
2.10	10.06.08	JKa	Added snCount
3.0	13.06.08	JKa	Editorial changes. Approved.
3.1	07.08.08	JKa	Added input changed extra information byte
3.2	16.09.08	JKa	Added event.
4.0	22.09.08	JKa	Review changes
4.1	30.10.08	JKa	PWR and Flags added, GARMIN_EVENT added.
5.0	18.12.08	HRa	Review changes.
5.1	21.01.08	JKa	Added NET_CHANGED event specific data, AD corrections
5.2	21.01.08	JKa	AD corrections
5.3	30.01.09	JKa	NET_CHANGED extra event information added (TRAX 4.1.6)
5.4	30.04.09	JKa	clarified packet descriptions
5.5	12.08.09	JKa	fix:AD extra information, change speed not available for power
5.6	17.05.10	JKa	Added AD_SAMPLING and FUEL_SAMPLING
5.7.0	26.05.10	HRa	Added pulse counters.
5.8.0	01.09.10	THä	Added R-series support. Editorial changes.
5.9.0	22.09.10	Jka	Modified pulse counters, histogram event added, fixed AD and FUEL_SAMPLING ID values
5.9.1	29.09.10	AMu	Review changes
6.0.0	29.09.10	HRa	Fix long format example. Editorial changes.
6.1.0	15.10.10	HRa	Added GPS speed validity indicators to Data validity field.

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1 INTRODUCTION

1.1 Overview

D Protocol consists of a single binary message packet for sending device status information including GPS data to a server application. Protocol is one-way only, that is, there are no response messages.

Note! It is possible that one TCP/IP packet contains more than one protocol packet. Wireless GSM devices optimize network usage by concatenating TCP packets when connection stays open.

2 PROTOCOL SPECIFICATION

Each protocol packet contains a packet header followed by a single packet payload ('device status snapshot').

Packet length should always be used when reading snapshot data since some fields are of variable length.

Protocol data fields are big-endian.

2.1 Protocol Field Selector

Protocol field selector enables optimization of sent data by dropping out unnecessary fields.

Field selector is a mask which defines dropped or included bytes. If bit is set, field is included in the snapshot.

Field Selector bits

Hex	Description
0x000001	Unit ID high. Identification is 7 bytes instead of 3.
0x000002	Field Selector bits.
0x000004	Timestamp. Snapshot recording time.
0x000008	GPS. Latitude, longitude, GPS time, satellite count, data validity.
0x000010	GPS Speed. Speed, Max speed, heading.
0x000020	AD. AD1 – AD4.
0x000040	IO. DIN status, output status.
0x000080	Trip1.
0x000100	Trip2.
0x000200	iButton. iButton ID.
0x000400	DLKP. Driver Log Keypad state.
0x000800	GPS extras. Altitude.
0x001000	Event specific additional bytes. Appended to the very end of the message.
0x002000	SnCount. Snapshot counter.
0x004000	Flag bits
0x008000	Power
0x010000	Pulse counter1 values.
0x020000	Pulse counter2 values.
0x040000-0x800000	RFU (reserved for future use).

Table 1: Protocol field selector values

Legacy:

0x0002FC	Default value when no field selector bits are are set. Matches D protocol version 1.
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Packet Id	Unit ID high	Unit ID low	Len	Selector bits
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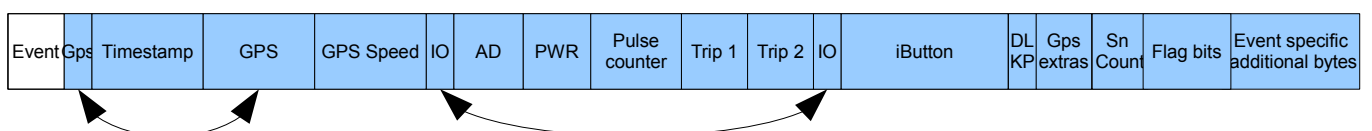


Illustration 1: Packet Structure with fields shown. Data selectable with same bits but separated by another field is shown with arrows. Coloured fields are optional.

2.2 Packet header

Field Selector bits	Field Byte Index	Field Name	Description															
-	0	Packet Identifier	Identifies this as a 'D' type packet. (Always an ASCII 'D' / 0x44)															
	1	Protocol version	<p>Protocol version identifier and flags.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>Unit ID length</td> <td>Selector</td> <td>-</td> <td>-</td> <td colspan="4">Version</td> </tr> </tbody> </table> <p>Unit ID length (used in protocol version 2, always 1 in R-series)</p> <ul style="list-style-type: none"> • 0 – short unit ID • 1 – long unit ID (7 bytes). <p>Selector (used in protocol version 2, always 1 in R-series)</p> <ul style="list-style-type: none"> • 0 – Selector bits not included • 1 – Selector bits (3 bytes) included in the protocol packet header <p>Bits 4-5: Reserved for future use</p> <p>Version is one of the following</p> <ul style="list-style-type: none"> 1 – D protocol version 1.0 compatible (default field selector) 2 – D protocol version 2.0 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Unit ID length	Selector	-	-	Version		
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
Unit ID length	Selector	-	-	Version														
0x0001	0	Unit ID High bytes	<p>Extended identifier for the unit. 4 bytes. High 4 bytes. Optional field, present only when selector bit 0x0001 is valid. For example, for IMEI 355632002225796 (0x143720729D684) the bytes 0x01, 0x43, 0x72 and 0x07 are set in this field.</p> <p>This field is included in protocol version 2 if the Unit ID length bit in Protocol version field is set.</p>															
	1																	
	2																	
	3																	
-	2	Unit ID low bytes	Identifier for the unit. 3 bytes.															
	3		This is the lowest 24 bits of the GSM device IMEI code. For example, for IMEI 355632002225796 (0x143720729D684) the bytes 0x29, 0xD6 and 0x84 are sent. See K505017 Calculating A1 IMEI from unit ID for more information about the unit ID.															
	4																	
	5	Snapshot length	Length of snapshot data in bytes. 2 bytes.															
	6																	
	0x0002	0	Selector bits	Selected field selector bit settings transmitted to server. Field selector bits show available fields. Unused bits are always 0.														
1		This field is included in protocol version 2 and higher if the Selector bit in Protocol version field is set.																
2																		

Table 2: Packet header

2.3 Snapshot data fields

Field Selector bits	Field Byte Index	Field Name	Description																
-	0	Event ID	ID of the event that caused the snapshot to be recorded. See chapter 3 for description of event ID codes. 1 byte.																
-	1	Event Information	Additional event dependent information. See chapter 3 for description of event information codes. 1 byte.																
0x0008	0	Data validity	<p>Data validity. 1 byte.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>currfix</td> <td>posfix</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>max speed</td> <td>speed</td> </tr> </tbody> </table> <p>speed – GPS based speed overflow indicator</p> <ul style="list-style-type: none"> 0 – Field <code>speed</code> contains correct value. 1 – Speed is over 255 km/h. Field <code>speed</code> contains lowest 8 bits of the actual value. <p>max speed – GPS based maximum speed overflow indicator</p> <ul style="list-style-type: none"> 0 – Field <code>Maximum speed</code> contains correct value. 1 – Maximum speed is over 255 km/h. Field <code>Maximum speed</code> contains lowest 8 bits of the actual value. <p>Bits 2-5: Reserved for future use</p> <p>posfix - GPS fix validity (fix status)</p> <ul style="list-style-type: none"> 0 – GPS data included in the packet is invalid. 1 – GPS data included in the packet is valid. <p>currfix - GPS data validity (Current fix status)</p> <ul style="list-style-type: none"> 0 – Device was not receiving GPS data when snapshot was recorded, i.e., GPS data is old. (time in bytes 3-6 is a “best guess”, time in 7-10 is the GPS data acquisition time). 1 – device was receiving GPS data when snapshot was recorded. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	currfix	posfix	-	-	-	-	max speed	speed
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0												
currfix	posfix	-	-	-	-	max speed	speed												
0x0004	0	Time	Time when snapshot was recorded as seconds since 1 st of January 1970 00:00. 4 bytes.																
	1																		
	2																		
	3																		
0x0008	1	GPS time	Time when GPS position data was recorded as seconds since 1 st of January 1970 00:00. 4 bytes.																
	2																		
	3																		
	4																		

	5	Latitude	GPS Latitude as millionths of a degree. Southbound is negative, northbound is positive. 32bit signed integer.																
	6																		
	7																		
	8																		
	9	Longitude	GPS Longitude as millionths of a degree. Westbound is negative, eastbound is positive. 32bit signed integer.																
	10																		
	11																		
	12																		
	13	Number of satellites	Number of visible satellites. 8bit unsigned integer.																
0x0010	0	Speed	Vehicle speed in km/h. 8bit unsigned integer. (Note: wrap-around in speeds over 255km/h)																
	1	Maximum speed	Maximum detected speed since last event as km/h. 8bit unsigned integer. Application updates maximum speed value whenever it reads GPS position, and resets the value every time a snapshot is sent. Accuracy is thus relative to application's GPS polling interval.																
	2	Heading	Vehicle heading in degrees / 2. 8bit unsigned integer. Multiply value by 2 to get heading in degrees. For example, 260° is sent as a value of 130. 0 or 360 degrees equals heading to North.																
0x0040	1	DIN status	<p>Digital input status. 1 byte.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>IGN</td> <td>-</td> <td>DIN6</td> <td>DIN5</td> <td>DIN4</td> <td>DIN3</td> <td>DIN2</td> <td>DIN1</td> </tr> </tbody> </table> <p>Each bit represents one digital output.</p> <ul style="list-style-type: none"> • 0 – Logical low • 1 – Logical High 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	IGN	-	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0												
IGN	-	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1												
0x0020	0	AD1	Voltage of analog input AD1 in millivolts. 16bit unsigned integer.																
	1																		
	2	AD2	Voltage of analog input AD2 in millivolts. 16bit unsigned integer.																
	3																		
	4	AD3	Voltage of analog input AD3 in millivolts. 16bit unsigned integer.																
	5																		
	6	AD4	Voltage of analog input AD4 in millivolts. 16bit unsigned integer.																
	7																		
0x8000	0	Main power	Voltage of main power in millivolts. 16bit unsigned integer.																
	1																		
	2																		

	3	EXT battery	Voltage of external battery in millivolts. 16bit unsigned integer.													
0x10000	0	PCNT1 rate	Latest pulse rate of pulse counter channel 1. 16 bit unsigned integer. Unit depends on configuration, default is pulses per second (PPS).													
	1															
	2	PCNT1 counter	Counter for pulse counter channel 1. 32 bit unsigned integer. Unit depends on configuration, default is number of pulses.													
	3															
	4															
5																
0x20000	0	PCNT2 rate	Latest pulse rate of pulse counter channel 2. 16 bit unsigned integer. Unit depends on configuration, default is pulses per second (PPS).													
	1															
	2	PCNT2 counter	Counter for pulse counter channel 2. 32 bit unsigned integer. Unit depends on configuration, default is number of pulses.													
	3															
	4															
5																
0x0080	0	Trip1 Distance	Distance travelled in meters since trip meter was reset. 32bit unsigned integer.													
	1															
	2															
	3															
0x0100	0	Trip2 Distance	Distance travelled in meters since trip meter was reset. 32bit unsigned integer.													
	1															
	2															
	3															
0x0040	1	Output status	Status of outputs. 1 byte.													
			<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td colspan="2">Output 2</td> <td colspan="2">Output 1</td> </tr> </tbody> </table> <p>Each output is represented by two bits.</p> <p>Output state bit masks:</p> <ul style="list-style-type: none"> • 00b – output X is off, open collector output is non-conductive • 01b – reserved value • 10b – output X is inactive, open collector output is non-conductive. • 11b – output X is active, open collector output is conductive. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	-	-	-	-	Output 2
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0									
-	-	-	-	Output 2		Output 1										
0x0200	0	iButton key ID	iButton key ID without family code or checksum. 6 bytes.													
	1		iButton key ID is all zeroes if driver was not logged in at the time the snapshot was recorded.													
	2															
	3		iButton key ID will always be present in the message if the snapshot was triggered by a IBUTTON event (see event ID field), that is, the key ID will also be present when event ID indicates that driver logs out (even if the driver is not													

	4		logged in any more when the snapshot is taken).
	5		
0x0400	0	DLKP state	Driver Log Keypad button pressed state 0...4 or 0xff if DLKP is not connected.
0x0800	0	GPS altitude	GPS altitude in metres. Antenna height above/below mean sea level. Signed 16-bit integer.
	1		
0x2000	0	Snapshot counter	Transport based snapshot counter. Counter is incremented for every snapshot at message formatting time, and it is destination specific. Note that formatting time is not send time.
	1		
0x4000	0	Flag bits (user definable)	State flags. Lowest 48 bits are user definable, others are either reserved, proxy or IO flags.
	1		
	2		
	3		
	4		
	5		
	6	Flag bits (hard-coded)	
	7		
0x1000	0...n	Event specific bytes	Event specific bytes.

Table 3: Packet payload (Maximum of 64 bytes + event specific bytes. Minimum of 2 bytes. Default 43 bytes)

3 EVENT ID AND INFORMATION CODES

Event ID contains the numeric identification of the event that caused the message to be sent. Event IDs are listed in table 4.

Event ID (decimal)	Event ID (hex)	Event
2	0x02	INPUT_CHANGED
3	0x03	OUTPUT_CHANGED
5	0x05	GPS_STATUS_CHANGED
7	0x07	IGN_ON
8	0x08	IGN_OFF
9	0x09	NET_CHANGED
11	0x0B	IBUTTON
16	0x10	POWER_SUPPLY_CHANGED
17	0x11	TEMP_OK
18	0x12	TEMP_HIGH
19	0x13	TEMP_LOW
20	0x14	BATTERY_LOW
21	0x15	BATTERY_OK (R series only)
23	0x17	TACHO_EVENT (A1 MAX only)
30	0x1E	AD_SAMPLING
31	0x1F	FUEL_SAMPLING
101	0x65	SOFTWARE_START
102	0x66	SOFTWARE_STOP (R series only)
104	0x68	START_MOVING
105	0x69	STOP_MOVING
106	0x6A	DIRECTION_CHANGED
107	0x6B	GEOFENCE
109	0x6D	ALARM_ACTIVE
110	0x6E	SCHEDULED_EVENT
111	0x6F	SPEED_LIMIT
112	0x70	DISTANCE_TRAVELED
113	0x71	AD_THRESHOLD
114	0x72	FMS_OVERSPEED (A1 MAX only)
115	0x73	FMS_OVERTEMP (A1 MAX only)
116	0x74	FMS_OVERREVOLUTIONS (A1 MAX only)
117	0x75	FMS_HARSH_BRAKING (A1 MAX only)
118	0x76	FMS_CRUISE_CONTROL (A1 MAX only)
119	0x77	DATA_EVENT
120	0x78	COMM_FAIL
121	0x79	FLAG_CHANGED
122	0x7A	DLKP_EMERGENCY_PRESS

123	0x7B	DLKP_STATE_CHANGED
124	0x7C	GPS_HARSH_BRAKING
125	0x7D	GPS_RAPID_ACCELERATION
129	0x81	COMM_SESSION_CLOSED
130	0x82	PCNT_DATA
131	0x83	PCNT_LIMIT
132	0x84	PCNT_STATE
142	0x8E	HISTOGRAM_EVENT
160	0xA0	GARMIN_EVENT

Table 4: Event ID codes

3.1 Event Information

Event Information byte contains additional information about the event that caused the snapshot to be recorded. Meaning of the value depends on the type of event. Values are described in table 4.

Some values refer to “*index in configuration*”. This refers to the relative location index of the configuration item in the application’s configuration. Each item is automatically assigned an index depending on the order of items in the configuration. The first defined item is given index 1, and the index is increased by one for each item.

Indexing example: A1 SW XML configuration, section geofences:

```
<geofences>
<geofence id="kuopio" latitude="62.889" longitude="27.630" radius="100" />
<geofence id="shop" latitude="62.9320" longitude="27.655" radius="10" />
<geofence id="office" latitude="62.888" longitude="27.669" radius="30" />
</geofences>
```

In the above configuration:

- Geofence ID kuopio is assigned index 1.
- Geofence ID shop is assigned index 2.
- Geofence ID office is assigned index 3.

Event ID	Event type	Value																
2	INPUT_CHANGED	Index of input triggering change. Value 1...6																
5	GPS_STATUS_CHANGED	This field is always 0 in A1. In R series this field indicates the new fix status <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>status</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>first fix</td> </tr> </tbody> </table> status - This bit is set if fix was acquired. first fix - This bit is set if this is first fix after startup.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	status	-	-	-	-	-	-	first fix
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
status	-	-	-	-	-	-	first fix											
9	NET_CHANGED	New network state <ul style="list-style-type: none"> • 0 - Not registered, not searching • 1 - Registered to home network • 2 - Not registered, searching • 3 - Registration denied • 4 - Unknown 																

		<ul style="list-style-type: none"> • 5 - Roaming • 6 - Network status not available (AT command error, no SIM) 																
11	IBUTTON	Type of IBUTTON event. <ul style="list-style-type: none"> • 1 – logged in • 0 – logged out 																
30	AD_SAMPLING	Index of AD input triggering change. Value 1...4																
31	FUEL_SAMPLING	Index of AD input triggering change. Value 1...4																
101	SOFTWARE_START	<p>Device reset and wakeup reason.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 12.5%;">Bit 7</th> <th style="width: 12.5%;">Bit 6</th> <th style="width: 12.5%;">Bit 5</th> <th style="width: 12.5%;">Bit 4</th> <th style="width: 12.5%;">Bit 3</th> <th style="width: 12.5%;">Bit 2</th> <th style="width: 12.5%;">Bit 1</th> <th style="width: 12.5%;">Bit 0</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td colspan="2" style="text-align: center;">wakeup2</td> <td colspan="2" style="text-align: center;">wakeup</td> <td colspan="2" style="text-align: center;">reset</td> </tr> </tbody> </table> <p>reset - reason for previous reset. One of the following binary values:</p> <ul style="list-style-type: none"> • 00b – power-on reset • 01b – watchdog reset due to internal watchdog of coprocessor • 10b – user reset: reset button pressed or GPRS module reset the coprocessor • 11b – power-cut generated the reset <p>wakeup - reason for previous wakeup from sleep or powerdown. One of the following binary values:</p> <ul style="list-style-type: none"> • 00b – no wakeup occurred or unknown reason for wakeup. • 01b – reserved for future use • 10b – wakeup due to transition on ignition input line. • 11b – RTC wakeup: wakeup occurred after predefined timeout. <p>wakeup2 – extended wakeup reason. Used only if wakeup is 01b.</p> <ul style="list-style-type: none"> • 00b – Ignition. • 01b – Motion sensor. • 10b – Digital input. • 11b – Reserved for future use. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	-	-	wakeup2		wakeup		reset	
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
-	-	wakeup2		wakeup		reset												
107	GEOFENCE	<p>Type of geofence event and index of geofence.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 12.5%;">Bit 7</th> <th style="width: 12.5%;">Bit 6</th> <th style="width: 12.5%;">Bit 5</th> <th style="width: 12.5%;">Bit 4</th> <th style="width: 12.5%;">Bit 3</th> <th style="width: 12.5%;">Bit 2</th> <th style="width: 12.5%;">Bit 1</th> <th style="width: 12.5%;">Bit 0</th> </tr> </thead> <tbody> <tr> <td colspan="2" style="text-align: center;">dir</td> <td colspan="6" style="text-align: center;">index</td> </tr> </tbody> </table> <p>dir – Direction of geofence event:</p> <ul style="list-style-type: none"> • 1 – geofence entered • 0 – geofence exited <p>index – Index of geofence in configuration.</p>	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	dir		index					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
dir		index																
109	ALARM_ACTIVE	Index of active alarm in configuration.																
110	SCHEDULED_EVENT	Index of scheduled event in configuration.																
111	SPEED_LIMIT	Type of speed limit event. <ul style="list-style-type: none"> • 1 – over speed limit • 0 – below speed limit 																
113	AD_THRESHOLD	<p>Type of AD event and index of AD input.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 12.5%;">Bit 7</th> <th style="width: 12.5%;">Bit 6</th> <th style="width: 12.5%;">Bit 5</th> <th style="width: 12.5%;">Bit 4</th> <th style="width: 12.5%;">Bit 3</th> <th style="width: 12.5%;">Bit 2</th> <th style="width: 12.5%;">Bit 1</th> <th style="width: 12.5%;">Bit 0</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">dir</td> <td style="text-align: center;">multi</td> <td colspan="2" style="text-align: center;">thresholdId</td> <td colspan="4" style="text-align: center;">index</td> </tr> </tbody> </table> <p>dir – bit indicating the direction of AD threshold event:</p> <ul style="list-style-type: none"> • 1b – over threshold • 0b – below threshold 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	dir	multi	thresholdId		index			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
dir	multi	thresholdId		index														

		<p>thresholdId – index bits of threshold which was crossed over and triggered eventhandling. Index bit values:</p> <ul style="list-style-type: none"> • 00b – threshold basic • 01b – threshold A • 10b – threshold B • 11b – threshold C <p>multi</p> <ul style="list-style-type: none"> • 0b – single threshold crossed • 1b – multiple thresholds. The indicated thresholdId depends on the direction of crossing. <ul style="list-style-type: none"> • dir 1b: Contains highest index threshold crossed, in the order of preference: C,B,A • dir 0b: Contains lowest index threshold crossed, in the order of preference: basic, A,B <p>index - Index of AD input:</p> <ul style="list-style-type: none"> • 0001b – AD1 • 0010b – AD2 • 0011b – AD3 • 0100b – AD4 • 1010b – Main power supply (channel 10) • 1011b – External backup supply (channel 11) <p>Example: 0x91 equals over threshold event for AD1 second threshold.</p>																
114	FMS_OVERSPEED	Type of threshold event. <ul style="list-style-type: none"> • 1 – over threshold • 0 – below threshold 																
115	FMS_OVERTEMP	Type of threshold event. <ul style="list-style-type: none"> • 1 – over threshold • 0 – below threshold 																
116	FMS_OVERREVOLUTIONS	Type of threshold event. <ul style="list-style-type: none"> • 1 – over threshold • 0 – below threshold 																
118	FMS_CRUISE_CONTROL	Type of status event. <ul style="list-style-type: none"> • 1 – on • 0 – off 																
124	GPS_HARSH_BRAKING	Maximum detected deceleration during event as km/h per second.																
125	GPS_RAPID_ACCELERATION	Maximum detected acceleration during event as km/h per second.																
130	PCNT_DATA	Pulse counter channel ID.																
131	PCNT_LIMIT	<p>Pulse counter channel ID and current state.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 12.5%;">Bit 7</th> <th style="width: 12.5%;">Bit 6</th> <th style="width: 12.5%;">Bit 5</th> <th style="width: 12.5%;">Bit 4</th> <th style="width: 12.5%;">Bit 3</th> <th style="width: 12.5%;">Bit 2</th> <th style="width: 12.5%;">Bit 1</th> <th style="width: 12.5%;">Bit 0</th> </tr> </thead> <tbody> <tr> <td colspan="2">state</td> <td>-</td> <td>-</td> <td colspan="4">channel ID</td> </tr> </tbody> </table> <p>channel ID Pulse counter channel ID.</p> <p>state – Current state of pulse rate.</p> <ul style="list-style-type: none"> • 00b – pulse rate is within normal range. • 01b – pulse rate is in low range. • 10b – pulse rate is in high range. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	state		-	-	channel ID			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
state		-	-	channel ID														
132	PCNT_STATE	Pulse counter channel ID and current state.																

		<table border="1"> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> <tr> <td>state</td> <td>-</td> <td>-</td> <td>-</td> <td colspan="4">channel ID</td> </tr> </table> <p>channel ID Pulse counter channel ID.</p> <p>state – Current state of pulse rate.</p> <ul style="list-style-type: none"> 0 – pulse counter is not receiving pulses. 1 – pulse counter is receiving pulses. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	state	-	-	-	channel ID			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
state	-	-	-	channel ID														

Table 5: Event information field values

For all other event IDs event information field is not used.

3.2 Event specific bytes

Event specific bytes are appended to the end of the message when snapshot is triggered by the event and selector bit for event specific bytes is set.

Event ID	Event type	Value																
2	INPUT_CHANGED	IO transitions of this input. Typically 1, but in case of IO line jitter could be more. One unsigned byte.																
9	NET_CHANGED	Current LAI code, 24-bit unsigned integer (MCC+MNC, Mobile Country Code + Mobile Network Code). Zero if network was not available at the time of snapshot generation (network lost event). Example: 24491 is presented as 0x00 0x5f 0xab																
30	AD_SAMPLING	AD measurement data as milliVolts (n pieces of 2-byte unsigned integer values)																
31	FUEL_SAMPLING	AD measurement data as milliVolts (n pieces of 2-byte unsigned integer values)																
113	AD_THRESHOLD	<p>Bytes 0-3 AD derivate (only for inputs 1-4): Changing speed of measured AD input as hundreths of mV per second. 32-bit signed integer Maximum value for A1 SW is 40000.00 mV/s and minimum -40000.00 mV/s</p> <p>Byte 4: AD threshold mask: Mask containing all the crossed threshold values for current AD input.</p> <table border="1"> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> <tr> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>C</td> <td>B</td> <td>A</td> <td>0</td> </tr> </table>	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	-	-	-	-	C	B	A	0
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
-	-	-	-	C	B	A	0											
119	DATA_EVENT	Data which triggered the event.																
121	FLAG_CHANGED	Changed flags as a mask. 64-bit unsigned integer. User flags start from 1, and fixed flags are at the high end. For example if only IO1 flag and user 1 flag are set they would generate following value: 0x0100000000000001																
130	PCNT_DATA	Pulse counter sample buffer data: a list of 32 bit unsigned integers. Each item is an average pulse rate. First value in list is the oldest one and the last value is the most recent.																
142	HISTOGRAM_EVENT	Event triggering histogram or histograms as a mask. 64-bit unsigned integer. Histograms are set in order they appear in configuration. For example if both first and second configured histograms are triggered at the same time, value would be 0x0000000000000003																
160	GARMIN_EVENT	The Garmin event that triggered this event as ASCII string. See S100320 A1 SW Garmin interface for Garmin event specification.																

Table 6: Event specific information.

4 EXAMPLES

4.1 Long format

Selector bits 0x011FFF.

Data is in raw format as bytes without any additional characters. Total packet size is 85 bytes.

```

0x44, //'D' protocol identifier
0xC2, //Protocol version identifier (both long unit ID and field selector bits
are included).
0x01, 0x43, 0x72, 0x07, // extended unit id
0x29, 0xD6, 0x84 // Unit ID (of value 355632002225796)
0x00, 0x43, // Payload data length: 67 bytes.
0x01, 0x1f, 0xff, // Selector bits. (14 byte header).
0x71, // Event ID. AD Threshold event.
0x91, // Event information. AD1, Threshold A over limit.
0xC0, // fix validity (both current fix and data fix are valid)
0x45, 0x0e, 0xf9, 0x06, // time
0x45, 0x0e, 0xf9, 0x06, // GPS time
0x03, 0xb2, 0x0b, 0x80, // latitude 62.000000
0x03, 0xb2, 0x0b, 0x80, // longitude 62.000000
0x06, // Number of satellites
0x64, // Speed 100km/h
0x65, // Max speed 101km/h
0xb3, // Heading 358 degrees
0x87, // Input status. IGN and DINS 1-3 on, others off
0x0c, 0xe3, // AD1 3299mV
0x0f, 0x01, // AD2 3841mV
0x0c, 0xe3, // AD3 3299mV
0x0c, 0xe3, // AD4 3299mV
0x00, 0x32, // PCNT1 rate, 50 pulses per second.
0x00, 0x00, 0x15, 0x20, // PCNT1 counter, 5408 pulses received.
0x00, 0x00, // PCNT2 rate, 0 pulses per second.
0x00, 0x03, 0x0a, 0xa2, // PCNT2 counter, 199330 pulses received.
0x00, 0x00, 0x3b, 0x13, // trip1 distance 15123 meters
0x00, 0x00, 0x00, 0x32, // trip2 distance 50 meters
0x03, // output status: Out 1 active, Out 2 off.
0x00, 0x00, 0x0b, 0xcb, 0x17, 0xac, // iButton key ID 00000BCB17AC
0xff, // DLKP not available
0x00, 0x99, // GPS altitude 153 meters above sea level
0x00, 0x01, 0x86, 0xa0 // Event specific data: AD change speed 1000 mV/second
0x02 // Event specific data: changed AD thresholds: A

```

4.2 Backwards compatible mode

Selector bits 0x0002FC, backwards compatible mode

Data is in raw format as bytes without any additional characters. Total packet size is 51 bytes.

```
0x44, //'D' protocol identifier
0x01, //Protocol version identifier
0x29, 0xD6, 0x84 // Unit ID (of value 355632002225796)
0x00, 0x2b, // Payload data length: 43 bytes.
0x07, // Event ID. IGN_ON event.
0x00, // Event information
0xC0, // fix validity (both current fix and data fix are valid)
0x45, 0x0e, 0xf9, 0x06, // time
0x45, 0x0e, 0xf9, 0x06, // GPS time
0x03, 0xb2, 0x0b, 0x80, // latitude 62.000000
0x03, 0xb2, 0x0b, 0x80, // longitude 62.000000
0x06, // Number of satellites
0x64, // Speed 100km/h
0x65, // Max speed 101km/h
0xb3, // Heading 358 degrees
0x87, // Input status. IGN and DINs 1-3 on, others off
0x0c, 0xe3, // AD1 3299mV
0x0f, 0x01, // AD2 3841mV
0x0c, 0xe3, // AD3 3299mV
0x0c, 0xe3, // AD4 3299mV
0x00, 0x00, 0x3b, 0x13, // trip1 distance 15123 meters
0x03, // output status: Out 1 active, Out 2 off.
0x00,0x00,0x0b,0xcb,0x17,0xac // iButton key ID 00000BCB17AC
```

5 APPENDIX A: VERSION 1 HEADER AND PAYLOAD

5.1 Packet header

Byte	Field Name	Description
0	Packet Identifier	Identifies this as a 'D' type packet. (Always an ASCII 'D' / 0x44)
1	Protocol version	Protocol version identifier. Value is one of the following. 0x01 – D Protocol version 1.0
2	Unit ID	Identifier for the unit. 3 bytes.
3		This is the lowest 24 bits of the GSM device IMEI code. For example, for IMEI 355632002225796 (0x143720729D684) the bytes 0x29, 0xD6 and 0x84 are sent. See K505017 Calculating A1 IMEI from unit ID for more information about the unit ID.
4		
5	Snapshot length	Length of snapshot data in bytes. 2 bytes.
6		

Table 7: Packet header (7 bytes)

5.2 Snapshot data fields

Byte	Field Name	Description																
0	Event ID	ID of the event that caused the snapshot to be recorded. See chapter 3 for description of event ID codes. 1 byte.																
1	Event Information	Additional event dependent information. See chapter 3 for description of event information codes. 1 byte.																
2	Data validity	Data validity. 1 byte. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>currfix</td> <td>posfix</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> </tbody> </table> <p>Bits 0-5: Reserved for future use</p> <p>posfix - GPS fix validity (fix status)</p> <ul style="list-style-type: none"> 0 – GPS data included in the packet is invalid. 1 – GPS data included in the packet is valid. <p>currfix - GPS data validity (Current fix status)</p> <ul style="list-style-type: none"> 0 – Device was not receiving GPS data when snapshot was recorded, i.e., GPS data is old. (time in bytes 3-6 is a “best guess”, time in 7-10 is the GPS data acquisition time). 1 – device was receiving GPS data when snapshot was recorded. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	currfix	posfix	-	-	-	-	-	-
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
currfix	posfix	-	-	-	-	-	-											
3	Time (high byte)	Time when snapshot was recorded as seconds since 1 st of January 1970 00:00. 4 bytes.																
4	Time																	
5	Time																	
6	Time (low byte)																	
7	GPS time (high byte)		Time when GPS position data was recorded as seconds since 1 st of January															

8	GPS time	1970 00:00. 4 bytes.																
9	GPS time																	
10	GPS time (low byte)																	
11	Latitude (high byte)	GPS Latitude as millionths of a degree. Southbound is negative, northbound is positive. 32bit signed integer.																
12	Latitude																	
13	Latitude																	
14	Latitude (low byte)																	
15	Longitude (high byte)	GPS Longitude as millionths of a degree. Westbound is negative, eastbound is positive. 32bit signed integer.																
16	Longitude																	
17	Longitude																	
18	Longitude (low byte)																	
19	Number of satellites	Number of visible satellites. 8bit unsigned integer.																
20	Speed	Vehicle speed in km/h. 8bit unsigned integer.																
21	Maximum speed	Maximum detected speed since last event as km/h. 8bit unsigned integer. Application updates maximum speed value whenever it reads GPS position, and resets the value every time a snapshot is sent. Accuracy is thus relative to application's GPS polling interval.																
22	Heading	Vehicle heading in degrees / 2. 8bit unsigned integer. Multiply value by 2 to get heading in degrees. For example, 260° is sent as a value of 130. 0 or 360 degrees equals heading to North.																
23	DIN status	Digital input status. 1 byte. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>IGN</td> <td>-</td> <td>DIN6</td> <td>DIN5</td> <td>DIN4</td> <td>DIN3</td> <td>DIN2</td> <td>DIN1</td> </tr> </tbody> </table> <p>Each bit represents one digital output.</p> <ul style="list-style-type: none"> • 0 – Logical low • 1 – Logical High 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	IGN	-	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
IGN	-	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1											
24	AD1 (high byte)	Voltage of analog input AD1 in millivolts. 16bit unsigned integer.																
25	AD1 (low byte)																	
26	AD2 (high byte)	Voltage of analog input AD2 in millivolts. 16bit unsigned integer.																
27	AD2 (low byte)																	
28	AD3 (high byte)	Voltage of analog input AD3 in millivolts. 16bit unsigned integer.																
29	AD3 (low byte)																	
30	AD4 (high byte)	Voltage of analog input AD4 in millivolts. 16bit unsigned integer.																
31	AD4 (low byte)																	
32	Trip Distance (high byte)	Distance travelled in meters since trip meter was reset. 32bit unsigned integer.																

33	Trip Distance																	
34	Trip Distance																	
35	Trip Distance (low byte)																	
36	Output status	<p>Status of outputs. 1 byte.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Bit 7</th> <th>Bit 6</th> <th>Bit 5</th> <th>Bit 4</th> <th>Bit 3</th> <th>Bit 2</th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td colspan="2">Output 2</td> <td colspan="2">Output 1</td> </tr> </tbody> </table> <p>Each output is represented by two bits.</p> <p>Output state bit masks:</p> <ul style="list-style-type: none"> • 00b – output X is off, open collector output is non-conductive • 01b – reserved value • 10b – output X is inactive, open collector output is non-conductive. • 11b – output X is active, open collector output is conductive. 	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	-	-	-	-	Output 2		Output 1	
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0											
-	-	-	-	Output 2		Output 1												
37	iButton key ID (high byte)	<p>iButton key ID without family code or checksum. 6 bytes.</p> <p>iButton key ID is all zeroes if driver was not logged in at the time the snapshot was recorded.</p> <p>iButton key ID will always be present in the message if the snapshot was triggered by a IBUTTON event (see event ID field), that is, the key ID will also be present when event ID indicates that driver logs out (even if the driver is not logged in any more when the snapshot is taken).</p>																
38	iButton key ID																	
39	iButton key ID																	
40	iButton key ID																	
41	iButton key ID																	
42	iButton key ID (low byte)																	

Table 8: Packet payload (43 bytes)

6 REFERENCES

K503050 A1 Track SW and Telematics SW User Manual

K505017 Calculating A1 IMEI from unit ID

ABBREVIATIONS AND DEFINITIONS

1-Wire	1-Wire is a device communications bus system designed by Dallas Semiconductor that provides low-speed data, signaling and power over a single wire (a Ground wire is also needed). It is typically used to communicate with small inexpensive devices such as digital thermometers, weather instruments etc. The bus only needs two wires, data and ground.
AD	Analog-to-digital . Electronic circuit that converts continuous signals to discrete digital numbers
ASCII	American Standard Code for Information Interchange . Character coding based on English alphabet.
CAN	Control Area Network is a serial bus system, which was originally developed for automotive applications in the early 1980's. The CAN protocol was internationally standardized in 1993 as ISO 11898-1 and comprises the data link layer of the seven layer ISO/OSI reference model.
DLKP	Driver Log Keypad is a A1 accessory with one or multiple buttons and leds. Pressing the button causes a state change in the box. This information is used for example to detect private / work driving.
EGNOS	European Geostationary Navigation Overlay Service (EGNOS) is a satellite navigation system under development. See GPS.
FMS	Fleet Management System is third parties access to vehicle data via CAN. The FMS-interface is an optional interface of different truck manufacturers. Supported information is dependent upon vehicle equipment. For further information, please see the relevant SAE and ISO 11898 documents.
GPS	Global Positioning System (GPS) is the only fully-functional satellite navigation system. A constellation of more than two dozen GPS satellites broadcasts precise timing signals by radio to GPS receivers, allowing them to accurately determine their location (longitude, latitude, and altitude) in any weather, day or night, anywhere on Earth. GPS also provides an extremely precise time reference. In late 2005, the first in a series of next-generation GPS satellites was added to the constellation, offering several new capabilities, including a second civilian GPS signal called L2C for enhanced accuracy and reliability. In the coming years, additional next-generation satellites will increase coverage of L2C and add a third and fourth civilian signal to the system, as well as advanced military capabilities. The Wide-Area Augmentation System (WAAS), available since August 2000, increases the accuracy of GPS signals to within 2 meters (6 ft) for compatible receivers. GPS accuracy can be improved further, to about 1 cm (half an inch) over short distances, using techniques such as Differential GPS (DGPS).
GSM	Global System for Mobile Communication , a standard for mobile phones and networks.
iButton	The iButton is a mechanical packaging standard that places a 1-Wire component inside a small stainless steel "button" similar to a disk-shaped battery. iButtons are connected to 1-Wire bus systems with an adaptor that connects the "lid" and "base" of the canister to an RJ-11 plug.
ID	Short form for Identity (for example a serial number)
IMEI	The International Mobile Equipment Identity (IMEI) is a number unique to every GSM and UMTS mobile phone. The IMEI (14 digits plus check digit) includes information on the origin, model, and serial number of the device. The structure of the IMEI is specified in 3GPP TS 23.003. The model and origin comprise the initial 8-digit portion of the IMEI, known as the Type Allocation Code (TAC). The remainder of the IMEI is manufacturer-defined, with a Luhn check digit at the end.
IO	Input/Output
TCP	Transmission Control Protocol (TCP) is a connection-oriented, reliable delivery byte-stream transport layer communication protocol, currently documented in IETF RFC 793. It does the task of the transport layer in the simplified OSI model of computer networks.
TCP/IP	Transmission Control Protocol / Internet Protocol , TCP-over-IP. See TCP.
WAAS	Wide-Area Augmentation (WAAS) . See GPS.