Lommy Eye

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History:

Date	Remarks
20140107	First version
20140130	Automatic operator shift and emergency server described
20140131	emergency server renamed to failover server
20140224	wolf-funtionality added.
20140327	MOVE-WAKEUP value 2 added. Parameter POS-DATA-MODE added. Parameter SMSSENDER added.
20140415	New parameter: TEMP-INPUT
20140424	CONF: command described
20140428	STATEMASK new default value 840000000 (was 0)
20140522	RST field added.
20140606	CAP-VDelay: time changed from 100ms to 100s
20140714	New parameter: GSM-CONNECT-TIMEOUT and GSM-VON
20140916	STAT command added.
20141029	New parameter: GPS-SKIP
20141215	"Moving-bits" added.
20150302	TRANS field added. Radius added to GPS structure. Gps speed corrected to km/h.
20150305	APPTYPE field added.
20150609	ANA field added.
20150625	"no wolf heard" alarm value changed to 8 (was 1)
20151111	MBIT only active while MOVE-WAKEUP=2
20160411	POS command added.
20160426	Wolf feature altered.
20160726	New parameter: MEAS-PULSE
20160816	direction added to GPS field
20170213	Gps.Speed corrected to meters/hour
20170310	Parameter MOVE-DELAY removed. Section explaining moving-reports rewritten.
20170327	New parameter added: TEMP-OFFSET
20170607	Note inserted in GPS structure: “Speed and Direction will be blank while Speed is below 10km/h”
20170607	Gps Speed is in km/h again!
20170802	PCB button will now erase any stored reports before rebooting and sending a report. New field: TEMP-EXT New parameter: TEMP-INPUT-EXT MOVE-WAKEUP=2 feature redefined New feature: VPORT LED’s will be indicating on first report after reset.
20170913	Typo’s corrected in VPORT-ALARM and VPORT-STATUS examples.
20171117	Parameter VPORT-LISTEN-INTERVAL has new default value=3600
20180102	TEMP-EXT field is now in milli-degrees
20180523	New parameter: OPT-CFG
20180820	Chronological sequence requirement in WEEK and SUN commands.
20180917	“Input triggered reports” section added.
20180926	Parameter BATT-LOWVOLTAGE added. Description of “Low battery” feature added.

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20190115	New parameter: OPERATOR-HANDLING
20200512	Parameter GSM-CONNECT-TIMEOUT new default value: 120 (was 60)
20201104	Recovery Mode added
20210115	Complete re-write
20210519	HDOP and SVUsed added to GPS-field
20210915	GSM Move Wakeup feature and MoveFiltering (MOVE-WAKEUP=3) added. PowerSaveMode feature added. New parameter: MOVE-REPORT-DELAY
20211006	Parameter deleted: REPORT-RETRY-DELAY
20211007	Parameters MOVE-REPORT-DELAY and MOVE-FILTER-PERIOD-COUNT and MOVE-FILTER-PERIOD-LEN added to parameter listing section.
20221026	Completly rebuild move logic. Added MOVE-TRIGGER-COUNT and MOVE-TRIGGER-LEN (replaced for MOVE-FILTER-PERIOD-LEN). Added MOVE-STOP-COUNT and MOVE-STOP-LEN. Remove GSM-MOVE-WAKEUP feature. Added valid RAT descriptions in reports. Added REPORT-INTERVAL-MOVE=0 feature for moving reports. Added FLEXSTREAM-CIRCULAR=0(or 1) to do not keep old reports on device. Added LED red blinks when move activity detected. Added support for I2C sensor temperature and humidity sensors. Parameter TEMP-INPUT-EXT renamed to INPUT-EXT. SUT message Data field TEMP-EXT renamed to INPUT-EXT.
20221222	Added PREFERRED-OPERATORS parameter. This is a list of preferred GSM operators (PLMN) to use if we are roaming on a foreign network. The list can contain a maximum of 200 entries (ex: "12345,33453,22121") Example < PREFERRED-OPERATORS>123456,334535,221241</ PREFERRED-OPERATORS> Fixed issue with calendar report infinite loop. Add UDP-RESPONSE-TIMEOUT param.
20220118	Fix preferred operators list parameter name to by PREFERRED-OPERATORS (not PREFERED-OPERATORS).
20220130	Add support for leagcy move stop condition (set MOVE-STOP-COUNT = 0 to turn on). Remove blinking red led on gsens activity. Enabling gsensor very close to DeepSleep function to reduce chance of issue with power draining ~800uA on deepsleep. In PowerSave mode only one Activity of gsensor wakeup device.
20230207	Fix button interrupt. Change MOVE-STOP-COUNT default to 0 (Legacy Mode by default).
20230208	Separate PREFERRED-OPERATORS to Operators.fps file to pass upto 200 entries of PLMN.
20230320	Change TOTAL server messages to TOTSERVER[CntServerTx, CntServerRx, CntGsmOn, SecGsmOn, CntReset, ErrCntGsmConnect, CntGpsOn, SecGpsOn, SecAwake, SecSleep] Add GPS on time and GPS turning-on counter Move awake and sleep timers to diagnostics (saved under file one time per 6 hours) Fix GPS timeout to 120s after button report triggered.
20230327	Fix for wrong firmware version in TNO messages: FWVER[%d].
20230524	Add TOTSERVER param. If "1" enable TOTAL SERVER messages by default. If "0" earlier behavieur - one TOTSERVER report per 30 reports. Enable VCAP measurements for 4G units. I2C support for sensor SHT31. PowerSaveMode bug fix. Requires firmware wchich support fal in version 1.15.
20230629	Add support for better triangulation for 2G and 4G units - based on new FAL function getCellInfoExtGSMFAL. PowerSave mode changes: starts 2.5 * REPORT-INTERVAL time after udp timeout or no coverage (any serving cell connected). End after receive ack from server. New 4G cells TELEGRAMS: LTE[0,{x,x,x,x,x},...] Fix for PLMN number when 6 digits. Fix for sendUDP mechanism (increment TNO only if received response with valid TNO). Builded with FAL 1.16.

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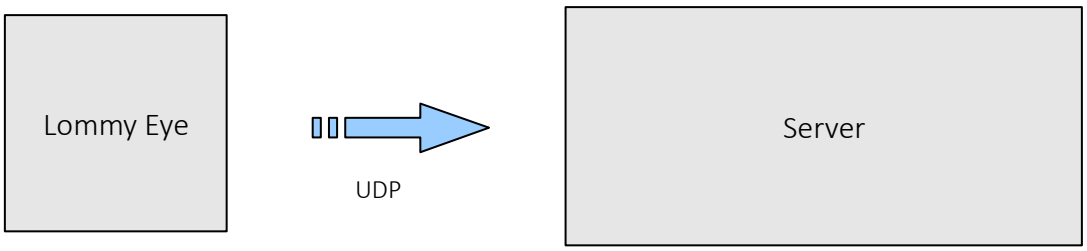
General Description

This document describes the Lommy Eye project.

The system consists of a Lommy device communicating with a server via UDP.
The device will periodically wake up and gather information about surrounding gsm cells and send these to the server.



LED's

The LED's will be indicating the device status, during the first report after each reset, caused by pressing the button on the PCB.
Red: Will be on if the supply voltage is ok.
Blue: Will give short flashes while GPS is searching. Will be on when GPS fix is achieved. Will be off if no GPS fix is achieved.
Yellow: Will be on when the device is connected to a base station.
When the report is sent, all LED's will be off.

Red: Blink when detect move activity if not indicating device status.

REPORTING (Normal and Moving)

"Normal reports" are sent every REPORT-INTERVAL.
"Moving reports" are sent when moving is started after REPORT-MIN-DELAY from last report, and every REPORT-INTERVAL-MOVE or every REPORT-MIN-DELAY if REPORT-INTERVAL-MOVE=0 while moving. Also, a report is sent when moving is stopped after REPORT-MIN-DELAY from last report.
The first moving reports after a non-moving period are delayed by MOVE-REPORT-DELAY.

GPS position is added to the reports, if GPS-TIMEOUT is set, and a GPS fix can be obtained.
If a GPS position is added, only the base cell information will be present in the report, not the neighbour cell information.

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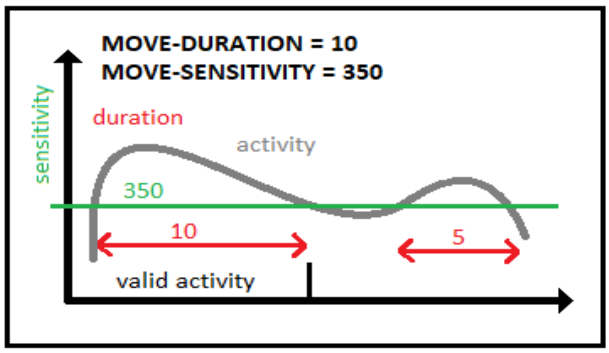
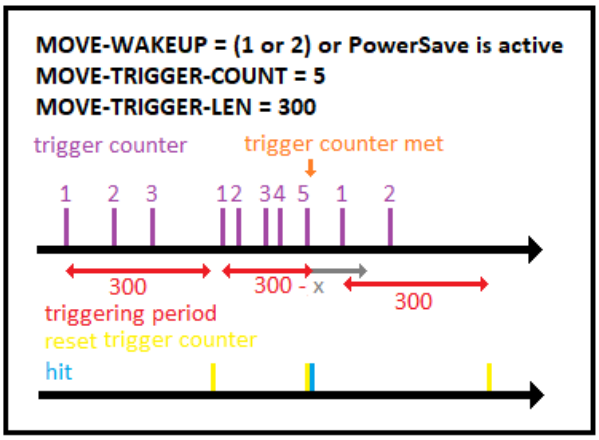
Move wakeup feature

1. This is first step of detect MOVE. If **MOVE-WAKEUP > 0** move feature is enabled. When reach sensitivity higher that **MOVE-SENSITIVITY** in time longer than **MOVE-DURATION** there is detection of move valid activity.

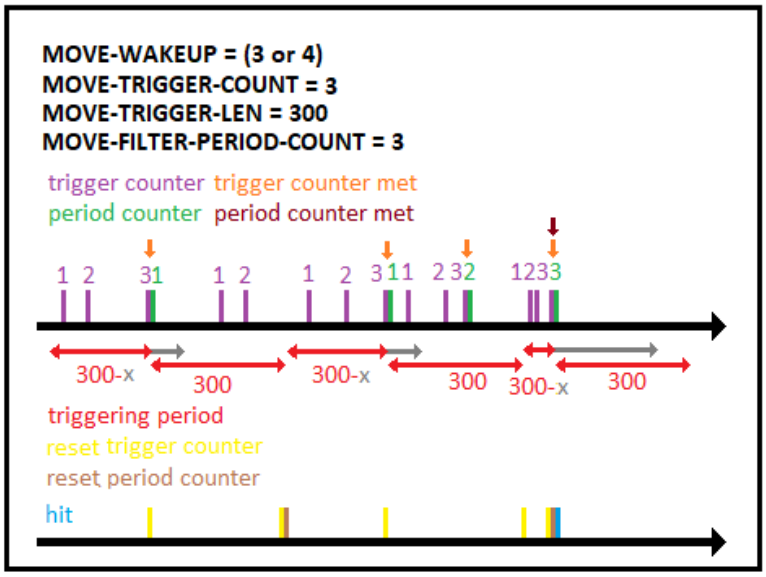


	All movement reports	Only stop movement report
Period filter is disabled	MOVE-WAKEUP = 1	MOVE-WAKEUP = 2
Period filter is enabled	MOVE-WAKEUP = 3	MOVE-WAKEUP = 4

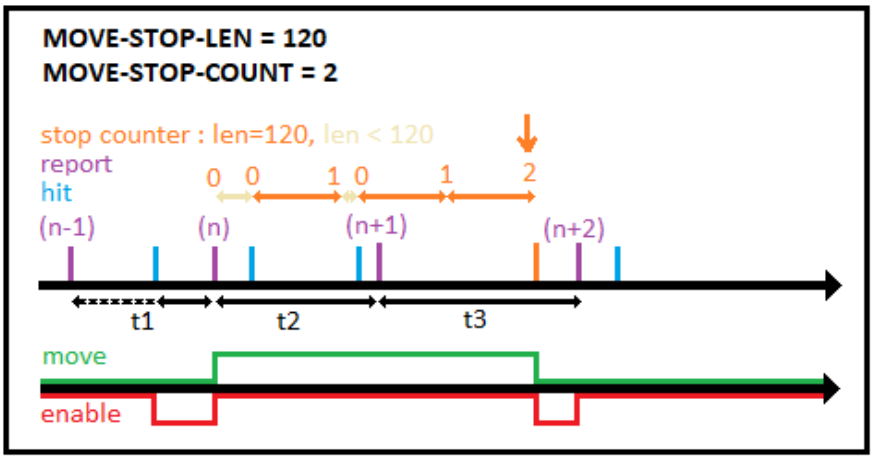
2. The second step looks for HIT signal. According to **MOVE-WAKEUP** setting, there is two scenarios.
   - Scenario 1: **Trigger counter** is incremented every **valid activity.** If **trigger counter met** **MOVE-TRIGGER-COUNT** there is valid trigger – **HIT**, **reset of trigger counter** and end of **triggering period**. Also, **reset trigger counter** every full **triggering period** of **MOVE-TRIGGER-LEN** (starts from first **valid activity**).



- **Scenario 2**: **Trigger counter** is incremented every **valid activity.** If **trigger counter met MOVE-TRIGGER-COUNT** there is valid trigger, **reset of trigger counter** and increase of **period counter**. If **period counter met MOVE-FILTER-PERIOD-COUNT** there is **HIT** and **reset period counter**. First and last **triggering period** ends if valid trigger, middle **triggering periods** waits to the end of **MOVE-TRIGGER-LEN**. Also, **reset trigger counter** and **reset period counter** every full **triggering period** of **MOVE-TRIGGER-LEN** if not **trigger counter met.**



3. The last step sets **move** state. If **HIT** happens **disable** move **activity** and wait to next report time, then set **move=1** and send report (or skip if MW=2 or MW=4) and start **stop counter** and **enable** move **activity** again. If no **HIT** condition happens in **MOVE-STOP-LEN** time, increment **stop counter**, if **stop counter** met **MOVE-STOP-COUNT** set **move=0** and **disable** move **activity.** Wait for next report time, send **move** stop report and **enable** move **activity** again.



MOVE-WAKEUP = 1 or MOVE-WAKEUP = 3
A report is sent when movement is started.
A report is sent every **REPORT-INTERVAL-MOVE** so long as the device is moving.
A report is sent, when movement is ended.

MOVE-WAKEUP = 2 or MOVE-WAKEUP = 4
No report is sent at the start of movement and during movement.
A report is only sent, when movement is ended.

Note: If MOVE-STOP-COUNT = 0, then legacy move checking feature is enabled. It mean that gsensor is activated MOVE-STOP-LEN time before report and checks for unit is still moving. Move stop feature is diabled – no additional wakeups for move stop checks.

ECHO Mode feature

Mode 0 : Echo feature is disabled.

Mode 1 : The device will search for any EchoTag which is defined in the ECHOLIST.
If the rssi value of the EchoTag is above a parameterized limit, the device will be connected to the EchoTag. Periodically, the device will check that the connected EchoTag is still within radio range. (In this case, the rssi will not matter.) If the EchoTag is not responding, the device will retry a number of times. If the EchoTag is still silent, the device will start seaching again.
A report is sent to the server if:
1. The device is unconnected and connects to a new EchoTag.
2. The device "hops" from one EchoTag to another.
3. The device loses connection and cannot find a new EchoTag.

Mode 2 : Like Mode 1, with the difference that a report is sent if:
1. The device is unconnected and connects to a new EchoTag.
2. The device loses connection and cannot find a new EchoTag.

Mode 3 : Like Mode 2, with the addition, that GPS position is only added if no EchoTag can be found or the EchoTag has changed. Used in "container mode", see below.

CONTAINER feature

Is running if **ECHO-MODE** is set to 3 and **MOVE-WAKEUP** is set to 2.
"Normal reports" are sent as usual, but "moving reports" are only sent when movement is stopped, and if no EchoTag can be found or if the device has "hopped" to a new EchoTag.
GPS positions will only be added if no EchoTags can be found.
(GPS-TIMEOUT must be set, to enable gps positions)

BEACON feature

The two ACT-bits "Beacon" and "Autobeacon" control the behavior:

"Beacon" ACT bit 0x00000002	"AutoBeacon" ACT bit 0x00000020	Behaviour
0	0	Beacon off
0	1	Beacon only on while no EchoTag is connected
1	x	Beacon on

While Beacon is on, the report interval is set to **REPORT-INTERVAL-BEACON**.
The device will periodically transmit a RF packet, enabling it to be tracked by a Flextrack Locator.

Button triggered reports

If the user presses the pcb button, the device will reboot.
Upon powering up, the device will create a report and send it to the server.
This report will include gps data (using timeout=120 sec).

Input triggered reports

Reports may be triggered by either of the two inputs.
The inputs must be enabled by parameter **OPT-CFG** (see parameters section).
If an enabled input changes state, a report will be sent.
PS: Input triggered reports are only enabled while RECOVERY-MODE is 0.

VPORT feature

If the parameter **VPORT-REPORT-MODE** is set, the device will listen for VPorts 11 seconds, every **VPORT-LISTEN-INTERVAL** second.
If **VPORT-REPORT-MODE** is set to 2, the device can handle RatTrap-VPorts.
The VPORT feature is described in a separate document.

WOLF feature

If the WOLFLIST is not empty, the device will be able to listen for "wolf"-items.
When the device is awakened by either g-sensor or one of the digital input changes state, the device will listen for "wolf"-items (RF).
If no wolf is heard, an ALARM is sent to the server.

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Recovery Mode

If the parameter **RECOVERY-MODE** is set, Recovery Mode is enabled:
RECOVERY-MODE = 1 : The Recovery Mode is “one-shot” and can only be re-armed by commands.
RECOVERY-MODE = 2 : The Recovery Mode is automatically re-armed, if Input 2 changes to idle.

Recovery Mode is triggered by Input2 (see parameter **RECOVERY-TRIG-LEVEL**).
When Input2 is triggered, Recovery Mode is started for the next **RECOVERY-DURATION** seconds.
During this time, reports are sent every **REPORT-INTERVAL-RECOVERY** second.
These reports will include a gps position, if available (see parameter **GPS-TIMEOUT-RECOVERY**).
Changing the standard parameter **REPORT-INTERVAL**, will end an ongoing Recovery Mode.

Commands:
RECOVERY-ON : Will (re-)arm the Recovery Mode, awaiting to be triggered by Input 2.
RECOVERY-OFF : Will end any ongoing Recovery Mode.

Important: Parameter **OPT-CFG** must be configured correct, to enable Input2

Low battery

It is possible to monitor and signal low battery, by setting parameter **BATT-LOWVOLTAGE** to the desired minimum level (in milli-volt).
E.g., if setting the parameter to 2600, the Eye will raise bit 2 in the SM field, if the battery voltage drops below this limit.
PS: The low bat monitoring is not useable when supercaps are mounted.

Power Save Mode

If the device cannot establish gsm connection during a period of 2,5 x **REPORT-INTERVAL**, the device will enter Power Save Mode.
During Power Save Mode, the device will send reports every REPORT-INTERVAL-POWER-SAVE seconds. Also, the GSensor will be enabled. If the device is awakened by the GSensor, a report will be sent after **POWER-SAVE-REPORT-DELAY** seconds.
Power Save Mode will be exited when the device establishes connection to gsm. Also, the GSensor will return to the enable/disable-state it had before.

Power Save Mode is enabled by default. It can be disabled by parameter **POWER-SAVE-MODE**.

Server transmissions

Retransmissions

If the Lommy does not receive an ACK, it will retransmit the Data telegram after **REPORT-MIN-DELAY** seconds. The device will continue to reuse the same TNO if no ACK has been received from the server.

The Lommy will retransmit max **REPORT-MAX-RETRY** times.
New retransmissions will only be granted, once a Data transmission has been successful.

"Failserver"

If no ACK has been received from the server after 9 tries, the device will send a short report to a predefined "failserver".
If an ACK is received from the normal server, the Lommy will stop sending reports to the failserver.
If no ACK is still not received, the device will reboot.

Extended cell scanning

For 4G module (EXS82-W) we have special algorithm to handling cell in neighbourhood.

There are up to 3 steps, based on configuration:

1. Scan LTE most common bands.
Notice: This step is enabled if RATMODE is 9 or 7- LTE with fallback to 2G or just LTE.

2. Scan LTE other bands.
Notice: This step is enabled if RATMODE is 9 or 7- LTE with fallback to 2G or just LTE.

3. Scan GSM bands.
Notice: This step is enabled if RATMODE is 9 or 0 - LTE with fallback to 2G or just 2G.

After each enabled step device check that we have reached MIN-CELL number. If yes, scan is completed.

Also we have 3 parameters to set bands in each steps: LTE-LOW-BANDS-1, LTE-LOW-BANDS-2 and

GSM-BANDS. This param is integer value in Tracker.fps, but represent is bitmask. To calculate bands just add all needed and convert it to integer.

For example defaults values calculation:
B20 will be 0x00080000 => **524288**

B3 and B8 will be 0x84 => **132**

GSM900 and GSM1800 will be 0x3 **=> 3**

// GSM BAND definitions

BAND_GSM_900 0x1

BAND_GSM_1800 0x2

BAND_GSM_850 0x4

BAND_GSM_1900 0x8

// LTE BAND definitions (low bands)

BAND_LOW_B1 0x00000001 //!< LTE 2100 (B1)

BAND_LOW_B2 0x00000002 //!< LTE 1900 (B2)

BAND_LOW_B3 0x00000004 //!< LTE 1800 (B3)

BAND_LOW_B4 0x00000008 //!< LTE 1700 (B4)

BAND_LOW_B5 0x00000010 //!< LTE 850 (B5)

BAND_LOW_B8 0x00000080 //!< LTE 900 (B8)

BAND_LOW_B12 0x00000800 //!< LTE 700 (B12)

BAND_LOW_B13 0x00001000 //!< LTE 700 (B13)

BAND_LOW_B18 0x00020000 //!< LTE 850 (B18)

BAND_LOW_B19 0x00040000 //!< LTE 800 (B19)

BAND_LOW_B20 0x00080000 //!< LTE 800 (B20)

BAND_LOW_B25 0x01000000 //!< LTE 1900 (B25)

BAND_LOW_B26 0x02000000 //!< LTE 850 (B26)

BAND_LOW_B27 0x04000000 //!< LTE 850 (B27)

BAND_LOW_B28 0x08000000 //!< LTE 700 (B28)

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Parameters

FLEXSTREAM-IP	text ("")	Server IP address and port, eg:"someserver.com:30000"
APN	text (internet)	GPRS apn
USERNAME	text ("")	GPRS username
PASSWORD	text ("")	GPRS password
DNS	text ("")	Custom DNS server
PIN	text ("")	SIM card PIN
SMS-SCA	text ("")	
SMSSENDER	list (+4550503185)	A list of phone numbers that are allowed to send SMS messages to the unit. The numbers MUST include the country code also. If set to "ALL", all senders will be accepted.
FAILSERVER	text ("")	FailServer IP address, eg:"somefailserver.com"
FAILSERVER-PORT	0- (30013)	FailServer port
PREFERRED-OPERATORS	text ("")	List of preferref operators PLMN codes ex 12345,123456,2134556. Up to 200 entries.
REPORT-INTERVAL	sec (86400)	Time between reports
REPORT-INTERVAL-MOVE	sec (3600)	Time between reports while device is moved (g-sensor)
REPORT-INTERVAL-BEACON	sec (3600)	Time between sending reports to the server, while Beacon is active
REPORT-INTERVAL-RECOVERY	sec (3600)	Report interval while Recovery Mode is active (RECOVERY-DURATION)
REPORT-MAX-RETRY	0-255 (3)	How many times will the device retry, if a server response (ACK) is not received.
REPORT-MIN-DELAY	sec (1800)	The minimum delay between sending reports to the server
MAX-SEND-REPORT	1- (5)	The maximum of reports send at ones to the server
ENABLE-EXT-CELL-INFO	0-1 (0)	Include extended cell info into reports.

GSM-VON	mV (3000)	Minimum voltage over super caps before report transmission is allowed.
GSM-CONNECT-TIMEOUT	sec (120)	Gsm connect timeout.
NOGSM-TIMEOUT	sec (86400)	If the device has not been able to connect to a gsm station during this time period, beacon will be started. Requires NOGSM-BROADCAST to be set to 1.
NOGSM-BROADCAST	0,1 (0)	If set to 1, beacon will be activated if gsm connection has failed for too long. (See NOGSM-TIMEOUT)
VCAP-DELAY	0- (100)	Delay to measure supercapacitor voltage.
FLEXSTREAM-CIRCULAR	0-100 (10)	Max number of items (reports) in the circular buffer. If 0 or 1 only newest report will be send.
GPS-TIMEOUT	sec (0)	How long the device must wait for a valid gps signal. (if set to 0, no gps position will be added to the report)
GPS-TIMEOUT-RECOVERY	sec (180)	Gps timeout while Recovery Mode is active (RECOVERY-DURATION).
GPS-SKIP	0- (3)	After achieving gps fix, the device will skip xx number of positions, to improve accuracy.
MAX-DOWNLOAD-BLOCK-SIZE	1- (20000)	The block size of RELOAD data.
RELOAD-MIN-DELAY	sec (1800)	The minimum delay between downloading blocks of RELOAD data. (See "Commands" section)
BATT-LOWVOLTAGE	mV (0)	Setting this parameter to a value bigger than 0, will enable monitoring and signaling of low battery (see “Low battery” description)
BEACON	0-1 (0)	See Beacon feature.
AUTO-BEACON	0-1 (0)	See Beacon feature.
BEACON-INTERVAL	sec (5)	Time between sending RF packets, while Beacon is active.
MOVE-WAKEUP	0-4 (0)	0 : Move wakeup feature disabled. 1-2 : Move wakeup feature enabled 3-4 : Filtered move wakeup enabled (See description of “Move wakeup feature”)
MOVE-REPORT-DELAY	sec (0)	See description under “REPORTING (Normal and Moving)”
MOVE-SENSITIVITY	milli-G 0-6000 (350)	The sensitivity of the G-Sensor. (Move detection)
MOVE-DURATION	milli-sec (10)	The duration of the G-Sensor activity. (Move detection)
MOVE-TRIGGER-LEN	Sec (60)	Time to check gsensor activities. If first or last this is not used. See MOVE-WAKEUP feature.

MOVE-TRIGGER-COUNT	Number (1)	How many gsensor activities to say trigger is valid. See MOVE-WAKEUP feature.
MOVE-FILTER-PERIOD-COUNT	0- (3)	How many periods with valid trigger to say “I am moving”. See MOVE-WAKEUP feature
MOVE-STOP-LEN	0- (300)	Time to check device is moving. In legacy mode - wakeup device before next report to check “I am still moving?” See more in MOVE-WAKEUP feature.
MOVE-STOP-COUNT	0- (0)	How many periods without valid trigger to say “I am no moving”. If set 0 then legacy mode is active for move-stop detection (default). See more in MOVE-WAKEUP feature.
ECHO-MODE	0-3 (0)	See "ECHO mode feature"
ECHO-INTERVAL	sec (60)	Time between checking for echo-tag presence
ECHOLIST	list ("")	A list of ECHO Tag ID’s, that the Eye will connect to. (Max 32) Value “ALL” means that the Eye will connect to any ECHO Tag.
ECHO-THRESHOLD	dbm (-80)	Minimum signal strength from echo-tag, before the device will connect to it.
WOLF-LISTEN-PERIOD	sec (45)	See "WOLF-feature".
VPORT-REPORT-MODE	0-2 (0)	0 = Never. VPorts are not used. 1 = Normal: VPort.fps defines min/max/hyst, which will trigger reports 2 = RatTrap: VPort.fps are ignored. Changes on certain counter values will trigger reports
VPORT-TIMEOUT	sec (7200)	If the device har not heard from a VPort within this time limit, the VPort is marked “mute”. A VPort-alarm will be sent.
VPORT-LISTEN-INTERVAL	sec (3600)	The device listens for VPorts with this interval. The device will listen for 11 seconds each time.
VPORT-STATUS-INTERVAL	sec (3600)	The device sends VPort status telegrams with this interval.
MEAS-PULSE	milli-sec (0)	If set to a value, a pulse with this length will be given on the output before measuring the two analog inputs. (the ANA data field) E.g. used to power up a sonar device before measuring the input value.
OPT-CFG	Bitfield (0)	This is a hex number setting different options on the OPT2 board present in some models. bit 0-7: not used bit 8: Input 1 is used bit 9: Input 2 is used (see also Recovery Mode)
TEMP-INPUT	0-2 (0)	Temperature measurement source. (See field "TEMP") 0 = cpu temperature (default) 1 = External sensor (MCP9701) on input 1 2 = External sensor (MCP9701) on input 2

INPUT-EXT	Bitfield (0)	This is a Dec. number activating input from external sensor source(s) (See data field "INPUT-EXT"). Bit 0 = External sensor (MCP9701) on input 1 Bit 1 = External sensor (MCP9701) on input 2 Bit 2 = Temperature sensor on I2C Bit 3 = Humidity sensor on I2C Ex: activating input 1 and humidity sensor on I2C: 1001 (bin) = 9 (dec).
TEMP-OFFSET	milli-degrees (0)	Temperature offset in milli-degrees Celsius. (10000 = 10 degrees)
TEMP-OFFSET-EXT	list milli-degrees (0,0)	External Temperature offset in milli-degrees Celsius.
RECOVERY-MODE	0,1 (0)	0: Recovery Mode is disabled. 1: Recovery Mode is enabled. See description elsewhere.
RECOVERY-TRIG-LEVEL	0,1 (0)	0: A low level on Input2 which will trigger Recovery Mode. 1: A high level on Input2 which will trigger Recovery Mode.
RECOVERY-DURATION	sec (86400)	The duration of Recovery Mode.
RATMODE	number (9)	Set preffered mode of access GSM radio. For 4G unit only. 0 - 2G, 7 - CAT_M1, 8 - CAT_NB, 9 - CAT_M1_2G_DUAL, 10 - CAT_M1_NB_DUAL, 11 - CAT_NB_2G_DUAL, 12 - CAT_M1_NB_2G_TRIPLE.
POWER-SAVE-MODE	0,1 (1)	0: Power Save Mode disabled 1: Power Save Mode enabled.
REPORT-INTERVAL-POWER-SAVE	sec (432000)	Report interval during Power Save Mode
POWER-SAVE-REPORT-DELAY	sec (600)	GSensor triggered reports will be delayed by this number of seconds, during Power Save Mode.
UDP-RESPONSE-TIMEOUT	sec (30)	How many secunds device wait to say no reposponse from the server.
TOTSERVER	0,1 (1)	TotalServer messages in each report. To disable use 0
MIN-CELLS	number (2)	Number to skip next cell scanning steps if reach minimal cells
LTE-LOW-BANDS-1	4G BANDS mask (524288)	First step in 4G. Look to extended cell scanning section to calculate value. Default is: B20
LTE-LOW-BANDS-2	4G BANDS mask (132)	Second step in 4G. Look to extended cell scanning section to calculate value. Default is B3 and B8
GSM-BANDS	2G BANDS mask (3)	GSM step. Look to extended cell scanning section to calculate value. Default is 900 and 1800

Commands

Commands can be sent to the device from the server, using the field `CMD[{name,value}]`.
These commands are supported:

RESET
The device will restart immediately.

RELOAD,server,type	`Example: RELOAD,dragonfly.fwupdate.dk/fl/,3`
Downloads a new Firmware or User Application (or both) from the given server. Type: 1 = Firmware 2 = User Application 3 = Both The new software will be downloaded in "chunks" of 20KB each with RELOAD-MIN-DELAY seconds in-between. Thus, downloading new firmware of 120KB will take around 3 hours. The device will not send any reports to the server while downloading is in progress. After download and install of the new software, the device will reset and include VER and FWVER in the very first report.	

CONF:parname,value (only by SMS)	`Example: CONF:PIN,1234`
Modify/add a configuration parameter in the unit. If the ”parname” does not exist, it will be created in the configuration parameters.	

STAT (only by SMS)
Sends a SMS message with the status of the unit, battery voltage etc.

POS (only by SMS)
Returns the current gps position. If no gps fix is achieved, a gsm position is returned instead. Examples: Time=16-04-11 07:38:51 Lat=N56.09.55 Lon=E009.32.37 Speed=0 Km/H Direction=237 Deg Sats=6 GSM<1,(238,1,348F,119,-81),(238,1,CD8,119,-86)>

GETCONF
The device configuration will be sent, the next time the device is connected to the server. (See also ACT bit 10)

RECOVERY-ON **RECOVERY-OFF**
See description of Recovery Mode.

Data telegram (Lommy to Server)

TNO	int	MANDATORY
The message number (-1 - -9999) ex: TNO[-552]		

ID	string	MANDATORY
Device ID ex: ID[1234567890]		

ECHO	structure	
ECHO information. Format: ConnStatus,ID ex1: ECHO[0,1122334455] - the device cannot connect to any echo tags. The last one heard was id=1122334455 ex2: ECHO[1,9988776655] - the device has connected to echo id=9988776655		

ICCID	string	
ICCID number of the sim card ex: ICCID[89450201845207198 12]		

RST	int	
Reset cause. RST is automatically included in the first DataTelegram after power-reset. ex: RST[1]		

FWVER	string	
Firmware Software version. FWVER is automatically included in the first DataTelegram after power-reset. Also, the server can request the device to include FWVER (see ACT in AckTelegram) ex: FWVER[67]		

VER	string	
Application Software version. VER is automatically included in the first DataTelegram after power-reset. Also, the server can request the device to include VER (see ACT in AckTelegram) ex: VER[10]		

APPTYPE	string	
Application Software type. APPTYPE is automatically included in the first DataTelegram after power-reset. Also, the server can request the device to include APPTYPE (see ACT in AckTelegram) ex: APPTYPE[1000]		

TIME	string	
The date/time in the device. Format: YYYYMMDDHHmmss If the date/time is not known by the device, this field will not be included.		

ex: TIME[20140107103208]

SM	UInt64	

Statemask bits of the device.
This value must be hexadecimal.
ex: SM[0]

bit	description
30	GSensor is triggered
29	Beacon is on
28	Wolf is heard
21	State of output
17	State of input 2
16	State of input 1
13	GSM Move Wakeup
4	Button pressed
2	Low battery detected

GSM	structure	

Gsm cell information.
Format: ServingTA,{MCC,MNC,cellID,LAC,rssi},...
So, the first value is "ServerTA". Next, a list of up to 16 gsm cells will follow.
The first in the list, can be serving cell, if we have GSM in ServingCellTechnology in RAT message. The rest holds the data for up to 15 neighbourgh stations.
cellID and LAC must be hexadecimal.
ex: GSM[2,{238,2,7D7A,0036,84},{238,20,1AA6,1772,18},{238,1,120B,011A,12},
{238,2,7D7B,0036,10},{238,1,019D,011A,10},{238,20,1AA5,1772,9},{238,20,5D8A,1772,8},
{238,20,6BDF,1773,7},{238,20,5D89,1772,7},{238,20,1D0A,1773,7},{238,1,1309,011A,7}]

LTE	structure	

Gsm cell information.
Format: ServingTA,{MCC,MNC,cellID,LAC,rssi},...
So, the first value is "ServerTA". This value is not used. The structure has been the same as in gsm to speed up the implementation.
Next, a list of up to 16 lte cells will follow.
The first in the list, can be the serving cell, if we have LTE in ServingCellTechnology in RAT message.
The rest holds the data for up to 15 neighbourgh stations.
cellID and LAC must be hexadecimal.
ex: LTE[0,{238,2,7D7A,0036,-84},{238,20,1AA6,1772,-18},{238,1,120B,011A,-12},
{238,2,7D7B,0036,-10},{238,1,019D,011A,-10},{238,20,1AA5,1772,-9},{238,20,5D8A,1772,-8},
{238,20,6BDF,1773,-7},{238,20,5D89,1772,-7},{238,20,1D0A,1773,-7},{238,1,1309,011A,-7}]

TOTSERVER	structure	

Format:
CntServerTx,CntServerRx,CntGsmOn,SecGsmOn,CntReset,ErrCntGsmConnect,CntGpsOn,SecGpsOn,SecAwake,SecSleep
CntServerTx: Number of telegrams sent by the device.
CntServerRx: Number of telegrams received by the device.
CntGsmOn: Number of times the Gsm module has been turned on.
SecGsmOn: Number of seconds the Gsm module has been turned on.
CntReset: Number of device resets.
ErrCntGsmConnect: Number of times the Gsm module has timeout condition when turning on.
CntGpsOn: Number of times the Gps module has been turned on.
SecGpsOn: Number of seconds the Gps module has been turned on.
SecAwake: Number of seconds device is working
SecSleep: Number of seconds device is sleeping

Lommy Eye

ex: TOTSERVER[451,450,423,12605,4,75,100,2000,102020,213010]

GPS	structure	
Gps data. Format: TimeToFix,Lat,Lon,Speed,Radius,Direction,HDOP,SVUsed TimeToFix in seconds. Lat is Latitude Lon is Longitude Speed in km/h Radius in meters (not used - will always be 0) Direction in degrees HDOP multiplied with 10. (92 equals 9.2) SVUsed: Number of satellites used for position fix Note: Speed and Direction will be blank if Speed is below 10 Km/h! ex: GPS[10,N56.04.8480,E9.46.4879,86,0,248,9,4]		

RAT	structure	

Radio access technology information.
Format: RadioAccessTechnology, ServingCellTechnology

Radio Access Technology	Description
2G	GSM
2G+	GSM with GPRS
3G	UTRAN
3G+	UTRAN w/HSDPA, 5=UTRAN w/HSUPA, 6=UTRAN w/HSDPA and HSUPA
M1	CAT-M1
NB	CAT-NB-IoT
UNKNOWN	Unknown RAT

Serving Cell Technology	Description
LTE	Serving cell is LTE
GSM	Serving cell is GSM
NONE	Serving cell is not connected

ex: RAT[M1, LTE] - try with M1, and successfully connected to LTE
ex: RAT[2G, GSM] - try with 2G, and successfully connected to GSM
ex: RAT[2G, NONE] - try with 2G, but unsuccessfully

(hint: no serving cell in GSM[], but GSM can containg neighboring cells with small range, and report can be sand later, when valid connection)

*NONE: Imagine that we see neighbouring cells, but can't connect to any as serving, so we don't have ServingCell in LTE[] or GSM[] only neighbouring cells information, if any.
Of course, this telegram will not go to server immediately, because of no connection, but waits for valid connection in memory.

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CAP	structure	
Information about battery voltage. Format: VStart,VEnd,VDelay "VStart" : measured just before turning the gsm module on. "VEnd" : measured just after turning the gsm module off. "VDelay" : measured 100s after turning the gsm module off. All measurements are in milli-volts. The measurements relate to the previous report session. ex: CAP[3243,3173,3171]		

TON	int	
The number of seconds the gsm module was turned on. The measurement relate to the previous report. ex: TON[41]		

TEMP	int	
The temperature measured by the device. In degrees celcius. The parameter TEMP-INPUT determines the source of the measurement. ex: TEMP[23]		

INPUT-EXT	array	
The external sensor values read by the device. The parameter INPUT-EXT determines which sensors are enabled. The first value(hex) tells which inputs are active: Bit 0 = External sensor (MCP9701) on input 1 Bit 1 = External sensor (MCP9701) on input 2 Bit 2 = Temperature sensor on I2C Bit 3 = Humidity sensor on I2C The next values are the readings in milli-degrees Celsius and humidity %. ex: INPUT-EXT[F,10751,10751,14003,97], INPUT-EXT[C,18003,29]. In case of errors when communicating with the I2C sensors, the temperature value is set to -99.999*C and the humidity field has a negative value and accordingly means: -1: deviceAddr not acked -2 wr data not acked -3 chksum error		

ANA	array	
The voltage measured at the two inputs. In mV. (See ACT in AckTelegram) ex: ANA[23,8760]		

ALARM	array	
Alarm ID's in the device. Alarm IDs> 0 : no alarm 8 : no wolf heard ex: ALARM[8]		

WEEK	array	
Sets a Weekday-calendar in the device. This will disable the traditional report interval system. The time entries will define 1-4 times to report each weekday (monday-saturday). If no entries are given (WEEK[] or WEEK[0]), the calendar is not used, and the device will revert to the standard report interval. Format: {HH,mm},... The entries must be in chronological sequence, like in this example: ex: WEEK[{8,0},{12,0},{20,0},{23,0}]		

SUN	array	
Sets a Sunday-calendar in the device. This will only work if a Weekday-calendar is also defined. The time entries will define 0-4 times to report on sundays. If no entries are given (SUN[] or SUN[0]), there will be no reports on sundays. Format: {HH,mm},... The entries must be in chronological sequence. ex: SUN[{15,0}]		

VPORT-STATUS	structure	
Status of all heard VPorts. (max 5 VPorts in each telegram) Format: [Date,Time,{VPortVer,ID,Type,Count,Data,...)},...] "Date" : YYYYMMDD "Time" : HHMMSS "VPortVer" : version of the VPort-protocol "ID" : serial number of the VPort device "Type" : type of VPort "Count" : number of data values to follow "Data" : 1-7 data values (determined by Count) ex with 1 VPort: VPORT-STATUS[20170712,150134,{10,3091210008,5,4,1,2,3,4}]		

VPORT-ALARM	structure	
Alarm codes from one VPort. Format: [Date,Time,ID,Type,Alarm,...] "Date" : YYYYMMDD "Time" : HHMMSS "ID" : serial number of the VPort device "Type" : type of VPort "Alarm" : 1-7 alarm codes ex: VPORT-ALARM[20170712,150134,3091210008,5,3,3,3,3]		

CONF	structure	
The device configuration. Format: [Count,Last,{Parname,Parval},...] "Count" : Incremental counter, starting from 0 every time the configuration is requested. "Last" : 0: More CONF-telegrams will follow. 1:The last CONF-telegram. "Parname" : name of the parameter "Parval" : value of the parameter ex: CONF[0,1,{APN,internet},{MOVE-WAKEUP,0},{REPORT-INTERVAL,86400}]		

CRC	UInt16	MANDATORY
crc calculation of the message. Note that the CRC must be the last item in the telegram, and preceded with a "*" This value must be hexadecimal.		

Response telegram (Server to Lommy)

ACK	int	MANDATORY
Acknowledge to a Data telegram (-1 - -9999) ex: ACK[-552]		

NAK	int	
Not-Acknowledge (-1 - -9999) ex: NAK[-552]		

TIME	string	
Set the date/time in the device. Format: YYYYMMDDHHmmss ex: TIME[20140107111231]		

ACT	UInt32	
Actions/Features to be enabled/disabled in the device. Each action has a bit: 0x00000001 = Include sim card ICCID number in next report 0x00000002 = Enable BEACON 0x00000004 = Include Application SW type and version in next report 0x00000008 = Include Firmware SW version in next report 0x00000010 = Enable Extended Cell Info (SNMON) 0x00000020 = Enable "AutoBeacon" mode. 0x00000040 = Enable digital input lav→høj event 0x00000080 = Enable DateTime info in TAG/VPORT fields 0x00000100 = Include ANA in reports. 0x00000200 = Include TOTSERVER in next report. 0x00000400 = Send the device configuration immediately. This value must be hexadecimal. These bit assignments are shared with other projects, also using the SUT protocol! ex: ACT[A2]		

WEEK	array	
Sets a Weekday-calendar in the device. This will disable the traditional report interval system. The time entries will define 1-4 times to report each weekday (monday-saturday). If no entries are given (WEEK[] or WEEK[0]), the calendar is not used, and the device will revert to the standard report interval. Format: {HH,mm},... The entries must be in chronological sequence, like in this example: ex: WEEK[{8,0},{12,0},{20,0},{23,0}]		

SUN	array	
Sets a Sunday-calendar in the device. This will only work if a Weekday-calendar is also defined. The time entries will define 0-4 times to report on sundays. If no entries are given (SUN[] or SUN[0]), there will be no reports on sundays. Format: {HH,mm},... The entries must be in chronological sequence. ex: SUN[{15,0}]		

SEED	UInt16	
Change seed value in the device. (Initial value in crc calculations.) This value must be hexadecimal. ex: SEED[1234]		

ECHOLIST	array	
Set a echo-tag list in the device. (see description of ECHO mode feature) ex: ECHOLIST[4711,4712,3091210008]		

PARAM	array	
Set a parameter value in the device. (see description of Parameters) Format: {ParName,ParValue},... ex: PARAM[{REPORT-INTERVAL,25},{ECHO-MODE,2}]		

CMD	array	
Send a command to the device. (see description of Commands) Format: {CmdName,Value1,Value2,...ValueX} ex1: CMD[{RELOAD,someserver.com/folder,2}] ex2: CMD[{RESET}]		

WOLFLIST	array	
Set a wolf-tag list in the device. (see description of the WOLF feature) ex: WOLFLIST[4711,4712,3091210008]		

Ack telegram (Lommy to Server)

(only required if Response telegram carries more than ACK and TIME fields!)

ACK	int	MANDATORY
Acknowledge to a Response telegram carrying data. ex: ACK[-552]		