RACOM
RADIO DATA NETWORKS

IEC protocol for MORSE

version 9.0.17.0
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1. Introduction

The IEC 870-5-101 protocol for MORSE is taken from the condensed definition for format FT 1.2 according to IEC 870-5-2. This format is used by SAT and Landis&Gyr, and thus the IEC 870-5-101 protocol is termed MORSE-L&G hereon in. The protocol implemented supports the unbalanced mode (Master/Slave) and partially the balanced mode according to definition of standard IEC 870-5-101.

This definition distinguishes three frames: a frame with variable length, a frame with fixed length and a frame with a single character.These frames are compressed and decompressed by the MORSE-L&G protocol according to the following rule.

The physical layer of the MORSE-L&G protocol uses the RS232 interface (SC channel).

Important

The terminology is unified from Setr version 9.0.17.0 according next schedule:

```
FEP Master - CU RADIOSLAVE ... CU RADIOMASTER - Slave PLC
```

CU (radiomodem) connected via SCC to PLC Master is called Radioslave (RS),
CU connected to PLC Slave is called Radiomaster (RM).
Changes appear at a new Setr version, the firmware version has not influence.

The older Setr uses the reverse terminology, also:

```
( PLC Master - CU RADIOMASTER ... CU RADIOSLAVE - Slave PLC )
```

2. Data Format

Terminology:

The Landis&Gyr control unit, which is also labelled as an FEP (Front End Processor), is connected through the SCC channel to the RADIOSLAVE radio modem. The RADIOMASTER radio modem is linked to the slave through the SCC channel.

Frame with variable length

```
| 0x68/8 | L/8 | L/8 | 0x68/8 | C/8 | A/8 | data/8*(L-2) | chk/8 | 0x16/8|
```

L length C+A+data, range (0..255), typically 11 bytes

C control field

A address field (address of RM communicated with)

data user data

chk check sum

The frame received from the external link is compressed by the MORSE-L&G protocol into the format which is sent via the MORSE communication channel:

```
| C/8 | data/8*(L-2) |
```

During compression a check is made on the field length C+A+data (L), field (chk) and the synchronisation field (68, 68 and 16). If one of these does not match the packet is discarded. Furthermore, in the case of the RADIOSLAVE protocol the destination station address is extracted. In the case of the RADIOMASTER protocol the address of the opposite station is designated as the sender of the previously received packet.

During decompression all fields are refreshed. Address field A is refreshed from the header of the MORSE packet, i.e. in the case of decompression in the RADIOMASTER protocol the recipient and in the case of the RADIOSLAVE protocol the sender.

Frames are transmitted in the USER DATA format.

Frame with fixed length

```
| 0x10/8 | C/8 | A/8 | chk/8 | 0x16/8 |
```

This frame is compressed by the MORSE-L&G protocol into the format:

```
| C/8 |
```

During compression a check is made on the field (chk) and the synchronisation field (10 and 16). If one of these does not match the packet is discarded. Furthermore, in the case of the primary protocol RADIOSLAVE, the destination station address is extracted. In the case of the secondary protocol RADIOMASTER the address of the opposite station is designated as the sender of the previously received packet.

During decompression all fields are refreshed. Address field A is refreshed from the header of the MORSE packet, i.e. in the case of decompression in the RADIOSLAVE protocol the recipient and in the case of the RADIOMASTER protocol the sender.

Frames are transmitted in the USER DATA format.

Frame with single character

```
| 0xE5/8 |
```

Frame E5 is transmitted as a packet with zero length. Other frames of this type (A2) are discarded.

In the case of the RADIOSLAVE protocol this frame is discarded. In the case of the protocol RADIOMASTER the address of the opposite station is designated as the sender of the previously received packet.

The frame is transmitted in the USER DATA format.

3. Implementation in Morse

Examples of FEP - RTU communication:

1) Request from the Master (FEP) about link status:

```
08:56:46.388 rxsim   5 | S00
1049 054E 16                  ...  FEP Master -> CU RS 06

08:56:46.403|                 |00000005 00000006|S00I   OUT    1| 89 5user
49                            ... CU RS 06 -> CU RM 05 (data paketu MORSE)

Monitoring: source 690F5505|7.
08:58:17.838 tx      5 | S00
1049 054E 16                  ... CU RM 05 -> RTU Slave
```

Response from the slave (RTU):

```
08:58:24.315 rxsim   5 | S00
100B 0510 16                  ...  RTU Slave -> CU RM 05

Monitoring: source 690F5506|0.
08:56:53.016|                 |00000006 00000005|S00I    IN    1|89 5user
0B                            ... CU RM 05 -> CU RS 06 (data paketu MORSE)

08:56:53.017 tx      5 | S00
100B 0510 16                  ... CU RS 06 -> FEP Master
```

2) Request from the Master (FEP) to reset the remote link:

```
Monitoring: source 690F5506|3.
09:18:13.287 rxsim   5 | S00
1040 0545 16                  ...  FEP Master -> CU RS 06

09:18:13.294|                 |00000005 00000006|S00I   OUT    1| 89 2user
40                            ... CU RS 06 -> CU RM 05 (data paketu MORSE)

Monitoring: source 690F5505|5.
09:19:44.718 tx      5 | S00
1040 0545 16                  ... CU RM 05 -> RTU Slave

09:19:45.718 tx      5 | S00
1040 0545 16                  ... opakované vysílání do RTU
                                  parametry CU RM 05: (i)=1000ms, (r)=1
```

Response from the Slave (RTU):

```
09:19:49.593 rxsim   5 | S00
1000 0505 16

Monitoring: source 690F5506|4.
09:18:18.250|                |00000006 00000005|S00I    IN    1|89 2user
00

09:18:18.251 tx      5 | S00
1000 0505 16
```

3) Request from the Master (FEP) about user data:

```
09:45:46.024 rxsim   5 | S00
105B 0560 16

09:45:46.040|                |00000005 00000006|S00I   OUT    1| 89 2user
5B

Monitoring: source 690F5505|1.
09:47:17.518 tx      5 | S00
105B 0560 16
```

Answer from RTU, containing C=08 and a user data ABCD:

```
09:47:21.921 rxsim  10 | S00
6804 0468 0805 ABCD 8516

Monitoring: source 690F5506|7.
09:45:50.609|                |00000006 00000005|S00I    IN    3|89 2user
08AB CD

09:45:50.610 tx     10 | S00
6804 0468 0805 ABCD 8516
```

4) Example of an RTU response by a frame with a single character E5:

```
Monitoring: source 690F5505|3.
09:52:13.614 rxsim   1 | S00
E5

Monitoring: source 690F5506|0.
09:50:42.252|                |00000006 00000005|S00I    IN    0|89 5user
                     ... frame E5 is transmitted as zero-length packet

09:50:42.252 tx      1 | S00
E5
```

5) Parameter local(7)B5B=on :

Reaction of CU6 at the master to frame 105B 0560 16 or 107B 0580 16 with parameter local(7)B5B=on :

```
09:42:00.926 rxsim   5 | S00
105B 0560 16                    ...  FEP -> CU06

09:42:00.949 tx      5 | S00
1009 050E 16                    ... CU06 -> FEP
                                does not transmit in radio channel
```

The RADIOMASTER protocol sends its packets to the source of the last request,i.e. to the RADIOSLAVE protocol. (Original member number is zero). This address is not configured.

4. Configuration parameters

```
L&G 870-5-2 IEC parameters:
PLC Master - CU RADIOSLAVE ... CU RADIOMASTER - Slave PLC
(m):RADIOSLAVE (wired to master) (s)kao:OFF
(t):0
(i):11000ms  (r):1
(R):0000  (g):0000
(d)uplicate packet check:ON  e(X)ept addr::00000000
(a)ddress mode:0
(T)ransparent:OFF
local (7)b5b:OFF
(c)ts control:OFF
m-bus calme(x):OFF
fern (n)umbering:OFF  t(S)ync:OFF
(A):00000000 DEFA(U)LT:00000000
(D):0 (L):2000 (I):0 (E):0 (N):0
(q)uit
>>
```

(m) protocol mode

- (S) RADIOSLAVE - CU connected to PLC Master
- (M) RADIOMASTER - CU connected to PLC Slave

ATTENTION - The Setr older than 9.0.17.0 uses the reverse labelling !

(s) (s)kao:OFF - obsolete - for communication with Skao device

(t) (t):0 - time synchronisation mode

RADIOSLAVE (primary) - the time in the modem is synchronised from the external device as follows:

0 no synchronisation pursued

1 time in CU is only synchronised by broadcast type frames for time synchronisation

2 time in CU is synchronised by frames according to point 1) and also by any other direct time frame

RADIOMASTER (secondary) - synchronisation of external device (RTU):

0 no synchronisation pursued

1 time in CU is synchronised by broadcast type frames for time synchronisation after receiving the addressed frame for time synchronisation

2 CU generates periodically the broadcast frame with the time synchronisation after receiving RTU response

3 time in external device is only synchronised by periodical addressed frames for time synchronisation of broadcast type. The period is product of next parametrs N*D(ms)

(i) (i):11000ms

RADIOSLAVE — the method for reduction number of packet incoming from SCC channel

The Landys&Gyr system generates repeated messages with a short repeat interval, e.g. 3x4 sec, which leads to the radio network becoming blocked under worse transmission conditions. Parameter (i) is used to set time in the RADIOSLAVE, e.g. 11500 ms, after which repeated messages from the FEP are ignored and thus creating space for unimpeded receipt of ACK from the Slave RTU.

RADIOMASTER — In the RADIOMASTER station (i) signifies a delay before repeated transmission to the L&G SLAVE.

(r) (r):1

RADIOSLAVE — enables checking of whether, in the case of more FEPs (and therefore Masters), the response is received through a reaction to its own request

RADIOMASTER — number of repeats when transmitts in SCC (0-off, 1, 2, 3... -on)

(R) obsolete

(g) obsolete

(d) (d)uplicate packet check:ON

RADIOSLAVE checks whether the received response appertains to the sent request. Responses with incorrect serial numbers are discarded.

(X) e(X)ept addr:00000000

Exception from parameter (d). For this address duplicated packets from air are accepted.

(a) (a)ddress mode:0

0 - uses 1 byte of the address

1 - uses 2 bytes of the address

(T) (T)ransparent:OFF

Switches on the transparent transmission of frames mode. The whole frame brought to the SCC port is then considered as data for the MORSE packet and is transmitted like this labelled as packet type 0x0A (prot data).

This mode is not used for packets arriving from the RF channel, because these packets already carry the packet type labelling 0x09 (user data) or 0x0A (prot data).

(7) local (7)b5b:OFF

In the case of the CU RADIOSLAVE a response to frame 105B 0560 16 or 107B 0580 16 is generated, when switching on this parameter, directly in the CU and the packet is not transmitted to air. It is used as a protective measure in the case that FEP generates these frames (RTU functionality test) repeatedly with a short period.

(c) (c)ts control:OFF

Special parameter for hw configuration.

(x) m-bus calme(x):OFF

Special parameter for Clamex temperature gauges, RADIOMASTER unit.

(n) fern (n)umbering

Special parameter for spontanneous packets numbering.

(S) t(S)ync

Special parameter for time synchronization.

(U) DEFA(U)LT:00000000

The packets generated spontaneously in the RTU are send to this address. If it is zero, then this packets are discarded. The packets sent as response to the request from center are sent to the questioners address.

(A) (A):00000000

This and the following parameters are used in SPP applications only for spontaneous communication of RADIOMASTER units. It is used in RM units, which generate the RTU's spontaneous messages.

If the address is written in A then the packet is sent to this address upon spontaneous communication with the CU RM. If A = 0, then the spontaneously generated message is discarded.

Next parameters should be in normal state set OFF:

(D) turns on the spontaneous mode

(L) CU calls locally the RTU's in set interval (ms) - frame type 0x7b / 0x5b

(I) After this time is sent the keep packet to the RADIOSLAVE.

(E) Number of repeats for call to RADIOSLAVE.

(N) See the time synchronisation RTU in RADIOMASTER mode.

5. History

- release 740 - 01/2006 - this description applies from this version
- 9.0.17.0 06/2007 - unification of terms RS/RM in the Setr
- 10.0.97.0 - 03/2010 - address mode 3 - more on support@racom.eu