MSC AND LVM CONCENTRATOR

FUNCTIONAL SPECIFICATION

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AMENDMENT REGISTER

Description of change	NAME	ISSUE	DATE
First issue	M.G.	I	15/10/12
The following modification will be implemented from version v0F ▪ Sec 5.4.8 added fields FSK_GAIN and BPSK_GAIN in the Status Table	M.G.	II	27/08/14
The following modification will be implemented from version v18 ▪ Sec. 5.2 New secret keys management ▪ Sec. 5.3.1 SINC-T retry with current clock has been introduced ▪ Sec. 5.3.4.13 APN Management in case of USER1 more than 16 bytes ▪ Sec. 5.3.5 New id 0x21 has been added for V-REG procedure ▪ Sec. 5.3.5 New id 0x22 has been added for N2PLOAD procedure ▪ Sec. 5.3.7 Nack in case of the image name is different from "MSCApp" ▪ Sec. 5.4.1 Management of MM520 meter has been added ▪ Sec. 5.4.1 Rows in T_CE have been increased to 2048 ▪ Sec. 5.4.2 Rows in T_KEY have been increased to 2048 ▪ Sec. 5.4.6 Rows in T_RPT have been increased to 2048 ▪ Sec. 5.4.7 SMS table has been added ▪ Sec. 5.4.8 Support for PLC_SLAVE field in T_STATUS ▪ Sec. 5.4.8 Default values for Tx gain have been increased ▪ Sec. 5.6.1 Rows in B(TRAPE.REQ) have been increased to 2048 ▪ Sec. 5.6.2 Rows in B(TRAPE.RESP) have been increased to 4096 ▪ Sec. 5.5.3 Rows in B(CE) have been increased to 2048 ▪ Sec. 5.5.4 Rows in B(CE_STAT) have been increased to 2048 ▪ Sec. 7.10 Management of MM520 meter has been added in GQBTI ▪ Sec. 7.17 N2PLOAD had been added ▪ Sec. 7.23.3 Rows in T_CEDATACE_TYPE have been increased to 2048 ▪ Sec. 7.23.3 Rows in T_CEDATA_VAL have been increased to 2048 ▪ Sec. 7.25 Link to V-REG procedure specification ▪ Sec. 7.26 Link to FW check specification ▪ Sec. 9.1.1.1 Rows in B(LMESS_REQ) have been increased to 2048 ▪ Sec. 9.1.2.3 Rows in B(IC_STAT) have been increased to 2048 ▪ Sec. 9.1.2.4 Rows in B(IC) have been increased to 2048 ▪ Sec. 9.1.3.1 Rows in T_IC_CONF have been increased to 2048 ▪ Sec. 9.1.3.3 Rows in AGIC/24 have been increased to 2048 ▪ Sec. 14 Bit I, J, M have been added for phase fault detection	M.G.	III	01/12/14
The following modification will be implemented from version v0E ▪ Sec. 5.3.1 Management of ΔKEY for RF channel in T_ATT ▪ Sec. 5.3.1 Management of MAIN_APP_SW_ENABLED in T_ATT ▪ Sec. 5.3.1 Management of APP_SW_ACTIVATOR in T_ATT	M.G.	IV	15/10/15

▪ Sec. 5.3.2 SPONT_2 as extension to SPONT field in T_TLC ▪ Sec. 5.3.2 AMM_NAME field has been added in T_TLC ▪ Sec. 5.3.3 Ethernet Table {T_ETH} - Tab. 250 ▪ Sec. 5.3.4.5 WakeUp_Ip with MSC ID sending for dynamic IP ▪ Sec. 5.3.4.7 GPRS_AUTH must be writable also in GPRS mode ▪ Sec. 5.3.4.9 Different FTP user for MBApp and GCApp ▪ Sec. 5.3.4.10 WakeUp_Spont with push functionality ▪ Sec. 5.3.4.12 IMEI of GPRS modem in T_GPRS ▪ Sec. 5.4.1 EXT2_F(PROC) Flags for Daily Closures profile in T_CE ▪ Sec. 5.4.1 New code for MM520evo meter in CS/VCS field of T_CE ▪ Sec. 5.4.8 ED_SPONT_BUFFER_2 in T_STATUS ▪ Sec. 5.7.1 Support for RF Parameters Table {T_RF_PAR} - Tab. 100 ▪ Sec. 0 Support for RF White List Table {T_RF_WL} – Tab. 102 ▪ Sec. 5.7.3 Support for RF CE Table {T_RF_CE} - Tab. 103 ▪ Sec. 5.7.4 Support for RF Key Table {T_RF_KEY} - Tab. 104 ▪ Sec. 5.7.5 Support for RF CE Neighbors Table {T_RF_NEIGH} - Tab. 105 ▪ Sec. 5.7.6 RF CE Number Table {T_RF_CE_NUM} - Tab. 109(*) ▪ Sec. 5.7.7 Support for RF_Reaction Group Spontaneous Table {T_RF_REACT_SPONT} - Tab. 110(*) ▪ Sec. 5.7.13 Support for RF_Transactions Buffer {B(RF_TRAPE.RESP)} - Tab. 16 ▪ Sec. 7.10.8 FTP directory for GQBTI ▪ Sec. 7.11.4 FTP directory for GQBTV ▪ Sec. 7.15 FTP directory for PLOAD ▪ Sec. 7.16.1 Address for Daily Closures profiles of N2PLOAD in T_PLOAD ▪ Sec. 7.16.2 FTP directory for NPLOAD ▪ Sec. 7.16.2 FTP directory for N2PLOAD ▪ Sec. 7.16.2 FTP directory for N2PDAILY ▪ Sec. 7.17 Support for Daily closures in N2PLOAD procedure ▪ Sec. 7.18.1 Support for "extended" CE DWLD ▪ Sec. 14 Bit W for GPRS Modem detection in the State message bit ▪ Sec. 14 Bit X for RF Module detection in the State message bit ▪ Sec. 14 Bit M for data loss condition of RF_TRAPE.RESP See also RF Transactions buffer 5.7.13 ▪ Sec. 19 Annex C with new GB messages ▪ Sec. 0 Annex D with use cases **The following modification will be implemented from version v11** ▪ Sec. 5.3.4.12 D_RESET_WAIT in T_GPRS ▪ Sec. 5.4.8 WAIT_TO_REBOOT in T_STATUS			
The following modification will be implemented from version v12 ▪ Sec. 5.3.1 MODEM_RETRY in T_ATT ▪ Sec. 5.3.1 AGENT_RETRY in T_ATT ▪ Sec. 7.3.2.2 Stop activity handling during CONN-C ▪ Sec. 7.17.2 Stop activity handling during N2PLOAD	M.G.	V	14/12/17

The following modification will be implemented from version v13 ▪ Sec. 14 Bit R has been removed ▪ Sec. 3 RF light support **The following modification will be implemented from version v14** Sec. 7.17 N2PLOAD algorithm has been modified			
The following modification will be implemented from version v15 ▪ Sec. Tariff Program Table {T_PRTA}$_{1...N}$ - Tab.201 to 215 deleted ▪ Sec. TARIFF PROGRAMMING Procedure (PRTA) deleted ▪ Sec. 5 Database encryption(*) ▪ Sec. 5.3.1 RF_PROTOCOL field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_PROTECTION field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 RF_LV_RETRY field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 RF_RETRY field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_NRN field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 RF_RSSI_NEIGH_UP field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_RSSI_NEIGH_DOWN field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_DEL_NEIGH field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BR_TIMOUT field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BLK_START1 field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BLK_TIMER1 field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BLK_START2 field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BLK_TIMER2 field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 BR_START field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 BR_TIMER field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_UNI_TIMER field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_BR_TIMER field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 NRN_L field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.2 New bit in SPONT_2 field in {T_TLC} - Tab. 2 ▪ Sec. 5.3.2 Additional AMM IP for WakeUp, Spontaneous and Last Gasp events has been added in {T_TLC} - Tab. 2 ▪ Sec. 5.3.4.3 GSM call back with GPRS_FLAG=1 ▪ Sec. 5.3.4.10 Spontaneous management in case of power failure ▪ Sec. 5.3.4.10 New values for GPRS_SPONT field in {T_GPRS} - Tab. 252 ▪ Sec. 5.3.4.10 Additional port socket for AMM_IP has been added in {T_GPRS} - Tab. 252 ▪ Sec. 5.3.4.15 SSH is now available ▪ Sec. 5.3.5 New values of PROC_EN to enable a TB both in PLC and RF in {T_PRI} - Tab. 3(*) ▪ Sec. 5.3.5 START_DT-POSIX fields in {T_PRI} - Tab. 3 ▪ Sec. 5.3.5 STATUS_DT-POSIX fields in {T_PRI} - Tab. 3 ▪ Sec. 5.3.5 PROC_STATUS fields in {T_PRI} - Tab. 3 ▪ Sec. 5.3.5 LAST_PROC_TIMING in {T_PRI} - Tab. 3(*) ▪ Sec, 5.3.7.1 RF module FW update support	M.G.	VI	27/08/19

▪ Sec. 5.3.8	CE_DWLD Enhancement have been implemented in {T_DWCE} - Tab. 22			
▪ Sec. 5.3.9	DWLD Control table {T_CE_DWC} - Tab. 67			
▪ Sec. 5.4.1	Support in EXT2_F(PROC) Flags for Daily Instantaneous and average Power Maximum Demand Register in {T_CE} - Tab. 4			
▪ Sec. 5.4.1	F(ACE)_STATUSx has been added in {T_CE} - Tab. 4(*)			
▪ Sec. 5.4.1	CE_CHANNEL in {T_CE} - Tab. 4			
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▪ Sec. 5.4.6	Manage of PATH_ID has been modified in {T_RPT} - Tab. 20			
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▪ Sec. 5.7.1	NEIGH_SNIFFER field in {T_RF_PAR} - Tab. 100(*)			
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▪ Sec. 5.7.1	LBT_MAX_ATT field in {T_RF_PAR} - Tab. 100(*)			
▪ Sec. 5.7.1	LBT_BO_PERIOD field in {T_RF_PAR} - Tab. 100(*)			
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▪ Sec. 5.7.3	CE_CHANNEL field in {T_RF_CE} - Tab. 103			
▪ Sec. 5.7.3	New value for REACTION GROUP in {T_RF_CE} - Tab. 103			
▪ Sec. 5.7.3	LAST POWER RF COMMUNICATION field in {T_RF_CE} - Tab. 103			
▪ Sec. 5.7.3	RF_F(ACE) field in {T_RF_CE} - Tab. 103			
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▪ Sec. 5.7.5	LAST POWER RF COMMUNICATION in {T_RF_CE_NEIGH} - Tab. 105			
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▪ Sec. 5.7.6	RF CE Number Table {T_RF_CE_NUM} - Tab. 109(*)			
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▪ Sec. 5.7.8	RF CE Buffer {RF_B(CE)} - Tab.111(*)			

▪ Sec. 5.7.9 {T_RF_PRI} - Tab. 112 to handle procedure via RF channel ▪ Sec. 5.7.9 LAST_PROC_TIMING in {T_RF_PRI} - Tab. 112(*) ▪ Sec. 5.7.10 {T_RF_CE_DW_C } - Tab. 113 ▪ Sec. 5.7.11 {T_RF_CE_DWL } - Tab. 114 ▪ Sec. 5.7.12 Open RF Transactions Buffer {B(RF_TRAPE.REQ)} - Tab. 115 ▪ Sec. 5.7.13 {B(RF_TRAPE.RESP)} - Tab. 16 DATA length is 154 bytes ▪ Sec. 6.1 New management for PLC and RF channel ▪ Sec. FATT procedure deleted ▪ Sec. 7.12 QVI procedure for voltage and interruption data(*) ▪ Sec. 7.17.1 LC_TIME_GZIP in {T_N2PLOAD} – Tab. 63 ▪ Sec. 7.17.1 LP_RETRY in {T_N2PLOAD} – Tab. 63 ▪ Sec. 7.17.1 DC_RETRY in {T_N2PLOAD} – Tab. 63 ▪ Sec. 7.17.4.1 N2PLOAD header zip file has been modified ▪ Sec, 7.17.4.2 PDAILY header zip file has been modified ▪ Sec. 7.17.4.1 N2PLOAD file name has been modified ▪ Sec, 7.17.4.2 PDAILY file name has been modified ▪ Sec. 7.17.5.2 Extended status word 3 added in GB(43) ▪ Sec. 7.17.6.2 Extended status word 3 added in GB(45) ▪ sec. 7.17.8 N2PLOAD Control table {T_N2PLOAD_C} – Tab. 63 ▪ Sec. 7.18.4 Support for Multi-Part DWLD ▪ Sec. 7.18.4 Support for APP4 DWLD (transactional scenario)(*) ▪ Sec. 7.20 CE Keys management in ACE procedure has been modified ▪ Sec. 8 RF Procedure ▪ Sec. 8 Listen Before Talk(*) ▪ Sec. 8.1 RF_SINC-T procedure(*) ▪ Sec. 8.2 Last call due to Load Profile ▪ Sec. 8.3 Last call due to Daily Closure ▪ Sec. 8.4 RF_CE_DWL procedure ▪ Sec. 8.5 TRF procedure ▪ Sec. 8.6 RF_ACE procedure ▪ Sec. 14 Bit P has been added in in {T_STATUS} - Tab. 254(*) ▪ Sec. 19 GB_SPONT_PROC_END (019.007) ▪ Sec. 19 GB_SPONT_RF_PROC_END (039.007) ▪ Sec. 19 GB_SPONT_RF_CE_KO (039.008)(*) ▪ Sec. 19 GB_SPONT_RF_STS_WORD (039.009)(*) ▪ Sec. 19 GB_SPONT_RF_CE_NACK (039.010)(*) ▪ Sec. 19 GB_SPONT_RF_PROC_RES (039.012)(*) ▪ Sec. 19 GB_SPONT_RF_DEL_NEIGH (039.036) ▪ Sec. 19 GB_SPONT_RF_RSSI_NEIGH (039.037) ▪ Sec. 19 GB_MSC_NACK (255) error code updating due to RF(*) ▪ Sec. 20 Updating flow chart (*) Future predisposition **The following modification will be implemented from version v16** ▪ Sec. 5 Database encryption ▪ Sec. 5.3.1 RF_PROTECTION field in {T_ATT} - Tab. 1(*)			

▪ Sec. 5.3.1 RF_LV_RETRY field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 RF_NRN field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 NRN_L field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.10 Modem 3G/GPRS updating procedure ▪ Sec. 5.3.4.12 MODEM_AUTH field in in {T_GPRS} - Tab. 252 ▪ Sec. 5.3.4.12 MODEM_MANUF field in in {T_GPRS} - Tab. 252 ▪ Sec. 5.3.4.12 MODEM_VER field in in {T_GPRS} - Tab. 252 ▪ Sec. 5.3.4.15 Telnet is no longer available ▪ Sec. 5.3.5 New values of PROC_EN to enable a TB both in PLC and RF in {T_PRI} - Tab. 3(*) ▪ Sec. 5.3.5 LAST_PROC_TIMING in {T_PRI} - Tab. 3(*) ▪ Sec. 5.3.7.1 MSC DWL procedure has been modified in order to skip the FW part already updated ▪ Sec. 5.4.1 F(ACE)_STATUSx has been added in {T_CE} - Tab. 4(*) ▪ Sec. 5.4.8 TIMEZONE field in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 WAIT_TO_MODEM_RESET field in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 FS_GG field in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 FS_LVS field in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 RF_HW field in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 New values for PROC_STATE field in {T_STATUS} - Tab. 254 ▪ Sec. 5.5.3 NRN_L (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.5.3 NRN_POSIX (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.5.3 NRN_L_POSIX (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.7.1 NEIGH_SNIFFER field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_ENABLE field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_RSSI_TH field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_MAX_ATT field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_BO_PERIOD field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_MAX_DELAY field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_BO_FLAT field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.1 LBT_OVERRIDE_DIS field in {T_RF_PAR} - Tab. 100(*) ▪ Sec. 5.7.3 RF_F(ACE)_STATUS1 field in {T_RF_CE} - Tab. 103(*) ▪ Sec. 5.7.3 RF_F(ACE)_STATUS2 field in {T_RF_CE} - Tab. 103(*) ▪ Sec. 5.7.6 RF CE Number Table {T_RF_CE_NUM} - Tab. 109(*) ▪ Sec. 5.7.7 Support for RF_Reaction Group Spontaneous Table {T_RF_REACT_SPONT} - Tab. 110(*) ▪ Sec. 5.7.8 RF CE Buffer {RF_B(CE)} - Tab.111(*) ▪ Sec. 5.7.9 LAST_PROC_TIMING in {T_RF_PRI} - Tab. 112(*) ▪ Sec. 7.12 QVI procedure for voltage and interruption data(*) ▪ Sec. 7.18.4 Support for APP4 DWLD (transactional scenario)(*) ▪ Sec. 8 Listen Before Talk(*) ▪ Sec. 8.1 RF_SINC-T procedure ▪ Sec. 14 Bit P has been added in in {T_STATUS} - Tab. 254(*) ▪ Sec. 19 GB_SPONT_RF_CE_KO (039.008)(*) ▪ Sec. 19 GB_SPONT_RF_STS_WORD (039.009)(*) ▪ Sec. 19 GB_SPONT_RF_CE_NACK (039.010)(*) ▪ Sec. 19 GB_SPONT_RF_PROC_RES (039.012)(*) ▪ Sec. 19 GB_MSC_NACK (255) error code updating due to RF ▪ Sec. 19 GB_LVC_VER (050.002) (*) Future predisposition			

The following modification will be implemented from version v18 ▪ Sec. 5.3.1 DLC_PROTOCOL field in {T_ATT} - Tab. 1 with value for M&M in BPSK ▪ Sec. 5.3.1 KEY field in {T_ATT} - Tab. 1 has different length for M&M protocol ▪ Sec. 5.3.1 RF_PROTECTION field in {T_ATT} - Tab. 1 ▪ Sec. 5.3.1 RF_LV_RETRY field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 RF_NRN field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.1 NRN_L field in {T_ATT} - Tab. 1(*) ▪ Sec. 5.3.5 New values of PROC_EN to enable a TB both in PLC and RF in {T_PRI} - Tab. 3(*) ▪ Sec. 5.3.5 New values of PROC_STATUS in {T_PRI} - Tab. 3 ▪ Sec. 5.3.5 LAST_PROC_TIMING in {T_PRI} - Tab. 3(*) ▪ Sec. 5.3.6 OLU state in {T_HHU} - Tab. 23 ▪ Sec. 5.3.7.1 Nack management in {T_LVC_DWL} - Tab. 21 ▪ Sec. 5.3.8 Nack management in {T_CE_DWL} - Tab. 22 ▪ Sec. 5.4.1 F(ACE)_STATUS1 in {T_CE} - Tab. 4(*) ▪ Sec. 5.4.1 F(ACE)_STATUS2 in {T_CE} - Tab. 4 ▪ Sec. 5.4.2 Two Way Authentication Table {T_KEY} - Tab. 24 ▪ Sec. 5.4.8 M&M_GAIN has been added in {T_STATUS} - Tab. 254 ▪ Sec. 5.4.8 FS_CUSTOMER has been added in {T_STATUS} - Tab. 254 ▪ Sec. 5.5.3 NRN_L (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.5.3 NRN_POSIX (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.5.3 NRN_L_POSIX (t) in {B(CE)} - Tab. 11(*) ▪ Sec. 5.7.1 NEIGH_SNIFFER field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_ENABLE field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_RSSI_TH field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_MAX_ATT field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_BO_PERIOD field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_MAX_DELAY field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_BO_FLAT field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.1 LBT_OVERRIDE_DIS field in {T_RF_PAR} - Tab. 100 ▪ Sec. 5.7.3 RF_F(ACE)_STATUS1 field in {T_RF_CE} - Tab. 103(*) ▪ Sec. 5.7.3 RF_F(ACE)_STATUS2 field in {T_RF_CE} - Tab. 103(*) ▪ Sec. 5.7.6 RF CE Number Table {T_RF_CE_NUM} - Tab. 109(*) ▪ Sec. 5.7.7 Support for RF_Reaction Group Spontaneous Table {T_RF_REACT_SPONT} - Tab. 110(*) ▪ Sec. 5.7.8 RF CE Buffer {RF_B(CE)} - Tab.111(*) ▪ Sec. 5.7.9 New values of PROC_STATUS in {T_RF_PRI} - Tab. 112 ▪ Sec. 5.7.9 LAST_PROC_TIMING in {T_RF_PRI} - Tab. 112(*) ▪ Sec. 7.3.3.2 PCONN-C algorithm has been modified for M&M ▪ Sec. 7.12 QVI procedure for voltage and interruption data(*) ▪ Sec. 7.18.4 Support for APP4 DWLD (transactional scenario)(*) ▪ Sec. 7.20.1 ACE algorithm has been modified for ELPE/SITRED ▪ Sec. 7.20.2 ACE algorithm has been modified for M&M ▪ Sec. 7.22.2 REC_CE algorithm has been modified for M&M ▪ Sec. 8 Listen Before Talk ▪ Sec. 8.1 RF SINC-T Procedure ▪ Sec. 12.3 Spontaneous messages are now handled in “stand alone” ▪ Sec. 14 Bit P has been added in in {T_STATUS} - Tab. 254	M.G.	VII	13/03/20

▪ Sec. 19 GB_SPONT_RF_CE_KO (039.008)(*) ▪ Sec. 19 GB_SPONT_RF_STS_WORD (039.009)(*) ▪ Sec. 19 GB_SPONT_RF_CE_NACK (039.010)(*) ▪ Sec. 19 GB_SPONT_RF_PROC_RES (039.012)(*) ▪ Sec. 19 GB_LVC_NACK (255) error code 71 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 74 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 75 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 76 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 78 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 82 updated ▪ Sec. 19 GB_LVC_NACK (255) error code 97 added ▪ Sec. 19 GB_LVC_VER (050.002) updated (*) Future predisposition			

CONTENT PAGE

1 Scope

This document describes the database, parameters of concentrator and the procedures between concentrator and CEs or other peripheral devices.

2 Applicability

This document is applicable to MSC/LVM Low voltage Concentrator for T520, P520 and MM520 project also name LVC, low voltage concentrator. The points marked in the document with (*) have to be considered as “future predisposition”.

3 Reference documents

[1] ENEL DH 901K Remote Meter Reading System for LV Customers - System Architecture.

[2] ENEL DH 910K Remote Meter Reading System for LV Customers – Single Phase Meter.

[3] ENEL DH 933K Remote Meter Reading System for LV Customers - LV Concentrator Manufacturing and Assembly

[4] ENEL DH 970K Remote Meter Reading System for LV Customers – Communication subsystem LV-C – AMM/NAS

[5] ENEL DH 971K Remote Meter Reading System for LV Customers – GB messages and TB messages

[6] ENEL DH 972K Remote Meter Reading System for LV Customers – Exchanged Information and Linking Procedures between LV-C and VSERV to support VAS

[7] ENEL DH 960K Remote Meter Reading System for LV Customers – Data exchange between meters and auxiliary devices (LV-C and others).

[8] ENEL DH 961K Remote Meter Reading System for LV Customers – LV Transceivers.

[9] ENEL DH 962K Remote Meter Reading System for LV Customers – LV line and physical protocol.

[10] ENEL DH 963K Remote Meter Reading System for LV Customers. CE Transparency to H. F. signals.

[11] ENEL DH 980K Remote Meter Reading System for LV Customers. Local Connection Between HHU/LV-C.

[12] ENEL DH 991K Remote Meter Reading System for LV Customers – Meters identification parameters.

[13] ENEL DH 995K Remote Meter Reading System for LV Customers – Meters tests and test conditions.

[14] ENEL DH 996K Remote Meter Reading System for LV Customers – LV-C identification parameters

[15] ENEL DH 997K Remote Meter Reading System for LV Customers – Absolute address of LV-C

[16] ENEL SQ 0091K Quality guarantee specs. for products supply (Quality Model: UNI EN ISO 9001).

[17] ENEL SQ/G/0002K Guide for preparing software-planning documents.

[18] CEI EN 61107 Data exchange for meter reading, tariff and load control – Direct Local Data Exchange

[19] ENEL DMI 0 90617 Gestione segreti MSC

[20] ENEL DMI 1 98904 MSC Data-Link Protocol and Physical Protocol

[21] ENEL DMI 1 98905 GAS Concentrator functional specification

[22] ENEL DMI 1 84651 GAS Concentrator RF Communication Profile and Use Cases

[23] EN 13757-4 Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)

[24] ENEL NT0295 Radio Management EN520

[25] ENEL NT0260 Table 250 for Ethernet Connection

[26] ENEL DMI 0 00096 Functional Specification CDF (MM520 new generation)

[27] ENEL DMI AB 000249 DH960K over WMBus profile

[28] ENEL DMI AB 000254 DH971 TRF messages

[29] ENEL DMI AC 000111- Gestione “light” delle comunicazioni RF

[30] ENEL NT0351 – FWGPRS

[31] ENEL NT0342 - GB_deviceBoardControl_LVM

[32] ENEL DMI AB 000357 Exchanged Information and linking procedures - Concentrator AMM GB & TB messages

[33] ENEL NT0337 New Recovery, Pconnc and Ace

[34] ENEL DMI 400022 Security Keys Management for MM520 Devices

4 Acronyms and abbreviations

CE : Static Electronic Meter

P520 : ENEL project based on LonTalk protocol (P520 CE)

T520 : ENEL project based on SITRED protocol (T520 CE)

LP620 : ENEL project based on M&M protocol (LP620 CE)

MM520evo : ENEL project based on multi-modulation protocol and RF use (MM520 CE)

MSC : Multi-Modulation and Multi- Service Low Voltage Concentrator

LVM : Low Voltage manager Concentrator

LVC : Generic named for Low Voltage Concentrator (MSC and LVM)

IC (FEI) : Customer interface (Front End Indoor)

UT-AGQ : Telemetering device for water, gas and heating meter

AMM : Remote Meter Reading Control Centre, also named BO (Back Office)

DLC : Distribution Line Carrier

PLC : Power Line Carrier

HHU : Hand Held Unit

LV : Low Voltage

TLG : Remote meter reading System (ENEL Telegestione)

The field “Field ID” (0xXXRRRRFF) of all the following tables reports the table dimensions in Byte.

Where:

- XX : Table (1 byte)
- RRRR : Row (2 bytes)
- FF : Field (1 byte)

5 Concentrator database

The concentrator data base must be composed by data structures updated by the cyclical activities of concentrator and by those carried out on request of the AMM.

The main activities that the concentrator must execute are referred to the LV network and they are:

- Static Meters management
- Determination of the state connection of LV network
- Estimate of some parameters for the quality of the power supply

All the information necessary for the execution of these activities, can be subdivided into two classes:

- Configuration parameters
- Management parameters

Configuration parameters are sent from the AMM to the concentrator and contain information such as the identities (T_CE, etc.) of the CE equipment attached to the concentrator, and other information such as the topology of the power distribution network. Such messages are identified in this document as “GB messages.” Management parameters are data sent from the concentrator to the CE and include data such as billing period data, daylight start time/end time data. Such messages are identified in this document as “TB messages.”

Concentrator should manage several services, for example GAS, heating, water, public lighting etc, for the other services different to electric refer to DMI 1 98905 “GAS Concentrator functional specification”.

All the concentrator data have to be recorded partially in RAM, part in a not volatile memory. Where not otherwise specified the described data have to be recorded in RAM. The data registered in a not volatile memory have to be programmed autonomously by concentrator or on request of the Centre or HHU.

The entire concentrator’s database has to be encrypted and authenticated in such a way that all the stored information have to appear random by an attacker that provides access to the mass storage disk or by unofficial procedure. The encryption and authentication process has to be transparent in such a way that AMM and HHU do not require knowledge of the underlying database security.

The encryption procedure has to use 128-AES CBC or CTR mode (or equivalent and more recent well-known encryption algorithm/mode agreed with e-distribuzione) with IV (Initialization Vector) diversified for every encryption/decryption phase and never reused even though the same table. Single operation such as read, write or retrieve a record has to produce an overhead above standard not encrypted database less than 15%. In order to get appropriate efficiency, only the requested tables/pages have to be decrypted not the entire database. When decrypted the requested tables should be kept in a volatile cache memory for the strictly necessary time to the operation.

Each ciphered table/page has to be authenticated by suitable algorithm such as AES CMAC or SHA-2 256 or equivalent well-known authentication algorithm to be agreed with e-distribuzione. Once the application performs a read from disk, the associated table/page MAC has to be checked and corrupted MAC event has to be reported in a dedicated event log … TBD by e-distribuzione. Encryption and authentication keys have to be different and unique for each concentrator, derived from a unique 128 bit key in a secure way. Detail about key to be used is under discussion.

5.1 DESCRIPTION OF CONFIGURATION PARAMETERS

The data necessary for the CE remote reading can be organised in a table containing the identifications of the CEs themselves. The CEs that are stored are those connected to the lines of the secondary substation. The majority of this data comes from the AMM/HHU, however, the concentrator can also calculate items such as the paths through repeaters to a given CE.

For what concerns the item components that represent the topological representation of the LV network, the following considerations are valid:

- The item “LV Bus-Bar” represents the logic vertex of the LV network supplied, by the secondary substation. The logic vertex is the connection between the LV Bus-Bar and the LV line.

- The sections (known topology scenario) directly connected to the bus-bar have to be clearly identifiable; they determine the start of “LV lines”, The sections are data base items with characteristics that can be set-up, as specified later in this document. A section is a segment of the LV line that can have a switch at one or both ends of it (the first section is directly connected to the LV Bus-Bar on one side, while the last section simply terminates at its end, all other sections have switches at both ends).

- Each section must have a list of identifiable electric connections, or rather all the sections connected to it.

- At concentrator level the eventual lines “which could be supplied” are not considered, but only those supplied; the variations of LV network have to be managed by Remote Meter Reading Control Centre, by the information coming from the concentrators and the SIGRAF Cartographic System data base.

- The tables can be both read and written. Every time that it is necessary to modify a table, it must be executed the previously concentrator activity suspension, with the GB_SOSP_ATT.REQ (018.002) command. When the table loading has been ended, it is necessary to reactivate the concentrator activity with the GB_RIPR_ATT.REQ (018.003) command.

- The buffers described in the following chapters are only reading tables. It is no possible to write them.

The CE identification code is structured on 6 bytes as described in ENEL DH 910K.

5.2 SECRET KEYS MANAGEMENT

Concentrator has to implement a new management of the three actual secrets in order to allow the access of the operator or AMM in read and write mode to its internal database with the following meaning:

- **PWD_HHU**: This key is used to local access via Zvei optical interface
- **PPP_Password**: This key is used via remote access during GSM authentication PPP-CHAP. Also used via remote access as password for Mutual Applicative Authentication via GPRS (AMM side)
- **LVC_MAA_Password**: This key, together with the previous, is used for mutual authentication applicative via GPRS (concentrator side)

These secrets have to be stored in the non-volatile memory of concentrator during the manufacturing process with random and different value for each concentrator with the rules reported in [34]. The three secrets will be different each other's and different to known string like "0x0000….", "0xFEB0…." or "0xFFFF….". At the end of manufacturing process no commands or procedures has to be available to read or write this keys.

When a read or write command of these fields is delivered the following handling must be:

- **GB_READTAB_(YYY).REQ (002)**: LVC must reply with a GB_LVC_NACK (255) Error code 39
- **GB_READTAB_(YYY).REQ (006)**: LVC must reply with the reading without sending the GB_LVC_NACK (255) message. In the response GB_READTAB_(YYY).RESP (007) all the non-readable fields must be padded with the 0xFF..FF value.
- **GB_READTAB_(YYY).REQ (008)**: LVC must reply with the reading without sending the GB_LVC_NACK (255) message. In the response GB_READTAB_(YYY).RESP (009) all the non-readable fields must be padded with the 0xFF..FF value.
- **GB_WRITE.REQ (004)**: LVC must reply with a GB_LVC_NACK (255) Error code 48.
- **GB_WRITETAB_(YYY).REQ (010)**: LVC must discard the value of a non-writeable field but all other data are written. The GB_LVC_NACK (255) must not be generated.
- **GB_WRITETAB_(YYY).REQ (030)**: LVC must discard the value of a non-writeable field but all other data are written. The GB_LVC_NACK (255) must not be generated.

Concentrator has to implement three different Delta Key values:

- **ΔPWD_HHU:** Delta values used to generate a new PWD_HHU secret key
- **ΔPPP_Password:** Delta values used to generate a new PPP_Password secret key
- **ΔLVC_MAA_Password:** Delta values used to generate a new LVC_MAA_Password secret key

The Delta key has to be 16 Bytes long.

Delta key values have to be manage as writable but not readable fields and they have to be stored in the non-volatile memory of concentrator.

When a read command of these fields is delivered the following handling must be:

- **GB_READTAB_(YYY).REQ (002)**: LVC must reply with a GB_LVC_NACK (255) Error code 39
- **GB_READTAB_(YYY).REQ (006)**: LVC must reply with the reading without sending the GB_ LVC_NACK (255) message. In the response GB_READTAB_(YYY).RESP (007) all the non-readable fields must be padded with the 0xFF..FF value.
- **GB_READTAB_(YYY).REQ (008)**: LVC must reply with the reading without sending the GB_ LVC_NACK (255) message. In the response GB_READTAB_(YYY).RESP (009) all the non-readable fields must be padded with the 0xFF..FF value.

Delta key values has to be used in order to generate a new secret key as combination [as indicated in other document] of original Key "Kx" (PWD_HHU, PPP_Password, LVC_MAA_Password) and its own delta key "ΔKx" (ΔPWD_HHU, ΔPPP_Password, ΔLVC_MAA_Password). Each secret haven't been changed but the modified value has to be evaluated runtime without overwrite the original key. If ΔKx is set to "0x00000000000000000000000000000000" concentrator has to restore the original Kx secret value.

5.2.1 PWD_HHU Management

Concentrator has to implement a provisional key used by operator to open a read/write communication session via Zvei optical probe.

> **PWD_HHU_Kp:** Provisional Key used to open data communication sessions. The provisional PWD_HHU_Kp hasn't to be readable or writeable and its hardcoded value has to be equal to "0xFEB0FEB0FEB0FEB0FEB0FEB0FEB0FEB0".

A new field in T_ATT has to be set in order to enable/disable the provisional PWD_HHU_Kp with the following meaning:

- **ADKp=0x00** → with this configuration it's allow to open communication sessions via Zvei optical probe only by means of PWD_HHU_Kp (default value);
- **ADKp=0x01** → with this configuration it's allow to open communication sessions via Zvei optical probe only by means of PWD_HHU.

When concentrator is set to enable PWD_HHU_Kp key it must not allow the following operations:

- Concentrator FW upgrade by means of Tab. 21-LVC_Download writing
- CE FW upgrade by means of Tab. 22-CE_Download writing

- TB commands procedures
- Read/Write from concentrator T_CE
- Kx update by means of ∆Kx fields writing in Tab. 1-T_ATT or Tab. 2-T_TLC

When one of these operations are required, a message of GB_LVC_NACK (255) with Error code 13 has to be generated.

The message of GB_LVC_NACK (255) with Error code 77 will continue to be present with the actual rules.

5.3 SYSTEM TABLES

The concentrator system tables must contain the following parameters:

- Concentrator identification number (to be showed in an "internal" [status table] structure)
- Daylight saving time start/end
- Present applications (type of customer, street lighting, home automation, etc.) other
- Closed network phone number (GSM, GPRS, etc)
- Closed network second phone number (GSM, GPRS, etc)
- Enable spontaneous call back to transmit to the BACK-OFFICE (AMM)
- Number of retries for spontaneous to the AMM
- Waiting time between spontaneous attempts
- Other parameters for different consumption management as specified in ENEL DH 910K
- Added to the tables an identifier row number
- Etc…

The concentrator system parameters are organised in the four following sub tables: three tables are directly programmable by AMM/HHU, the other is a status table – see chapter 11.

5.3.1 Activation Table {T_ATT} - Tab. 1

Table contains parameters used by AMM during the local or remote activation of concentrator:

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
0x01000101	TLG	1	Concentrator remote controlled or “stand alone” • 0x00= Remote controlled • 0x01= Stand Alone
0x01000102	APPL	1	Authenticated reading (Only P520/T520): • 0x00= Auth. reading disabled • 0x01= Auth. reading enabled for all procedures
0x01000103	NRN	1	Parameter that defines the maximum number of no answers in succession of a CE that the system must stand. The procedure, for error recovery after this number has been exhausted, is found in this document in the description of {B(CE)} in 5.5.3 (e.g. if LV_RETRY” register (see below) is set to 3, then concentrator tries the message and 3 retries for a total of 4 attempts. If there is no answer to any of these attempts, NRN is incremented by 1)
0x01000104	LV_RETRY	1	Parameter that defines the number of retries that the concentrator has to do on a CE that does not answer to a message that foresees a reply. If the parameter is 0x00, after the first attempt, concentrator must not retransmit the message. The default value is set by AMM. LV retry is the number of polls attempted with no answer for determining that the meter has failed. During SINC-T/SINC procedure each retry has to be sent with the new current time of the concentrator in order to avoid a clock misalignment of the meter. For further information refers to 20.8 [Tx_Msg_CE_PLC].
0x01000105	LV_TIMER	1	Where the LV_TIMER is the encoded timeout value used by the agent to communicate with the target. (Only P520, see table below)
0x01000106	DIOL (GI/MI)	2	Start date of daylight saving time. This parameter is fundamental for the CE synchronisation management relevant the daylight saving time

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
	DFOL (GF/MF)	2	End date of daylight saving time. This parameter is fundamental for the CE synchronisation management relevant the daylight saving time
	LST	2	Start time of daylight saving time, specified in local time
	LET	2	End time of daylight saving time, specified in local time
	DSMIN	1	Daylight saving correction value
0x01000107	ID_SS	15	Secondary Substation identifier (DTEZ - MV Node – Bus bar). Alphanumeric byte; e.g. DD102454345T01 (+ the blank character) • DD10 : Management code • 2 : Node's series • 454345 : LV node • T : Element code • 01 : Element identifier
0x01000108	PWD_HHU	16	Key used to local access via Zvei optical interface[1]
0x01000109	LVC_SUB-SECTION	1	Sub section of the node
0x0100010A	LVC_PROGRESSIVE	1	Progressive number assigned to the node
0x0100010B	LENGTH	1	Length of the concentrator section
0x0100010C	LVC_SECTION	6	The concentrator section bytes; main address of the transformer belonging to the secondary substation. A concentrator ID can be either 0, 1, 3 or 6 bytes long. If the "concentrator section" is less than 6 bytes long, the "concentrator section" bytes are left justified. It is recommended to use always 3 bytes concentrator Sections for concentrator. Each concentrator would be given a unique concentrator Section. This ensure two things:

[1] Field encrypted in the internal database

Tab. 01 - Activation Table			
Field ID	**Field Name**	**Size**	**Meaning**
			• If there is any communication leakage between substations, there will not be accidental address conflict. • If a CE is moved from one concentrator to another, there will not be any accidental address conflict Default value: 3 bytes
0x0100010D	KEY	12 / 32	Authentication key[2] used by the concentrator to modify the meter keys during ACE procedure. The field has different length in relation to the DLC_PROTOCOL: • DLC_PROTOCOL=0x00: the field is 12 bytes long; • DLC_PROTOCOL=0x01: the field is 12 bytes long; • DLC_PROTOCOL=0x02: the field is 32 bytes long. It means that the internal field is 32 bytes long but in relation to the DLC_PROTOCOL value the reading and writing GB command shall be structured with the above lengths.
0x0100010E	STALE_TIME	2	If the time stamp in the response is N seconds greater than or less than the concentrator' s current time, the two way authenticated response will be reject (see TB 251 ACK codes). A value of zero means use a default value of N, the same of the meter. This value is expressed in seconds. (Not used)
0x0100010F	DLC_PROTOCOL	1	It defines the type of communication protocols that the modem of the concentrator shall adopt to communicate with the meter: • 0x00 = The concentrator shall adopt the communication technology supported by P520/MM520 ENEL project (PSK Elpe) to communicate with the meter, the key used for meter authentication will be 12 bytes long;

[2] Field encrypted in the internal database

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
			• 0x01 = The concentrator shall adopt the communication technology supported by T520/MM520 ENEL project (FSK SITRED) to communicate with the meter, the key used for meter authentication will be 12 bytes long; • 0x02 = The concentrator shall adopt the communication technology supported by MM520 ENEL project (BPSK M&M) to communicate with the meter, the key used for meter authentication will be 16 bytes long. Default=0x01.
0x01000110	RF_PROTOCOL	1	It defines the application layer protocol that the RF modem of the concentrator shall adopt to communicate with the meter: • 0x00 = The RF modem of the concentrator has to transmit and receive data in compliance to W_MBUS communication protocol at application layer. • 0x01 = the RF modem of the concentrator has to transmit and receive data in compliance to DLMS/COSEM communication protocol at application layer. [3] • 0xFF = the RF modem of the concentrator has to be disabled in receiving and transmitting mode. Default=0x00.
0x01000111	∆PWD_HHU	16	Delta values used to generate a new PWD_HHU secret key[4]
0x01000112	ADKp	1	Flag to enable or disable the provisional PWD_HHU_Kp • 0x00= Kp Enabled • 0x01= Kp Disabled

[3] future predisposition

[4] Field encrypted in the internal database

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
0x01000113	ΔKEY_RF_1	32	The key is used as delta to modify the meter KEY_RF_1 (Not used)[5]
0x01000114	ΔKEY_RF_2	32	The key is used as delta to modify the meter KEY_RF_2 (Not used)[6]
0x01000115	MAIN_APP_SW_ENABLED	1	This field indicates which is the applicative SW that is in charge to write the shared tables (1, 2, 251, 252) and does the wakeup procedure/spont. The other applicative can only read those tables, or in case the connection is not established, it proceeds as it is the main application SW and establish the connection. The GB (018.20) is delivered to switch from master to slave, only the master application can send it. • 0x01 = Slave • 0x02 = Master
0x01000116	APP_SW_ACTIVATOR	1	By this field is possible to activate/deactivate the GCApp: • 0x00 = Value must be rejected; • 0x01 = Only MBApp activated, concentrator manages just the electricity meters; • 0x02 = Both MBApp and CGApp activated, concentrator manages electricity meters and additional services like Gas meters. Default=0x01
0x01000117	MODEM_RETRY	1	Parameter that defines the number of retries that the concentrator has to do at modem level on a CE that does not answer to a message that foresees a reply. (Only P520)
0x01000118	AGENT_RETRY	1	Parameter that defines the number of retries that the agent has to do on a CE target that does not answer to a message that foresees a reply. (Only P520)

[5] Field encrypted in the internal database

[6] Field encrypted in the internal database

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
0x01000119	NRN_L(*)	1	Parameter that defines the maximum number of no answers in succession of long messages during N2PLOAD procedure for a CE. The procedure, for error recovery after this number has been exhausted, is found in this document in the description of {B(CE)} in 5.5.3. If there is no answer to any of these attempts, NRN_L (t) is incremented by 1.
0x0100011A	RF_LV_RETRY(*)	1	Parameter that defines the number of retries that the concentrator has to do via RF on a CE that does not answer via PLC to a message that foresees a reply. If the parameter is 0x00, after the first attempt, concentrator must not retransmit the message. The default value is set by AMM. LV retry is the number of polls attempted with no answer for determining that the meter has failed. During SINC-T/SINC procedure each retry has to be sent with the new current time of the concentrator in order to avoid a clock misalignment of the meter. For further information refers to 20.8 [Tx_Msg_CE_PLC]. Default 0x00.
0x0100011B	RF_RETRY	1	Parameter that defines the number of retries that the concentrator has to do via RF on a CE that does not answer to a message that foresees a reply. If the parameter is 0x00, after the first attempt, concentrator must not retransmit the message. The default value is set by AMM. LV retry is the number of polls attempted with no answer for determining that the meter has failed. During SINC-T/SINC procedure each retry has to be sent with the new current time of the concentrator in order to avoid a clock misalignment of the meter. For further information refers to 20.9 [Tx_Msg_CE_RF]. Default 0x01.
0x0100011C	RF_NRN	1	Parameter that defines the maximum number of no answers in succession of a CE via RF that the system must stand. The procedure, for error recovery after this number has been exhausted, is found in this document in the description of {RF_B(CE)} in 5.7.8 (e.g. if RF_RETRY" register is set to 3, then concentrator tries the message and 3 retries for a total of 4 attempts. If there is no answer to any of these attempts, NRN is incremented by 1). For further information refers to 20.9 [Tx_Msg_CE_RF].

Tab. 01 - Activation Table			
Field ID	**Field Name**	**Size**	**Meaning**
			Default 0x0A.
0x0100011D	RF_RSSI_NEIGH_UP	1	Threshold in RSSI value used to notify a new "up" level of RSSI in the GB_SPONT_RF_RSSI_NEIGH (039.037). If zero the spontaneous shall not be handled. Default=0x00.
0x0100011E	RF_RSSI_NEIGH_DOWN	1	Threshold in RSSI value used to notify a new "down" level of RSSI in the GB_SPONT_RF_RSSI_NEIGH (039.037). If zero the spontaneous shall not be handled. Default=0x00.
0x0100011F	RF_DEL_NEIGH	1	This byte indicates how long in days a meter will be stored in the T_RF_CE_NEIGH after the last received message. When the RF_DEL_NEIGH threshold is reached the entry in T_RF_NEIGH shall be deleted and the GB_SPONT_RF_DEL_NEIGH (039.036) is generated, if enabled. The zero value means that the meter is never deleted. Default=0x1C.
0x01000120	RF_PROTECTION	1	Register for the definition of the protection level in the RF communication, see below. Default=0x00.
0x01000121	RF_BR_TIMEOUT	1	Register to define the timeout between two consecutive RF broadcast messages during RF_CE_DWL. The timeout is expressed in 0,1 s. The default value is the lower value that can be handled during the RF broadcast. If for any reason a lower value is set, a GB_NACK(255) is returned. Default=0x03 (300 ms)
0x01000122	RF_BLK_START1	1	Starting time in hours of the window in which the concentrator shall not send any RF messages related to RF_CE_DWL and RF_ACE, for further details see at 8.4. For example a value 0x0F means 15:00:00. The range values should be 0 ÷ 23, otherwise a GB_NACK(255) is returned. Default=0x0F (15:00:00)

Tab. 01 - Activation Table

Field ID	Field Name	Size	Meaning
0x01000123	RF_BLK_TIMER1	1	Duration in hours starting from "RF_BLK_START1" of the window in which the concentrator shall not send RF messages related to RF_CE_DWL and RF_ACE, for further details see at at 8.4. The range values should be 0 ÷ 24, otherwise a GB_NACK(255) is returned. Default=0x03
0x01000124	RF_BLK_START2	1	Starting time in hours of the window in which the concentrator shall not send any RF messages related to RF_CE_DWL and RF_ACE, for further details see at at 8.4. For example a value 0x0F means 15:00:00. The range values should be 0 ÷ 23, otherwise a GB_NACK(255) is returned. Default=0x00 (00:00:00)
0x01000125	RF_BLK_TIMER2	1	Duration in hours starting from "RF_BLK_START2" of the window in which the concentrator shall not send RF messages related to RF_CE_DWL and RF_ACE, for further details see at at 8.4. The range values should be 0 ÷ 24, otherwise a GB_NACK(255) is returned. Default=0x00 (Disabled)
0x01000126	BR_START	1	Starting time in hours of the window in which the concentrator can send the broadcast messages, for further details see RF_CE_DWL at 8.4. For example a value 0x02 means 02:00:00. The range values should be 0 ÷ 23, otherwise a GB_NACK(255) is returned. Default=0x00
0x01000127	BR_TIMER	1	Duration in hours starting from the "BR_START" of the windows in which the concentrator can send the broadcast messages, for further details see RF_CE_DWL at 8.4. The range values should be 0 ÷ 24, otherwise a GB_NACK(255) is returned. Default=0x05

Tab. 01 - Activation Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x01000128	RF_UNI_TIMER	2	It's the spacing time in seconds in which the concentrator can send unicast messages via RF for each hour, for further details see RF_CE_DWL at 8.4. Default=0x0154 (340 seconds).
0x01000129	RF_BR_TIMER	2	It's the spacing time in seconds in which the concentrator can send broadcast messages via RF for each hour, for further details see RF_CE_DWL at 8.4. Default=0x00B4 (180 seconds).

(*) Future predisposition

Only for P520 the following values of LV_TIMER must be used:

VALUE	DURATION (milliseconds)	VALUE	DURATION (milliseconds)	VALUE	DURATION (milliseconds)	VALUE	DURATION (milliseconds)
0	16	4	64	8	256	12	1024
1	24	5	96	9	384	13	1536
2	32	6	128	10	512	14	2048
3	48	7	192	11	768	15	3072

Only the three highest values are used by concentrator; if AMM set a value $\leqslant$ 12, then concentrator uses in any case the 13 value.

RF_PROTECTION values and meanings:

	b7	b6	b5	b4	b3	b2	b1	b0
Value	Key length	…	…	…	Write message	Read message	…	Spont message

0	16 bytes				With Protection	With Protection		Without Protection
1	32 bytes				Without Protection	Without Protection		With Protection

The table has to be stored in the no-volatile memory of concentrator.

5.3.2 *Telecommunication Table {T_TLC} - Tab. 2*

Table contains fields related to communication, like for example spontaneous management, ip address etc**:**

Tab. 02 - Telecommunication Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x02000101	SPONT	4	Enable/disable the spontaneous generation of the corresponding event to the AMM: • Bit_x = 0x00 → Spontaneous disable • Bit_x = 0x01 → Spontaneous enable See table below for the spontaneous bit mask list
0x02000102	TIME_TO_RETRY	1	Gap of seconds between two attempts in calling the AMM. (default 60 seconds)
0x02000103	N1_T	22	Closed network first phone number. Alphanumeric, ASCII encoded with a null 0x00 byte terminator
0x02000104	N2_T	22	Closed network second phone number, if N1_T is not available. Alphanumeric, ASCII encoded with a null 0x00 byte terminator
0x0200010F	IP_IDENT	1	Identifier of IP Address AMM/LVC and other communication options. **Bit0 = 0** → AMM_IP_ADDRESS uses v4 **1** → AMM_IP_ADDRESS uses v6 **Bit1 = 0** → LVC_IP_ADDRESS uses v4 **1** → LVC_IP_ADDRESS uses v6 **Bit2 = 0** → USES ONE-WAY CHAP (only called target issues challenge) **1** → USES MUTUAL AUTHENTICATION CHAP (both sides issue challenge) **Bit3 = 0** → LVC_PPP_PASSWORD has to be used as password in the concentrator digest computation **1** → PWD is agreed between AMM and LVC and it has to be used by concentrator as LVC PWD

Tab. 02 - Telecommunication Table

Field ID	Field Name	Size	Meaning
0x02000105	AMM_IP_ADDR	16	IP Address of AMM. The IP can be either Ipv4 or Ipv6 coded like a binary number in network order
0x02000106	LVC_IP2_ADDRESS	16	Specify the local IP address to be used on physical link of COM2. The IP address can be either IPv4 or IPv6
0x02000107	N_RETRY	1	Number to retries allowed towards AMM. (default value=3)
0x02000108	PPP_USERNAME	16	Username 16 ASCII characters max including terminator Zero terminated. (dedicated field for GSM/PSTN transmission)
0x02000109	PPP_PASSWORD	16	Password 16 Bytes full range binary used via remote access during GSM authentication PPP-CHAP. Also used via remote access as password for Mutual Applicative Authentication via GPRS (AMM side)[7]
0x0200010A	MODEM_INIT_STRING	128	Initialisation string for the modem. ASCII characters. Up to 128 bytes with null 0x00 byte terminated
0x0200010B	MODEM_INIT_STRING_1	32	Broken up into 4 segments to enable access by HHU. The HHU has to refer to modem String Part [1] one 32-byte block at a time
0x0200010C	MODEM_INIT_STRING_2	32	Broken up into 4 segments to enable access by HHU. The HHU has to refer to modem String Part [2] one 32-byte block at a time
0x0200010D	MODEM_INIT_STRING_3	32	Broken up into 4 segments to enable access by HHU. The HHU has to refer to modem String Part [3] one 32-byte block at a time
0x0200010E	MODEM_INIT_STRING_4	32	Broken up into 4 segments to enable access by HHU. The HHU has to refer to modem String Part [4] one 32-byte block at a time
0x02000110	PPP_LONG_PASSWD	20	Reserved[8]

[7] Field encrypted in the internal database

[8] Field encrypted in the internal database

Tab. 02 - Telecommunication Table

Field ID	Field Name	Size	Meaning
0x02000111	LVC_MAA_USERNAME	16	Username 16 ASCII characters max including terminator. Zero terminated if length is < 16 bytes (dedicated field for Mutual Applicative Authentication)
0x02000112	LVC_MAA_PASSWORD	16	Password 16 Bytes full range binary used for Mutual Applicative Authentication via GPRS (concentrator side)[9]
0x02000113	NMS_IP_ADDRESS	16	Reserved for SNMP
0x02000114	LVC_IP1_ADDRESS	16	Specify the local IP address to be used on physical link of COM1. The IP address can be either Ipv4 or Ipv6
0x02000115	AMM_NAME	32	Name for AMM IP DNS resolution. The DNS address has to be negotiated during the IPCP/PPP phase. If zero the AMM_IP_ADDR shall be used.
0x02000116	ΔPPP PASSWORD	16	Delta values used to generate a new PPP_PASSWORD secret key[10]
0x02000117	ΔLVC_MAA PASSWORD	16	Delta values used to generate a new LVC_MAA_PASSWORD secret key[11]
0x02000118	SPONT_2	4	Extension of SPONT field managed with the same rules
0x02000119	AMM_IP_WAKEUP	16	IP Address of AMM for WAKEUP_IP procedure. The IP can be either Ipv4 or Ipv6 coded like a binary number in network order. If zero the AMM_IP_ADDR and AMM_NAME is used. For management see 5.3.4.5 in T_GPRS
0x0200011A	AMM_NAME_WAKEUP	32	Name for AMM IP DNS resolution for WAKEUP_IP procedure. The DNS address has to be negotiated during the IPCP/PPP phase. If zero the AMM_IP_WAKEUP is used. For management see 5.3.4.5 in T_GPRS

[9] Field encrypted in the internal database

[10] Field encrypted in the internal database

[11] Field encrypted in the internal database

Tab. 02 - Telecommunication Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x0200011B	AMM_IP_SPONT1	16	IP Address 1 of AMM for spontaneous management. The IP can be either Ipv4 or Ipv6 coded like a binary number in network order. Address for: • TRAPE.RESP events GB(019.xxx), except for GB(019.018); • TRAPE.RESP events like TB response; • VTRAPE.RESP events GB(021.xxx); • VTRAPE.RESP events like IC response; If zero the AMM_IP_ADDR and AMM_NAME is used. For management see 5.3.4.10 in T_GPRS
0x0200011C	AMM_NAME SPONT1	32	Name 1 for AMM IP DNS resolution for spontaneous management. The DNS address has to be negotiated during the IPCP/PPP phase. Address for: • TRAPE.RESP events GB(019.xxx), except for GB(019.018); • TRAPE.RESP events like TB response; • VTRAPE.RESP events GB(021.xxx); • VTRAPE.RESP events like IC response; If zero the AMM_IP_SPONT1 is used. For management see 5.3.4.10 in T_GPRS
0x0200011D	AMM_IP_SPONT2	16	IP Address 2 of AMM for spontaneous management. The IP can be either Ipv4 or Ipv6 coded like a binary number in network order. Address for: • RF_TRAPE.RESP events GB(039.xxx), except for GB(039.034) with EG_COD 0x1E; • RF_TRAPE.RESP events like TRF response; If zero the AMM_IP_ADDR and AMM_NAME is used. For management see 5.3.4.10 in T_GPRS

Tab. 02 - Telecommunication Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x0200011E	AMM_NAME SPONT2	32	Name 2 for AMM IP DNS resolution for spontaneous management. The DNS address has to be negotiated during the IPCP/PPP phase. Address for: • RF_TRAPE.RESP events GB(039.xxx), except for GB(039.034) with EG_COD 0x1E; • RF_TRAPE.RESP events like TRF response; If zero the AMM_IP_SPONT2 is used. For management see 5.3.4.10 in T_GPRS
0x0200011F	AMM_IP_SPONT3	16	IP Address 3 of AMM for spontaneous management. The IP can be either Ipv4 or Ipv6 coded like a binary number in network order. Address for: • TRAPE.RESP events GB(019.018) of concentrator last gasp; • RF_TRAPE.RESP events GB(039.034) with EG_COD 0x1E of meter last gasp; If zero the AMM_IP_ADDR and AMM_NAME is used. For management see 5.3.4.10 in T_GPRS
0x02000120	AMM_NAME_SPONT3	32	Name 3 for AMM IP DNS resolution for spontaneous management. The DNS address has to be negotiated during the IPCP/PPP phase. Address for: • TRAPE.RESP events GB(019.018) of concentrator last gasp; • RF_TRAPE.RESP events GB(039.034) with EG_COD 0x1E of meter last gasp; If zero the AMM_IP_SPONT3 is used. For management see 5.3.4.10 in T_GPRS

Note: the item number doesn’t indicate the physical position of the above field in the table.

The following bit mask of SPONT field has to be used to enable the related spontaneous:

Bit	Spontaneous	Code
Bit 0	HHU INITIALIZATION	GB(019.005)

Bit	Spontaneous	Code
Bit 1	CHANGE MODE	GB(019.004)
Bit 2	BUFFER FULL	GB(019.006)
Bit 3	V-REG	GB0(19.017)
Bit 4	TB PROCEDURE END	GB(019.007)
Bit 5	ACE PROCEDURE END	GB(019.007)
Bit 6	ALCA PROCEDURE END	GB(019.007)
Bit 7	FATT PROCEDURE END	GB(019.007)
Bit 8	BE PROCEDURE END	GB(019.007)
Bit 9	CONN-C PROCEDURE END	GB(019.007)
Bit 10	STATUS WORD CE / AGQ	GB(019.009)
Bit 11	STATUS WORD IC	GB(021.009)
Bit 12	CE / AGQ NOT REACHABLE	GB(019.008)
Bit 13	SECTION NOT REACHABLE	GB(019.002)
Bit 14	LINE NOT REACHABLE	GB(019.003)
Bit 15	IC NOT REACHABLE	GB(021.008)
Bit 16	DOWNLOAD PROCEDURE END	GB(019.007)
Bit 17	NACK FROM CE	GB(019.010)
Bit 18	AVAILABLE	
Bit 19	SPONT_STATE	GB(019.001)
Bit 20	PLOAD/NPLOAD/N2PLOAD PROCEDURE END	GB(019.007)
Bit 21	PCONNC PROCEDURE END	GB(019.007)
Bit 22	GESIC_A PROCEDURE END	GB(021.007)
Bit 23	GQBT- I PROCEDURE END	GB(019.007)
Bit 24	RESERVED	
Bit 25	IC_B PROCEDURE END	GB(021.007)
Bit 26	TIME PROCEDURE	GB(021.020)

Bit	Spontaneous	Code
Bit 27	NACK FROM IC	GB(021.010)
Bit 28	PRIOR	GB(021.021)
Bit 29	GQBT-V PROCEDURE END	GB(019.007)
Bit 30	FILE SYSTEM FULL	GB(019.012)
Bit 31	RECOVERY CE PROC END	GB(019.007)

The following bit mask of SPONT_2 field has to be used to enable the related spontaneous:

Bit	Spontaneous	Code
Bit 0	LVC_POWER_OFF	GB(019.018)
Bit 1	LVC_POWER_ON	GB(019.018)
Bit 2	GPRS_IMEI	GB(019.019)
Bit 3	RF_BUFFER_FULL	GB(039.006)
Bit 4	RF_SN	GB(039.019)
Bit 5	RF_NEW_NEIGH	GB(039.023)
Bit 6	RF_CE_EVENT	GB(039.034)
Bit 7	RF_DEL_NEIGH	GB(039.036)
Bit 8	RF_RSSI_NEIGH_UP	GB(039.037)
Bit 9	RF_RSSI_NEIGH_DOWN	GB(039.037)
Bit 10	RF ACE PROCEDURE END	GB(039.007)
Bit 11	RF DOWNLOAD PROCEDURE END	GB(039.007)
Bit 12	TRF PROCEDURE END(*)	GB(039.007)
Bit 13	RF_CE_KO(*)	GB(039.008)
Bit 14	RF_STATUS WORD_CE / AGQ(*)	GB(039.009)
Bit 15	RF_CE_NACK(*)	GB(039.010)
Bit 16	Not Used	…
Bit 17	QVI PROCEDURE END(*)	GB(019.007)

Bit	Spontaneous	Code
Bit 18	GB_RF_ACE_PROC_RES(*)	GB(039.012)
Bit 19	GB_RF_CE_DWL_PROC_RES(*)	GB(039.012)
Bit 20	TRF_RES(*)	TRF(003), TRF (007), TRF (009), TRF (251), TRF (251)
Bit 21	Not Used	…
Bit 22	Not Used	…
Bit 23	Not Used	…
Bit 24	Not Used	…
Bit 25	Not Used	…
Bit 26	Not Used	…
Bit 27	Not Used	…
Bit 28	Not Used	…
Bit 29	Not Used	…
Bit 30	Not Used	…
Bit 31	Not Used	...

(*) Future predisposition

In case of GPRS active and event socket open, concentrator will deliver the spontaneous through this socket.

In case of GPRS active and event socket closed/listen (Open sockets are at all-time managed by AMM), the SPONT field indicates the spontaneous type that, once generated, have to trigger the Wake-up Spont procedure (for detail see T_GPRS).

LVC_POWER_OFF spontaneous shall have the highest priority.

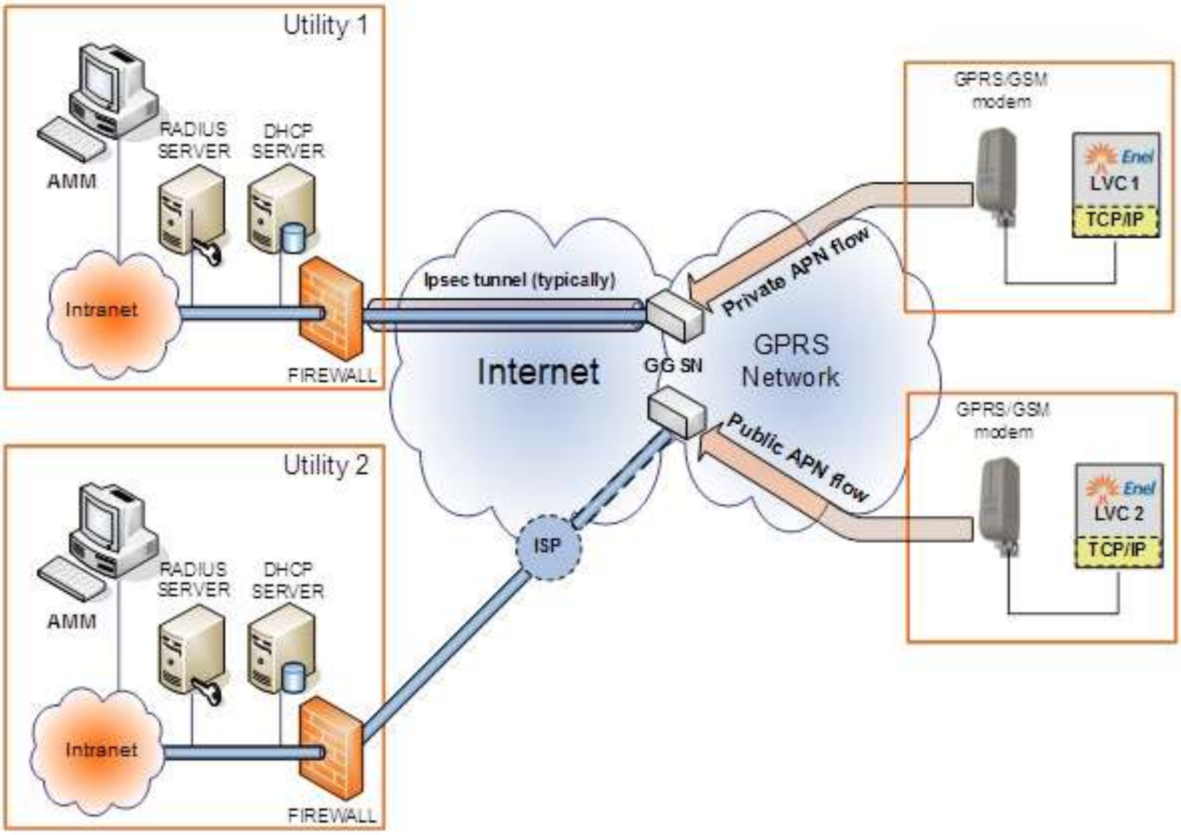
The table has to be stored in the no-volatile memory of concentrator.

5.3.3 Ethernet Table {T_ETH} - Tab. 250

For further details refer to [25].

5.3.4 GPRS Table {T_GPRS} - Tab. 251, 252

This section describes the preliminary requirements of an extension of concentrator firmware such to allow to support "natively" the communication on a GPRS/3G network, when connected with a GSM/GPRS/3G modem. The rules described for the connection, following named just as GPRS, it shall be also valid in case of 3G. (see below a generic GPRS connection flow for private or public APN). The use of this extension requires software adjustment on AMM side also, to adapt the communication module to the new requirements.



Generic GPRS connection flow

5.3.4.1 Main GPRS requirements

At the power-on, concentrator, checks the presence of the modem over its serial port and connects itself to the GPRS net. In case of Private APN, the GGSN (Gateway Gprs Support Node) establishes a dialog with the corporate Server Radius and after Authentication/IP assignment phases, realizes the tunnel (IPsec typically) with the intranet (Utility 1 in the Fig.). In case of public APN, GGSN realizes the link versus the internet.

AMM should manage static or dynamic IP addressing mode of the concentrator (DHCP Client). Anyway, AMM could not to know the IP address of each concentrator in case of public APN (dynamic public addressing). In this case a mechanism is necessary to inform AMM (see later).

The GPRS connection of the concentrator has to be ‘always on’, so it is necessary concentrator to be able to detect modem disconnection from the GPRS net (e.g. ‘NO CARRIER’ message sent from the modem to the concentrator or equivalent mode) and to reactivate it.

In order to retain alive the GPRS connection when no data is exchanged (‘always on’ in the requirement), a “keep alive” procedure has to be implemented and executed. The concentrator has to use the embedded PPP/TPC/IP stack (no PPP/TPC/IP stack inside the GPRS modem has to be used) and connecting it on the GPRS net by means of the dial-up like modality (ATD command).

5.3.4.2 GPRS disabling and GSM incoming call management

In order to manage the transitory phase and for "backup" purpose, concentrator has to be able to handle the "traditional" GSM communication mode only.

Besides, it is required to handle a GSM call when a GPRS connection is active or not active. This and the previous requirement can be implemented by means of a new flag GPRS_FLAG (see GPRS table below), with the values and meaning shown in the Table.

5.3.4.3 concentrator’s Modem Serial Port management

In order to allow more flexibility only during a GPRS session on the concentrator’s serial port connected to the modem, a register COM_RATE sized 1 byte is implemented in the GPRS table. The value of the register and the relative baud rate the concentrator has to use during the GPRS communication are illustrated below.

COM_RATE	Baud Rate [bps]
1	300
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600

9	115200
10	230400
11	460800
12	921600

Again, in order to allow the modem to communicate at the previous rates, at the boot and after each modem or concentrator reset, inside the 'modem initialization' phase, the concentrator will send the AT command AT+IPR=0 (autobauding).

Moreover, following a boot or following a concentrator or modem reset, concentrator will wait 6 seconds before performing the 'modem initialization' phase.

<table>
<tr><th>GPRS_FLAG</th><th>Meaning</th></tr>
<tr><td>0</td><td>GSM modem - Only GSM mode works (old mode); GPRS mode is not active, no GPRS AT commands and no PDP context are sent. The concentrator has to set its serial port to 9600 bps over the serial port connected to the modem</td></tr>
<tr><td>1</td><td>GPRS modem - Both GSM and GPRS connection types are handled. At the power-on GPRS connection is made (by requirement it is 'Always On'), but it is also possible to switch, accept and establish an incoming GSM connection. The concentrator has to set its serial port rate to the bps value written in the COM_RATE register on the port connected to the modem
▪ When a GPRS connection is active and the sockets 50000/50001/50003 are closed (in listen state) and a GSM data call is incoming, 'RING' pin is ON over the concentrator serial port.
In this case the concentrator by means of transition HIGH → LOW of the pin DTR has to close the GPRS connection to answer (AUTOANSWER) to the GSM caller. It is in charge of concentrator handling of TCP sockets. Note that the pin DTR has to be previously set by the AT message AT&D1 on the power-up.
The concentrator will reactivate the GPRS connection when the GSM call has been terminated.
▪ When a GPRS connection is active AND the sockets 50000/50001/50003 are open (TCP connection is active) an incoming GSM data call hasn't to be considered (concentrator hasn't to handle it).
▪ If no GPRS connection is active, an incoming GSM call has to be handled.
▪ The GSM call back shall not be handled</td></tr>
<tr><td>2</td><td>Console - A PPP session is accepted by concentrator (concentrator accepts only incoming connection) and authenticate through CHAP (concentrator is passive). The T_TLC PPP table secrets have to be used for CHAP. The console is also used as Linux console for service logging.</td></tr>
</table>

3	**Router or generic device** – An outgoing direct PPP session is established by concentrator toward a generic communication device (e.g. Asynchronous router) connected to the serial port. The authentication mode to be used is CHAP. The T_TLC table PPP secrets have to be used for CHAP.

5.3.4.4 Sockets management

A register TO_SOCKETS with the size showed in the GPRS Tables has to be implemented. When the GPRS connection is active, the register indicates how many minutes concentrator has to wait before to close the #50000, #50001, #50003 & #21 sockets (not the GPRS connection) in case of any data are exchanged on the aforementioned sockets.

Concentrator has to close the #50000, #50001, #50003 and #21 sockets when for the entire last TO_SOCKETS minutes no data have been exchanged between concentrator and AMM on both COM1 and COM2. As special value, when TO_SOCKETS=0x00 no time-out has to be considered. In this case concentrator has to leave as they are the sockets already opened, until explicit AMM closing.

Due to physical level restrictions, the TO_SOCKETS register will work as mirror in the #251 and #251 GPRS Tables (see at end of the document), such that if the register is changed in the e.g. #251 GPRS table, concentrator will also update it in the #252 GPRS Table.

5.3.4.5 WAKE-UP IP Procedure

Since in case of dynamic IP addressing (e.g. from a public ISP-Internet Service Provider and public APN) AMM is not able to know the IP assigned at the concentrator, this one has to inform the AMM by a “Wake-Up IP” procedure. An appropriate flag named WAKEUP_IP is required to enable/disable the procedure.

WAKEUP_IP	Meaning
0	The Wake-Up IP procedure is disabled. The call has been successful when PPP IP is handshaked with the context.
1	The Wake-Up IP procedure is enabled. Once connected at the APN and received the dynamic IP, the concentrator should inform AMM by a TCP Open&Close on the IP port specified by the WAKEUP_IP_P register in the T_GPRS using the destination IP address configured in the T_TLC table (AMM_IP_WAKEUP field). If WAKEUP_IP_P=0 then the port number 58692 has to be used. If AMM IP in T_TLC table is “0.0.0.0”, the Wake-Up IP procedure has not to run. The call has been successful only if the concentrator is able to open the IP socket on the AMM.

2	The Wake-Up IP procedure is enabled. Once connected at the APN and received the dynamic IP, the concentrator should transmit the Concentrator ID on the IP port specified by the WAKEUP_IP_P register in the T_GPRS using the destination IP address configured in the T_TLC table (AMM_IP_WAKEUP field). If WAKEUP_IP_P=0 then the port number 58692 has to be used. If AMM IP in T_TLC table is 0.0.0.0, the Wake-Up IP procedure has not to run. The call has been successful only if the concentrator is able to open the IP socket on the AMM.

5.3.4.6 "Keep-Alive" function by Wake-Up IP

When during a GPRS connection no data is exchanged between client and server for a time that exceed a specified interval, the network operator could release the connection. To avoid this, concentrator periodically has to generate a very small quantity of data in order to "Keep-Alive" the connection. In addition, a listener running on central system side, could verify connectivity problems.

To do this the Wake-Up IP procedure has to be used as notification toward the central system.

A parameter named WakeUP_Rate sized 1 byte, specifies the Wake-Up IP rate to the central system or more exactly, toward the "Keep-Alive" listener process. When WakeUP_Rate=0 the notification is disabled (note that if WakeUP_Rate=0 and WAKEUP_IP=1 the Wake-Up IP procedure run the same, one time) when WakeUP_Rate=n the notification starts every n*10 minutes from the first Wake-Up IP procedure. E.g. WakeUP_Rate=3, the function starts each 30 minutes. It has to be possible by AMM/HHU to access to the WakeUP_Rate and WAKEUP_IP registers in order to Read/Write it.

5.3.4.7 Mutual Applicative authentication

Only for the GPRS connection mode, a Mutual Authentication procedure (over the applicative layer) has to be executed first of each attempt of data exchange between AMM and concentrator and vice versa.

The authentication procedure, like challenge-response:

- is based on GB messages
- take place on the socket 50000
- has to begin by concentrator (LVC→AMM)
- has to be always executed in both side AMM→LVC and LVC→AMM (mutual) in order to authenticate the concentrator when AMM is connecting to it and, from concentrator side, to authenticate the AMM by the concentrator

Before authentication is executed:

- the concentrator has to accept the Open Socket only for the socket 50000

- only the GB command required for the procedure (see later in the document) will be accepted
- In case of reception of not allowed GB commands, a NACK response will be delivered by the concentrator with the error code 86 (Security blocked). If the authentication succeeds then the concentrator will put the sockets 50001 in listen state. In this case opening of the sockets 50001 will be allowed

When the GPRS communication session is terminated, all the sockets on both AMM and M concentrator SC have to be closed.

Note for AMM/LVC implementation: As for GSM, on the concentrator side, to make sure the communication session has been terminated, concentrator has to receive from AMM the GB018.14 (Call Termination).

Anyway, in case of no data exchanged over all the open sockets for TO_SOCKET minute, concentrator has to close them. A new authentication procedure is required to exchange data.

If a failed attempt of mutual authentication happen, the concentrator has to:

- close the socket 50000
- disable activities via GPRS for 1 minute. The timer hasn't to be reset in case of power down/reboot
- save the data/time of the event on two apposite registers and increment a "failed authentication" apposite counter

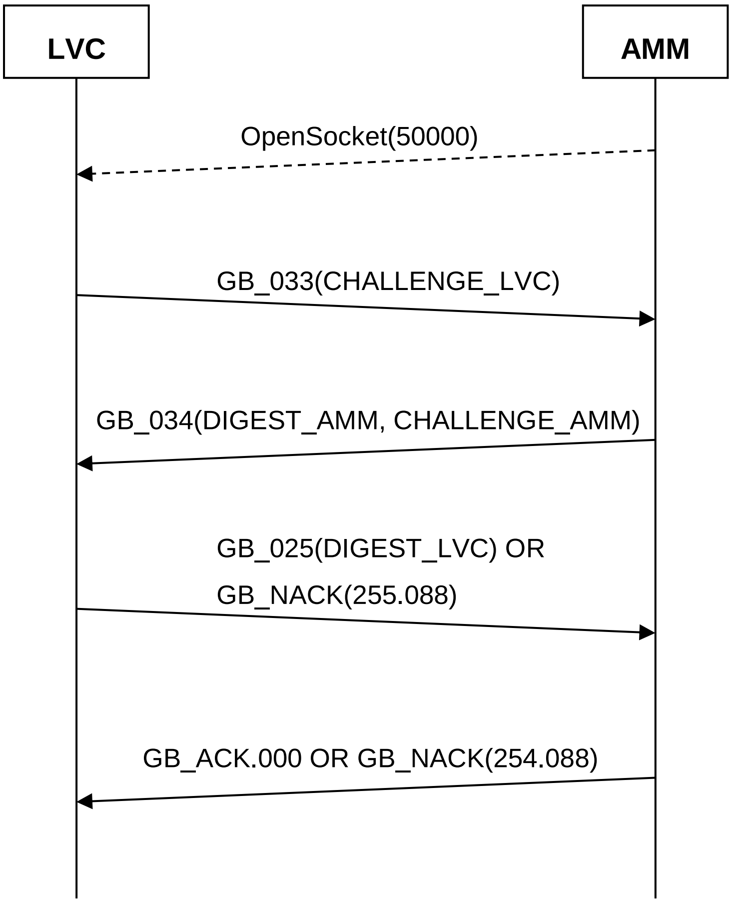
Mutual Authentication succeeds when concentrator receives "ACK" at the last message (see later).

It has to be possible to enable/disable the Authentication procedure by means of a new flag GPRS_AUTH with the following values and meaning:

GPRS_AUTH	Meaning
0	Via GPRS all the sockets (50000, 50001, 50002, 50003 and 21) can be opened on the concentrator side and no authentication is required to exchange data.
1	Via GPRS only the socket 50000 can be opened by the AMM; no messages ha to be accepted and no other sockets can be opened first that authentication procedure has been completed (see above). Special management for the socket #21 is required (see later).

Once GPRS_AUTH register is set (MAA has been enabled), concentrator will be predisposed to accept authentication process only starting from the successive #50000 socket open attempt. At the same way, starting from the successive #50000 socket attempt, concentrator will need of the GB (038) command to open the FTP session. Due to physical level restrictions, the GPRS_AUTH register will work as mirror in the #251 and #251 GPRS Tables (see at end of the document), such that if it is changed in the e.g. #251 GPRS table, concentrator will also update it in the #252 GPRS Table.

5.3.4.8 Authentication flow



Where:

- CHALLENGE_LVC (80bytes) = LVC_MAA_USERNAME* (16bytes) + RANDOM(64bytes)
- CHALLENGE_AMM (80bytes) = AMM_PPP_USERNAME* (16bytes) + RANDOM(64bytes)
- DIGEST_AMM (64bytes) = SHA-512 [AMM_PPP_PASSWORD** + CHALLENGE_LVC]
- DIGEST_LVC (64bytes) = SHA-512 [LVC_MAA_PASSWORD** + CHALLENGE_AMM]

* padded with binary “0” if length<16 bytes

** not padded

AMM_PPP_USERNAME and AMM_PPP_PASSWORD are the canonical User and Password used in the GSM PPP “one way” CHAP, while the registers LVC_PPP_USERNAME and LVC_PPP_PASSWORD are described below.

The SHA-512 algorithm has to be used during the computation of the Digest string.

A precondition is that the procedure always begin from the concentrator side by means of the GB message 33, but the communication is always started by AMM by the Open of the socket 50000**.**

Two 16 bytes registers LVC_PPP_USERNAME and LVC_PPP_PASSWORD are implemented inside the concentrator in the table T_TLC.

If IP ADDRESS IDEN [bit 3] = 1 (default) then a password agreed between AMM and concentrator has to be used by concentrator as concentrator password, (in this version, “a”+AMM_PPP_PASSWORD).

If IP ADDRESS IDEN [bit3] = 0 then (mutual CHAP has been implemented) the LVC_PPP_PASSWORD has to be used as password in the concentrator digest computation.

Note: Some tests need to be executed in order to evaluate the time/costs amount happening during the authentication procedure.

5.3.4.9 FTP authentication parameters

In order to improve security over FTP, FTP_USER and FTP_PASSWORD parameters will be delivered for each session by the AMM to the concentrator, by means of a special GB (038) message first of each FTP session (see Enel DH 971K - GB detail). If the message is accepted, the concentrator send to AMM an acknowledgement message or else a no-acknowledgement with error code 90 (BadFtpUser). In the first case, from the reception of the GB (038), concentrator will consider valid the FTP User and Password for the next 10 minutes only. Concentrator has to put the socket 21 in listen state only after reception of the correct message GB 038. Once the timer has reached 10 minutes AND no data have been exchanged in the last 10 minutes, concentrator has to close the port 21. In this case a new GB (038) is requested to put in listen state the port 21. The timer has to be reset by concentrator each time some data are exchanged via FTP.

In case the port 21 is in “listen” or “established” state, concentrator is not able to accept new GB (038) command.

Note that if GPRS_AUTH=0 the session has always to be considered anonymous, so no GB (038) message is required to open the session. In case of GSM connection, actual FTP modality has to be used (“anonymous” session).

Each service managed by the concentrator shall have a different set of username to access the FTP connection with GPRS_AUTH=0, the user are reported below:

- Electric Power service: the user is “*anonymous*” or “*mbaftpuser*”
- GAS service: the user is “*gcftpuser*”

5.3.4.10 Spontaneous management

In case of spontaneous, a "Wake-Up Spont" procedure has to be used in case of GPRS connection active (but sockets 50000/50001/50003 in listen on the concentrator side).

It has to be possible to disable the spontaneous messages via GPRS by means of a new flag GPRS_SPONT (see GPRS table below) with the following meaning and values:

GPRS_SPONTx	Description
0	The spontaneous always should be sent via standard GSM call back, except for GPRS_FLAG=0x01. If a GPRS connection is active (socket should be close) it has to be closed and subsequently reactivated after the spontaneous sending.
1	Concentrator should always inform AMM of the presence of spontaneous messages by a TCP Open&Close on the IP port specified by GPRS_SPONTx_P register in the T_GPRS using the destination IP address configured in the T_TLC (AMM_IP_SPONTx field). If GPRS_SPONTx_P=0 then the port number 58693 has to be used. If AMM IP in T_TLC is "0.0.0.0", the Wake-Up Spont procedure has not to run. In any case the GSM call back has not be handled with GPRS_FLAG=0x01. In case of a spontaneous sending fails, the 3G/GPRS connection shall not be re-established.
2	Concentrator should always transmit to AMM the spontaneous messages on the IP port specified by GPRS_SPONTx_P register in the T_GPRS using the destination IP address configured in the T_TLC (AMM_IP_SPONTx field). If GPRS_SPONT_P=0 then the port number 58693 has to be used. If AMM IP in T_TLC is "0.0.0.0", the Wake-Up Spont procedure has not to run. Moreover, if a GPRS channel is not available at the moment of spontaneous messages (connection down, 'ERROR' after an ATD…), concentrator has to send the spontaneous messages as soon as the connection is established. The concentrator algorithm to handle the un-sent spontaneous messages shall be sizing with the same number of events that TRAPE.RESP and RF_TRAPE.RESP can save. In any case the GSM call back has not be handled with GPRS_FLAG=0x01. At spontaneous messages transmission over IP, the concentrator shall add its LVC_ID (16 Bytes) after the "Timestamp Date/time of event" field of the event saved in the TRAPE.RESP or RF_TRAPE.RESP (see the example below). For each spontaneous send over IP, concentrator expects an ACK from AMM. If the ACK is loss or a NACK is received, concentrator will retry the transmission of the spontaneous message, according to the policy described in paragraph 20.1 [Tx_Spont_To_AMM]. In case of a power failure occurs all the ongoing spontaneous sending shall be suspended in order to transmit the GB_LVC_POWER_OFF(019.018) with the highest priority. In case of a spontaneous sending fails, the 3G/GPRS connection shall not be re-established.

3	Concentrator should always inform AMM of the presence of spontaneous messages by a TCP Open&Close on the IP port specified by GPRS_SPONTx_P register in the T_GPRS using the destination IP address configured in the T_TLC (AMM_IP_SPONTx field). If GPRS_SPONTx_P=0 then the port number 58693 has to be used. If AMM IP in T_TLC is “0.0.0.0”, the Wake-Up Spont procedure has not to run. In any case the GSM call back has not be handled with GPRS_FLAG=0x01. In case of a spontaneous sending fails, the 3G/GPRS connection shall be re-established.
4	Concentrator should always transmit to AMM the spontaneous messages on the IP port specified by GPRS_SPONTx_P register in the T_GPRS using the destination IP address configured in the T_TLC (AMM_IP_SPONTx field). If GPRS_SPONT_P=0 then the port number 58693 has to be used. If AMM IP in T_TLC is “0.0.0.0”, the Wake-Up Spont procedure has not to run. Moreover, if a GPRS channel is not available at the moment of spontaneous messages (connection down, ‘ERROR’ after an ATD…), concentrator has to send the spontaneous messages as soon as the connection is established. The concentrator algorithm to handle the un-sent spontaneous messages shall be sizing with the same number of events that TRAPE.RESP and RF_TRAPE.RESP can save. In any case the GSM call back has not be handled with GPRS_FLAG=0x01. At spontaneous messages transmission over IP, the concentrator shall add its LVC_ID (16 Bytes) after the “Timestamp Date/time of event” field of the event saved in the TRAPE.RESP or RF_TRAPE.RESP (see the example below). For each spontaneous send over IP, concentrator expects an ACK from AMM. If the ACK is loss or a NACK is received, concentrator will retry the transmission of the spontaneous message, according to the policy described in paragraph 20.1 [Tx_Spont_To_AMM]. In case of a power failure occurs all the ongoing spontaneous sending shall be suspended in order to transmit the GB_LVC_POWER_OFF(019.018) with the highest priority. In case of a spontaneous sending fails, the 3G/GPRS connection shall be re-established.

Message : **SPONT saved in the buffer** By this message LVC notifies to AMM its power-off/on.

GB_SPONT_LVC_POWER_OFF/ON (019.018)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	018 (GB_SPONT_ LVC_POWER_OFF/ON)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Status	1	Power-off=1 Power-on= 2

Message : **SPONT sent as spontaneous** By this message LVC notifies to AMM its power-off/on.

GB_SPONT_LVC_POWER_OFF/ON (019.018)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	018 (GB_SPONT_ LVC_POWER_OFF/ON)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
LVC_ID	**16**	
Status	1	Power-off=1 Power-on= 2

5.3.4.11 GPRS modem reset management

If allowed, concentrator has to reset the communication device (GPRS modem or router, not PSTN lowering its voltage line. When after GPRS_RETRY (see the GPRS table), any connection take place, the reset has to be sent. In this case, after the reset, concentrator still try to connect to the network for other GPRS_RETRY, after which, the time GPRS_BREAK (see the GPRS table) has to be wait. It has to be possible to disable the reset mechanism by means of a flag named D_RESET with the follow values and meaning:

D_RESET	Meaning
0	Reset is disabled to be sent in case of expired retry. The current retry schema has to be used: 1. GPRS_RETRY 2. GPRS_BREAK 3. Return to the point 1
1	Reset is enabled to be sent in case of expired retry. The schema of the connection retry/reset is the follow: 1. GPRS_RETRY 2. MODEM RESET 3. Wait for D_RESET_WAIT 4. GPRS_RETRY 5. GPRS_BREAK Return to the point 1

5.3.4.12 GPRS table structure

A set of parameters to be used in the GPRS modality has to be expected. These parameters have to be added in the concentrator table ID 252.

A table ID 251 will be the same as table ID 252 but referred to COM1 instead of COM2.

The structure is as follow:

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB000101	GPRS_FLAG	1	See the document. Default GPRS_FLAG=2

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB000102	GPRS_RETRY	1	GPRS connection attempts (the first is not enclosed) when the connection fail. Default GPRS_RETRY=3
0xFB000103	GPRS_RETRY_TIMER	1	Seconds between two GPRS connection attempts. Default GPRS_RETRY_TIMER=60 sec
0xFB000104	GPRS_BREAK	1	Minutes to try next GPRS dial (one gprs dial includes all retry attempts on APNs). Value GPRS_BREAK=0 means GPRS dial one time after power on. Default GPRS_BREAK=30 min
0xFB000105	PDP_ADDRESS	16	PDP IP address to be enclosed inside the PDP context message. Default PDP_ADDRESS=0.0.0.0
0xFB000106	WAKEUP_IP	1	See the document. Default WAKEUP_IP=0x00
0xFB000107	WAKEUP_IP_P	2	Wake Up IP destination port of AMM_IP_ WAKEUP. Default 0x00 means 58692
0xFB000108	GPRS_SPONT1	1	See the document. Default GPRS_SPONT1=0x00
0xFB000109	GPRS_SPONT1_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT1. Default 0x00 means 58693.
0xFB00010A	GPRS_AUTH	1	See the document. Default GPRS_AUTH=0.
0xFB00010B	DT_FAILED_AUTH	6	Last failed authentication Data/Time. Default = 2001.01.01 00:00
0xFB00010C	N_FAILED_AUTH	2	Number of failed authentication procedures. Default = 0
0xFB00010D	APN1	32	Access Point Name. Default APN1=empty

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB00010E	IMSI1	5	IMSI identification for APN association. Default IMSI1=empty
0xFB00010F	USER1	16	Username. Default USER1=empty
0xFB000110	PASSWORD1	16	Password. Default PASSWORD1=empty
0xFB000111	APN2	32	Access Point Name. Default APN2=empty
0xFB000112	IMSI2	5	IMSI identification for APN association. Default IMSI2=empty
0xFB000113	USER2	16	Username. Default USER2=empty
0xFB000114	PASSWORD2	16	Password. Default PASSWORD2=empty
0xFB000115	APN3	32	Access Point Name. Default APN3=empty
0xFB000116	IMSI3	5	IMSI identification for APN association. Default IMSI3=empty
0xFB000117	USER3	16	Username. Default USER3=empty
0xFB000118	PASSWORD3	16	Password. Default PASSWORD3=empty
0xFB000119	APN4	32	Access Point Name. Default APN4=empty
0xFB00011A	IMSI4	5	IMSI identification for APN association. Default IMSI4=empty

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB00011B	USER4	16	Username. Default USER4=empty
0xFB00011C	PASSWORD4	16	Password. Default PASSWORD4=empty
0xFB00011D	APN5	32	Access Point Name. Default APN5=empty
0xFB00011E	IMSI5	5	IMSI identification for APN association. Default IMSI5=empty
0xFB00011F	USER5	16	Username. Default USER5=empty
0xFB000120	PASSWORD5	16	Password. Default PASSWORD5=empty
0xFB000121	COM_RATE	1	See the document. Default COM_Rate=7
0xFB000122	WAKEUP_RATE	1	See the document. Default WakeUP_Rate=0
0xFB000123	IP_ADDRESS1	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFB000124	IP_MASK1	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFB000125	IP_METRIC1	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFB000126	IP_ADDRESS2	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB000127	IP_MASK2	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFB000128	IP_METRIC2	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFB000129	IP_ADDRESS3	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFB00012A	IP_MASK3	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFB00012B	IP_METRIC3	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFB00012C	IP_ADDRESS4	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFB00012D	IP_MASK4	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFB00012E	IP_METRIC4	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFB00012F	IP_ADDRESS5	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFB000130	IP_MASK5	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0

Tab. 251 - GPRS Table (COM1)

Field ID	Field Name	Size	Meaning
0xFB000131	IP_METRIC5	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFB000132	TO_SOCKETS	1	See the document. Default TO_SOCKET=2
0xFB000133	D_RESET	1	See the document
0xFB000134	APN1_SFX	12	See the document. Default APN1_SFX=empty
0xFB000135	RND_DELAY	1	Maximum random value expressed in seconds concentrator has to wait (besides other defined time-out) before to connect/reconnect through the GPRS network. Concentrator has to wait RND_DELAY seconds only at the first connection retry. Register range allowed 0..255. E.g. RND_DELAY=5, concentrator has to randomly wait from 0 to 5 seconds before connect/reconnect. Default=10
0xFB000136	GPRS_IMEI	15	Last Modem IMEI read from concentrator on COM1 during modem initialization (AT+CGSN). If no modem is detected by the concentrator, the value recorded refers to the last device connected. When this value changes an event of GB (019.019) is recorded in TRAPE.RESP.
0xFB000137	D_RESET_WAIT	1	Time in minutes to wait between the last modem HW reset command and the next GPRS_RETRY attempts. Default D_RESET_WAIT=0x04 (4 min)
0xFB000138	GPRS_SPONT2	1	See the document. Default GPRS_SPONT2=0x00
0xFB000139	GPRS_SPONT2_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT2. Default 0x00 means 58693.
0xFB00013A	GPRS_SPONT3	1	See the document. Default GPRS_SPONT3=0x00

Tab. 251 - GPRS Table (COM1)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFB00013B	GPRS_SPONT3_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT3. Default 0x00 means 58693.
0xFB00013C	MODEM_AUTH	1	Type of modem GPRS authentication: • 0x00 → PAP authentication • 0x01 → CHAP authentication Default 0x00.
0xFB00013D	MODEM_MANUF	30	Type of GPRS/3G modem connected, response of the AT*MANUF command. Default 0x00.
0xFB00013E	MODEM_VER	30	Version of the GPRS/3G modem connected, response of the AT*VER command. Default 0x00.

Tab. 252 - GPRS Table (COM2)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFC000101	GPRS_FLAG	1	See the document. Default GPRS_FLAG=0
0xFC000102	GPRS_RETRY	1	GPRS connection attempts (the first is not enclosed) when the connection fail. Default GPRS_RETRY=3
0xFC000103	GPRS_RETRY_TIMER	1	Seconds between two GPRS connection attempts. Default GPRS_RETRY_TIMER=60 sec
0xFC000104	GPRS_BREAK	1	Minutes to try next GPRS dial (one GPRS dial includes all retry attempts on APNs). Value GPRS_BREAK=0 means GPRS dial one time after power on. Default GPRS_BREAK=30 min
0xFC000105	PDP_ADDRESS	16	PDP IP address to be enclosed inside the PDP context message. Default PDP_ADDRESS=0.0.0.0

Tab. 252 - GPRS Table (COM2)

Field ID	Field Name	Size	Meaning
0xFC000106	WAKEUP_IP	1	Field to enable the WAKEUP_IP procedure, for details see the document. Default WAKEUP_IP=0
0xFC000107	WAKEUP_IP_P	2	WAKEUP_IP destination port of AMM_IP_WAKEUP. Default WAKEUP_IP_P=0 means port 58692
0xFC000108	GPRS_SPONT1	1	Field to enable the GPRS_SPONT1, for details see the document. Default GPRS_SPONT1=0
0xFC000109	GPRS_SPONT1_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT1. Default GPRS_SPONT1_P=0 means port 58693
0xFC00010A	GPRS_AUTH	1	See the document. Default GPRS_AUTH=0.
0xFC00010B	DT_FAILED_AUTH	6	Last failed authentication Data/Time. Default = 2001.01.01 00:00
0xFC00010C	N_ FAILED_AUTH	2	Number of failed authentication procedures. Default = 0
0xFC00010D	APN1	32	Access Point Name. Default APN1= internet.wind.biz
0xFC00010E	IMSI1	5	IMSI identification for APN association. Default IMSI1=22288
0xFC00010F	USER1	16	Username. Default USER1=empty
0xFC000110	PASSWORD1	16	Password. Default PASSWORD1=empty
0xFC000111	APN2	32	Access Point Name. Default APN2=empty
0xFC000112	IMSI2	5	IMSI identification for APN association. Default IMSI2=empty

Tab. 252 - GPRS Table (COM2)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFC000113	USER2	16	Username. Default USER2=empty
0xFC000114	PASSWORD2	16	Password. Default PASSWORD2=empty
0xFC000115	APN3	32	Access Point Name. Default APN3=empty
0xFC000116	IMSI3	5	IMSI identification for APN association. Default IMSI3=empty
0xFC000117	USER3	16	Username. Default USER3=empty
0xFC000118	PASSWORD3	16	Password. Default PASSWORD3=empty
0xFC000119	APN4	32	Access Point Name. Default APN4=empty
0xFC00011A	IMSI4	5	IMSI identification for APN association. Default IMSI4=empty
0xFC00011B	USER4	16	Username. Default USER4=empty
0xFC00011C	PASSWORD4	16	Password. Default PASSWORD4=empty
0xFC00011D	APN5	32	Access Point Name. Default APN5=empty
0xFC00011E	IMSI5	5	IMSI identification for APN association. Default IMSI5=empty
0xFC00011F	USER5	16	Username. Default USER5=empty

Tab. 252 - GPRS Table (COM2)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFC000120	PASSWORD5	16	Password. Default PASSWORD5=empty
0xFC000121	COM_RATE	1	See the document. Default =7
0xFC000122	WAKEUP_RATE	1	See the document. Default WakeUP_Rate=0
0xFC000123	IP_ADDRESS1	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFC000124	IP_MASK1	16	The network IP mask to associate to the physical interface into the routing. Default value 255.255.255.255
0xFC000125	IP_METRIC1	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 20
0xFC000126	IP_ADDRESS2	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFC000127	IP_MASK2	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFC000128	IP_METRIC2	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFC000129	IP_ADDRESS3	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFC00012A	IP_MASK3	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0

Tab. 252 - GPRS Table (COM2)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFC00012B	IP_METRIC3	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFC00012C	IP_ADDRESS4	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFC00012D	IP_MASK4	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFC00012E	IP_METRIC4	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFC00012F	IP_ADDRESS5	16	The network IP to associate to the physical interface into the routing table. Default value 0.0.0.0
0xFC000130	IP_MASK5	16	The network IP mask to associate to the physical interface into the routing. Default value 0.0.0.0
0xFC000131	IP_METRIC5	1	The Metric to associate into the routing table. If both three fields are 0 the routing table has not to be created. Default value 0
0xFC000132	TO_SOCKETS	1	See the document. Default TO_SOCKET=2
0xFC000133	D_RESET	1	See the document
0xFC000134	APN1_SFX	12	See the document. Default APN1_SFX=empty

Tab. 252 - GPRS Table (COM2)

Field ID	Field Name	Size	Meaning
0xFC000135	RND_DELAY	1	Maximum random value expressed in seconds concentrator has to wait (besides other defined time-out) before to connect/reconnect through the GPRS network. Concentrator has to wait RND_DELAY seconds only at the fist connection retry. Register range allowed 0..255. E.g. RND_DELAY=5, concentrator has to randomly wait from 0 to 5 seconds before connect/reconnect. Default=10
0xFC000136	GPRS_IMEI	15	Last Modem IMEI read from concentrator on COM2 during modem initialization (AT+CGSN). If no modem is detected by the concentrator, the value recorded refers to the last device connected. When this value changes an event of GB (019.019) is recorded in TRAPE.RESP.
0xFC000137	D_RESET_WAIT	1	Time in minutes to wait between the last modem HW reset command and the next GPRS_RETRY attempts. Default D_RESET_WAIT=0x04 (4 min)
0xFC000138	GPRS_SPONT2	1	Field to enable the GPRS_SPONT2, for details see the document. Default GPRS_SPONT2=0
0xFC000139	GPRS_SPONT2_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT2. Default GPRS_SPONT2_P=0 means port 58693
0xFC00013A	GPRS_SPONT3	1	Field to enable the GPRS_SPONT3, for details see the document. Default GPRS_SPONT3=0
0xFC00013B	GPRS_SPONT3_P	2	GPRS Spontaneous destination port of AMM_IP_SPONT3. Default GPRS_SPONT3_P=0 means port 58693
0xFC00013C	MODEM_AUTH	1	Type of modem GPRS authentication: • 0x00 → PAP authentication • 0x01 → CHAP authentication Default 0x00.

Tab. 252 - GPRS Table (COM2)			
Field ID	**Field Name**	**Size**	**Meaning**
0xFC00013D	MODEM_ MANUF	30	Type of GPRS/3G modem connected, response of the AT*MANUF command. Default 0x00.
0xFC00013E	MODEM_VER	30	Version of the GPRS/3G modem connected, response of the AT*VER command. Default 0x00.

5.3.4.13 APN management

At the power-On/reboot/serial re-connection, the concentrator has to read the IMSI parameter from the Modem/SIM and compare the first 5 characters [length (IMSI) received can be ⩾5] of this one with the values at the columns 14, 18, 22, 26, 30 of the table 252 in order to find a match. In case of match, the correspondent APN in the same group number has to be used for the next GPRS call. In case of multiples match on multiple columns, the extra APNs has to be considered as backup APNs.

About the APN USER used during APN authentication process, the following procedure has to be used to define it:

- If concentrator uses the APN1 then the USER1 must be joined with the APN1_SFX in order to have an APN1_USER of 28 bytes length → *APN1 USER = USER1 + APN1_SFX*
- If concentrator uses APN2, APN3, APN4, APN5 then the USER1, USER2, USER3, USER5 must be considered with own values
- If the default APN USER="***" then concentrator has to set the APN USER=

  trunc*[LVC1 ID]+APN_SFX

- If the default APN USER<>"***" then concentrator has to leave as is the register

LVC_ID is the concentrator identifier found in the T_STATUS.

*The trunc function applied to the concentrator ID field has to delete the "XXX" sub-field from it.

E.g. :

LVC_ID="18LVM50810000001"

trunc["18CEC50810000001"] = "1850810000001"

5.3.4.14 Connection steps

Summarizing, activity of concentrator at the power-on after a reset or GPRS disconnection will be:

- Verify the presence of the modem, set DTR pin and others parameters (modem initialization)
- If GPRS_FLAG<>0 then
- Send the PDP context, AT+GDCONT="…"
- Initiate a GPRS "call" by the dial-up like modality (e.g. ATD*99***<cid>)
- Once connected, put the sockets 50000/50001/50003/21 in 'listen' state. In case of GPRS authentication enabled, only the sockets 50000 has to be in listen
- In case of "Wake-Up IP" procedure enabled, steps above mentioned have to be executed.

5.3.4.15 SSH connection

The telnet service shall not be available but SSH connection is implemented.

5.3.5 *Priority Table {T_PRI} - Tab. 3*

It contains concentrator application procedures that can be run via PLC channel with the relative priority and activation time.

Tab. 03 - Priority Table (up to 36 rows)

Field ID	Field Name	Size	Meaning
0x03000101	PROCEDURE	1	Coding of Procedure Default=Row number
0x03000102	MIN_ACT_INTERVAL	2	This number defines the minimum spacing in minutes between procedure invocations. This serves to limit the number of times a procedure can run. A value of zero means that no minimum spacing is imposed (the procedure may run as frequently as necessary). For example, if after a procedure completes it should not run for another hour regardless of what new stimulus occurs, then set this to 60. Default=0x0000
0x03000103	MAX_ACT_INTERVAL	2	This number defines the maximum allowed spacing in minutes between procedure invocations. This serves to ensure a certain minimum procedure execution daily frequency. A value of zero means that the procedure need not run at all and will not be scheduled on an interval basis (except due to Activation Instance value). For example, if a procedure is to be run at least twice a day, set this to 720. MAX_ACT_INTERVAL shall be calculated starting from the ACT_INSTANT set from AMM. Default=0x0000
0x03000104	PRIORITY	1	Priority of the procedure range from 1 to 6: • 0x01 = High priority • 0x06 = Low priority Default=0x03
0x03000105	PROC_EN	1	Flag to enable a procedure: • 0x00 = Disabled • 0x01 = Enabled on PLC; • 0x02 = Enabled on both PLC and RF(*) Note that the hybrid value (0x02) is handled only by TB procedure, See flow chart in 20.8 [Tx_Msg_CE_PLC]. Default=0x00

Tab. 03 - Priority Table (up to 36 rows)

Field ID	Field Name	Size	Meaning
0x03000106	ACT_INSTANT	3	This number defines a specific time of day at which a procedure is run. This value can be set independent the other intervals. If AMM wants to provide only an Activation Instant and no max or min interval, it can do by specifying some Activation Instant with max/min intervals of 0. Default=0x000000
0x03000108	TIMEOUT	2	A timeout in minutes that generates the stop of a procedures at a fixed time. Also, it has been foreseen the GB_SPONT_PROC_END (019.007) see ENEL DH 971K I, to detect if the procedure has been aborted or not. With Procedure Timeout = 0x00, the procedure is never ending. Default=0x0000
0x03000109	PROTECTION	1	Reserved Default=0x00
0x0300010A	START_DT-POSIX	4	Posix Time related to the last procedure activation. Default=0x00000000
0x0300010B	STATUS_DT-POSIX	4	Posix Time related to the PROC_STATUS updating. Default=0x00000000
0x0300010C	PROC_STATUS	1	Procedure status; it’s updated during the procedure process, see below. Default=0x00
0x0300010D	LAST_PROC_TIMING(*)	3	Duration in seconds of the last procedure running. The msb b[23] shall be used to indicate the abort condition: • 0x00= Procedure completed without abort • 0x01= Procedure completed with abort Default=0x000000

(*) Future predisposition

In relation to PROC_STATUS field the followings codes are handled:

STATUS CODE			DT-POSIX_STATUS
Value	**Meaning**	**Description**	**Meaning**
0x00	Not Used	Default value	…
0x01	Running	Procedure starts	Procedure starting
0x02	Done	Procedure ends	Procedure ending
0x03	Stop Activity	Procedure is aborted/suspended due to a Stop Activity command	Stop Activity
0x04	Disk Full	Procedure ends but disk full condition happens	Procedure ending
0x05	EB Failure	Procedure ends but a failure on EB occurs	Procedure ending
0x06	Procedure Timeout	Procedure ends due to timeout	Procedure ending
0x07	Priority	Procedure is suspended by another procedure with higher priority	Procedure suspension
0x08	LV-Net	Communication disabled on LV network	Procedure ending
0x09	Priority_To_Stop_Activity	Procedure stopped by priority and then by stop activity	Stop Activity
0x0A	Priority_To_LV-Net	Procedure stopped by priority and then by LV_NET disable	Procedure ending
0x0B	Power_Up	Procedure Aborted due to power off and up, set only during power up	Procedure ending
0x0C	Abort	Procedure Aborted due to disable or DWL CE changed image	Procedure ending

Acronyms	Procedure	Minimum activation interval	Maximum activation interval	Priority	Proc_en	Activation Instant	Timeout
SINC-T	01	0	360	5	1	--:--	
SINC	02	0	0	2	1	--:--	

CONN-C	03	0	0	2	0	--:--	
CONN-R	04	0	0	2	0	--:--	
Reserved	05	-	-	-	-	--:--	
TB Procedure	06	0	0	3	2	--:--	
Reserved	07	-	-	-	-	--:--	
ALCA	08	0	0	1	1	--:--	
ACE	09	0	0	3	0	--:--	
Reserved	0A	-	-	-	-	--:--	
B.E.	0B	0	0	3	1	00:10	
GESIC_A	0C	0	0	3	0	--:--	
AG_24	0D	0	0	3	1	00:45	
AG_IC	0E	60	226	3	0	--:--	
LDET	0F	0	0	2	0	--:--	
GQBT-I	10	Not used	Not used	3	0	--:--	
PLOAD	11	0	0	4	0	03:15	
DWLD	12	0	0	1	0	…	
PILL[12]	13	0	0	2	0	--:--	
PCONNC	14	0	0	2	0	--:--	
PCONNR	15	0	0	2	0	--:--	
GESIC_B	16	0	0	4	0	--:--	
IC_B	17	0	0	4	0	--:--	
TIMETO	18	0	0	2	0	--:--	
GQBT-V	19	Not used	Not used	3	0	--:--	
RECOVERY_CE	1A	0	0	3	0	--:--	

[12] future predisposition

CEDATA	1B	0	0	3	0	--:--	
PSINC-T	1C	0	0	4	0	--:--	
Reserved	1D	-	-	-	-	--:--	
Reserved	1E	-	-	-	-	--:--	
Reserved	1F	-	-	-	-	--:--	
NPLOAD	20	0	0	4	0	--:--	
V-REG	21	0	0	3	0	--:--	
N2PLOAD	22	0	0	3	0	--:--	
Reserved	23	-	-	-	-	--:--	
QVI	24	0	0	4	0	--:--	

Note: the values showed in the table have to be understood to be as examples. They are not the default values. The values are set by AMM.

The table has to be stored in the no-volatile memory of concentrator.

5.3.6 HHU Table {T_HHU} - Tab. 23

The HHU table must contain the information set-up by HHU/AMM and relevant for setting the HHU protocol timers on the concentrator.

Tab. 23 - HHU Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x17000101	CONNECTION_TIMEOUT	2	Time in second after which the concentrator considers the HHU to be disconnected Range 5 to 600 Default = 30
0x17000102	MESSAGE_TIMEOUT	2	Maximum time in milliseconds, to wait for an incoming transfer after sending a message in the MS phase Range 200 to 5000 Default = 1500

Tab. 23 - HHU Table

Field ID	Field Name	Size	Meaning
0x17000103	TURNAROUND_DELAY	2	Minimum time in milliseconds, between reception and transmission phase Range 20 to 500 Default = 200
0x17000104	INTER-BYTE_TIMEOUT	2	Maximum time in milliseconds, between two characters in a message Range 200 to 5000 Default = 200
0x17000105	FAIL_COUNT	1	HHU fail connection counter, when FAIL_COUNT= MAX_FAIL_COUNT, the HHU port is blocked. The FAIL_COUNT comes back to zero at HHU port unblocking. Range 0 to 255
0x17000106	MAX_FAIL_COUNT	1	Max fails counter: it's the trigger set for HHU blocking. 0=not allowed and return NACK at writing. Range 1 to 255 Default=0x0A (10)
0x17000107	TS_BLOCK	4	Posix time when the blocking trigger starts, FAIL_COUNT= MAX_FAIL_COUNT
0x17000108	WAIT_BLOCK	1	Hours to be waited after block triggering, to unblock; 0=not allowed and return NACK at writing; 1 to 254= hours to be wait; 255=wait next midnight. Default=0xFF

Data communication sessions have to be managed by the concentrator in order to avoid any security lack or hacking attempt.

The concentrator has to implement a procedure that locks the access to the local optical interface after a programmable consecutive number of failed authentication attempts [MAX_FAIL_COUNT]. A failed authentication attempt has to be considered as a wrong digest that HHU has sent to the concentrator.

The digest is considered included into a message the HHU has addressed to the local concentrator to perform read/write commands. The counters of consecutive failed authentication attempts have to be reset every time the concentrator receives a message with a valid digest via the optical interface.

The locked communication optical interface has to be unlocked (by unlocking the optical interface, the concentrator can be accessed by means of this communication port) by the concentrator after a programmable period of time [WAIT_BLOCK]. No procedure and/or commands through optical interface have to be available in order to manually unlock the locked communication interfaces. The only command permitted to enable the optical port is the reset of the status word, P bit in T_STATUS.

The value of [WAIT_BLOCK] defines the hour, starting from the lock instant [TS_BLOCK], at the end of which the concentrator has to unlock the optical interface. An example is described below:

Ex. 1

WAIT_BLOCK = 0x02

Lock instant: 12:34, 01/02/2008

The concentrator has to unlock the optical port at: 14:00, 01/02/2008

If the value of [WAIT_BLOCK] registers is set to 0xFF, the concentrator has to unlock the interface at the beginning of the day next to the one in which the communication interface has been locked.

Ex. 2

WAIT_BLOCK = 0xFF

Lock instant: 14:34, 01/02/2008

The concentrator has to unlock the optical port at: 00:00, 02/02/2008

The table has to be stored in the no-volatile memory of the concentrator.

5.3.7 *Concentrator Download Table {T_LVC_DWLD} - Tab. 21*

The current table allows to run a file previously downloaded via FTP on to the concentrator. The most common use of this solution is the upgrade of the concentrator firmware but it can be used also execute scripts; for example to switch the modem to the maintenance mode.

The fields in the table are defined as follows:

Tab. 21 - LVC Download Table

Field ID	Field Name	Size	Meaning
0x15000101	IMAGE_ID	8	Identifier of the Image to run
0x15000102	ACTIVATE_DT	6	Activation Date Time It has to show the switchover date/time
0x15000103	LVC_DT- DIGEST	8	Concentrator Date Time and Digest. This field has the following property: If the field is all zero (16 bytes of zeroes), it will be ignored. If not, the date/time is used as an expiration time and the digest as validation of the image. If the expiration time has passed, then the file will not be usable for downloads. The Digest will be computed by Entire File Contents and Date/Time. Note there is no concentrator sub-section/concentrator progressive prefix. The concentrator must not to do the DIGEST check when DWLD procedures is requested to run for itself.

The table has to be stored in the no-volatile memory of concentrator.

5.3.7.1 Concentrator software update

The concentrator software update file has to be downloaded to the concentrator from the server using a private IP protocol. The concentrator shall continue working during whole the download process. If the download is interrupted, concentrator can restart and run the original software until a successful download is accomplished.

Below an example for “MBApp” updating, with similar rules it can be updated also the “EBApp” and the Fw of the RF module, only for LVM it can be update also the RTE Fw.

In case of the package to be downloaded contains the same running version of EBApp or RF, that specific updating should be skipped by the concentrator.

The download of the concentrator application shall be performed as follows:

- AMM shall use FTP to load a new image called MSCApp<imageid>.bin into the MSC and LVMApp<imageid>.bin into the LVM. The <imageid> is an up to 8 characters (not zero terminated variable part of the file name identifying the version of the file
    - Two copies of the image, the current and the new one (this is the update itself), shall reside on the concentrator up to the end of the update process.
    - The current image must remain intact and its name must not change.

The activation of the concentrator application shall be done through the following steps:

- AMM writes T_LVC_DWLD fields:
    - IMAGE_ID;
    - ACTIVATE_DT;
- Concentrator checks the new image for a correct digest. The image bytes are digested with the current key and the digest must match. This may take several seconds to complete and the switch to the new image will not occur unless the digest matches. The activation of the new image shall be refused and the file shall not be run, in case:
    - the file is not found or the image file name has an header different from "*MSCApp*", moreover a GB_NACK (255) Error Code 75 shall be returned immediately at tab. 21 writing; the table will be zeroed by the concentrator.
    - the digest does not match, moreover a GB_NACK (255) Error Code 76 shall be returned immediately at tab. 21 writing; the table will be zeroed by the concentrator.
    - The download image file date/time has expired, moreover a GB_NACK (255) Error Code 78 shall be returned immediately at tab. 21 writing; the table will be zeroed by the concentrator.
- AMM sends the *"Start Activity"* command
- At activation date/time concentrator shall reboot to the new image.
- New image checks itself for validity. If the check is:
    - OK → the old image is deleted and the new image is marked as the current image in non-volatile memory. This is done in such a way that failure at any time either causes the process to be repeated or to succeed.
    - KO → concentrator shall attempt to recover the previous version of the image in fail.
- Once the switchover succeeds, the T_LVC_DWLD has to be zeroed to indicate completion.
- The current version of the concentrator software shall be write in the T_STATUS.

5.3.8 CE Download Table {T_CE_DWLD} - Tab. 22

This table allows the AMM to tell the concentrator what types of CEs to load, and how to load them. The table is 4 deep and thus up to four different loads can be specified. The fields in the table are defined as follows:

Tab. 22 - CE Download Table (up to 4 rows)

Field ID	Field Name	Size	Meaning
0x16000101	IMAGE_ID	8	This has to be a one to eight character string which is used to formulate the image name. The allowable characters are limited to the set supported by the concentrator file system, but the ASCII characters "A"-"Z", "a"-"z", "0"-"9", "_", "-", and "." are safe to use. Unused characters should be zero (decimal). Images are placed in the root directory of the concentrator file system using FTP. The file name constructed will be of the form CeApp<imageId>.bin.
0x16000102	TYPE_ID	1	It shows the type of CE that is to be loaded. This field is matched against the type bits (4..6) in the CE_STATE field of the CE table. All requested, enabled CEs with a matching TYPE_ID will be loaded with the specified image. This allows the table to specify several different images to be loaded into different types of meters. With the value 0xFF the image will be applied to all meters without any "TYPE_ID" matching.
0x16000103	ACTIVATE_DT	6	This field has to show the switchover date/time. If it is all zeroes, then the concentrator will choose its own switchover date/time. If it is not all zeroes, then the concentrator will use this date/time. In the case of an externally imposed date/time, the download procedure will not wait for switchovers to occur, and will consider the download successful when the switchover time has been set. It is up to the AMM to validate the switchovers occurred (e.g., by polling the meters download control table via a TB message). In case of DWLD multi-part the date/time inserted shall be used like switchover time for the last APPx file of the package.
0x16000104	DO_ALL	1	This field has to indicate that all applicable CE's should be downloaded. When the download procedure begins, the F(DWLD) bit in the CE table is automatically set for each enabled CE that matches the TYPE_ID. After the CE entries have been set, the DO_ALL field will be cleared. After that point, the normal procedures for the F(DWLD) are followed. This allows downloading all meters without explicitly setting their F(DWLD) bits, and still provides for tracking the completion status of individual meters. If the field TYPE_ID is programmed as 0xFF then the concentrator must set the F(DWLD) bit for all the meters loaded in T_CE
0x16000105	LOOP_LIMIT	1	Number of attempts for each meter inside a single procedure loop, 0x00 means ten attempts.

Tab. 22 - CE Download Table (up to 4 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x16000106	DT- DIGEST	8 8	CE Date Time and Digest. This field has the following property: If the field is all zero (16 bytes of zeroes), it will be ignored. If not, the date/time is used as an expiration time and the digest as validation of the image. If the expiration time has passed, then the file will not be usable for downloads. The Digest will be computed by Entire File Contents and Date/Time. Note there is no section/progressive prefix. (not used)
0x16000107	GLOBAL_LOOP	1	Number of total procedure attempts over the meters not yet updated with success in the previous cycle.
0x16000108	DWC_RESET	1	By this bit mask is possible to reset the historical flags F(DWC) in Tab. 67 and enable/disable the “optimize” DWLD for the involves meter, see below.
0x16000109	Reserved	1	Default=0x00
0x1600010A	STATUS_EN	1	Flag to enable or disable the T_CE_DWC Control Table zip creation, see below.

In relation to DWC_RESET field the following values must be handled:

- DWC_RESET = 0x00:
  - If the firmware file is different from the previous loaded, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file but each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.
  - If the firmware file is equal to the previous loaded, the concentrator will go on to download the modules in relation of the F(DWC) register bits, saved as historical flag at the end of the previous download cycle. Each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.

- DWC_RESET = 0x01:

  - In both cases, if the firmware file is different from the previous loaded or not, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.

- DWC_RESET = 0x02:
  - If the firmware file is different from the previous loaded, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded without any APPx firmware check between meter and firmware file
  - If the firmware file is equal to the previous loaded, the concentrator will go on to download the modules in relation of the F(DWC) register bits, saved as historical flag at the end of the previous download cycle. Each module will be downloaded without any APPx firmware check between meter and firmware file

- DWC_RESET = 0x03:
  - In both cases, if the firmware file is different from the previous loaded or not, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded without any APPx firmware check between meter and firmware file.

In relation to STATUS_EN field the following values are used to enable/disable the table zip creation

b7	…	b1	b0	Meaning
…	…	…	…	…
…	…	1	0	Zip file handling

The download procedure will process this table serially. That is, one image will be loaded then the next and so on. Once an image is completely loaded, the entry is removed from the control table.

The activation of the new meter image shall be refused and the file shall not be downloaded, in case the file is not found or the image file name has an header different from "*CeApp*", moreover a GB_NACK (255) Error Code 75 shall be returned immediately at tab. 22 writing; the table will be zeroed by the concentrator.

The table has to be stored in the no-volatile memory of concentrator.

5.3.9 CE Download Control Table {T_CE_DWL_C} - Tab. 67

By this table AMM can acquired additional info about CE Download process via PLC, it contains:

Tab. 67 - CE DWLD CONTROL Table (up to 2048 rows**)**			
Field ID	**Field Name**	**Size**	**Meaning**
0x43000101	F(DWC)	1	Control mask of the download, see below for further details.
0x43000102	DT_POSIX	4	Timestamp in hex of the last update of the line.
0x43000103	APP1_DWL	2	App1 version read from binary file header.
0x43000104	APP2_DWL	2	App2 version read from binary file header.
0x43000105	PLC_DWL	2	Modem PLC version read from binary file header.
0x43000106	RF_DWL	2	Modem RF version read from binary file header.
0x43000107	SCENARIO_DWL	2	Scenario version read from binary file header.
0x43000108	AVAILABLE_DWL	2	Available version read from binary file header.
0x43000109	FIXED_VER	2	Bootloader version read on meter
0x4300010A	APP1_VER	2	App1 version read on meter.
0x4300010B	APP2_VER	2	App2 version read on meter.
0x4300010C	PLC_VER	2	Modem PLC version read on meter
0x4300010D	RF_VER	3	Modem RF version read on meter
0x4300010E	AVAILABLE_VER	2	Available field for future App version read on meter
0x4300010F	APP1_CW	2	Last control word read from meter during APP1 download.
0x43000110	APP2_CW	2	Last control word read from meter during APP2 download.
0x43000111	PLC_CW	2	Last control word read from meter during Modem PLC download.
0x43000112	RF_CW	2	Last control word read from meter during Modem RF download.
0x43000113	SCENARIO_CW	2	Last control word read from meter during Scenario download.
0x43000114	AVAILABLE_CW	2	Last control word read from meter during Available download.

Tab. 67 - CE DWLD CONTROL Table (up to 2048 rows**)**			
Field ID	**Field Name**	**Size**	**Meaning**
0x43000115	DWL_STATUS	1	Code of download status, see below for further details.

F(DWC) is used from concentrator as Download control bit mask with the following meaning:

Flag	Value	Meaning	Set by	Cleared by
F(DWC_APP1)	0x0002	DWLD APP1 version on CE	LVC	LVC
F(DWC_APP2)	0x0004	DWLD APP2 version on CE	LVC	LVC
F(DWC_PLC)	0x0008	DWLD PLC version on CE	LVC	LVC
F(DWC_RF)	0x0010	DWLD RF version on CE	LVC	LVC
F(DWC_SCENARIO)	0x0020	DWLD APP4 (Scenario) on CE	LVC	LVC
F(DWC_AVAILABLE)	0x0040	DWLD APPx (available APPx) on CE	LVC	LVC

When download starts the concentrator sets the F(DWC_x) flags in relation of the part includes in the image programmed in the T_CEDWLD. At the end of the DWLD process, if completed with success flags are reset, on the contrary they are kept high in order to inform the central system of which part has been updated or not. In addition flags are used by concentrator in case of sequential procedure activation with the same CeApp<imageId>.bin on the same meters. By this way the concentrator exactly knows which part needs to be update, historical flags are also used during the “global loop” retries.

If AMM programs a new download with a different CeApp<imageId>.bin then the concentrator must delete and then properly update the F(DWC) flags for the involves meter.

DWL_STATUS can assume the following status codes:

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x00	Target Disabled	DWLD starts and F(INTR)=0 in CE_Table
0x01	DWLD Disabled	DWLD starts and F(DWLD)=0 in CE_Table
0x02	To Do	DWLD starts and F(DWLD)=1 in CE_Table
0x03	Type_ID	DWLD starts and Type_ID in CE_Table doesn’t match

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x04	Done APP1	APP1 download ends with success
0x05	Done APP2	APP2 download ends with success
0x06	Done PLC	PLC download ends with success
0x07	Done RF	RF download ends with success
0x08	Done SCENARIO	SCENARIO download ends with success
0x09	Done AVAILABLE	AVAILABLE download ends with success
0x0A	In Progress APP1	APP1 Start Load writing with success
0x0B	In Progress APP2	APP2 Start Load writing with success
0x0C	In Progress PLC	PLC Start Load writing with success
0x0D	In Progress RF	RF Start Load writing with success
0x0E	In Progress SCENARIO	SCENARIO Start Load writing with success
0x0F	In Progress AVAILABLE	AVAILABLE Start Load writing with success
0x10	Incompatible APP1	CE “Nack” after APP1 Start Load writing
0x11	Incompatible APP2	CE “Nack” after APP2 Start Load writing
0x12	Incompatible PLC	CE “Nack” after PLC Start Load writing
0x13	Incompatible RF	CE “Nack” after RF Start Load writing
0x14	Incompatible SCENARIO	CE “Nack” after SCENARIO Start Load writing
0x15	Incompatible AVAILABLE	CE “Nack” after AVAILABLE Start Load writing
0x16	Skipped APP1	APP1 download skipped due to part already present

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x17	Skipped APP2	APP2 download skipped due to part already present
0x18	Skipped PLC	PLC download skipped due to part already present
0x19	Skipped RF	RF download skipped due to part already present
0x1A	Skipped SCENARIO	SCENARIO download skipped due to part already present
0x1B	Skipped AVAILABLE	AVAILABLE download skipped due to part already present
0x1C	Check APP1	During Single loop resume of APP1
0x1D	Check APP2	During Single loop resume of APP2
0x1E	Check PLC	During Single loop resume of PLC
0x1F	Check RF	During Single loop resume of RF
0x20	Check SCENARIO	During Single loop resume of SCENARIO
0x21	Check AVAILABLE	During Single loop resume of AVAILABLE
0x22	Packet APP1 OK	All APP1 packets Received
0x23	Packet APP2 OK	All APP2 packets Received
0x24	Packet PLC OK	All PLC packets Received
0x25	Packet RF OK	All RF packets Received
0x26	Packet SCENARIO OK	All SCENARIO packets Received
0x27	Packet AVAILABLE OK	All AVAILABLE packets Received
0x28	Digest Error APP1	Digest Error in APP1 Packets
0x29	Digest Error APP2	Digest Error in APP2 Packets

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x2A	Digest Error PLC	Digest Error in PLC Packets
0x2B	Digest Error RF	Digest Error in RF Packets
0x2C	Digest Error SCENARIO	Digest Error in SCENARIO Packets
0x2D	Digest Error AVAILABLE	Digest Error in AVAILABLE Packets
0x2E	Switchover APP1	APP1 Switchover writing with success
0x2F	Switchover APP2	APP2 Switchover writing with success
0x30	Switchover PLC	PLC Switchover writing with success
0x31	Switchover RF	RF Switchover writing with success
0x32	Switchover SCENARIO	SCENARIO Switchover writing with success
0x33	Switchover AVAILABLE	AVAILABLE Switchover writing with success
0x34	Switch Fail APP1	APP1 done Ko due to Switch Fail
0x35	Switch Fail APP2	APP2 done Ko due to Switch Fail
0x36	Switch Fail PLC	PLC done Ko due to Switch Fail
0x37	Switch Fail RF	RF done Ko due to Switch Fail
0x38	Switch Fail SCENARIO	SCENARIO done Ko due to Switch Fail
0x39	Switch Fail AVAILABLE	AVAILABLE done Ko due to Switch Fail
0x3A	Single Loop	Single Loop Limit ends without success
0x3B	Global Loop	Global Loop Limit ends without success
0x3C	CE Not Reachable	CE Not reachable during unicast message

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x3D	Wrong Key	CE Key error

All the fields are readable but not writeable, each row is linked to T_CE in order to keep CE_ID association.

In case of decommissioning or if a T_CE entry is deleted then the concentrator must erase the linked row.

The zip file of T_CEDWC control table, if enabled, must be saved in /disk/ftp/pub/log. In order to avoid file system saturation the same rules described for N2PLOAD zip generation have to be applied. Table will be saved with the following naming:

tab_cedwc.fdb_5201276A.gz

Where **5201276A** is the creation date in POSIX notation

The table has to be stored in the no-volatile memory of concentrator.

5.3.10 Modem 3G/GPRS updating

The concentrator shall be able to update the FW related to 3G/GPRS modem connected, for further details refer to [30].

5.4 DATA BASE DIMENSION

The Data Base of concentrator shall be able to contain the following minimum requirements for

PLC communication:

- no. LV lines 24
- no. Sections for concentrator 255
- no. Peripheral units via PLC for concentrator 2048

RF communication:

- no. Peripheral units via RF for concentrator 2048
- Communication parameters and spontaneous management of at least 4096 CEs whose RF messages are received by the concentrator though it is not managed via RF by the concentrator.

CEs managed via RF and those via PLC could be two completely separated groups, in other words a CE could be managed via PLC by a Concentrator and via RF by another Concentrator.

5.4.1 CE Table {T_CE} - Tab. 4

It contains the identification code of reachable meters in the subtended LV network. The T_CE configuration can be carried out by the AMM or by a portable terminal (HHU) connected to concentrator.

T_CE structure (not volatile, programmable memory), is as follows:

Tab. 4 CE TABLE (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x04000101	ID_CE	6	CE identification as described in ENEL DH 910K
0x04000102	CE_SUB_SECTION	1	CE identification Sub Section
0x04000103	CE_PROGRESSIVE	1	CE identification progressive of the node
0x04000104	LINE	1	CE line communication. See below
0x04000105	CE_F(INTR)	1	DLC Enable/Disable to the current CE: • 0x00 = DLC Disabled • 0x01 = DLC Enabled
0x04000106	CE_F(PROC)	1	Bit mask for procedure activation. See below
0x04000107	SEC	1	Section Identifier

Tab. 4 CE TABLE (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x04000108	CS/VCS/CE_MODEL	1	Bit mask for CS/VCS setting and CE_MODEL. See below
0x04000109	CE_STATE	1	State of meter and CE_TYPE. See below
0x0400010A	VAS_F(PROC)	2	Services activated on IC. See below
0x0400010B	CD_KEY	12	Current CE authentication key[14]
0x0400010C	ID_IC	6	Customer Interface Identification; structured as ID_CE. The null value indicates IC not present
0x0400010D	IC_SUB_SECTION	1	IC identification Sub Section
0x0400010E	IC_PROGRESSIVE	1	IC identification progressive of the node
0x0400010F	EXT_F(PROC)	2	Bit mask to define which type of load profile has to be read. See below
0x04000110	CE_INTERVAL	1	Value of interval used by NPLOAD in case of INTERVAL = 0xFF in T_PLOAD. See below
0x04000111	EXT2_F(PROC)	4	Fetch daily closure and daily instantaneous power maximum demand profiles, same rules of EXT_F(PROC). See below
0x04000112	F(ACE)_STATUS1	1	CE status1 during meter acquisition procedure ACE. See below for status code(*)
0x04000113	F(ACE)_STATUS2	1	CE status2 during meter acquisition procedure ACE. See below for status code
0x04000114	CE_CHANNEL	1	Communication channel for the current meter: • 0x00 = Meter handled only via PLC; value is set by concentrator if the ADDR is present only in T_CE • 0x01 = Meter handled both via PLC and RF; value is set by concentrator if the same ADDR is present also in T_RF_CE.

(*) Future predisposition

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[14] Field encrypted in the internal database

In relation to LINE field, the following values are applied (Bit 4, 5 and 6 are unused):

Bit 7	…	Bit 3	Bit 2	Bit 1	Bit 0	Value	Line
0	…	0	0	1	1	Line Marked (3)	R
0	…	0	1	1	1	Line Marked (7)	S
0	…	1	0	1	1	Line Marked (11)	T
0	…	0	0	1	0	Line Marked (2)	RS
0	…	0	1	1	0	Line Marked (6)	ST
0	…	1	0	1	0	Line Marked (10)	TR
1	…	0	0	1	1	Line Marked (131)	R Inv
1	…	0	1	1	1	Line Marked (135)	S Inv
1	…	1	0	1	1	Line Marked (139)	T Inv
1	…	0	0	1	0	Line Marked (130)	SR
1	…	0	1	1	0	Line Marked (134)	TS
1	…	1	0	1	0	Line Marked (138)	RT

In relation to CE_F(PROC) field the following bit mask represents multiple procedure states:

Flag	Value	Purpose	Set by	Cleared by
F(ACE)	0x01	Acquisition of the CE	LVC/AMM	LVC
F(PLOAD)[15]	0x02	Fetch load profile	AMM	LVC
F(…)	….	<Reserved>		
F(LDET)	0x08	Line Detection of CE	AMM	LVC
F(DWLD)	0x10	Download CE	LVC/AMM	LVC
F(…)	0x20	<Reserved>		
F(…)	….	<Available>		

[15] See note at EXT_F(PROC) register

F(PSINC-T)	0X80	Partial SINC-T for connection check	AMM	AMM

The semantics of these flags is as follows:

The AMM has to set any of these flags. The concentrator will clear the flag when the corresponding procedure completes. The concentrator will set a flag only when it sees that some condition mandates that the procedure be run. The AMM can clear a flag as well to cancel a pending operation; however, caution should be used when clearing F(ACE) as it may leave the network in an inconsistent state.

When a flag is set for any CE, the corresponding procedure will be scheduled automatically. If the AMM wishes to set the bit but not have the procedure run, the procedure must be disabled by the AMM. When the procedure is enabled, it will then run. As each CE is successfully processed, the corresponding F(PROC) bit is cleared. Thus, at procedure completion, the AMM has to determine which CEs were successfully processed by viewing the F(PROC) bits. Upon notification of procedure completion, those CEs which have F(PROC) bits can be inferred to have not been successfully processed.

Note that placing multiple bits into a single byte will require some discipline on the part of the AMM. In particular, when modifying this byte, the AMM has to do a “read modify write” operation. In this way, the current state of the byte can be determined, the appropriate bit(s) set/cleared, and then the value is written back. Without this discipline, the AMM could accidentally clear a bit that was set by the concentrator or set a bit already cleared by the concentrator . Note that while the concentrator is in the “stopped” state, the AMM need not worry about the byte being changed by the concentrator.

In relation to CS/VCS/CE_MODEL field the following values are used:

CE_KNOW_TOPOLOGY		
bit 1	**bit 0**	**Meanings**
0	0	Normal
0	1	Master of Section
1	0	Vice Master of Section
1	1	Meter of Be

CE_MODEL		
bit 7	**bit 6**	**Meanings**
0	0	P520/T520 Meter
0	1	MM520 Meter

1	0	MM520evo Meter
1	1	Available

The bit (b6-b7) must to be used in order to mark a meter as P520/T520, MM520 or MM520evo. Bits are set from AMM during commissioning and used from concentrator in order to know which meters have the additional Extended Status Words (0x1702 and 0x1703) and the Notification Status Word (0xFD01 and 0xFD02). The new extended status words (Extended status word_2 and Extended status word_3) will be read together to the first Extended status word (0x1701) with the same rules in case of MM520 and MM520evo meters. The above bits are also used by concentrator to collect data for header zip creation, like for example N2PLOAD, QI and QV procedure. The bit b0 and b1 are managed with current rules for known topology network, 0/1/2/3/X to find out if that CE is respectively: 0= Normal; 1= Master Repeater of Section; 2= Vice Master (secondary repeater) of Section; 3= Meter of Be or X= other. The remaining bits (b2-b4) are unused. The handling of CS/VCS field is in charge of the AMM, both for setting or resetting.

In relation to CE_STATE field the following values are used:

Bit 0	Bit 1	Meanings	Status
0	0	Not active and not programmed	Meter has not completed the production process. Calibration, programmable parameters and default values are not in a known state. The state remains until the production software indicates that all production tasks are complete
0	1	Not active and programmed	Meter operating outside of contract
1	0	Active with reduced functionality	Meter operating with a tariff error, or any other useful error condition
1	1	Active and programmed	Normal meter operation

Bit 6	Bit 5	Bit 4	Meanings
0	0	0	Single phase meter
1	0	0	Poly phase meter
0	1	0	Available
1	1	0	Available
0	0	1	Available
1	0	1	Available
0	1	1	Available

Bit 6	Bit 5	Bit 4	Meanings
1	1	1	Available

It will be in charge of AMM to manage and to handle the remaining combination of bits 4, 5, 6 for the appropriate matching of CEs typology with the "fixed" SW version.

Bit 7	Meanings
0	Meter used for all customer
1	Meter installed in MV Sub Station for BE procedure

VAS-F(PROC) contains the indications of the different services offered. The features are similar to those described for CE_F(PROC). This bit mask represents multiple procedure states:

Flag	Value	Purpose	Set by	Cleared by
F(AIC)	0x0004	Acquisition IC	AMM/LVC	LVC
F(DAIC)	0x0040	De-acquisition IC	AMM	LVC
F(DWLD)	0x0010	Download IC	AMM	LVC
F(LDET)	0x0008	Line Detection of IC (tbd)	AMM	LVC
F(AG_IC)	0x0002	AG_IC procedure	AMM	LVC
F(AG_24)	0x0020	AG_24 procedure	AMM	LVC
F(…)	0x0080	<Reserved>	…	…
F(IC_B)	0x0100	IC_B procedure	AMM	LVC
F(GESIC_A)	0x0200	GESIC_A procedure	AMM	LVC
F(GESIC_B)	0x0400	GESIC_B procedure	AMM	LVC
F(GQBT-I)	0x0800	GQBT-I procedure	AMM	AMM
F(GQBT-V)	0x1000	GQBT-V procedure	AMM	AMM
F(…)	0x2000	<Reserved>	…	…
F(V-REG)	0x4000	V-REG procedure	AMM	AMM/LVC

For all the new IC procedures, the flag is set/cleared only by the AMM and it controls whether the procedure operates on the associated IC. Additionally, for the IC-B and GESIC-A procedures, behaviour must be defined for when the procedure is denied:

NACK anomaly code 7 is sent if the F(PROC) bit is not set when the AMM submits the request or when the procedure tries to process the request.

EXT_F(PROC) has to be used as bit mask by AMM to define which type of load profile has to be read:

Flag	Value	Purpose	Set by	Cleared by
F(PL_VA)	0x0002	Virtual Active profile	AMM	AMM
F(PL_VR)	0x0004	Virtual Reactive profile	AMM	AMM
F(PL_NA)	0x0008	Negative Active profile	AMM	AMM
F(PL_NIR)	0x0010	Negative inductive Reactive profile	AMM	AMM
F(PL_PCR)	0x0020	Positive capacitive Reactive profile	AMM	AMM
F(PL_NCR)	0x0040	Negative capacitive Reactive profile	AMM	AMM

During NPLOAD the CE_INTERVAL value has to be used in case of INTERVAL = 0xFF in T_PLOAD:

CE_INTERVAL	Meanings
0	Special case-load profile of the current day has to be detected (0<hh<24)
1	Load profile of the previous day has to be detected
2	Load profile of the last two previous days has to be detected
3	Load profile of the last three previous days has to be detected
…	…
…	…
60	Load profile of the last 60 previous days has to be detected (MAX VALUE)
246	Special case-the whole content of the circular buffer has to be detected
248	Special case- Load profile of the previous month has to be detected handling the “end of month”
252	Special case- Load profile of the previous two months has to be detected handling the “end of month”

EXT2_F(PROC) has to be used as bit mask by AMM to define which type of daily closure and instantaneous power maximum demand profile has to be read

Flag	Value	Purpose	Set by	Cleared by
F(DC1_C1)	0x00000002	Daily closures (DC) for A+ and/or Instantaneous power maximum demand (IPMD) for W+ and/or Average daily power maximum demand (APMD) for W+	AMM	AMM
F(DC2_C1)	0x00000004	Daily closures (DC) for L+ and/or Instantaneous power maximum demand (IPMD) for L+	AMM	AMM
F(DC3_C1)	0x00000008	Daily closures (DC) for A- and/or Instantaneous power maximum demand (IPMD) for W- and/or Average daily power maximum demand (APMD) for W-	AMM	AMM
F(DC4_C1)	0x00000010	Daily closures (DC) for C+ and/or Instantaneous power maximum demand (IPMD) for C+	AMM	AMM
F(DC5_C1)	0x00000020	Daily closures (DC) for C- and/or Instantaneous power maximum demand (IPMD) for C-	AMM	AMM
F(DC6_C1)	0x00000040	Daily closures (DC) for L- and/or Instantaneous power maximum demand (IPMD) for L-	AMM	AMM
F(DC1_C2)	0x00000080	Daily Closures_1 of Contract_2(*)	AMM	AMM
F(DC2_C2)	0x00000100	Daily Closures_2 of Contract_2(*)	AMM	AMM
F(DC3_C2)	0x00000200	Daily Closures_3 of Contract_2(*)	AMM	AMM
F(DC4_C2)	0x00000400	Daily Closures_4 of Contract_2(*)	AMM	AMM
F(DC5_C2)	0x00000800	Daily Closures_5 of Contract_2(*)	AMM	AMM
F(DC6_C2)	0x00001000	Daily Closures_6 of Contract_2(*)	AMM	AMM

The field F(ACE)_STATUS_CODEx shall be updated during the ACE process with the following values:

F(ACE)_STATUS CODE1		
Value	**Meaning**	**Description**
0x00	Commissioned	When F(ACE) is set to 0 by LVC(*)
0x01	Replaced	When F(ACE) is set to 0 by AMM(*)
0x02	To Do LVC	When F(ACE) is set to 1 by LVC(*)
0x03	To Do AMM	When F(ACE) is set to 1 by AMM(*)

(*) Future Predisposition

F(ACE)_STATUS CODE2		
Value	**Meaning**	**Description**
0x00	...	Before any “TO CE” frame or meter commissioned
0x01	CE Not Reachable	CE never reachable during ACE
0x02	Cross-Talk	ACE completed without any phase matching
0x03	Diagnostic problem	CE NACK received during ACE (different from key error)
0x04	Key Error	ACE completed without any key matching

In case of a row is deleted for CE decommissioning activity, the F(ACE)_STATUS_CODEx shall be zeroed from concentrator. The fields shall be readable but not writable.

The whole list of codes will be updated during the development step.

In case of CE decommissioning (CE_ID in T_CE is deleted), concentrator shall clear the linked rows of:

- T_CE (Tab. 4): other fields different from CE_ID
- T_RPT (Tab. 20): Two paths set to -1 including the involved repeater
- T_KEY (Tab. 24)
- CEDATA (Tab. 41, 43)
- B(CE) (Tab. 11)
- B(CE_STAT) (Tab. 18, 19)
- T_CE_DWLD_C (Tab. 67)
- T_N2PLOAD_C (Tab. 68)

- All the tables referring the IHD and/or the RF communications shall be updated where needed

A similar table (same structure and meaning) must be arranged in case a different remote-controlled device is present (e.g. UT-AGQ).

5.4.2 *Two Way Authentication Table {T_KEY} - Tab. 24*

This table contains the authentication keys for CEs and ICs, as follow:

Tab. 24 Two way authentication Table (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x18000101	ID_CE	6	CE identification
0x18000102	KW_CE	32	CE authentication key (K1) used for write command authentication[16]
0x18000103	KR_CE	32	CE authentication key (K2) used for read command authentication[17]

Table is handled only with DLC_PROTOCOL=0x02 (M&M) with the following rules:

- DLC_PROTOCOL=0x00/0x01: the CD_KEY in T_CE is used for meter authentication, the keys used by the concentrator are 12 bytes long.
- DLC_PROTOCOL=0x02: the KW_CE and KR_CE are used for meter authentication, the keys used by the concentrator are 16 bytes long.

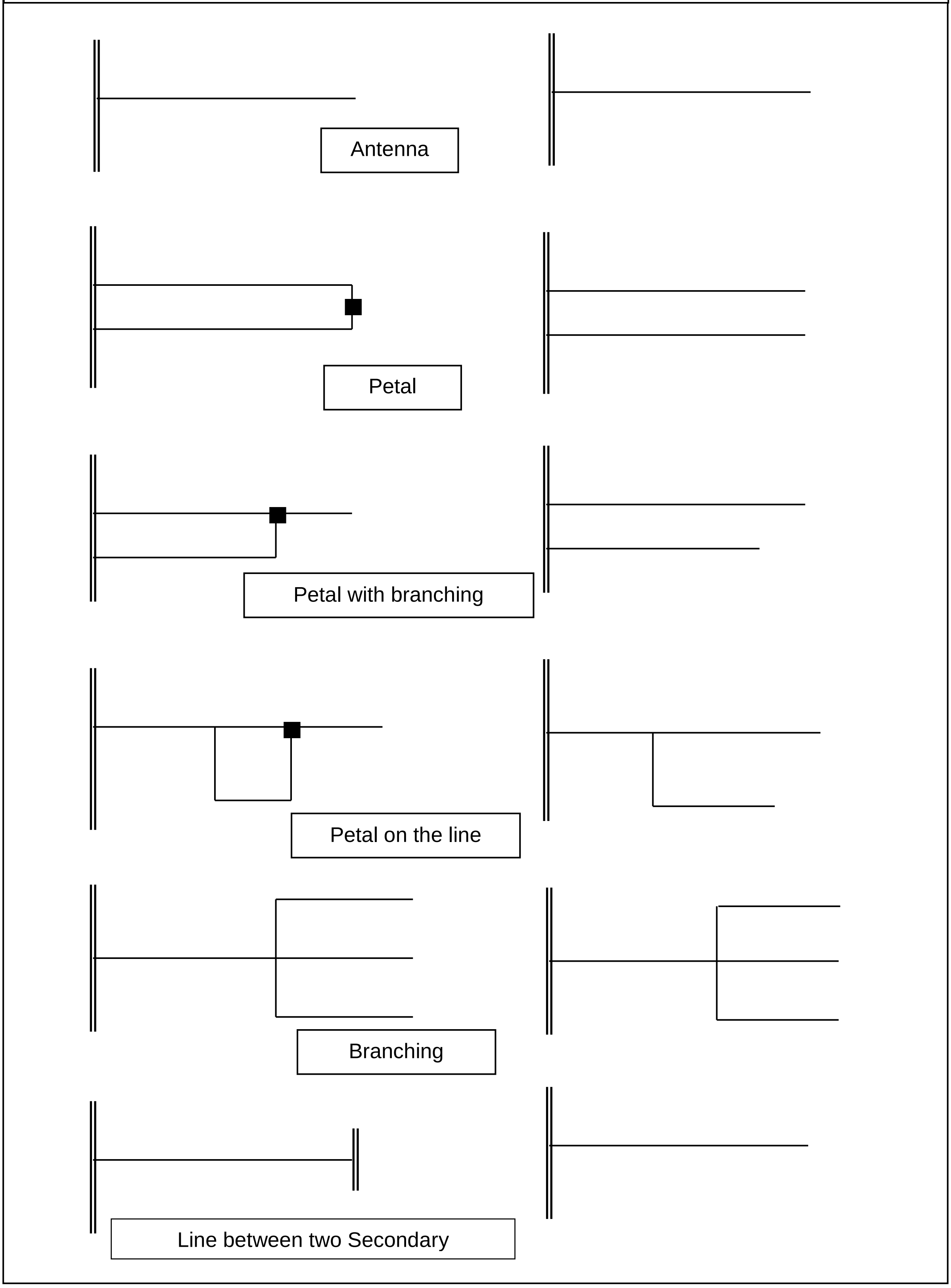
The topology configuration of the network departing from concentratorand the characteristics of the items that compose it has to be represented with the tables as described below:

[16] Field encrypted in the internal database

[17] Field encrypted in the internal database

- Section Tables
- Connection/Communication Tables.

Typologies of LVC subtended LV line and their representation



5.4.3 Lines Table {T_LIN} - Tab. 6

The line table must contain the information regarding the lines starting from an LV network bus-bar.

Each line must be coded progressively and it has to be indicated the section identifier or the progressive by which the LV network is connected to the bus-bar.

<table>
<tr><th colspan="5">Tab. 6 - Lines Table (up to 24 rows)</th></tr>
<tr><th>Field ID</th><th colspan="2">Field Name</th><th>Size</th><th>Meaning</th></tr>
<tr><td>0x06000101</td><td colspan="2">LINE</td><td>1</td><td>Number of the line (LV network). Range 1-24. The coding of the lines is conventional, it has to have a value in the concentrator data base and must to be automatically associated from the concentrator configuration program.</td></tr>
<tr><td rowspan="2">0x06000102</td><td colspan="2">PROGRESSIVE</td><td>1</td><td>Section identifier, if the line is connected to the LV bus bar with a section. Range 1 – 255.</td></tr>
<tr><td colspan="2">NODE</td><td>1</td><td>Electrical interconnection Node identifier, if the line is connected to the LV bus bar with an electrical branch. Range 1024 – 2048.</td></tr>
<tr><td>0x06000103</td><td colspan="2">EVENTS_EN</td><td>1</td><td>Flag to enable events generation. If this flag is set = 1, then for that line are enabled KO events. When the bit 14 in T_TLC spont is set and a state variation of the line occurs, a spontaneous message has to be sent to AMM.</td></tr>
<tr><td rowspan="3">0x06000104</td><td rowspan="3">CONN-C (LKO)</td><td>R</td><td>1</td><td rowspan="3">It means that on the line of communication of the CE a CO NN-C has been requested.</td></tr>
<tr><td>S</td><td>1</td></tr>
<tr><td>T</td><td>1</td></tr>
<tr><td rowspan="3">0x06000105</td><td rowspan="3">CONN-R(LKO)</td><td>R</td><td>1</td><td rowspan="3">It means that on the line of communication of the CE a CONN-R has been requested.</td></tr>
<tr><td>S</td><td>1</td></tr>
<tr><td>T</td><td>1</td></tr>
<tr><td>0x06000106</td><td colspan="2">CONN-R_FIRST_ONLY</td><td>1</td><td>When true, this field indicates that CONN-R is to only test the first section of a line of communication of the CE, when false is to test the first and the last section line detected of the line of communication of the CE</td></tr>
</table>

N.B. "lm" = line marked

The table has to be stored in the no-volatile memory of concentrator.

5.4.4 Section Tables {T_SEZ} - Tab. 7

The Section table must contain the information set-up by HHU/AMM and relevant to the LV network sections.

Tab. 7 - Sections Table (Up to 255 rows)

Field ID	Field Name		Size	Meaning
0x07000101	LINE		1	Progressive of the line Range 1 ÷ 24
0x07000102	SEC		1	Progressive of the section Range 1 ÷ 255
0x07000103	F(INTR)		1	Flag of section testability: It shows if it is possible to communicate with the section
0x07000104	F(INIB)	R	1	Flag of repetition inhibition (per line detected); If it is set the section cannot be used as repeater
		S	1	
		T	1	
0x07000105	F(INTD)		1	Flag that shows if the section is directly testable (without repeaters)
0x07000106	IRIPE	R	1	Address of the eventual repeater section-line of communication (section/phase) imposed by the BACK-OFFICE [it has to be defined for each line of communication R(3), S(7), T(11)]. 0=No repeater section-line of communication, otherwise range 1 ÷ 255; if this field is not specified in the section table, then the concentrator is to set the IRIPEs in the section buffer as they are determined. Thus, after a power cycle, the IRIPE values that were learned must be-relearned because the section buffer is volatile.
		S	1	
		T	1	
0x07000107	EVENTS_EN		1	This field does not control whether spontaneous calls are made for events but rather whether events are generated at all. If this flag is set = 1, then for that section are enabled KO events. When the bit 13 in T_TLC spont is set and a state variation of the line occurs, a spontaneous message has to be sent to AMM.

The table has to be stored in the not volatile memory of concentrator.

5.4.5 Connection Table {T_COL} - Tab. 8

The connection table T_COL contains the connections among lines and sections or between sections and lines

Tab. 8 - Connection Table (up to 512 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x08000101	BUSBAR/SEC/NODE	2	Identification of the first (second) connection vertex • LV bus bar Value = 65535 • Section Range 1-255 • Node Range 1024-2048
0x08000102	BUSBAR/SEC/NODE	2	Identification of the first (second) connection vertex • LV bus bar Value = 65535 • Section Range 1-255 Node Range 1024-2048
0x08000103	STATE	1	State of connection between the two elements; • 0x00 = Closed • 0x01 = Open • 0xFF = Virtual connection

The default operation is that the concentrator will build the repeater tables automatically and assume that the physical topology of the power line network is unknown.

The table has to be stored in the not volatile memory of concentrator.

5.4.6 Repeat Table {T_RPT} - Tab. 20, 120, 121

The concentrator software handles three formats of T_RPT in relation to the DLC_PROTOCOL value:

- DLC_PROTOCOL=0x00: table 20 and 120 are handled
- DLC_PROTOCOL=0x01: table 20 and 120 are handled
- DLC_PROTOCOL=0x02: table 121 is handled

The Repeat table #20 must contain the information set-up by HHU/AMM and relevant to the LV network sections. This table indicates how to reach each node on the network from the concentrator.

It is structured as follow:

Tab. 20 - Repeat Table (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x14000101	CE_ID	6	Unique node ID identifier of the node
0x14000102	LOCK	1	0x01 means path locked by AMM
0x14000103	PATH_ID	1	Specifying whether we are currently using the master path or vice-master (alternate) path. 1 means use vice-master path. The repeater table has two repeater address lists that it calls the master path and vice-master (alternate) path. Thus, the repeater table defines for each target a master and vice-master repeater "path". Within each path is a list of nodes to use as repeaters. Flag is automatically set/unset by the concentrator in relation to the last Path, Master or Vice-Master, that has allowed to reach the meter.
0x14000104	MASTER_PATH	22	Repeater path as follows: 7 * 16 bits repeat table indices, one per repeater, followed by 8 bits predisposition designations one per hop. A repeat table index of zero terminates the path. A repeat table index of –1 means the path is undefined.
0x14000105	VICE-MASTER_PATH	22	Repeater path as follows: 7 * 16 bits repeat table indices, one per repeater, followed by 8 bits predisposition designations one per hop. A repeat table index of zero terminates the path. A repeat table index of –1 means the path is undefined.

The Repeat table #120 must contain the information set-up by HHU/AMM and relevant to the LV network sections. This table indicates how to reach each node on the network from the concentrator.

It is structured as follow:

Tab. 120 - Repeat Table (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x78000101	CE_ID	6	Unique node ID identifier of the node
0x78000102	LOCK	1	0x01 means path locked by AMM

Tab. 120 - Repeat Table (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x78000103	PATH_ID	1	Specifying whether we are currently using the master path or vice-master (alternate) path. 1 means use vice-master path. The repeater table has two repeater address lists that it calls the master path and vice-master (alternate) path. Thus, the repeater table defines for each target a master and vice-master repeater “path”. Within each path is a list of nodes to use as repeaters. Flag is automatically set/unset by the concentrator in relation to the last Path, Master or Vice-Master, that has allowed to reach the meter.
0x78000104	MASTER_PATH	3	Repeater path as follows: • 2 bytes, primary repeater (CE number, 0 for direct, -1 for none) • 1 byte, predisposition designations one per hop
0x78000105	VICE-MASTER_PATH	3	Repeater path as follows: • 2 bytes, primary repeater (CE number, 0 for direct, -1 for none) • 1 byte, predisposition designations one per hop

These two tables mirror each other. So, the table 20 interface is preserved while achieving the goal of making the storage and communication more efficient (eventually, once all need for the table 20 format has been eliminated, table 20 could be deprecated).

The data must be stored internally only in table 120 format. Table 20 would not actually exist as a real table but would only exist as an interface for accessing the data in table 120 in the table 20 format. When reading from table 20, the response is built in a straightforward way using the contents of table 120. When writing to table 20, a subset of the information has to be written to table 120 (the repeater information is ignored as this is deduced from the other entries in table 120).

The repeat path of each CE is a series of CE indices. The repeat path is followed until 0 is reached or the end of the path is reached. So, if the first entry in the path is 0, than the CE is directly reachable.

The repeat table is mated tightly to the CE table. Thus, the indices in the repeat table refer to CE table row numbers. The CE ids in the repeat table must match those in the CE table, row by row. Therefore, if the AMM wishes to reorganize the CE table in a way that rows get changed around, then the repeat table must be changed in the same way. When CE Table entries are changed such that they don’t match up with repeat table entries, only the non-matching repeat table entries are cleared out.

The Repeat table #121 must contain the information set-up by HHU/AMM and relevant to the LV network sections. This table indicates how to reach each node on the network from the concentrator.

Tab. 121 – Repeat Table (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x790000101	ENABLE+PHASE (of the chain1)	1	Enable: 4 most significant bits, Phase: 4 less significant bits. The Enable=1 flag is the chain used to reaches the meter in the same row in T_CE. Only one row can have Enable=1. Other chains have Enable=0. The phase is an indication (without inversion information) of the phase of the first meter to send messages. If first meter is the target, the phase is the same of communication. If the target is reached by hops, the phase is the same to communicate with the first meter in the chain. It's related to the target meter present in row R_x in T_CE.
0x790000102	REPEATER 1 (of the chain 1)	6	ADCE (absolute address) of the first meter of the chain to communicate with the target. The phase in field 1 is related to this meter. "0x000000000000" this address is associate to the direct communication with the concentrator and the phase in field 1 is the communication phase of the meter.
0x790000103	REPEATER 2 (of the chain 1)	6	ADCE (absolute address) of the second meter of the chain to communicate with the target. If there is not a second repeater the ADCE is "0x000000000000". The same to have the stop in the following fields about repeaters.
0x790000104	REPEATER 3 (of the chain 1)	6	Same as above, it's for the third repeater.
0x790000105	REPEATER 4 (of the chain 1)	6	Same as above, it's for the fourth repeater.
0x790000106	REPEATER 5 (of the chain 1)	6	Same as above, it's for the fifth repeater.
0x790000107	REPEATER 6 (of the chain 1)	6	Same as above, it's for the sixth repeater.

0x790000108	REPEATER 7 (of the chain 1)	6	Same as above, it's for the seventh repeater.
0x790000109	ENABLE+PHASE (of the chain2)	1	Enable: 4 most significant bits, Phase: 4 less significant bits. As the field 0x01 specified above, but related for the chain 2 of the meter in the same row "R_x" present in T_CE.
0x79000010A	REPEATER 1 (of the chain 2)	6	ADCE (absolute address) of the first meter of the chain two. As field 0x02 specified above, but related for chain 2.
0x79000010B	REPEATER 2 (of the chain 2)	6	Second repeater for chain 2. As field 0x03, but for the chain number 2.
0x79000010C	REPEATER 3 (of the chain 2)	6	Third repeater for chain 2. As field 0x04, but for the chain number 2.
0x79000010D	REPEATER 4 (of the chain 2)	6	fourth repeater for chain 2. As field 0x05, but for the chain number 2.
0x79000010E	REPEATER 5 (of the chain 2)	6	fifth repeater for chain 2. As field 0x06, but for the chain number 2.
0x79000010F	REPEATER 6 (of the chain 2)	6	sixth repeater for chain 2. As field 0x07, but for the chain number 2.
0x790000110	REPEATER 7 (of the chain 2)	6	seventh repeater for chain 2. As field 0x08, but for the chain number 2.
0x790000111	ENABLE+PHASE (of the chain3)	1	Enable: 4 most significant bits, Phase: 4 less significant bits. As the field 0x01 specified above, but related for the chain 3 for the meter in the same row "R_x" present in T_CE.

0x790000112	REPEATER 1 (of the chain 3)	6	ADCE (absolute address) of the first meter of the chain three. As field 0x02 specified above, but related for chain 3.
0x790000113	REPEATER 2 (of the chain 3)		Second repeater for chain 3. As field 0x03, but for the chain number 3.
0x790000114	REPEATER 3 (of the chain 3)	6	Third repeater for chain 3. As field 0x04, but for the chain number 3.
0x790000115	REPEATER 4 (of the chain 3)	6	Fourth repeater for chain 3. As field 0x05, but for the chain number 3.
0x790000116	REPEATER 5 (of the chain 3)	6	Fifth repeater for chain 3. As field 0x06, but for the chain number 3.
0x790000116	REPEATER 6 (of the chain 3)	6	Sixth repeater for chain 3. As field 0x07, but for the chain number 3.
0x790000117	REPEATER 7 (of the chain 3)	6	Seventh repeater for chain 3. As field 0x08, but for the chain number 3.

If one of the chains is not present, the value of ENABLE+PHASE is 0x00, all the ADCEs are equal to 0xFFFFFFFFFFFF.

If a chain has not all the seven repeaters filled, the remaining repeaters are equal to 0x000000000000.

The Enable=2, means the chain does not have communication with meter, at the first possibility of PCONNC, the meter will be discovered by PCONNC procedure.

The chains are filled following this behaviour:

1. 1° chain -> is the shortest chain to reach the meter;
2. 2° chain -> is the chain with most quality;
3. 3° chain -> is the chain more new then others. The last used during the PCONNC or RECOVERY to reach the meter target.

Every chain is built following the new table 152, filled the first time during RECOVERY procedure. When a meter is not reachable every chain has ENABLE=2. After the PCONNC run, if the meter is discovered again, the last chain is write in table 121. After the new discovered due to a PCONNC, the chain 1 and 2 will have ENABLE=0 and the third chain has ENABLE=1.

If the meter remains not discovered after a PCONNC, the ENABLE=2 for all the chains.

After a recovery if chains 1 and 2 change, they will be substituted with the two new found. The third chain is filled only at the first time during commissioning (if is possible to recreate this with table 152) and every time during PCONNC.

For further details, see NT0337 Recovery, Pconnc and Ace.

The tables have to be stored in the no-volatile memory of concentrator.

5.4.7 SMS Table {T_SMS} - Tab. 235

In order to allow concentrator to notify in “real time” the Back Office its power fail condition, occurred after a fault on the MV/LV network, the delivery of a SMS (Short Message Service) must be properly handled by the concentrator FW.

Keeping in mind the HW features of the concentrator, a dedicated structure in the concentrator’s DB, named as “T_SMS” (Short Message Service Table) must be supported in order to manage:

- The delivery of an “alarm” SMS, signalling the power fail condition in which concentrator has entered
- The delivery of a “recovery” SMS, signalling the recovery of normal working condition

For sake of clarity, the power fail condition has to be intended as occurring on all the three phases that supply concentrator; a fault on a single phase or on a couple of phases, for the scope of “T_SMS”, is not considered a power fail condition and do not imply alarm/recovery SMS delivery.

Both “alarm” and “recovery” SMS must be placed to the same phone numbers.

The SMS table is designed as follow:

Tab. 235 - SMS Table

Field ID	Field Name	Size	Meaning
0xEB000101	N1_T	22	Closed network first phone number for SMS msg; (alphanumeric, ASCII encoded with a null 0x00 byte terminator)
0xEB000102	N2_T	22	Closed network second phone number for SMS msg; (alphanumeric, ASCII encoded with a null 0x00 byte terminator)
0xEB000103	N3_T	22	Closed network third phone number for SMS msg; (alphanumeric, ASCII encoded with a null 0x00 byte terminator)
0xEB000104	ALARM_SMS_EN	1	“Alarm” SMS delivery enabled/disabled: • 0x01 = Enable • 0x00 = Disable (default 0x00)

Tab. 235 - SMS Table

Field ID	Field Name	Size	Meaning
0xEB000105	DELIVERY_ALARM_SMS	1	It defines the number of delivery that the concentrator has to do for “Nx_T” numbers (if able), in placing alarm SMS (default 3). The following rule is applied: • If only “N1_T” number is defined, then the deliveries will be done only on this number • If only “N1_T” and “N2_T” numbers are defined, then the LVM will try two times on the “N1_T” and one on “N2_T” • If all three “Nx_T” are defined, then concentrator will try one time for each “Nx_T”
0xEB000106	TIME_TO_DELIVER_ALARM_SMS	1	Space in time (seconds/10), between the power fail condition and the “alarm” SMS delivery (default 15)
0xEB000107	ALARM_SMS_HEADER	15	Fixed part that copies the “ID_SS” register (T_ATT). If the field is programmed as “empty” then concentrator must copy the value of “ID_SS” field of T_ATT and keep the alignment between the two fields. Otherwise, if ≠ “empty”, the value programmed by AMM will be sent as Alarm SMS Header (15 chars)
0xEB000108	ALARM_SMS_TXT	89	Variable part (89 chars) for text editing of the “alarm” SMS (default txt: Assenza tensione apparato e sbarra BT). See below
0xEB000109	RECOVERY_SMS_EN	1	“Recovery” SMS delivery enabled/disabled: • 0x01 = Enable • 0x00 = Disable (default 0x00)
0xEB00010A	DELIVERY_RECOVERY_SMS	1	It defines the number of delivery that the concentrator has to do for each “Nx_T” number, in placing “recovery” SMS (default 3). Same mechanism of “delivery alarm SMS
0xEB00010B	TIME_TO_DELIVER_RECOVERY_SMS	2	Space in time (seconds), between the recovery from power fail and the “recovery” SMS delivery (default 300s)
0xEB00010C	RECOVERY_SMS_HEADER	15	Fixed part that copies the “ID_SS” register (T_ATT). If the field is programmed as “empty” then concentrator must copy the value of “ID_SS” field of T_ATT and keep the alignment between the two fields. Otherwise, if ≠ “empty”, the value programmed by AMM will be sent as Alarm SMS Header (15 chars)

Tab. 235 - SMS Table			
Field ID	**Field Name**	**Size**	**Meaning**
0xEB00010D	RECOVERY_SMS_TXT	89	Variable part (89 chars) for text editing of the "Recovery" SMS (default txt: Ripristino tensione apparato e sbarra BT)

The message of "Alarm" SMS (116 chars) delivered from concentrator is composed by:

Alarm SMS:

SMS Header	DT event	SMS TXT

Where:

- **SMS Header**: "15 bytes" for the Alarm SMS Header programmed
- **DT Time**: "12 bytes" for "DateTime" (yy.mm.dd - hh:mm:ss) of the power fail event. concentrator must add in the SMS the date and time of the last power fail
- **SMS Text**: "89 bytes" for the Alarm SMS TXT programmed

The message of "Recovery" SMS (116 chars) delivered from concentrator is composed by:

Recovery SMS:

SMS Header	**DT event**	**SMS TXT**

Where:

- **SMS Header**: "15 bytes" for the Recovery SMS Header programmed
- **DT Time**: "12 bytes" for "DateTime" (yymmdd hhmmss) of the power on event. concentrator must add in the SMS the date and time of the last power on
- **SMS Text**: "89 bytes" for the Recovery SMS TXT programmed

The table has to be stored in the no-volatile memory of concentrator

5.4.8 Status Table {T_STATUS} - Tab. 254

The concentrator's diagnostic result has to be available in the status table. Here are the status table items IDs and the data structure:

Tab. 254 - Status Table

Field ID	Field Name	Size	Meaning
0xFE000101	DATE	4	Date
0xFE000102	TIME	3	Time
0xFE000103	DST	1	Daylight saving time
0xFE000104	STATE	3	Concentrator State Message
0xFE000105	OPTS	4	By this bit mask it's possible to enable/disable filtering of specific ID-LOG, see chapter below Default=0xFFFFFFFF
0xFE000106	ADLVC	6	Absolute address of concentrator
0xFE000107	MIP_VER	1	Version of Microprocessor
0xFE000108	LVC_VER	3	Main Application version (MBApp) composed by yy.xx.zz, where: • yy is the fixed part (“0A” for LVM and “07” for MSC) • xx is the minor sub-version • zz is the major version Example: • MSC → 07.0E.16 • LVM → 0A.0E.16
0xFE000109	HW_VER	2	HW version of concentrator
0xFE00010A	ROM_VER	2	Extension Board version (EBApp)

Tab. 254 - Status Table

Field ID	Field Name	Size	Meaning
0xFE00010B	PROC_STATE	1	Procedures State: • 0x00 = Start Activity • 0x01 = DWL EB in progress • 0x02 = Stop Activity State 0x01 means that concentrator is updating EBApp and no procedure can be run over PLC, the pending/new activities will be scheduled at the end of the downloading. That state 0x01 is automatically sets by the concentrator when EBApp download is ongoing and restored to 0x01 at procedure ending.
0xFE00010C	LAST_PROC	1	Current procedure running on PLC
0xFE00010D	LAST_CE	2	Last CE Index during a procedure running
0xFE00010E	MEM_REMAIN	4	Bytes of heap remaining
0xFE00010F	MEM_LARGE	4	Bytes in largest available
0xFE000110	MEM_CHCK	4	Memory heap check code actually the same as Microsoft memory heap check codes. Don't mess with these values since they are not used by the routines that create the result. These values are for decoding the result: MEMCHK_HEAPEMPTY (-1) MEMCHK_HEAPOK (-2) MEMCHK_HEAPBADBEGIN (-3) MEMCHK_HEAPBADNODE (-4) MEMCHK_HEAPEND (-5) MEMCHK_HEAPBADPTR (-6)
0xFE000111	IDENTIFIER	16	Identifier of concentrator (see ENEL DH 996K)
0xFE000112	HW_DIAG	2	HW Diagnostic code, translation of POST. See Power On Self-Test error chapter

Tab. 254 - Status Table

Field ID	Field Name	Size	Meaning
0xFE000113	SW_DIAG	2	SW Diagnostic code, serious error detected by app SWDIAG_NONE 0 SWDIAG_BOOT_LOOP 1 SWDIAG_GB_FILE_ERROR 2 SWDIAG_CERTIFICATE_ERROR 3 EB_DWL_ERROR 7
0xFE000114	LOG_THRESHOLD	1	LOG_THRESHOLD define a filter so that all the log event with same or minor LOG-LEVEL than the threshold will be enabled and all events with higher LOG-LEVEL should be disabled. See below Default=0x04
0xFE000115	Available	1	
0xFE000116	Available	1	
0xFE000117	Available	1	
0xFE000118	Available	1	
0xFE000119	Available	1	
0xFE00011A	CHAP_FAIL	2	Counter of the failed attempts occurred at concentrator CHAP session.
0xFE00011B	LAST_CHAP	7	Date and Time at which the last CHAP failure has occurred. These two columns (CHAP failure) default to an all zero value. They may not be reset. The CHAP failure counter wraps around after the full value reached. The concentrator has to count and log each CHAPFAIL due to a bad password from the AMM. It does not count failures detected by the AMM due to a bad password in the concentrator, or application-level authentication failures.

Tab. 254 - Status Table

Field ID	Field Name	Size	Meaning
0xFE00011C	ED_SPONT_BUFFER	4	Enable/disable the event generation of the corresponding event in the Trape.Resp buffer: • Bit_x = 0x00 → Event logged • Bit_x = 0x01 → Event not logged The ED_SPONT_BUFFER is mated tightly to the ”SPONT” field, see T_TLC for the bit mask list. The default value is 0x00000000.
0xFE00011D	V_SEED	16	Writable/not readable for FW check integrity

Tab. 254 - Status Table			
Field ID	**Field Name**	**Size**	**Meaning**
0xFE00011E	LOG_ENABLE	1	Flag indicating activation status of logging: • 0x00 = Logging is not active • 0x01 = The log is stored until at least one of the two conditions LOG_MIN_SPACE or LOG_MAX_SPACE is reached, after that the logging automatically disable itself. The logging functionality will be enabled until the free space of the ftp/pub/log directory is greater than LOG_MAX_SPACE – [1.5 MB]. Where 1.5 MB is a conservative memory corresponding to a medium-high “log.gz” file dimension. The logging shall be disabled if, after the moving of the compressed file to the “ftp/pub/log” directory, the “log” directory free space becomes lower than 1.5 MB. On the other hand, if total disk free memory becomes lower than LOG_MIN_SPACE, the logging shall be also disabled. When at least one of the above two conditions is true, the logging is stopped by setting the LOG_ENABLE to zero and zipping the current “temp” file. If the “log” directory becomes greater than LOG_MAX_SPACE due to the moving of a bigger compressed file, the logging shall be disabled with the same above rule. • 0x02 = The log is stored until at least one of the two conditions LOG_MIN_SPACE or LOG_MAX_SPACE is reached, after that the logging will erase the oldest historical log file without disable itself. When a compressed file has to be moved to the “ftp/pub/log” directory and it becomes greater than LOG_MAX_SPACE, the older historical files shall be deleted until the log directory dimension comes back lower than LOG_MAX_SPACE. With similar rule if the total disk free memory becomes lower than LOG_MIN_SPACE, the older historical files shall be deleted until the free disk memory comes back greater than LOG_MIN_SPACE. In case of there are not historical files, the “temp” file shall be compressed in order to free memory. If a different value is written, the command must be rejected and a GB_NACK(255) with error code 48 is returned. Default 0x00

Tab. 254 - Status Table			
Field ID	**Field Name**	**Size**	**Meaning**
0xFE00011F	LOG_DT	4	Last activation time stamp in POSIX notation of logging Default 0x00000000
0xFE000120	FSK_GAIN	1	Value of the PLC Tx gain for FSK modulation, by this field is possible to set the gain from 0 to 31 (default 0x17)
0xFE000121	PSK_GAIN	1	Value of the PLC Tx gain for PSK modulation, by this field is possible to set the gain from 0 to 31 (default 0x1D)
0xFE000122	ALARM_SMS	2	Counter of “Alarm” SMS
0xFE000123	RECOVERY_SMS	2	Counter of “Recovery” SMS
0xFE000124	DT_LAST_ALARM_SMS	4	Date and Time of last alarm SMS in POSIX notation
0xFE000125	DT_LAST_ RECOVERY _SMS	4	Date and time of last recovery SMS in POSIX notation
0xFE000126	PLC_SLAVE	1	Reserved for life test
0xFE000127	ED_SPONT_BUFFER_2	4	Extension of ED_SPONT_BUFFER field managed with the same rules. Default value is 0xFFFFFFFF.
0xFE000128	WAIT_TO_REBOOT	1	Time in hours to wait after the last 50000 open&close socket to reboot the system (MBApp, PPP connection and HW modem GPRS). WAIT_TO_REBOOT=0x00 means automatic reboot deactivated. Default WAIT_TO_REBOOT=0x48 (72 hours)
0xFE000129	LOG_MIN_SPACE	1	It defines the minimum disk free memory in MB to stop or erase the historical log file in relation to the LOG_ENABLE value. For further details, see LOG_ENABLE. If a value < 2 is written, the command must be rejected and a GB_NACK(255) with error code 48 is returned. Default 0x02

Tab. 254 - Status Table

Field ID	Field Name	Size	Meaning
0xFE00012A	LOG_TIMEOUT	2	It defines the duration in minutes of the logging activity starting from its enabling. When the timeout is spent, the concentrator has to zip immediately the current "temp" log file. If the LOG_TIMEOUT is set to zero the logging is never ending. After a power-off/on cycle, the timeout counter is reset. Default 0x78 (120 min)
0xFE00012B	LOG_MAX_SPACE	1	It defines the maximum space in MB of the ftp/pub/log directory in which the logging can store the compressed file. For further details, see LOG_ENABLE. If the field is set to zero, all the free disk can be used to save the compressed file keeping just the LOG_MIN_SPACE as threshold. Default 0x00
0xFE00012C	LAST_PROC	1	Current procedure running on RF
0xFE00012D	LAST_CE	2	Last CE Index during a procedure running on RF
0xFE00012E	RF_VER	2	RF module software version
0xFE00012F	RTE_VER	4	RTE module software version (only LVM concentrator)
0xFE000130	FS_VER	3	File system version (only LVM concentrator)
0xFE000131	TIMEZONE	128	TIMEZONE to indicate the clock shift in respect to the UTC reference (only LVM concentrator). Default TIMEZONE= 0x4575726F70652F526F6D6500..00 (Europe/Rome)
0xFE000132	WAIT_TO_RESET	1	Time in hours to wait after the last 50000 open&close socket to reset the 3G/GPRS modem connected to the concentrator (the reset shall be HW). WAIT_TO_RESET=0x00 means automatic reset deactivated. Default WAIT_TO_RESET=0x18 (24 hours)
0xFE000133	FS_GG	3	GreenGrass File system version (only LVM concentrator)
0xFE000134	FS_LVS	3	LVS File system version (only LVM concentrator)
0xFE000135	RF_HW	1	RF module hardware version

Tab. 254 - Status Table			
Field ID	**Field Name**	**Size**	**Meaning**
0xFE000136	M&M_GAIN	1	Value of the PLC Tx gain for BPSK modulation, by this field is possible to set the gain from 0 to 31 (default 0x1A, TDB)
0xFE000137	FS_CUSTOMER	3	File system version for customer (only LVM concentrator)

5.4.8.1 Logging information structure

Every logging activity is performer through a record that is written in a file or sent through the logging socket 50002.

Each record structure is as follows:

LEN	TIME-STAMP	ID-LOG	LOG-LEVEL	STRING-LOG	CHECKSUM

Where:

- LEN (2 bytes): is the log message LEN (including headers and CHECKSUM);
- TIME-STAMP (5 bytes): is the instant when the trace is taken, the format is first 4 bytes are time/date in Posix format, last byte is a number in the range of 0-100 which is expressed in 10ms time slots (1/100 s).
- ID-LOG (1 byte): is the log type identifier field (see table below)
- LOG-LEVEL (1 byte): this field identify the depth of log type:
  - 0 = ERROR: All critical conditions that are required to appear on any log
  - 1 = WARNING: All conditions that are not critical but still need to appear in any log activity
  - 2 = INFO: This log level is the standard log level for any information that is normal to appear into the logs.
  - 3 = DEBUG: This is auxiliary information to be used for debugging and testing activity.
  - 4 = DUMP: This is detailed information only to trace internal activity into the code (such as parameters conversions, messages preprocessing …)

- STRING-LOG (variable size): is the logged information in binary format; every logged information should strip clear KEY information whatever log is used. In order to achieve this all-eventual key Exchange should be filled in with 0xFFs (used as place holder instead of the key). All logged information with IDs: 0x09, 0x0A, 0x0B, 0x0C, 0x0D, 0x10, should be logged in ASCII format since they are essentially comments.

- CHECKSUM (1 byte): is used to protect information starting by the first byte after LEN and ending to the last byte before CHECKSUM itself (checksum should be calculated as sum byte per byte without carry).

ID-LOG	Meaning	Filter Event Bit
0x01	Message from HHU (From HHU)	0
0x02	Message to HHU (To HHU)	1
0x03	Message from DLC (From CE)	2
0x04	Message to DLC (To CE)	3
0x05	Message from da SOCKET 50000 (From AMM)	4
0x06	Message to SOCKET 50000 (To AMM)	5
0x07	Message from da SOCKET 50001 (From SPONT)	6
0x08	Message to SOCKET 50001 (To SPONT)	7
0x09	Procedure booking (Book Procedure)	8
0x0A	Procedure Starting (Begin Procedure)	9
0x0B	Procedure End (End Procedure)	10
0x0C	Message from MODEM	11
0x0D	Message to MODEM	12
0x10	Generic comment	15
0x15	Internal message from EB (From Xboard)	20
0x16	Internal message to EB (To Xboard)	21

ID 0x10 is collecting all the comments that are not related to with all the other IDs such as tracing information of PPP, auxiliary comment messages, comments on used steps, open/close socket messages, parameters used for transaction processing...

5.4.8.2 "In Line" Tracing

In order to execute tracing activities while directly connected to the concentrator is necessary to provide an interface which allow to directly capture logging information in real time: for this reason the concentrator has to provide an IP socket (50002) in order to allow the remote connection: the TCP connection to this socket allows an external device to receive the log messages in the same format as the one detailed. The "In line" tracing is always available when the log is enabled, in case mutual applicative authentication is active into the concentrator the 50002 socket will be treated as socket 50001: it will not be possible to open the socket unless the applicative authentication has succeeded.

In any case, the socket 50002 is a “receive only” socket and no request can be transmitted over this socket to the concentrator.

There is no relation between “In line” and “Off line” tracing: this two methods are completely independent. No log filtering is possible over 50002 socket: eventually this filtering activity is left to the log client.

5.4.8.3 “Off line” Tracing

In order to perform “off line” analysis the concentrator must also log all relevant information to log files; the log file is structured as a stream of records in the same format above detailed.

There are two types of log file: current (or “temp”) log file and historical log files.

The current log file is only writable by the application and read only for other system tasks (the application should guarantee the proper contention management in case an external tasks read the file content while application is dumping the file; there are several conditions which cause the log file closing and storing to historical log file:

- The log file reaches the size of 5 MB;
- Six hours are spent after the current log file has been created;
- The concentrator power off and then on;
- The [LOG_TIMEOUT] is spent;
- The log is disabled.

In the previous conditions the log file is closed, compressed and stored in the ftp/pub/log directory with the following naming:

“log_xxxxxxxx.log.gz”

Where xxxxxxxx is an incremental number not including time stamp.

Time stamp shall not be used since at boot the application starts logging before synchronizing the SW RTC to EB HW RTC.

The current log file must not be accessible through the ftp while historical log files will obviously available to the standard anonymous user or in case of applicative authentication to the authenticated user. The logging activities over log files are completely independent by the state of socket 50002.

5.4.8.4 Log event filter

Since log files size could rapidly fill up the FLASH of the concentrator, it’s necessary to introduce a filtering feature on the log records stored into log files. This filtering should not be applied to “In line” logging.

- Type filtering: based on the ID it should be possible to enable/disable filtering of specific ID-LOG. In order to achieve this it must be used the parameter [OPTS]. Each bit of [OPTS] word is used to enable the specific correspondent ID-LOG

- Priority filtering: a field [LOG_THRESHOLD] has to be defined so that all the log event with same or minor LOG-LEVEL then the threshold will be enabled and all events with higher LOG-LEVEL should be disabled. This filter will only apply to log ID 0x10. Other logs will never be filtered by LOG-LEVEL.

Just as an example if [LOG_THRESHOLD] is set to zero, the log will report only logs marked with ERROR LOG-LEVEL.

As a general role for LOG_LEVEL assignment, all ID_LOG category which don't have any level (such as for example ID_LOG 0x01) should be used at category "INFO" since they can be disable through the type filtering mode and enabled independently by LOG_THRESHOLD.

The table has to be stored in the no-volatile memory of concentrator.

5.5 DESCRIPTION OF GENERAL PARAMETERS

5.5.1 Line Buffer {B(ST_LIN)} - Tab. 12

Tab. 12 - LINE BUFFER (Up to 24 rows)

Field ID	Field Name		Size	Meaning
0x0C000101	LINE		1	Line identifier
0x0C000102	F(LKO)	R	1	Line status (for each line of communication). When all F(LKO) registers are set, a condition of line opened is probably occurred. Every changes in line status must be notified to the Back Office by means of spontaneous call back (if enabled).
		S	1	
		T	1	

5.5.2 Section Buffer {B(ST_SEZ)} - Tab. 10

The data of this Buffer have to be computed dynamically on the basis of configuration information and processing performed by concentrator.

Tab. 10 - SECTION BUFFER (Up to 255 rows)

Field ID	Field Name		Size	Meaning
0x0A000101	SEZ		1	Section address. Range 1 ÷ 255
0x0A000102	F(RGCS)	R	1	Reachability (1=Reachable) of the section interrogating the CE Master. It has to be repeated for the three lines of communication 3 (R), 7 (S), 11 (T)
		S	1	
		T	1	
0x0A000103	F(RGVC)	R	1	Reachability (1=Reachable) of the section interrogating the CE Vice Master. The information has to be repeated for the three lines of communication 3, 7, 11
		S	1	
		T	1	
0x0A000104	INRG	R	1	Reachability index (updated every communication session) that has to refer to the messages OK or KO; INRG(i+1) =(INRG(i) * 99 + measurement)/100. Where measurement is either 100 or 0 depending upon whether the current message was successful or not. It is any time we communicate with the master/vice master. The concentrator has to use floating point math and store a float result and round up/down internally and produce an integer result externally. In this case, then the percentage will move down much faster than it moves up. This is only true above 50%. Below 50% the opposite is true. For example, if INRG is 98, it will take 50 successes for it to reach 99 and a single failure to reach 97. If INRG is 2, it will take 50 failures to reach 1 and a single success to reach 3. Also, each reachability index is initialised to 100 on power up and after commissioning (acquisition of CE)
		S	1	
		T	1	
0x0A000105	IRIPE	R	1	Address of the eventual repeater section-line of communication found out by concentrator. 0=No repeater section, otherwise range 1 ÷ 255. The concentrator must try to find out the repeater section-line of communication if the AMM has not “imposed” (see the note at IRIPE field in T_SEZ). The IRIPE field in the section buffer will be set based on the path required to reach the section master. For example, assume two sections, 1 and 2 in the same line. Assume the master of section 2/line 3 is directly reachable. Assume the vice master of that same section-line is reachable only by using section 1 as a repeater. In this case, the IRIPE field in the section buffer for this section-line will be set to 0
		S	1	
		T	1	

Tab. 10 - SECTION BUFFER (Up to 255 rows)				
Field ID	**Field Name**		**Size**	**Meaning**
0x0A000106	ONSI_SEZ	R	1	At least one of CE of the SEC/LINE without time reference
		S	1	
		T	1	
0x0A000107	F(ST_SEZ)		1	This flag must indicate the section state. It must have value: 1 if the section is directly reachable or through repetition, 0 if the section is not reachable. Each flag changing has to be notified to the AMM with a single alarm (section not reachable/reachable) or summarised (KO/OK alarm line)

During the "check" phase of CONN-C procedure, if all the sections on the three lines detected belonging to a line are Not Reachable, the AMM has to be notified, if the function is enabled, the only summarised information "Line KO"[20] and not the Not Reachability of the single Section-Line of communication with the CE. Vice versa, starting from a scenario of "Line KO". If at least one section of the line is reachable, the concentrator puts the line state "OK line section", and all the sections are considered "Reachable", then start again the check procedure of CONN-C connection and at the end the AMM is notified the state "Line OK" and of all the Not Reachable sections.

"Line KO" signalling, has to be transmitted to the AMM even after a CONN-R execution if the tested sections, prior the switch / disconnector in "OPEN" condition along the LV network, are not reachable.

The state variation has to be notified to the AMM through the GB_SPONT_LIN_KO (019.003) message or GB_READTAB_(LIN).RESP (007.006)message (spec. ENEL DH 971K) for "KO line " and "OK line" respectively.

5.5.3 CE Buffer {B(CE)} - Tab. 11

Buffer contains information about reachability of the meter

Tab. 11 - CE Buffer (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x0B000101	CE_ID	6	CE identification

[20] If the spontaneous are enabled to detect KO lines, they should also be enabled for the passage of the line to ok state

Tab. 11 - CE Buffer (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x0B000102	%RAG	1	Reachability indicator that has to refer to the messages OK or KO: %RAG(i+1) =(%RAG(i)*99+measurement)/100. Where measurement is either 100 or 0 depending upon whether the current message was successful or not. The concentrator has to use floating point math and store a float result and round up/down internally and produce an integer result externally. In this case, then the percentage will move down much faster than it moves up. (This is only true above 50%. Below 50% the opposite is true. For example, if INRG is 98, it will take 50 successes for it to reach 99 and a single failure to reach 97. If INRG is 2, it will take 50 failures to reach 1 and a single success to reach 3). Also, each reachability index is initialised to 100 on power up and after acquisition of CE
0x0B000103	ONSI	1	CE without time reference
0x0B000104	CE_STATE	1	The CE buffer CE state (bits 0,1 & 4-7) is initially set to the value from the CE table after a "start". After polling the CE, the CE state (bits 0,1 only) in the CE buffer and CE table are updated with the result of this poll
0x0B000105	F(RAG)	1	CE not reachable flag, see § 7.2
0x0B000106	...		Reserved
0x0B000107	NRN(t)	1	Number of no answers, in a row, of CE. See below
0x0B000108	E(g-gp)	4	Register of daily consumption (must be reset before the BE procedure)
0x0B000109	CE_NSW1	2	Normal Status Word 1 of CE
0x0B00010A	IC_ST	2	Status word of IC
0x0B00010B	CE_NACK	1	Once a NACK has been received during a background procedure from a CE, then the NACK will live forever in the CE buffer. The only way to confirm that it is no longer nacking, is to power cycle the concentrator
0x0B00010C	IC_NACK	1	Once a NACK has been received during a background procedure from an IC, then the NACK will live forever in the CE buffer. The only way to confirm that it is no longer nacking, is to power cycle the concentrator
0x0B00010D	NRN_L (t)(*)	1	Same rules of NRN(t) but liked only to the long message during N2PLOAD procedure

Tab. 11 - CE Buffer (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x0B00010E	NRN_POSIX(*)	4	Last time in Posix of the NRN(t)=NRN condition. When the PCONN-C starts the meter with last NRN activation shall be managed as first.
0x0B00010F	NRN_L_POSIX(*)	4	Last time in Posix of the NRN_L(t)=NRN_L condition. When the PCONN-C starts the meter with last NRN_L activation shall be managed as first

(*) Future predisposition

In relation to NRN(t), if this value overflows the NRN System parameter in the T_ATT, the concentrator must activate PCONN-C for the line of communication to which the CE belongs and send an alarm. [e.g. for known topology scenario, in case is requested to communicate with the CE master and it is not reachable, concentrator has to skip to the vice. Thus, will be increased the NRN(t) value for each time we try to communicate with the master (it is mandatory to try to connect master first and then after a negative result the vice). When the NRN(t) value will be coincident with the NRN value described on the T_ATT, the concentrator will send a spontaneous message GB (019.008) state=1 declaring the CE master not reachable/unavailable. It is possible to try to use the CE master until the F(INTR) of T_CE is managed. In this way it is possible to cut the communication toward the CE master and use only the CE vice. If spontaneous are enabled, the concentrator sends the “CE’s not reachability” status when NRN(t) = NRN and after the transmission of the spontaneous message, the concentrator has to execute, only in case the spontaneous are enabled the NRN(t) field reset. If spontaneous are not enabled, the CE not reachable event is buffered in the response buffer. For the condition above described, when a CE, first known to be not reachable, has then changed its state and it is newly reachable, the concentrator will generate the GB (019.008) spont event with state=0: CE OK. See description of GB (019.008) in Enel DH 971K 1st part.

Before SPONT_CE_KO delivering, PCONN-C has to be scheduled first (if enabled) in order to recover the communication of the CE for which NRN(t)=NRN. The list of meters to be managed shall be order taking into account the NRN_POSIX field. If even after this attempt the CE still results to be not reachable, then event of CE not reachability state will be generated and if Spont bit in T_TLC table is enabled, spontaneous call back will be placed by the concentrator to the AMM.

With similar rules the NRN_L(t) shall be incremented by 1 every time a long message fails during N2PLOAD procedure. When the NRN_L value reaches the NRN_L in T_ATT, the PCONN-C is scheduled to search a new path like for NRN(t). The SPONT_CE_KO is not generated in any case due to NRN_L.

In case of “Repeater Failure” the register NRN(t) shall be incremented both in Target and both in Repeater.

The buffers must match the tables, row for row with no holes, then this means the buffers must initially be filled in with default values. So if the AMM for example, writes a new row in the CE table. The concentrator will create a corresponding row in the CE buffer for this new CE. It must then provide a set of default values for the fields in the buffer. Since BUFCE is updated with the information incoming from T_CE, the “% RAG” and “CEState” fields will be filled in BUFCE; % RAG = 100, etc. In case of “Repeater” the register %RAG shall be incremented or decremented both in Target and both in Repeater.

The concentrator will create buffer rows that match the table rows when a "Start" is issued by the AMM. Thus, if the AMM were to do a "Stop", write a new CE row and then read the CE buffer, there would be no corresponding entry in the CE buffer for the new CE. This new CE buffer row will only appear once the AMM issues a "Start".

In case concentrator receives a NACK (DIGEST not correct) from the inquired CE, it has to re-run the digest generation or regeneration procedure to the CE and then retry the sending of the message to that CE, before delivering any spontaneous message of CE’s anomaly.

A similar table (same structure and meaning) must be arranged in case a different remote-controlled device is present (e.g. UT-AGQ).

5.5.4 Current and Previous CE Statistic Buffer {B(CE_STAT)} - Tab. 18, 19

Tab. 18 - Current Ce Statistic(t) (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x12000101	CE_ID(t)	6	CE identification
0x12000102	DIRECT(t)	1	OK messages in direct way (same path of associated CE)
0x12000103	RIP(t)	1	OK messages through repetition. Rip field only counts when retries were required and the transaction succeeded. Number of times the transaction succeeded by using a non-zero number of LV retries
0x12000104	CSEZ(t)	1	OK messages through CE Master Section or vice Master section (repeater)
0x12000105	NUM(t)	1	Total number of messages. (Number of transaction attempted). The maximum size of this field has to be 255. When this field reaches 255, it stops incrementing and all other counters or that CE also stop incrementing

Tab. 19 - Previous Ce Statistic(gp) (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x13000101	CE_ID(gp)	6	CE identification

Tab. 19 - Previous Ce Statistic(gp) (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x13000102	DIRECT(gp)	1	OK messages in direct way (same path of associated CE)
0x13000103	RIP(gp)	1	OK messages through repetition. Rip field only counts when retries were required and the transaction succeeded. Number of times the transaction succeeded by using a non-zero number of LV retries
0x13000104	CSEZ(gp)	1	OK messages through CE Master Section or vice Master section (repeater)
0x13000105	NUM(gp)	1	Total number of messages. (Number of transaction attempted). The maximum size of this field has to be 255. When this field reaches 255, it stops incrementing and all other counters or that CE also stop incrementing

Note: when the concentrator is broadcasting, statistics have not to be incremented at all.

For a more detailed description see at 7.1.2.3.

5.5.5 Not Reachable Sections (NR) Buffer for CONN-C/R {B(NNRG)} - Tab. 13

This buffer must contain the addresses of “Not Reachable” sections found out with the check mechanism of the whole connection (CONN-C and FATT).

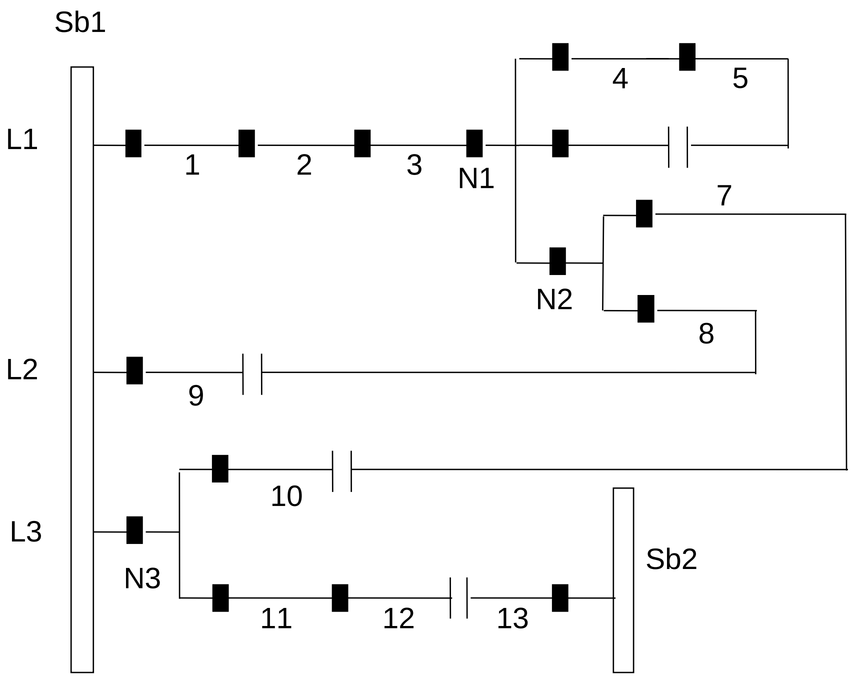
Tab. 13 - Buffer Not Reachable Sections (up to 765 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x0D000101	IND_SEC	1	Not Reachable section-line of communication address
0x0D000102	SEZ_RIPE	1	Repeating section address
0x0D000103	LINE_RIPE	1	Repeating section-line of communication

The line of communication of the Ind. Sec will be the same of LINE_RIPE.

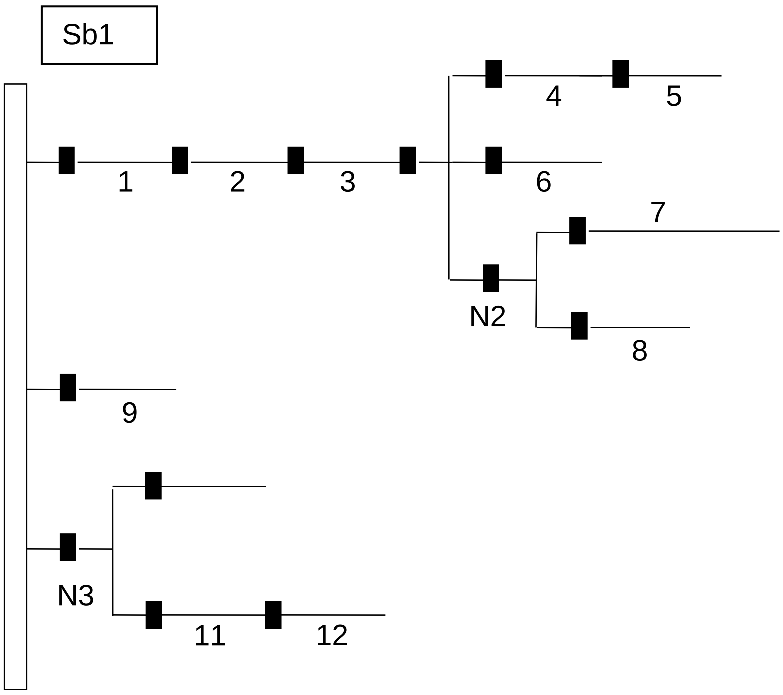
If a section recorded in B(NNRG) becomes OK, it has to be removed from B(NNRG).

<u>Example</u>:

The network configuration, after described, is represented with the tables below



The representation shown above is modified in the table shown below using the principal graphs



Ind BAR	inf_x
Sb1	

Bar Table

Line	Sec/Node	Inf_x
L1	1	
L2	9	
L3	N3	

Line Table

Connection		State
Sz/Sb/Nd 1	Sz/Sb/Nd 2	
Sb1	1	C
Sb1	9	C
Sb1	N3	C
1	2	C
2	3	C
3	N1	C
4	N1	C
4	5	C
6	N1	C
N1	N2	C
7	N2	C
8	N2	C
10	N3	C
11	N3	C
11	12	C

Connection Table

5.6 GENERAL DATA AT CONCENTRATOR LEVEL

The AMM, HHU and concentrator can all originate messages and thus should all have different ranges.

The numbers transaction ID range for byte 1-2 is:

AMM ⇒ LVC	0 ⇒ 2047	FOR GB MESSAGE
	2048 ⇒ 9999	FOR TB MESSAGE
HHU ⇒ LVC	10000 ⇒ 12047	FOR GB MESSAGE
	12048 ⇒ 19999	FOR TB MESSAGE
LVC ⇒ AMM/HHU	20000 ⇒ 22047	FOR GB MESSAGE
	22048 ⇒ 29999	FOR TB MESSAGE
AMM ⇒ LVC	30000 ⇒ 38195	FOR IC MESSAGE (TBD)
HHU ⇒ LVC	38196 ⇒ 46391	
LVC ⇒ AMM/HHU	46392 ⇒ 48439	

5.6.1 Open Transactions Buffer {B(TRAPE.REQ)} - Tab. 14

This buffer must be used to contain transaction requests that the AMM dispatches to concentrator for the activities to perform on the field. Each record of this buffer comes out from the explicit request that the AMM dispatches to concentrator. The AMM can require eliminating a specific transaction from the buffer through the message TB_ID_TRAS_RESET (032) or GB_RESET_ID (020).

The buffer must be able to contain at least 2048 transactions of TB type; the loading of the transaction in B(TRAPE.REQ) by the Centre, has to be done using suitable messages (see ENEL DH 971K). If there are the conditions, the concentrator must accept the request and record it in the buffer. While if the buffer maximum capacity is reached, at the relative transaction request, the concentrator must answer with the message TB-255 o GB-255 relative to error code: “B(TRAPE.REQ) full”.

Eventual transaction requests with an “Id_Transaction” already present in the buffer have to be refused with the diagnostic message TB-255 o GB-255 having the error code relevant to “Id_Transaction already in B(TRAPE.REQ).”

When a transaction is completed, the transaction end message has to be dispatched to the AMM.

Tab. 14 - Open transactions Buffer (up to 2048 rows)

Field ID	Field name	Size	Meaning
0x0E000101	DATE_TIME_RCV	6	The date and time the transaction was received from the AMM
0x0E000102	DATE_TIME_SENT	6	The date and time the transaction was initiated with the CE
0x0E000103	MSG_TYPE	1	FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See ENEL DH 971K II
	MSG_CODE	1	FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See ENEL DH 971K II
	MSG_LENGTH	2	FIELD Data Length of 2 bytes containing the Length in byte of the whole data FIELD (from xx to yyy). See ENEL DH 971K II
	ID_TRANS	2	Id of the transaction requested (single or multiple). This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.
	STEP	1	This is the step in the transaction. If any step fails, the entire transaction is considered to have failed and the transaction number and the failed step are reported to the AMM. No attempt is made by the concentrator to back out previous steps, the concentrator just scans ahead in the buffer to the next transaction number and begins a new transaction
0x0E000104	DATA	141	Data necessary for the completion of the transaction (variable in function of the transaction). This field has to be sized on the longest set of data necessary for a transaction (Data field length till up 71 bytes; see ENEL DH 971K). The “Data” field includes the following format: • 64 bytes for data • 1 byte for AUTP (authentication / priority) • 6 bytes for CEA or ICA (CE/IC address)

The following general ordering rules have to be as follow. These apply to messages being delivered from the TRAPE.REQ and LMESS_REQ (see 7.1.1.1) to the devices. They also apply to messages being delivered from the MESS_REC (see 7.1.2.1) and TRAPE.RESP (see 4.4.6.2) to the AMM.

a. All priority messages are delivered first, then all non-priority messages.
b. Within a priority level, messages are delivered based on the time of reception (REQ_TIME or DateTimeRCV).

If two messages have the same time stamp, then, if there is a transaction number, messages are delivered in increasing transaction order (e.g., 7000, 7001, 7002 or 9998, 9999, 2048). If there is no transaction number (i.e., MESS_REC), delivery order for identically time-stamped messages is arbitrary.

Note: applying the same rules to both the MESS structures (see 7.1.1.1/7.1.2.1) and the TRAPE structures it will be easier to eliminate any issues with "holes" in the TRAPE. The above behaviour will be equivalent to the existing TRAPE behaviour as long as the AMM and HHU deliver TB messages in increasing transaction number order.

When the AMM deletes a transaction, all the steps at and after the specified step are deleted. For example, if the TRAPE had entries 20000.1, 20000.2 and 20000.3, then a GB.020 for 20000.2 would delete 20000.2 and 20000.3. It has to be specified that the deletion process terminates when it can't find the next successive step.

For example, if a transaction were submitted with IDs 20000.1, 20000.2, 20000.3 and 20000.66, then a delete of 20000.2 would delete only 20000.2 through 20000.3 assuming that multiple step transactions are only submitted with successive steps (otherwise, it would be necessary to read till up 255, before terminating deletion process); proper GB and TB NACKs will be generated by the concentrator (see Enel DH 971K).

The buffer has to be stored in the no-volatile memory of concentrator. If the concentrator reboots after the execution of a certain number of transactions, it has to take a “snapshot” after every message and thus no TB messages are repeated.

5.6.2 End Transactions Buffer {B(TRAPE.RESP)} - Tab. 15

The buffer must be able to contain at least 4096 records (TB response and GB spontaneous). concentrator must collect data requested by open transactions and store the results in B(TRAPE.RESP) buffer, waiting to respond to the AMM for the completion of transactions.

Tab. 15 - End transactions Buffer (up to 4096 rows)

Field ID	Field name	Size	Meaning
0x0F000101	DATE_TIME_RCV	6	The date and time the response was received from the CE.
0x0F000102	DATE_TIME_SENT	6	The date and time the transaction was initially attempted to be sent to the AMM. This time is stamped at the beginning of the first transmission attempt.
0x0F000103	MSG_TYPE	1	FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See ENEL DH 971K I/II
	MSG_CODE	1	FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See ENEL DH 971K I/II
	MSG_LENGTH	2	FIELD Data Length of 2 bytes containing the Length in byte of the whole data FIELD (from xx to yyy). See ENEL DH 971K I/II
	ID_TRANS	2	Id of the transaction requested. This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.
	STEP	1	The step of the transaction that corresponds to the returned data.
0x0F000104	DATA	154	Data requested in the transaction. This field has to be sized on the longest set of data necessary for a transaction. In case of transaction failure the DATA field should contain the related NACK error (Data field length till up 71 byte; see ENEL DH 971K). The “Data” field includes the following format: • 64 bytes for data • 1 byte for AUTP (authentication / priority. It is not included as part of the TB response) • 6 bytes for CEA or ICA (CE/IC address)

When the response buffer fills up, all procedures will enter the "stopped" state. It is then up to the AMM to resume procedure processing via a "start procedures" request after retrieving the responses.

The buffer has to be stored in the no-volatile memory of concentrator.

When the port 50001 (event pipe) is opened, spontaneous related to ICs [GB…(021)-tbd-] have to be dispatched before each other message contained in the concentrator buffers (for a presumable market test, after that test it should be agreed another port - 50012- tbd).

In other words: the contents of the VTRAPE.RESP are delivered prior to the contents of the TRAPE.RESP.

So, the actual ordering is as follows:

1. VTRAPE.RESP events (021.xxx) in FIFO order;
2. VTRAPE.RESP IC-B responses in FIFO order;
3. TRAPE.RESP events (019.xxx) in FIFO order;
4. TRAPE.RESP FATT and BE messages, generic TB and ALCA responses in FIFO order.

When reading a VTRAPE.RESP or TRAPE.RESP via GB (100), the order will be the same as above. That is, all events in the table are returned first in FIFO order followed by all non-events in the table in FIFO order.

5.6.3 Buffer Messages for CE Display {B(MESS)} - Tab. 17

The buffer must be able to contain at least 120 records. The concentrator has to store, in each record of the buffer, the strings of a format to send to CE and/or IC after AMM request.

Tab. 17 - Buffer messages for CE display (up to 120 rows)

Field ID	Field name	Size	Meaning
0x11000101	DSP_SYM	2	A set of flags corresponding to each special symbol to be displayed.
0x11000102	DSP_CODING	2	The code number of the register to be displayed.
0x11000103	MSG_ID	1	The back office may assign a unique message identity to each message structure in the table. The concentrator can transmit very short messages when configuring the automatic display list or the push button display list.
0x11000104	DSP_TEXT	16	Contains the actual text to be displayed and is comprised of 16 ascii characters. A special character is used '}' to indicate where in the message the selected register is to be placed.

Tab. 17 - Buffer messages for CE display (up to 120 rows)			
Field ID	**Field name**	**Size**	**Meaning**
0x11000105	DSP_SM	1	If non-zero gives the number of a special hard coded message. An example message would be the time and date which can't easily be represented in a generic format.
0x11000106	DSP_DIVIDE	1	The absolute value held in the register is divided by 10 to the power held in this field.
0x11000107	DSP_SI	1	A set of flags indicating special instructions for the message. These may include instructions to display the specified register as text or maybe to display leading zeroes.

The AMM must dispatch the string through the message GB_WRITETAB_(MES).REQ (010.017). The storing of n string is determined by the id value, if the id position is already busy it is cancelled and overwritten by the new one. Then the AMM must ask to concentrator to send these strings to the single CE.

The loading of the messages in B(MESS) by the AMM must happen, as already mentioned, through the message GB…(010.017) containing the string to memorise. The cancellation of the string must happen by dispatching a new message with an empty string[21].

The buffer has to be stored in the no-volatile memory of concentrator.

[21] To verify after selection of protocol

5.7 RF TABLES

The following chapter describes the table to manage the meters via RF communication channel.

5.7.1 RF Parameters Table {T_RF_PAR} - Tab. 100

This table contains the RF communication parameters of the concentrator.

<table>
<tr><th colspan="5">Tab. 100 - RF Parameters Table</th></tr>
<tr><th>Field ID</th><th>Field Name</th><th>Size</th><th colspan="2">Meaning</th></tr>
<tr><td rowspan="2">0x64000101</td><td rowspan="2">RF_ADLVC</td><td rowspan="2">8</td><td>MANUFACTURER (EDI = 1489)</td><td>2 Bytes</td></tr>
<tr><td>ADLVC (LVC Id used also via PLC)</td><td>6 Bytes</td></tr>
<tr><td>0x64000102</td><td>CHANNEL</td><td>1</td><td colspan="2">RF communication channel
• 0x00 : 1a;
• 0x01 : 1b;
• 0x02 : 2a (default);
• 0x03 : 2b;
• 0x04 : 3a;
• 0x05 : 3b;
• 0x06 : 0.
For further information about physical link parameters refers to [23] Table 18.
Channel 2a is the default, it has following details:
• Centre frequency : 169.431250 [MHz];
• Channel spacing : 12.5 [kHz];
• Modulation : GMSK @ 2.4 [kbps].</td></tr>
<tr><td>0x64000103</td><td>POWER</td><td>1</td><td colspan="2">RF transmitting power
• 0x00: 27 [dBm] (Default);
• 0x01: 24 [dBm];
• 0x02: 20 [dBm].</td></tr>
</table>

0x64000104	RESPONSE DELAY (t_{RO})	1	The transmitter must start transmitting the preamble after last bit of received frame within the time delay determinate by this byte: • 0x00: slow mode • 0x01: fast mode For further information refers to [23] Table 19.
0x64000105	RF_SN	16	Serial Number of the connected Radio device. If no Radio is detected by the concentrator, the value recorded refers to the last device connected. When this value changes an event of GB (039.19) is recorded in RF_TRAPE.RESP. For further details refer to 20.7 [RF_Module].
0x64000106	LBT_ENABLE	1	To enable/disable the LBT: • 0x00 : LBT disabled • 0x01 : LBT enabled Default = 0x00
0x64000107	LBT_RSSI_TH	1	If the RSSI is above (stronger signal) than this threshold, the channel is considered occupied (-dBm) Range=0x32 - 0x64 (50 - 100) Default =0x63 (-99dBm)
0x64000108	LBT_MAX_ATT	1	Maximum number of attempts before giving up, o transmitting anyway (override) Range=0x03 - 0x08 Default = 0x05
0x64000109	LBT_BO_PERIOD	2	Time in millisecond used to calculate the back-off time Default = 0x0014 (20 ms)
0x6400010A	LBT_MAX_DELAY	2	The maximum delay in millisecond before giving up, or transmitting anyway (override) Range=0xFA - 0x3E8 (250 - 1000) Default=0x02EE (750ms)
0x6400010B	LBT_BO_FLAT	1	A parameter to limit the exponential increase of back-off time

			Range=1-8 Default = 0x03
0x6400010C	LBT_OVERRIDE_DIS	1	To disable the OVERRIDE • 0x00 : Override enabled • 0x01 : Override disabled
0x6400010D	NEIGH_SNIFFER	1	This field is used to enable/disable the neighbour sniffer file generation, for detail see also T_NEIGH: • 0x00 → Sniffer file generation is disabled; • 0x01 → Sniffer file generation is enabled with the manufacturer ID filter set in T_RF_WL. The file does not include the payload. • 0x02 → Sniffer file generation is enabled with the manufacturer ID filter set in T_RF_WL. The file includes the payload; • 0x03 → Sniffer file generation enabled without the manufacturer ID filter set in T_RF_WL. The file does not include the payload. 0x04 → Sniffer file generation enabled without the manufacturer ID filter set in T_RF_WL. The file includes the payload. Default=0x00.
0x6400010E	NEIGH_SNIFFER_LONG	1	Timing in day to keep the NEIGH sniffer file in order to free memory; for example with the default value only the last seven sniffer files are present. Default=0x07

(*) Future predisposition

5.7.2 RF White List Table {T_RF_WL} - Tab. 102

This table contains the identification code of all the manufacturer that shall be managed by the concentrator.

All messages transmitted by a device with a Manufacturer Id not included in this table shall be ignored and immediately discarded by concentrator.

Tab. 102 - RF White List Table (up to 100 rows)

Field ID	Field Name	Size	Meaning
0x66000101	MANUFACTURER ID1	2	Identification code of the 1st allowed meter manufacturer (Es: 18A9 – "Edi Manufacturer for ENEL CEs"
0x66000102	MANUFACTURER ID2	2	Identification code of the 2nd allowed meter manufacturer
...	...	...	...
0x66000164	MANUFACTURER ID100	2	Identification code of the 100th allowed meter manufacturer

For further information about the use of this table see also 20.2 [Rx_Msg_RF].

5.7.3 RF CE Table {T_RF_CE} - Tab. 103

This table contains the identification code of the meters in the subtended RF network managed by the current concentrator. The CE table configuration can be carried out by the AMM or by a portable terminal (HHU) connected to concentrator.

Each row refers to a CE, the CE_TABLE structure (not volatile, programmable memory) is as follows:

<table>
<tr><th colspan="5">Tab. 103 - RF CE Table (up to 2048 rows)</th></tr>
<tr><th>Field ID</th><th>Field Name</th><th>Size</th><th colspan="2">Meaning</th></tr>
<tr><td rowspan="2">0x67000101</td><td rowspan="2">RF_ADDRESS</td><td rowspan="2">8</td><td>MANUFACTURER (EDi = 18A9)</td><td>2 Bytes</td></tr>
<tr><td>ADCE (CE Id used also via PLC)</td><td>6 Bytes</td></tr>
<tr><td>0x67000102</td><td>CE_CHANNEL</td><td>1</td><td colspan="2">Communication channel for the current meter:
0x00 = Meter handled only via RF; value is set by concentrator if the ADDR is present only in T_RF_CE.
0x01 = Meter handled both via PLC and RF; value is set by concentrator if the same ADDR is present also in T_CE.</td></tr>
<tr><td>0x67000103</td><td>POWER RF COMMUNICATION</td><td>1</td><td colspan="2">$\overline{RSSI}$ Averaged on last 10 received messages.</td></tr>
<tr><td>0x67000104</td><td>LAST RF_MSG TIMESTAMP</td><td>6</td><td colspan="2">Time/Date (hh:mm:ss dd/mm/yy) of the last message received via RF from the current CE and used for the $\overline{RSSI}$</td></tr>
<tr><td>0x67000105</td><td>CE_TYPE_STATE</td><td>1</td><td colspan="2">For the meaning of this field refers below</td></tr>
<tr><td>0x67000106</td><td>REACTION GROUP</td><td>1</td><td colspan="2">Reaction Group of the CE, this value leads to the T_REACT_SPONT where is described the management of each spontaneous received from the CE via RF. Zero means no reaction group and all the RF CE spontaneous shall be handled in the same way following the setting of b[6] of ED_SPONT_BUFFER2 and SPONT2. On the other hand the value 1 means reaction group1, 2 reaction group2, etc,,

Default=0x00</td></tr>
<tr><td>0x67000107</td><td>LAST POWER RF COMMUNICATION</td><td>1</td><td colspan="2">$\overline{RSSI}$ of the last received message</td></tr>
</table>

Tab. 103 - RF CE Table (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x67000108	RF_F(ACE)	1	Bit mask for RF ACE procedure activation and result. See below for status code.
0x67000109	RF_F(ACE)_STATUS1	1	CE status1 during meter acquisition procedure RF_ACE. See below for status code.
0x6700010A	RF_F(ACE)_STATUS2	1	CE status2 during meter acquisition procedure RF_ACE. See below for status code.
0x6700010B	RF_F(DWL)	1	Bit mask for RF DWL_CE procedure activation and result. See the below for status code.

In relation to [CE_TYPE_STATE] the following values are used:

Bit 0	Bit 1	Meanings	Status
0	**0**	Not active and not programmed	Meter has not completed the production process. Calibration, programmable parameters and default values are not in a known state. The state remains until the production software indicates that all production tasks have been completed.
0	**1**	Not active and programmed	Meter operating outside of contract.
1	**0**	Active with reduced functionality	Meter operating with a tariff error, or any other useful error condition.
1	**1**	Active and programmed	Normal meter operation.

Bit 6	Bit 5	Bit 4	Meanings
0	0	0	Single phase smart meter
1	0	0	Poly phase smart meter
0	1	0	Available

1	1	0	Available
0	0	1	Available
1	0	1	Available
0	1	1	Available
1	1	1	Available

In relation to “**RF_F(ACE)**” field the following bit mask represents multiple procedure states:

Value	Purpose	Set by	Unset by
0x01	**CE to be acquired**: b[0] is set by: • LVC when a new RF_ADDR or RF_KEY is written by AMM; • LVC when b[7] is set from 1 to 0 by AMM • AMM when a RF_ACE is required. b[0] is unset by: • LVC when the meter is acquired with success during RF_ACE; • LVC when b[1] or b[2] are set during RF_ACE; • AMM to skip a meter in the RF_ACE procedure	LVC/AMM	LVC/AMM
0x02	**CE unreachable**; b[1] is set by concentrator if the meter is unreachable during the last RF_ACE procedure. In addition to b[1] also the b[7] is set by concentrator in order to disable the RF communication, b[0] is unset.	LVC	LVC
0x04	**CE key error**; b[2] is set by concentrator when at least one key doesn’t match after the last RF_ACE procedure. In addition to b[2] also the b[7] is set by concentrator in order to disable the RF communication, b[0] is unset.	LVC	LVC
0x08	…		
0x10	…		
0x20	…		
0x40	…		
0x80	**CE Disabled**; b[7] is used to enable/disable the RF communication: • 0 → communication enabled; • 1 → communication disabled. If AMM set b[7] to zero, concentrator shall set b[0]	LVC/AMM	AMM

When the b[0] is set (meter not commissioned) no procedure are available for that meter a part of the RF_ACE.

If a bit "set or clear by LVC" is written by AMM a GB_NACK(255) code TBD is generated.

The field F(ACE)_STATUS_CODEx shall be updated during the RF_ACE process with the following values:

RF_F(ACE)_STATUS CODE1		
Value	**Meaning**	**Description**
0x00	Commissioned	When b[0] of RF_F(ACE) is set to 0 by LVC
0x01	Replaced	When b[0] of RF_F(ACE) is set to 0 by AMM
0x02	To Do LVC	When b[0] of RF_F(ACE) is set to 1 by LVC
0x03	To Do AMM	When b[0] of RF_F(ACE)) is set to 1 by AMM

RF_F(ACE)_STATUS CODE2		
Value	**Meaning**	**Description**
0x00	...	...
0x01	In Progress	Before any "TO CE" frame to the involved CE
0x02	...	(Not used)
0x03	...	(Not used)
0x04	KW_Error	ACE completed without any write key matching
0x05	KR_Error	ACE completed without any read key matching
0x06	CE Not Reachable	CE never reachable during ACE
0x07	CE Reachable	CE reachable during ACE but not commissioned
0x08	Diagnostic problem	CE NACK received during ACE
0x09	···	(Not used)

In case of a row is deleted for CE decommissioning activity, the RF_F(ACE)_STATUS_CODEx shall be zeroed from concentrator. The fields shall be readable but not writable.

The whole list of codes will be updated during the development step.

In relation to [RF_F(DWLD)] field the following bit mask represents multiple procedure states:

Value	Purpose	Set by	Unset by
0x01	**CE TO BE DOWNLOADED:** b[0] is set by: • LVC when the field “DO_ALL” is set in T_RF_CE_DWL by AMM; • AMM when the RF_CE_DWL procedure is required, the other bit are reset by concentrator. b[0]=0 is unset by: • LVC when the meter is downloaded with success during the RF_CE_DWL; • LVC when b[1], b[2] or [b3], b[4], b[5], b[6] are set during RF_CE_DWL; • AMM to skip a meter in the RF_CE_DWL procedure, the other bit are reset by concentrator.	LVC/AMM	LVC/AMM
0x02	**CE UNREACHABLE:** b[1] is set by concentrator if the download fails due to a reachability issue; b[0] is unset.	LVC	LVC
0x04	**CE KEY ERROR:** b[2] is set by concentrator if the download fails due to a key error; b[0] is unset.	LVC	LVC
0x08	**CE NACK:** b[3] is set by concentrator if the download fails due to a CE Nack; b[0] is unset.	LVC	LVC
0x10	**SWITCH FAIL:** b[4] is set by concentrator if the download fails due to a Switch Fail; b[0] is unset.	LVC	LVC
0x20	**TYPE_ID**: b[5] is set by concentrator if the download fails due to a TYPE_ID mismatching; b[0] is unset.	LVC	LVC
0x40	**DIGEST ERROR:** b[6] is set by concentrator if the download fails due to a Digest Error; b[0] is unset.	LVC	LVC
0x80	…		

As general rule, AMM should add in T_RF_CE only meters already present in the T_RF_NEIGH.

In case of CE decommissioning (CE_ID in RF_T_CE deleted), concentrator shall clear the linked rows of:

- T_RF_CE (Tab. 103), other fields different from CE_ID
- T_RF_KEY (Tab. 104)
- RF_B(CE) (Tab. 111)
- T_RF_CE_DWL_C (Tab. 113)

For further information about the management of this table fields refers to 20.6 [Adding_CE_in_T_RF_CE] and 8.6 [RF_ACE].

5.7.4 RF Key Table {T_RF_KEY} - Tab. 104

For every CE, the concentrator shall store the following keys for encryption and authentication. Each row of this table is directly linked to the CE recorded in the same row of RF_CE Table.

The structure shall be the following:

Tab. 104 - RF KEY Table (up to 2048 rows)				
Field ID	**Field name**	**Size**	**Meaning**	
0x68000101	RF_ADDRESS	8	MANUFACTURER (EDi = 18A9)	2 Bytes
			ADCE (CE Id used also via PLC)	6 Bytes
0x68000102	KEYRF1	32	Operational key for encryption and authentication in writing operations[22]	
0x68000103	KEYRF2	32	Operational key for encryption and authentication in reading operations. This key is also used by the CE in encrypt spontaneous sent via RF[23]	

For further information about the management of this table fields refers to 8.6 [RF_ACE].

The table has to be stored in the no-volatile memory of concentrator.

[22] Field encrypted in the internal database

[23] Field encrypted in the internal database

5.7.5 RF CE Neighbours Table {T_RF_NEIGH} - Tab. 105

The information about a CE – not in the RF_CE Table – whose RF messages are received by the concentrator, will be recorded in this table.

A dedicated row is created for each new CE received by the concentrator both in protected and not protected way. The new row is added by filling the first blank one, being the table sorted keeping free-rows at the bottom of the table, there shall be no empty rows between those written. The same rule shall be applied in case of a row is deleted due to the RF_DEL_NEIGH limit is reached for a meter.

CE_NEIGHBOURS Table (not volatile, programmable memory) is sized at 4096 rows and has the following structure:

<table>
<tr><th colspan="5">Tab. 105 - RF CE Neighbours Table (up to 4096 rows)</th></tr>
<tr><th>Field ID</th><th>Field Name</th><th>Size</th><th colspan="2">Meaning</th></tr>
<tr><td rowspan="2">0x69000101</td><td rowspan="2">RF_CE_ADDR</td><td rowspan="2">8</td><td>MANUFACTURER (EDi = 18A9)</td><td>2 Bytes</td></tr>
<tr><td>ADCE (CE Id used also via PLC)</td><td>6 Bytes</td></tr>
<tr><td>0x69000102</td><td>FIRST RF_MSG TIMESTAMP</td><td>6</td><td colspan="2">Time/Date (hh:mm:ss dd/mm/yy) of the first message received from the current CE and used for the $\overline{RSSI}$</td></tr>
<tr><td>0x69000103</td><td>LAST RF_MSG TIMESTAMP</td><td>6</td><td colspan="2">Time/Date (hh:mm:ss dd/mm/yy) of the last message received from the current CE and used for the $\overline{RSSI}$</td></tr>
<tr><td>0x69000104</td><td>POWER RF COMMUNICATION</td><td>1</td><td colspan="2">$\overline{RSSI}$ Averaged on last 10 received messages.</td></tr>
<tr><td>0x69000105</td><td>F(EVENT)</td><td>1</td><td colspan="2">Enable/Disable the creation of an EVENT in RF_TRAPE.RESP for RF messages received from the current CE:
• 0x00 : Disabled
• 0x01 : Enabled
This only readable field is modified by concentrator in relation to the RF_PROTECTION setting in T_ATT.
• RF_PROTECTION=0x00 → F(EVENT)=0x01
• RF_PROTECTION=0x01 → F(EVENT)=0x00
Default=0x01</td></tr>
</table>

Tab. 105 - RF CE Neighbours Table (up to 4096 rows)

Field ID	Field Name	Size	Meaning
0x69000106	F(SPONT)	1	Enable/Disable the generation of a SPONTANUEOUS message to AMM for RF messages received from the current CE: • 0x00 : Disabled • 0x01 : Enabled This only readable field is modified by concentrator in relation to the RF_PROTECTION setting in T_ATT. • RF_PROTECTION=0x00 → F(SPONT)=0x01 • RF_PROTECTION=0x01 → F(SPONT)=0x00 Default=0x01
0x69000107	LAST POWER RF COMMUNICATION	1	$\overline{RSSI}$ of the last received message

For further information about the management of this table fields refers to 20.5 [Adding_CE_in_T_RF_CE] and 8.6 [RF_ACE].

The RSSI value is calculated by the following formula:

$$RSSI = - 130 + 2 \text{ x } [value]$$

concentrator shall also provide a daily .csv file with all the RF communications listened during the day, File has to be created in relation to the setting of the NEIGH_SNIFFER field in the T_RF_PAR and it shall include for each communication at least:

- RF_ADDRESS
- RSSI
- TIMESTAMP

<u>The file can include also the complete messages received by RF, including data field, in relation to the NEIGH_SNIFFER value set in T_RF_PAR.</u>

<u>Example</u>:

“**NEIGH_070010_5201276A.csv.gz**”

Where:

NEIGH is a standard prefix for neighbour table

070010 is the concentrator SW version

5201276A is the file Posix time creation

csv.gz is the standard suffix

At the end of the day the .csv file has to be zipped and made available in /disk/ftp/pub/neigh in the concentrator file system. There is one .zip file for every day; by the file analysis AMM can retrieve the real state of the RF communication in order to associate meter with concentrator. The whole content of the file is TBD

The C data structure for the CE_Neigh Table has to be done by manufactures in separate document: "Data structures of the GC messages" (see struct_GCCENeighTable).

5.7.6 RF CE Number Table {T_RF_CE_NUM} - Tab. 109

In order to know how many CE are in tables T_NEIGH and T_CE and simplify the reading of those tables, T_NEIGH is ordered without leaving empty row when a CE is moved to T_RF_CE, while it is not possible for tables T_CE and all the tables associated to it. In this case the following table as to be used to know which rows are empty or not.

The table has to be stored in the RAM memory.

Tab. 109 - RF CE Number Table

Field ID	Field Name	Size	Meaning
0x6D000101	Table ID(*)	1	If Table ID is 04 means T_ CE, 103 is T_RF_CE while 105 is T_RF_NEIGH Default=Row number
0x6D000102	Mask of bit(*)	512	If the bit is 0 means the row is empty (CE_ID) otherwise it is in use. Default=0x000
0x6D000103	Tot Number of CE(*)	2	Total number of CE in T_RF_NEIGH, T_RF_CE or T_CE Default=0x0000

Table	Row
T_RF_CE	0001
T_RF_NEIGH	0002
T_CE	0003

5.7.7 RF Reaction Group Spontaneous Table {T_RF_REACT_SPONT} - Tab. 110

In this table for each reaction group is described the set of action the concentrator has to carry out when it receives a Spontaneous via RF from a CE.

Every field of this table is 15 Bytes long. Each bit refers to an event type generated by the CE, the field is then readable in the following way:

Generic field 0x6E0001xx of T_RF_REACT_SPONT Table					
bit 120	bit 119	...	bit 3	bit 2	bit 1
Code event 0x78	Code event 0x77	...	Code event 0x03	Code event 0x02	Code event 0x01

For those fields with an even address (RG_y_Event_Rec) the meaning of value bit is:

- bit xx = 0 → No event shall be recorded in the RF.TRAPE.RESP when the linked Code Event is transmitted from a CE of the current Reaction Group (RGy) and it's received by the concentrator;
- bit xx = 1 → An event shall be recorded in the RF.TRAPE.RESP when the linked Code Event is transmitted from a CE of the current Reaction Group (RGy) and it's received by the concentrator.

For those fields with an odd address (RG_y_Spont_Gen) the meaning of value bit is:

- bit xx = 0 → No spontaneous shall be generated and transmitted to AMM when the linked Code Event is transmitted from a CE of the current Reaction Group (RGy) and it's received by the concentrator;

- bit xx = 1 → A spontaneous GB(039.034) shall be generated and transmitted to AMM when the linked Code Event is transmitted from a CE of the current Reaction Group (RGy) and it's received by the concentrator.
  In case the concentrator shuts down before generating the spontaneous, it will generate it as soon as possible after the reboot. Only for the spontaneous of CE Power OFF Start/End event, all the spontaneous not sent shall be ignored at the LVM restart (only the recorded event in RF_TRAPE.RESP will remain).

In the table for every Reaction Group is described how the concentrator has to act when a spontaneous is received coming from a CE belonging a specific group.

Tab. 110 - Reaction Group Spontaneous Table

Field ID	Field name	Size	Meaning
0x6E000101	RG1_Event_Rec(*)	15	Event record management for Reaction Group 1
0x6E000102	RG1_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 1
0x6E000103	RG2_Event_Rec(*)	15	Event record management for Reaction Group 2
0x6E000104	RG2_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 2
0x6E000105	RG3_Event_Rec(*)	15	Event record management for Reaction Group 3
0x6E000106	RG3_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 3
0x6E000107	RG4_Event_Rec(*)	15	Event record management for Reaction Group 4
0x6E000108	RG4_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 4
0x6E000109	RG5_Event_Rec(*)	15	Event record management for Reaction Group 5
0x6E00010A	RG5_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 5
0x6E00010B	RG6_Event_Rec(*)	15	Event record management for Reaction Group 6

Tab. 110 - Reaction Group Spontaneous Table			
Field ID	**Field name**	**Size**	**Meaning**
0x6E00010C	RG6_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 6
0x6E00010D	RG7_Event_Rec(*)	15	Event record management for Reaction Group 7
0x6E00010E	RG7_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 7
0x6E00010F	RG8_Event_Rec(*)	15	Event record management for Reaction Group 8
0x6E000110	RG8_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 8
0x6E000111	RG9_Event_Rec(*)	15	Event record management for Reaction Group 9
0x6E000112	RG9_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 9
0x6E000113	RG10_Event_Rec(*)	15	Event record management for Reaction Group 10
0x6E000114	RG10_Spont_Gen(*)	15	Spontaneous generation and transmission management for Reaction Group 10

For further information about the management of a CE spontaneous reception refers to 20.3 [Rx_Spont_CE_in_T_RF_Neigh] and 20.4 [Rx_Spont_CE_in_T_RF_CE].

5.7.8 RF CE Buffer {RF_B(CE)} - Tab. 111

Buffer contains information about reachability of the meter

Tab. 11 - CE Buffer (up to 2048 rows)				
Field ID	**Field Name**	**Size**	**Meaning**	
0x6F000101	RF_CE_ADDR(*)	8	MANUFACTURER (EDi = 18A9)	2 Bytes
			ADCE (CE Id used also via PLC)	6 Bytes

Tab. 11 - CE Buffer (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x6F 000102	RF_%RAG(*)	1	Reachability indicator that has to refer to the messages OK or KO: %RAG(i+1) =(%RAG(i)*99+measurement)/100. Where measurement is either 100 or 0 depending upon whether the current message was successful or not. The concentrator has to use floating point math and store a float result and round up/down internally and produce an integer result externally. In this case, then the percentage will move down much faster than it moves up. (This is only true above 50%. Below 50% the opposite is true. For example, if INRG is 98, it will take 50 successes for it to reach 99 and a single failure to reach 97. If INRG is 2, it will take 50 failures to reach 1 and a single success to reach 3). Also, each reachability index is initialised to 100 on power up and after acquisition of CE
0x6F000103	RF_ONSI(*)	1	CE without time reference
0x6F000104	RF_CE_STATE(*)	1	The CE buffer CE state (bits 0,1 & 4-7) is initially set to the value from the CE table after a "start". After polling the CE, the CE state (bits 0,1 only) in the CE buffer and CE table are updated with the result of this poll
0x6F000105	RF_F(RAG) (*)	1	CE not reachable flag
0x6F000106	...	1	Reserved
0x6F000107	RF_NRN(t) (*)	1	Number of no answers for a CE, see below.
0x6F000108	…	4	Reserved
0x6F000109	RF_CE_NSW1(*)	2	Normal Status Word 1 of CE
0x6F00010A	…	2	Reserved
0x6F00010B	RF_CE_NACK(*)	1	Once a NACK has been received during a background procedure from a CE, then the NACK will live forever in the CE buffer. The only way to confirm that it is no longer nacking, is to power cycle the concentrator
0x6F00010C	…	1	Reserved

In relation to RF_NRN(t), if this value overflows the RF_NRN parameter in the T_ATT, the concentrator will send a spontaneous message GB(039.008) state=1 declaring the CE not reachable/unavailable. If spontaneous are enabled, the concentrator sends the "CE's not reachability" status when NRN(t) = NRN and after the transmission of the spontaneous message, the concentrator has to execute, only in case the spontaneous are enabled the NRN(t) field reset. If spontaneous are not enabled, the CE not reachable event is buffered in the response buffer. For the condition above described, when a CE, first known to be not reachable, has then changed its state and it is newly reachable, the concentrator will generate the GB(039.008) spont event with state=0: CE OK.

The buffers must match the tables, row for row with no holes, then this means the buffers must initially be filled in with default values. So if the AMM for example, writes a new row in the T_CE, the concentrator will create a corresponding row in the CE buffer for this new CE. It must then provide a set of default values for the fields in the buffer. Since BUFCE is updated with the information incoming from T_CE, the "% RAG" and "CEState" fields will be filled in BUFCE; % RAG = 100, etc.

In case concentrator receives a NACK (DIGEST not correct) from the inquired CE, it has to re-run the digest generation or regeneration procedure to the CE and then retry the sending of the message to that CE, before delivering any spontaneous message of CE's anomaly.

A similar table (same structure and meaning) must be arranged in case a different remote-controlled device is present (e.g. UT-AGQ).

5.7.9 Priority Table {T_RF_PRI} - Tab. 112

It contains all the concentrator application procedures that can be run via RF channel with the relative priority and activation time.

Tab. 112 – RF Priority Table (up to 36 rows)

Field ID	Field Name	Size	Meaning
0x70000101	PROCEDURE	1	Coding of Procedure Default=Row number
0x70000102	MIN_ACT_INTERVAL	2	This number defines the minimum spacing in minutes between procedure invocations. This serves to limit the number of times a procedure can run. A value of zero means that no minimum spacing is imposed (the procedure may run as frequently as necessary). For example, if after a procedure completes it should not run for another hour regardless of what new stimulus occurs, then set this to 60. Default=0x0000

Tab. 112 – RF Priority Table (up to 36 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x70000103	MAX_ACT_INTERVAL	2	This number defines the maximum allowed spacing in minutes between procedure invocations. This serves to ensure a certain minimum procedure execution daily frequency. A value of zero means that the procedure need not run at all and will not be scheduled on an interval basis (except due to Activation Instance value). For example, if a procedure is to be run at least twice a day, set this to 720. MAX_ACT_INTERVAL shall be calculated starting from the ACT_INSTANT set from AMM. Default=0x0000
0x70000104	PRIORITY	1	Priority of the procedure range from 1 to 6: • 0x01 = High priority • 0x06 = Low priority Default=0x03
0x70000105	PROC_EN	1	Flag to enable a procedure: • 0x00 = Disabled • 0x01 = Enabled on RF. See flow chart in 20.9 [Tx_Msg_CE_RF] Default=0x00
0x70000106	ACT_INSTANT	3	This number defines a specific time of day at which a procedure is run. This value can be set independent the other intervals. If AMM wants to provide only an Activation Instant and no max or min interval, it can do by specifying some Activation Instant with max/min intervals of 0. Default=0x000000
0x70000107	TIMEOUT	2	A timeout in minutes that generates the stop of a procedures at a fixed time. Also, it has been foreseen the GB_SPONT_PROC_END (039.007) to detect if the procedure has been aborted or not. With Procedure Timeout = 0x00, the procedure is never ending. Default=0x0000
0x70000108	PROTECTION	1	Reserved Default=0x00

Tab. 112 – RF Priority Table (up to 36 rows)

Field ID	Field Name	Size	Meaning
0x70000109	START_DT-POSIX	4	Posix Time related to the last procedure activation. Default=0x00000000
0x7000010A	STATUS_DT-POSIX	4	Posix Time related to the PROC_STATUS updating. Default=0x00000000
0x7000010B	PROC_STATUS	1	Procedure status; it's updated during the procedure process, see below. Default=0x00
0x7000010C	LAST_PROC_TIMING(*)	3	Duration in seconds of the last procedure running. The msb b[23] shall be used to indicate the abort condition: • 0x00= Procedure completed without abort • 0x01= Procedure completed with abort Default=0x000000

(*) Future predisposition

In relation to PROC_STATUS field the followings codes are handled:

STATUS CODE			DT-POSIX_STATUS
Value	**Meaning**	**Description**	**Meaning**
0x00	Not Used	Default value	…
0x01	Running	Procedure starts	Procedure starting
0x02	Done	Procedure ends	Procedure ending
0x03	Stop Activity	Procedure is aborted/suspended due to a Stop Activity command	Stop Activity
0x04	Disk Full	Procedure ends but disk full condition happens	Procedure ending
0x05	EB Failure	Procedure ends but a failure on EB occurs	Procedure ending
0x06	Procedure Timeout	Procedure ends due to timeout	Procedure ending

STATUS CODE			DT-POSIX_STATUS
Value	**Meaning**	**Description**	**Meaning**
0x07	Priority	Procedure is suspended by another procedure with higher priority	Procedure suspension
0x08	LV-Net	Communication disabled on LV network	Procedure ending
0x09	Priority_To_Stop_Activity	Procedure stopped by priority and then by stop activity	Stop Activity
0x0A	Priority_To_LV-Net	Procedure stopped by priority and then by LV_NET disable	Procedure ending
0x0B	Power_Up	Procedure Aborted due to power off and up, set only during power up	Procedure ending
0x0C	Abort	Procedure Aborted due to disable or DWL CE changed image	Procedure ending

Acronyms	Proc	Minimum activation interval	Maximum activation interval	Priority	Proc_en	Activation Instant	Timeout	…
RF_SINC-T	01	Not used	Not used	4	1	Not used	Not used	…
…	…	…	…	…	…	…	…	…
TRF	06	0	0	1	1	--:--:--	0	…
…	…	…	…	…	…	…	…	…
RF_ACE	09	0	0	2	0	--:--:--	0	…
…	…	…	…	…	…	…	…	…
RF_CE_DWL	18	Not used	Not used	3	0	--:--:--	0	…

Note: the values showed in the table have to be understood as examples.

The table has to be stored in the no-volatile memory of concentrator.

5.7.10 RF CE Download Control Table {T_RF_CE_DWL_C} - Tab. 113

By this table AMM can acquired additional info about CE Download process via RF, it contains:

Tab. 113 – RF CE DWLD CONTROL Table (up to 2048 rows**)**

Field ID	Field Name	Size	Meaning
0x71000101	F(DWC)	1	Control mask of the download, see below for further details.
0x71000102	DT_POSIX	4	Timestamp in hex of the last update of the line.
0x71000103	APP1_DWL	2	App1 version read from binary file header.
0x71000104	APP2_DWL	2	App2 version read from binary file header.
0x71000105	PLC_DWL	2	Modem PLC version read from binary file header.
0x71000106	RF_DWL	2	Modem RF version read from binary file header.
0x71000107	SCENARIO_DWL	2	Scenario version read from binary file header.
0x71000108	AVAILABLE_DWL	2	Available version read from binary file header.
0x71000109	FIXED_VER	2	Bootloader version read on meter
0x7100010A	APP1_VER	2	App1 version read on meter.
0x7100010B	APP2_VER	2	App2 version read on meter.
0x7100010C	PLC_VER	2	Modem PLC version read on meter
0x7100010D	RF_VER	3	Modem RF version read on meter
0x7100010E	AVAILABLE_VER	2	Available field for future App version read on meter
0x7100010F	APP1_CW	2	Last control word read from meter during APP1 download.
0x71000110	APP2_CW	2	Last control word read from meter during APP2 download.
0x71000111	PLC_CW	2	Last control word read from meter during Modem PLC download.
0x71000112	RF_CW	2	Last control word read from meter during Modem RF download.
0x71000113	SCENARIO_CW	2	Last control word read from meter during Scenario download.
0x71000114	AVAILABLE_CW	2	Last control word read from meter during Available download.

Tab. 113 – RF CE DWLD CONTROL Table (up to 2048 rows)			
Field ID	**Field Name**	**Size**	**Meaning**
0x71000115	DWL_STATUS	1	Code of download status, see below for further details.

F(DWC) is used from concentrator as Download control bit mask with the following meaning:

Flag	Value	Meaning	Set by	Cleared by
F(DWC_APP1)	0x0002	DWLD APP1 version on CE	LVC	LVC
F(DWC_APP2)	0x0004	DWLD APP2 version on CE	LVC	LVC
F(DWC_PLC)	0x0008	DWLD PLC version on CE	LVC	LVC
F(DWC_RF)	0x0010	DWLD RF version on CE	LVC	LVC
F(DWC_SCENARIO)	0x0020	DWLD APP4 (Scenario) on CE	LVC	LVC
F(DWC_AVAILABLE)	0x0040	DWLD APPx (Available APPx) on CE	LVC	LVC

When download starts the concentrator sets the F(DWC_x) flags in relation of the part includes in the image programmed in the T_CEDWLD. At the end of the DWLD process, if completed with success flags are reset, on the contrary they are kept high in order to inform the central system of which part has been updated or not. In addition flags are used by concentrator in case of sequential procedure activation with the same CeApp<imageId>.bin on the same meters. By this way the concentrator exactly knows which part needs to be update, historical flags are also used during the “global loop” retries.

If AMM programs a new download with a different CeApp<imageId>.bin then the concentrator must delete and then properly update the F(DWC) flags for the involves meter.

DWL_STATUS can assume the following status codes:

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x00	Target Disabled	DWLD starts and F(INTR)=0 in CE_Table
0x01	DWLD Disabled	DWLD starts and F(DWLD)=0 in CE_Table
0x02	To Do	DWLD starts and F(DWLD)=1 in CE_Table
0x03	Type_ID	DWLD starts and Type_ID in CE_Table doesn’t match

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x04	Done APP1	APP1 download ends with success
0x05	Done APP2	APP2 download ends with success
0x06	Done PLC	PLC download ends with success
0x07	Done RF	RF download ends with success
0x08	Done SCENARIO	SCENARIO download ends with success
0x09	Done AVAILABLE	AVAILABLE download ends with success
0x0A	In Progress APP1	APP1 Start Load writing with success
0x0B	In Progress APP2	APP2 Start Load writing with success
0x0C	In Progress PLC	PLC Start Load writing with success
0x0D	In Progress RF	RF Start Load writing with success
0x0E	In Progress SCENARIO	SCENARIO Start Load writing with success
0x0F	In Progress AVAILABLE	AVAILABLE Start Load writing with success
0x10	Incompatible APP1	CE “Nack” after APP1 Start Load writing
0x11	Incompatible APP2	CE “Nack” after APP2 Start Load writing
0x12	Incompatible PLC	CE “Nack” after PLC Start Load writing
0x13	Incompatible RF	CE “Nack” after RF Start Load writing
0x14	Incompatible SCENARIO	CE “Nack” after SCENARIO Start Load writing
0x15	Incompatible AVAILABLE	CE “Nack” after AVAILABLE Start Load writing
0x16	Skipped APP1	APP1 download skipped due to part already present

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x17	Skipped APP2	APP2 download skipped due to part already present
0x18	Skipped PLC	PLC download skipped due to part already present
0x19	Skipped RF	RF download skipped due to part already present
0x1A	Skipped SCENARIO	SCENARIO download skipped due to part already present
0x1B	Skipped AVAILABLE	AVAILABLE download skipped due to part already present
0x1C	Check APP1	During Single loop resume of APP1
0x1D	Check APP2	During Single loop resume of APP2
0x1E	Check PLC	During Single loop resume of PLC
0x1F	Check RF	During Single loop resume of RF
0x20	Check SCENARIO	During Single loop resume of SCENARIO
0x21	Check AVAILABLE	During Single loop resume of AVAILABLE
0x22	Packet APP1 OK	All APP1 packets Received
0x23	Packet APP2 OK	All APP2 packets Received
0x24	Packet PLC OK	All PLC packets Received
0x25	Packet RF OK	All RF packets Received
0x26	Packet SCENARIO OK	All SCENARIO packets Received
0x27	Packet AVAILABLE OK	All AVAILABLE packets Received
0x28	Digest Error APP1	Digest Error in APP1 Packets
0x29	Digest Error APP2	Digest Error in APP2 Packets

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x2A	Digest Error PLC	Digest Error in PLC Packets
0x2B	Digest Error RF	Digest Error in RF Packets
0x2C	Digest Error SCENARIO	Digest Error in SCENARIO Packets
0x2D	Digest Error AVAILABLE	Digest Error in AVAILABLE Packets
0x2E	Switchover APP1	APP1 Switchover writing with success
0x2F	Switchover APP2	APP2 Switchover writing with success
0x30	Switchover PLC	PLC Switchover writing with success
0x31	Switchover RF	RF Switchover writing with success
0x32	Switchover SCENARIO	SCENARIO Switchover writing with success
0x33	Switchover AVAILABLE	AVAILABLE Switchover writing with success
0x34	Switch Fail APP1	APP1 done Ko due to Switch Fail
0x35	Switch Fail APP2	APP2 done Ko due to Switch Fail
0x36	Switch Fail PLC	PLC done Ko due to Switch Fail
0x37	Switch Fail RF	RF done Ko due to Switch Fail
0x38	Switch Fail SCENARIO	SCENARIO done Ko due to Switch Fail
0x39	Switch Fail AVAILABLE	AVAILABLE done Ko due to Switch Fail
0x3A	Single Loop	Single Loop Limit ends without success
0x3B	Global Loop	Global Loop Limit ends without success
0x3C	CE Not Reachable	CE Not reachable during unicast message

DWL_STATUS CODE		
Value	**Meaning**	**Description**
0x3D	Wrong Key	CE Key error

All All the fields are readable but not writeable, each row is linked to T_RF_CE in order to keep CE_ID association.

If a meter is handled both in PLC in T_CE and both in RF in T_RF_CE the table shall be linked in order to update both tables at the same time.

In case of decommissioning or if a T_CE entry is deleted then the concentrator must erase the linked row.

The zip file of T_CEDWC control table, if enabled, must be saved in /disk/ftp/pub/log. In order to avoid file system saturation the same rules described for N2PLOAD zip generation have to be applied. Table will be saved with the following naming:

tab_rf_cedwc.fdb_5201276A.gz

Where **5201276A** is the creation date in POSIX notation

The table has to be stored in the no-volatile memory of concentrator.

5.7.11 RF CE Download Table {T_RF_CE_DWL} - Tab. 114

This table allows the AMM to tell the concentrator what types of CEs to load, and how to load them. The table is 4 deep and thus up to four different loads can be specified. The fields in the table are defined as follows:

Tab. 114 – RF CE Download Table (up to 4 rows)

Field ID	Field Name	Size	Meaning
0x72000101	IMAGE_ID	8	This has to be a one to eight character string which is used to formulate the image name. The allowable characters are limited to the set supported by the concentrator file system, but the ASCII characters "A"-"Z", "a"-"z", "0"-"9", "_", "-", and "." are safe to use. Unused characters should be zero (decimal). Images are placed in the root directory of the concentrator file system using FTP. The file name constructed will be of the form CeApp<imageId>.bin. Default=0x0000000000000000
0x72000102	TYPE_ID	1	It shows the type of CE that is to be loaded. This field is matched against the type bits (4..6) in the CE_STATE field of the CE table. All requested, enabled CEs with a matching TYPE_ID will be loaded with the specified image. This allows the table to specify several different images to be loaded into different types of meters. With the value 0xFF the image will be applied to all meters without any "TYPE_ID" matching. Default=0x00
0x72000103	ACTIVATE_DT	6	This field has to show the switchover date/time. If it is all zeroes, then the concentrator will choose its own switchover date/time. If it is not all zeroes, then the concentrator will use this date/time. In the case of an externally imposed date/time, the download procedure will not wait for switchovers to occur, and will consider the download successful when the switchover time has been set. It is up to the AMM to validate the switchovers occurred (e.g., by polling the meters download control table via a TB message). In case of DWLD multi-part the date/time inserted shall be used like switchover time for the last APPx file of the package. Default=0x000000000000
0x72000104	DO_ALL	1	This field has to indicate that all applicable CE's should be downloaded. When the download procedure begins, the F(DWLD) bit in the T_RF_CE is automatically set for each enabled CE that matches the TYPE_ID. After the CE entries have been set, the DO_ALL field will be cleared. After that point, the normal procedures for the F(DWLD) are followed. This allows downloading all meters without explicitly setting their F(DWLD) bits, and still provides for tracking the completion status of individual meters. If the field TYPE_ID is programmed as 0xFF then the concentrator must set the F(DWLD) bit for all the meters loaded in T_RF_CE. Default=0x00

Tab. 114 – RF CE Download Table (up to 4 rows)

Field ID	Field Name	Size	Meaning
0x72000105	LOOP_LIMIT	1	Number of attempts for each meter inside a single procedure loop, 0x00 means ten attempts. Default=0x00
0x72000106	DT- DIGEST	8 8	CE Date Time and Digest. This field has the following property: If the field is all zero (16 bytes of zeroes), it will be ignored. If not, the date/time is used as an expiration time and the digest as validation of the image. If the expiration time has passed, then the file will not be usable for downloads. The Digest will be computed by Entire File Contents and Date/Time. Note there is no section/progressive prefix. (not used) Default=0x00000000000000000000000000000000
0x72000107	GLOBAL_LOOP	1	Number of total procedure attempts over the meters not yet updated with success in the previous cycle. Default=0x00
0x72000108	DWC_RESET	1	By this bit mask is possible to reset the historical flags F(DWC) in Tab. 113 and enable/disable the "optimize" DWLD for the involves meter, see below. Default=0x00
0x72000109	Reserved	1	Default=0x00
0x7200010A	STATUS_EN	1	Flag to enable or disable the T_RF_CE_DWC Control Table zip creation, see below. Default=0x00

In relation to DWC_RESET field the following values must be handled:

- DWC_RESET = 0x00:
  - If the firmware file is different from the previous loaded, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file but each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.

  - If the firmware file is equal to the previous loaded, the concentrator will go on to download the modules in relation of the F(DWC) register bits, saved as historical flag at the end of the previous download cycle. Each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.

- DWC_RESET = 0x01:
  - In both cases, if the firmware file is different from the previous loaded or not, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded only if the APPx firmware read from the meter is different from the APPx firmware file. When download starts the F(DWC) register bits are reset in according to the modules that have to be skipped after the meter version reading.

- DWC_RESET = 0x02:
  - If the firmware file is different from the previous loaded, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded without any APPx firmware check between meter and firmware file
  - If the firmware file is equal to the previous loaded, the concentrator will go on to download the modules in relation of the F(DWC) register bits, saved as historical flag at the end of the previous download cycle. Each module will be downloaded without any APPx firmware check between meter and firmware file

- DWC_RESET = 0x03:
  - In both cases, if the firmware file is different from the previous loaded or not, the concentrator will download all modules on the meters. F(DWC) register bits are set according to the modules available in the firmware file. Each module will be downloaded without any APPx firmware check between meter and firmware file.

In relation to STATUS_EN field the following values are used to enable/disable the table zip creation

b7	…	b1	b0	Meaning
…	…	…	…	…
…	…	1	0	Zip file handling

The download procedure will process this table serially. That is, one image will be loaded then the next and so on. Once an image is completely loaded, the entry is removed from the control table.

The table has to be stored in the no-volatile memory of concentrator.

5.7.12 Open RF Transactions Buffer {B(RF_TRAPE.REQ)} - Tab. 115

This buffer must be used to contain transaction requests that the AMM dispatches to concentrator for the activities to perform on the field. Each record of this buffer comes out from the explicit request that the AMM dispatches to concentrator. The AMM can require eliminating a specific transaction from the buffer through the message TB_ID_TRAS_RESET (032) or GB_RESET_ID (020).

The buffer must be able to contain at least 2048 transactions of TRF type; the loading of the transaction in B(RF_TRAPE.REQ) by the Centre, has to be done using suitable messages (see [28]). If there are the conditions, the concentrator must accept the request and record it in the buffer. While if the buffer maximum capacity is reached, at the relative transaction request, the concentrator must answer with the message TB(255) o GB(255) relative to error code: “B(RF_TRAPE.REQ) full”.

Eventual transaction requests with an “Id_Transaction” already present in the buffer have to be refused with the diagnostic message TB(255) o GB(255) having the error code relevant to “Id_Transaction already in B(RF_TRAPE.REQ).”

When a transaction is completed, the transaction end message has to be dispatched to the AMM.

Tab. 115 - Open transactions Buffer (up to 2048 rows)

Field ID	Field name	Size	Meaning
0x73000101	DATE_TIME_RCV	6	The date and time the transaction was received from the AMM
0x73000102	DATE_TIME_SENT	6	The date and time the transaction was initiated with the CE
0x73000103	MSG_TYPE	1	FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See [28]
	MSG_CODE	1	FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See [28]
	MSG_LENGTH	2	FIELD Data Length of 2 bytes containing the Length in byte of the whole data FIELD. See [28]
	ID_TRANS	2	Id of the transaction requested (single or multiple). This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.
	STEP	1	This is the step in the transaction. If any step fails, the entire transaction is considered to have failed and the transaction number and the failed step are reported to the AMM. No attempt is made by the concentrator to back out previous steps, the concentrator just scans ahead in the buffer to the next transaction number and begins a new transaction
0x73000104	DATA	154	Data necessary for the completion of the transaction (variable in function of the transaction). This field has to be sized on the longest set of data necessary for a transaction (Data field length till up 154 bytes; see [28]). The "Data" field includes the following format: • 1 byte for AUTP (authentication / encryption) • 6 bytes for CEA (CE_ID) • 147 byets for D (data field)

The following general ordering rules have to be as follow. These apply to messages being delivered from the RF_TRAPE.REQ to the devices. They also apply to messages being delivered from the RF_TRAPE.RESP to the AMM.

a. All priority messages are delivered first, then all non-priority messages.

b. Within a priority level, messages are delivered based on the time of reception (REQ_TIME or DateTimeRCV).

If two messages have the same time stamp, then, if there is a transaction number, messages are delivered in increasing transaction order (e.g., 7000, 7001, 7002 or 9998, 9999, 2048). If there is no transaction number, delivery order for identically time-stamped messages is arbitrary.

When the AMM deletes a transaction, all the steps at and after the specified step are deleted. For example, if the RF_TRAPE had entries 20000.1, 20000.2 and 20000.3, then a GB(020) for 20000.2 would delete 20000.2 and 20000.3. It has to be specified that the deletion process terminates when it can't find the next successive step.

For example, if a transaction were submitted with IDs 20000.1, 20000.2, 20000.3 and 20000.66, then a delete of 20000.2 would delete only 20000.2 through 20000.3 assuming that multiple step transactions are only submitted with successive steps (otherwise, it would be necessary to read till up 255, before terminating deletion process); proper GB and TRF NACKs will be generated by the concentrator (see [28]).

The buffer has to be stored in the no-volatile memory of concentrator. If the concentrator reboots after the execution of a certain number of transactions, it has to take a “snapshot” after every message and thus no TRF messages are repeated.

5.7.13 End RF Transactions Buffer {B(RF_TRAPE.RESP)} - Tab. 16

This buffer must be used by concentrator to store the results of transactions (TRF responses, CE spontaneous and GB responses/events related to RF communication), waiting to forward them to the AMM in order to complete the transactions.

The buffer must be able to contain at least 4096 records.

Tab. 16 - End RF transactions Buffer (up to 4096 rows)

Field ID	**Field name**	**Size**	**Meaning**
0x10000101	DATE_TIME_RCV	6	The date and time the response was received from the CE
0x10000102	DATE_TIME_SENT	6	The date and time the transaction was initially attempted to be sent to the AMM. This time is stamped at the beginning of the first transmission attempt
0x10000103	MSG_TYPE	1	FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See ENEL DH 971K
	MSG_CODE	1	FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See ENEL DH 971K
	MSG_LENNGTH	2	FIELD Data Length of 2 bytes containing the Length in byte of the whole data FIELD. See ENEL DH 971K
	ID_TRANS	2	Id of the transaction requested. This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.
	STEP	1	The step of the transaction that corresponds to the returned data.
0x10000104	DATA	154	Data requested in the transaction. This field has to be sized on the longest set of data necessary for a transaction. (Data field length till up 154 bytes; see [28]). The "Data" field includes the following format: • 1 byte for AUTP (authentication / encryption) • 6 bytes for CEA (CE_ID) • 147 byets for D (data field)

When the port 50003 (RF_Event_Pipe) is opened, all the entries have to be dispatched in order to empty the concentrator buffers with FIFO algorithm. Like for TRAPE.RESP, also the RF_TRAPE.RESP can be read from AMM by the GB (100) command with the same rules.

If the concentrator reaches the buffer full condition (no more entry available) it must zip the table and provide it in the /ftp/pub/buffer directory in order to be downloaded by AMM. After the zip creation concentrator will empty the RF_ Buffer and saved as first entry an event GB (039.050) in order to inform AMM about the zip creation.

Table will be saved with the following naming:

buf_rf_trsp_5201276A.fdb.gz

Where:

- **5201276A** is the creation date in POSIX notation;

In order to avoid file the system saturation when the available space is less than 5 MB of the total disk, the oldest zip file shall be deleted by concentrator. If that condition occurs and none zip files are present in the ftp/pub/buffer directory, the zip functionality shall not be performed. In this case, once reached the buffer full condition (no more entry available), the RF_TRAPE.RESP shall be handled as a circular buffer with FIFO logic and the “M” bit of the state bits is set in order to inform AMM about the starting time of the data loss condition. The “M” bit shall be automatically reset by the concentrator only if the zip succeeded or at least an entry is properly dispatched via 50003 socket.

The buffer has to be stored in the no-volatile memory of concentrator.

6 FUNCTIONALITY

This chapter describes the concentrator functionality when it is connected to a remote controlled AMM.

The concentrator must also function in “stand–alone” modality, using a subset of functionality described as given in chapter 6.

The concentrator activity must evolve for each procedure in accordance to the value defined in each specific field in the T_PRI and T_RF_PRI.

The procedures invoked to carry out the various activities have to be started by concentrator in one of the following ways:

- Cyclical trigger (background) that uses the internal watch;
- Events recalled by the peripherals through Status Word flag;
- Events required by the AMM.

The transactions of a procedure, once started, must not be interrupted. However, it is possible to interrupt a cyclical procedure, at the end of each transaction, or of a multiple procedure, at the end of each single sequence, with a procedure that has higher priority level.

For this reason some priority levels are found out (from 1 to 6). A high level number corresponds to low priority. (See Fig. 2)

6.1 LIST OF PROCEDURES

The following is the list of the concentrator's procedures. They can be interrupted and carried out in more cycles.

- Clock Synchronisation (SINC-T) (5) background SINC-T
- Clock Synchronisation (SINC) (2) internal request SINC
- Comp. Connection check (CONN-C) (2) on req.\bckgrd CONN-C
- Red. Connection check (CONN-R) (2) on req.\bckgrd CONN-R
- Partial CONN-C (PCONNC) (2) on request PCONN-C
- Partial CONN-R (PCONNR) (2) on request PCONN-R
- TB-PROCEDURE:
  - Clock Synchronisation (NSINC) (3) on request TB-PROCEDURE
  - Clock Synchronisation (ASINC) (3) on request TB-PROCEDURE
  - Identification Parameters (IDEN) (3) on request TB-PROCEDURE
  -
  - Bad-Payer Procedure (KMOR) (3) on request TB-PROCEDURE
  - Diagnostic Procedure (DIAG) (3) on request TB-PROCEDURE
  - CE Reading (LETT) (3) on request TB-PROCEDURE
  - Line Request (LREQ) (3) on request TB-PROCEDURE
  - Modem Status (STSTAT) (3) on request TB-PROCEDURE
  - Message Display (MESS) (3) on request TB-PROCEDURE
- Load shedding (ALCA) (1) on request ALCA
- CE Automatic Acquisition (ACE) (.) on request ACE
- IC Automatic Acquisition (ACIC) (.) on request ACIC
- Energy Balance (CE-BE) (3) at 00.45 BE
- Customer Interface Procedure (GESIC_A) (4) on request GESIC_A
- Customer Interface Upgrade (AG_24) (3) background AG_24
- Customer Interface Upgrade (AG_IC) (3) background AG_IC
- Load Profile Procedures (PLOAD) (3) at 03:15 PLOAD
- CE Download procedure (DWLD) (2) on request DWLD
- LV Network Quality Service (GQBT) (3) on req.\bckgrd GQBT
- CE Line detection (LDET) (2) on request LDET
- Customer Interface Procedure (GESIC_B) (3) on request GESIC_B
- TIMETO (TIMETO) (2) on request TIMETO
- Recovery CE (REC_CE) (3) on request RECOVERY_CE

• CE data collecting	(CEDATA)	(3)	on req.\bckgrd	CEDATA
• Partial Clock Synchronisation	(PSINC-T)	(4)	on req.\bckgrd	PSINC-T
• Logging	(LOGGING)	(1)	background	LOGGING
• New Load Profile Procedure	(NPLOAD)	(3)	on request	NPLOAD
• Registers integrity	(V-REG)	(4)	background	V-REG
• Fast Load Profile Procedure	(N2PLOAD)	(3)	on request	N2PLOAD
• Fast Quality Interruption	(QI)	(4)	on request	QI
• Fast Quality Variation	(QV)	(5)	on request	QV

Each procedure can be activated via PLC or RF in relation to the T_PRI and RF_T_PRI rules and configuration. In any case the two channels shall be handled simultaneously by concentrator and, for example, during a CONN-C procedure via PLC it can run also at the same time a TRF procedure via RF.

The concentrator, at completion of each action, has to verify if in the meantime there is the necessity to carry out a procedure with higher priority (e.g. if the AMM has required a load reduction procedure in this case it performs the ALCA procedure and then it goes on with the elementary procedure, next the suspended procedure).

Some specific rules are also valid for the following procedures:

- CONN_C/R have the function to verify the state connection of LV network departing from concentrator. The results of the CONN procedures have to be used by other procedures for communication purposes.

Given that, an “enabled line” is one which has at least one enabled section, it is possible than define:

- PCONN-C, this procedure can be run to compute unknown repeat paths. It attempts to resolve paths that are still unknown. It is used to process an enabled CE line of communication one time that has CONN-C requested via the T_LIN. It is also used one time when a CE line of communication belonging to an OK line is first detected to be KO by any line KO event generating procedure.

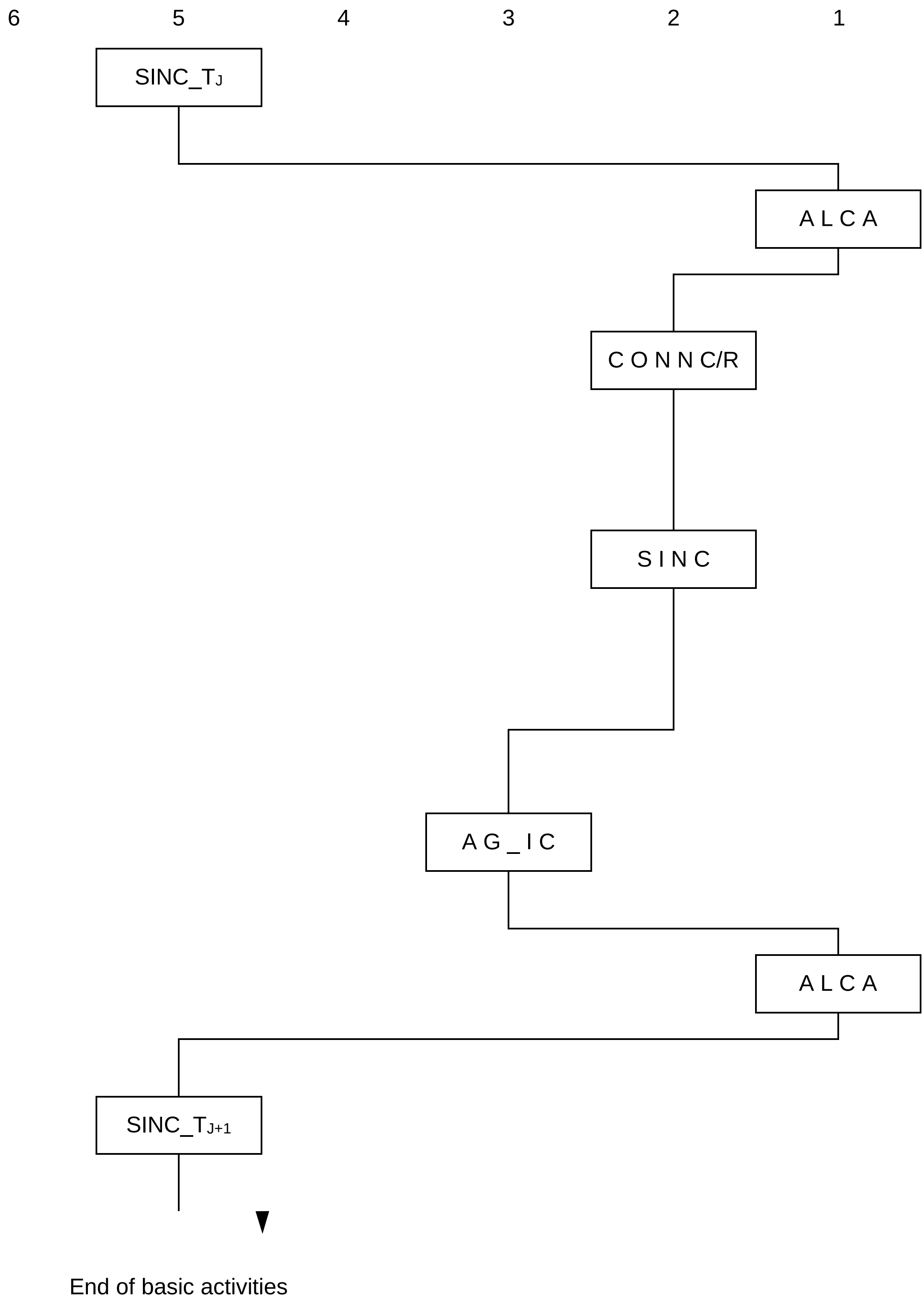
- PCONN-R, this is used to process an enabled CE line of communication one time that has CONN-R requested via the T_LIN. It is also used one time when a line is first detected to be KO by any KO event generating procedure (CONN-R or CONN-C). Note that this one time execution of PCONN-R occurs even if the line is not normally qualified for CONN-R.

- SINC (clock update), has the function to synchronise all the CE watches that require it.

- ALCA (load shedding), only if required by the AMM, that has the function of load reduction.

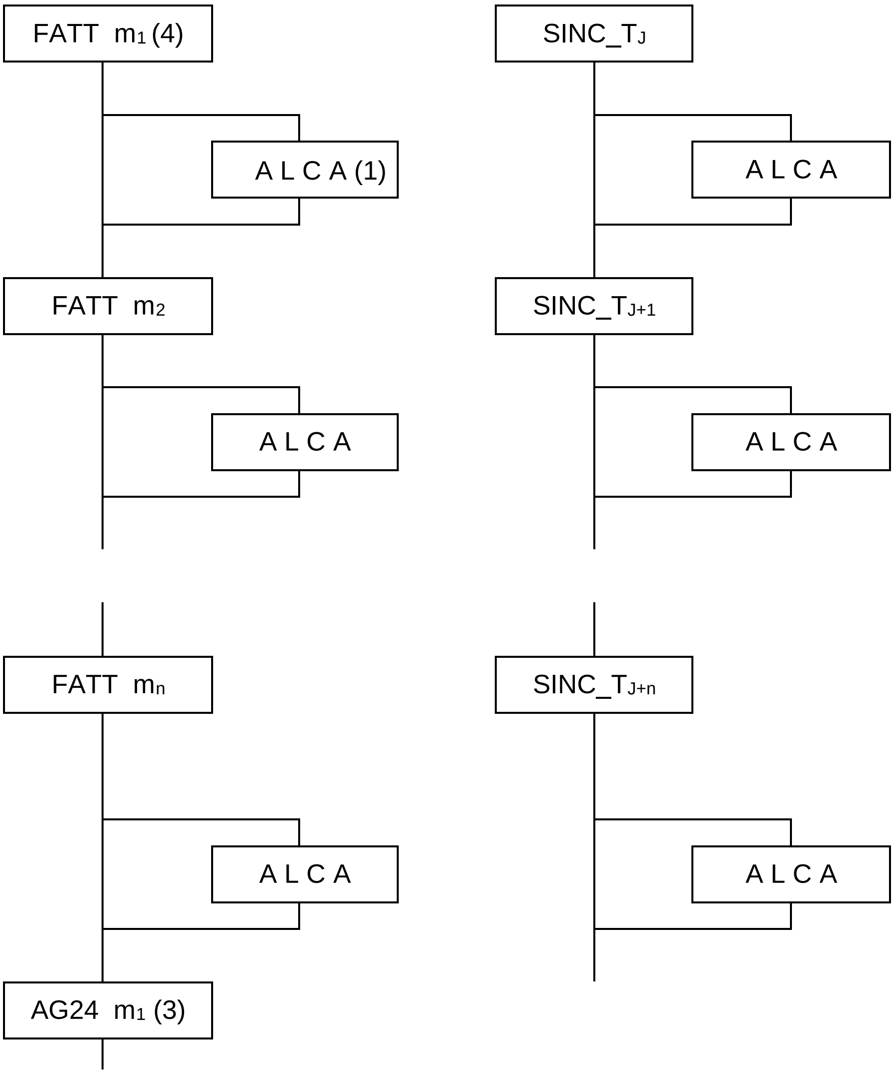
The values showed in the “priority activation” field have to be understood to be as examples. They are not the default values. The values are set by AMM.

PRIORITY



6
5
4
3
2
1
SINC_TJ
A L C A
C O N N C/R
S I N C
A G _ I C
A L C A
SINC_TJ+1
End of basic activities

For single transactions on CE, micro-activity is considered ended on CE. Example:



Where m_1, m_2, ...m_n and J, J+1, …J+n represent the indivisible elementary actions (example: CE interrogation) and (X) priority level;

The concentrator interacts with the AMM and with each CE attached to it. The functions of the concentrator are described in the following chapters.

6.2 COMMUNICATION WITH AMM

The concentrator communicates with the AMM with TCP/IP. The primary connection is via PPP (Point to Point Protocol) employing CHAP (Challenge Authentication Protocol). A serial line is connected to a GSM or other similar modem (e.g. GPRS).

6.3 CONCENTRATOR FUNCTIONS

There are three applications supported by the concentrator:

- Meter data is aggregated in the concentrator for upload to the AMM at appropriate times based on assigned communication schedules.
- An alarm / event application detects communication failures, meter tampering, theft, and meter failures. This information is sent to the AMM.
- A software update application allows software updates to be performed on the concentrator and the meters.

For more details, see the following chapters.

6.4 AMM COMMUNICATION

The connection between the AMM and the concentrator can be initiated by either party. PPP/CHAP/TCP-IP is used for the connection.

PPP is password protected. A user name and password are configured into the concentrator so that the connection can be made. The CHAP protocol is used to avoid passwords crossing the links.

The concentrators all have parametric IP addresses (the IP address is configurable). The used TCP ports are private to this application. They are chosen so as not to conflict with other AMM functions.

When the AMM wishes to connect to the concentrator, it makes the modem call, establishes PPP, and then connects to socket 50000 and 50001 in the concentrator to exchange GB, TB and IC messages.

Then AMM connects to sockets 50000 and 50001 in the concentrator to exchange GB, TB and IC messages.

In order to terminate a call with the concentrator, AMM has to deliver the GB_CALL_TERMINATION (018.014) command.

When the port 50001 (event pipe) is opened, spontaneous related to ICs [GB…(021) tbd] have to be dispatched before each other message contained in the concentrator buffers.

6.5 METER / RESIDENTIAL ROUTER COMMUNICATION

The concentrator communicates with the meter and Residential Router devices via A-Band connections. To assist communication where required, it is possible to assign repeating functions to meters. These repeating meters CE cs, CE vcs are assigned by the concentrator using an algorithm to determine good choices for repeaters. Every meter has a path to it consisting of its address and the addresses of any repeaters.

Communications may be protected in two ways. For network management operations, an authenticated protocol is used. This authentication method (MD5) allows the verification that the sender of the message is authentic. Since the meters are polled to provide their data back to the concentrator, the authenticated algorithm would only verify the poll request as authentic, but not the data coming back from the meter. For meter application download, metering data upload and meter profile upload, and other network management functions, a two way authentication mechanism will be provided at the application layer. It will prevent record/playback attacks. Such messages will contain a security "dynamic" digest of the message contents and a date/time along with a shared secret. The "dynamic" digest will be sent in the request and in the response thus providing two way authentication.

The following functions have to be provided via this communication:

- Autonomous loading of tariff tables into meters.
- Autonomous uploading of meter data from the meter to the concentrator.
- Autonomous uploading of meter load profile data from the meter to the concentrator.
- Autonomous application download to the meters using multicast services.
- Periodic polling of the meters and residential routers to get state of health information as well as to accumulate non-time critical data.
- A pass through between the LNS server network and the A-Band and C-Band devices. Allowing LNS to remotely commission meters, residential routers and devices within the home.
- Schedule driven call establishment with the back office system for transmission of power consumption and load profile information.
- Alarm driven call establishment with the back office system to report time critical events to the back office system, for example power outages, tampering, or value added service events.

6.6 CONFIGURATION OF CONCENTRATOR

Configuration of the concentrator can be accomplished via the optical serial connection ZVEI IEC 62056-21 mode C.

The configuration parameters include, but are not limited to, the following:

- GSM primary and secondary phone numbers or PSTN phone number.
- The schedule for calling the phone numbers to connect to the central office.
- PPP username and password.
- Modem configuration strings.
- IP address and port assignments.

6.7 PROVIDE FOR EXPANSION FUNCTION

The concentrator has to provide approximately 10% of the total memory available for bug fixes and additional functions in the future.

The microprocessor currently selected for the concentrator shall have two serial lines. One is allocated to the GSM connection and one serial line is available for expansion in the future for either the serial pass-through function or for connection to the local optical HHU, if a serial line is required for this function.

6.8 POWER MAINS FEATURES

The following features have to be provided to monitor and control the power distribution:

Date/Time Service

The date/time has to be set in the concentrator from the server periodically. The concentrator sets the date/time in the meters periodically.

Load Profiling

Load profiling is a configurable feature and can be enabled or disabled in the concentrator. Meter data is collected periodically and provided for upload to the server. The approximate size of the data stored per meter is 16K bytes/month. Data can be sampled at a configured interval from the meters. This interval is subject to the constraints of communication bandwidth and the number of meters. The total amount of data to be stored for all meters is no less than that required for 10 meters.

Meter's Load Profiling is not available concurrently with program download of either the concentrator or meters. The same space in the concentrator is used for both (PLOAD and DWLD) functions.

Total Energy Consumption

This is the billing data that is collected once every billing period. This data is collected from the meters periodically and stored in the concentrator.

Fault Detection of the Meters

Meters have to be polled by the concentrator on a configurable interval to check for faults. If a meter fails to respond for a configurable number of successive polls, then it is considered in fault.

Tamper Detection

If a CE reports tampering, the concentrator has to respond according to the spont flags in the TLC table.

Meter Parameters

CE parameters can be changed from the AMM or HHU via concentrator.

Load Shedding

Load shedding thresholds can be sent to meters from the AMM via the concentrator.

CE Line Detection for Best Communication

Every concentrator has to be coupled to all 3 lines of communication and can send out a packet relative to a line of communication. Every meter has a zero crossing detector to detect the line of the communication.

Collection of communication statistics

The concentrator and meters report their statistics via suitable messages.

Self-Test

The concentrator has to perform a power-on self-test. Failures have to be reported to the AMM (see chapter 15).

7 PLC PROCEDURES

7.1 COMMUNICATION BETWEEN AMM AND LVC

(See ENEL DH 971K / ENEL DH 970K)

7.2 COMMUNICATION BETWEEN LVC AND CE

When the concentrator sends a message, with answer associated, to a CE in the case of lack of answer the concentrator must make a number of retransmissions equal to “LV_RETRY”. This parameter can be configured and initialised per default as 1. Setting LV_RETRY=0 no retransmission is done. If the concentrator cannot communicate with a meter, error analysis must be performed to determine whether only the meter has failed or there is a more widespread failure, such as a power transmission fault.

For example, in case of known topology, when concentrator sends a message, (that expects an answer) to a CE not configured as Master Section in the case of lack of answer, after LV_RETRY attempts, concentrator must send the message through the CEcs, using it as a repeater.

If the concentrator does not receive an answer even after “LV_RETRY" transmissions, done by using the Master Section as repeater, the following cases could be met:

- If even CEcs is not reachable, the transaction is closed with a negative result (“NR section for the transaction” – see DH971K ACK 251 coding). Next CONN_C must be activated on the appropriate marked line 3, 7, 11.

- If CEcs is reachable (but not the involved CE) the RAG flag has to be “set” in Buffer_CE; this flag has to be “reset” when the CE is reachable (see SINC_T).

In case of known topology, the concentrator will write on the T_CE, for example after the CONN-C procedure, the CE that will be master and vice master section (it could be foreseen a “transparent” CE buffer entry to indicate CEcs or CEvcs).

The repeater selection in the known topology case must be limited to master and vice master, regardless of master/vice masters are designated by the AMM or chosen by the concentrator.

Every time that a CE answers with the NACK message (see ENEL DH 960K), the concentrator must consider the transaction failed. Consequently on reception of NACK code, the concentrator must notify it to the AMM.

Every time that CE answers with the message BT…(ACK), the State Word has to be checked.

If in the State Word the ONSI bit is "set", the concentrator must require the set clock updating it. When the State Word shows some anomalies different from ONSI[24] (8), the AMM has to notify it by mean the message GB_SPONT_STS_WORD (019.009). This is valid for remote-management transactions.

Rules to carry out transactions on CE

- The multiple activities (e.g. FATT, ALCA) have to be performed only for the sections "reachable" for CONN_C/R. Regardless of the reachability state of an individual CE, all procedures should continue to attempt to reach that CE. However, if an entire section is known to be not reachable, then no attempts will be made to reach any CEs on that section from certain multiple activity procedures. This comprises ALCA, FATT, BE, DWLD, SINC, SINC-T, DACE, (AG-IC, AG-24, GESIC-B, tbd). It does not include ACE, CONN-R or CONN-C. Here "not reachable" means that the CE or section is expected to be in communication but cannot be reached due to some unknown communication failure or unexpected line opening. No exception is made for the degenerate case of a single CE on a section. If there is a section X on line 3 that is not reachable, but section x, line 7 and 11 are reachable, then the multiple activity procedures continue to operate on sections X lines 7 and 11 only.

- The single activities have to be always performed.

- On the "not inquierable (testable)" sections no activity is performed.

7.3 CONNECTION AND SYNCHRONISATION CHECK PROCEDURE (CONN AND SINC-T)

Objectives of the procedures are:

- Verify the presence of malfunction on line that determines the opening of the LV line switch in the secondary substation and for the section immediately before the boundary line, check if they are really supplied by the secondary substation (CONN-R).

- Verify if the sections are reachable directly or through the use of repeaters; find repeater and upgrading of the T_RPT table; determine the line (Line Detection) of communication if the line is unknown (CONN-C) for unknown topology.

- Verify the reachability state and keep the synchronisation of the watches of each single CE, through the routing table (SINC-T).

The connection check activity has to be executed, line per line, and might happen in:

[24] Verify if there are other flags besides ONSI that belong to an ordinary management.

- **“complete" (CONN-C)**
- **“partial” (PCONN-C)**
- **"reduced” (CONN-R)**
- **“partial” (PCONN-R)**

Topology would be considered as unknown in the case for example where the sections are defined and CEs are assigned to sections, but no lines or connections are defined. Also, the topology is considered unknown if at least one of line, section, bus bar or connection table is empty.

For the known topology we will have:

The connection check activity **"complete" CONN-C** must interrogate the CEcs or the CEvcs, only on the lines of communication on which it has been activated plus determining repeat path to those CEs on that line of communication .

The connection check activity **"reduced" CONN-R** must be limited to interrogate the CEcs or CEvcs (3 section-line of communication) of the first section after the switch and of that/those immediately before the boundary line (or the last).

The synchronisation activity **"total" (SINC-T)** must interrogate all the CEs.

7.3.1 Total synchronisation Procedure (SINC-T)

With this activity the concentrator must interrogate all and only the CEs supplied by the secondary substation, where the concentrator is connected. PURPOSE

Statistic control of CE reachability in order to improve the routing of CE updating the LVCCeCommStat; it also provides temporal data for the synchronisation of the peripheral units.

DESCRIPTION

The steps on which the activity is structured are the following:

- synchronisation through the transmission of temporal references with request of the State Word in a normal format;
- flag control “presence of diagnostic alarms” (PAD) to require the State Word in an extended format;

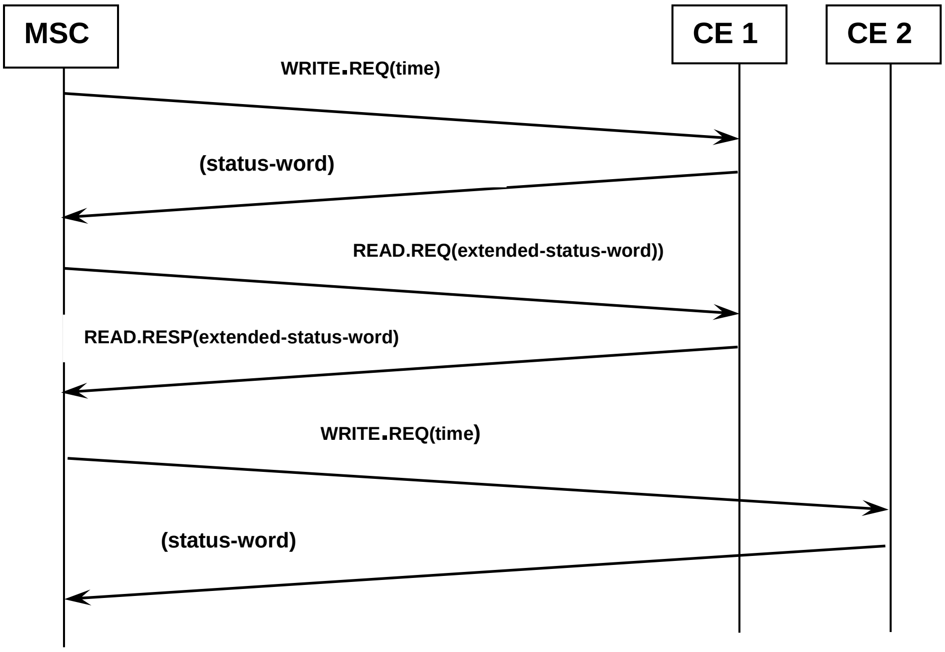
ASSOCIATED MESSAGES

Transmission of date and hour	**WRITE.REQ (004)**
State Word answer in normal format	**(status-word)**
State Word request with extended diagnostic	**READ.REQ (extended-status-word)**

If PAD is present:

Status Word request with extended diagnostic	**READ.REQ (extended-status-word)**
Status Word answer with extended diagnostic	**READ.RESP (extended-status-word)**

Examples of interchange messages for SINC-T procedures



7.3.2 Complete connection check Procedure (CONN-C)

As follows, procedure has different meaning between known and unknown topology, note also that CONN-C is not use with DLC_PROTOCOL=0x02; in that case the PCONNC is used instead of CONN-C.

7.3.2.1 Known topology

The procedure has to verify the reachability of the sections normally supplied, finds repeater and updates the T_RPT table. The communication of these sections has to be attempted directly (step 1a), or in case of not reachability, through repeaters searched on the same line of communication (step 1b).

The CONN-C is a background procedure that always tests all “enabled lines” (see “CONNC/R scheduling“ section).

For the CONN_C description, definitions used in the algorithms are the follow:

$CE_{CS/VCS}$: CE Master Section or CE Vice Master Section

CExs: It is the CE Master Section, or CE_{CS} or CE_{VCSC}.

The Vice Master serves only as a redundant back-up for the master. It follows the basic tenet of known topology which is that all CEs in a section are reachable via the same repeat path (that of the master).

Therefore after CONN-C, all CEs, including the Vice Master, will inherit the repeat paths determined for the master. Only in the case where the master is not reachable will CONN-C determine a repeat path directly for the Vice Master in which case all CEs in the section will inherit the repeat paths of the Vice Master (including the master).

Eventual changes of the line status must notify an alarm to the AMM (if enabled in the Spont field in T_TLC).

For the sections that do not belong to the KO Lines and that are part of the supplied network, the concentrator must memorise and/or notify the Centre (if enabled) the eventual modifications of their Reachability State (lost or retrieved) respect the previous state and associated temporal information.

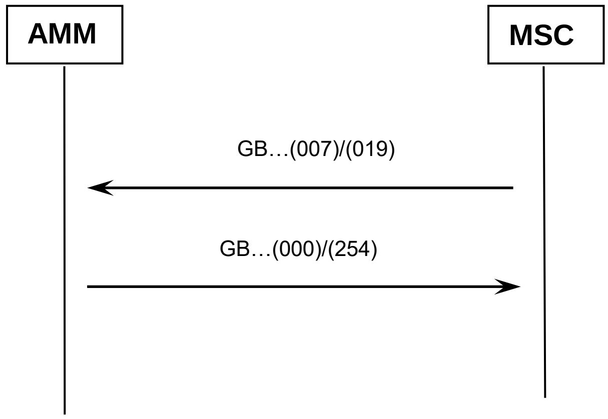
Once errors start to occur, there are a couple conditions that may initiate CONN-C including CONN-R detecting a failure and other procedures encountering individual CE NRN conditions. It seems there is the potential for many failure conditions to spawn CONN-C causing it to run quite a lot. It is necessary to plan to only schedule CONN-C for a particular line of communication upon seeing one of these conditions if the CONN-C procedure was not already booked for this line of communication (of course, the priority table can still be used as an additional control).

In case of sections that are supplied by other substation it will be the AMM that, after the Not Reachability of that section, must check if those sections are supplied by other substation.

Notice that the sections without CE must not be interrogated by concentrator, but have to be “set” as “Not Reachable” all the first CONN-C executed by concentrator without notifying it to the AMM.

The spontaneous signalling of the reachability state of the section at completion of CONN-C must be enabled or disabled with dedicated messages.

If a CONN-C finds a section-line of communication is not reachable, then it has to test each section-line of communication on its far side individually.



Algorithm

REPEAT for the sections relative the lines (R, S, T) for which CONN-C is booked.

Algorithm step 1a, 1b

REPEAT END

Interrogation Algorithm (step 1a)

This step is applied to all the sections that can be interrogated, directly specified in B (ST_SEC). It is not applied to the sections that have a repeater “predefined by the AMM”.

REPEAT for all the “testable” section/line of communication belonging to the line.

The concentrator transmit **"READ.REQ of Status Word"** message to CE_{XS} from the n-section supplied by LV line.

IF CE_{XS} answers

IF CE_{XS} has the ONSI bit high (no time on them)

concentrator sets flag on the n-section

ENDIF

ELSE (CE_{XS} does not answer)

The concentrator must flag the n-section as not reachable.

ENDIF

REPEAT END

If all the “testable” sections are reachable, the concentrator:

- Must reset the flag “F(LKO)” relative to that line of communication on {B(ST_LIN)} Line Buffer.

If any “testable” section is reachable, the concentrator

- Must “set” the flag F(ST_SEZ) to indicate the Reachability of all the sections of the detected line (determination of the line trigger).

If there are Not Reachable sections, the concentrator:

- Must execute the algorithm step 1b

Interrogation Algorithm (step 1b)

REPEAT for all the “Not Reachable” sections SEZj at step 1a and for those with predefined repeater (the T_SEZ has an IRIPE specified for that section-line of communication), imposed by the AMM.

FIND OUT the section used as repeater (SEZripe), relatively to that line of communication, the first “reachable” immediately before SEZj (that must contain at least one CE on that line of communication and that must not be inhibited to repetition); is has to be associated to the section SEZj.

In case a SEZj section has an “imposed” repeater, this repeater is used if already reached, otherwise it is skipped.

REPEAT END

REPEAT for all the SEZj section interested to step 1b that is associated with a repeating section (SEZripe).

TRANSMIT message **READ.REQ (status-word)** to CExs of SEZj using CEcs or CEvcs of SEZripe

IF CExs of SEZj answers

The concentrator must memorise in B(ST_SEZ) the address of SEZripe for SEZj (if different from the previous one).

IF CExs of SEZj has the ONSI bit high

The concentrator sets the relative flag in B(ST_SEZ) SEZj and in Buff_CE

ENDIF

The concentrator must eliminate SEZj from the not reachable ones.

ELSE (CExs of SEZj does not answer)

The concentrator must leave SEZj among the not reachable ones.

ENDIF

REPEAT END

In other words:

Step	Action
1a	Determines the sections having direct reachability
1b $_1$ … …	Determines the reachable sections through repeater spotted among those before by 1a
1b $_n$ … …	Determines the reachable sections through repeater spotted among those before by 1b $_{n-1}$
1b $_k$	It has not determined any reachable section having used those before and spotted at 1b $_{k-1}$[25]

[25] The iteration of step 1b must stop also when reaching a maximum number of admitted repetitions (to each k action a repeater is added).

If all the sections are reachable the CONN-C algorithm must end.

CONN-C End:

If some sections are not reachable, concentrator must request the CONN-C activity for the following cycle on this line of communication.

In case of reaching at least one section, if the global KO Line flag relative to the line had been "set" previously (as a result of CONN-C):

- the state of line of communication section has to be set on "Reachable";
- the KO line flag relative to line of communication has to be "reset;
- the CONN-C has to be booked on the line of communication;

Note: About CONN-C behaviour, the mechanism above described has to honour the following logic in its implementation.

First of all, for each subtended CE, the concentrator has to request the CE's status word. If the message succeeds and the CE replies to the concentrator, this one has to deliver again to the CE a long message request, e.g. the reading of register 0x0504 (a part of the load profile).

If the CE replies also at this message, then the path is OK, elsewhere the concentrator has to continue to try by means of another path. In any case, the concentrator has to store in the non-volatile memory the first path found out by the CE's status word reading.

If the CE replies only at the short message for all the candidate paths, the concentrator has to store in the repeater table the first path found out by means of the CE status word reading only.

This logic has to be also true for ACE and PCONNC procedures.

When Use CONN-C

The CONN-C procedure must be performed:

1. on all the lines in the following cases:
   - At concentrator start-up
   - The AMM has to book the CONN-C after the communication activation on LV network after sending the GB_COM_BT_ATT.REQ (018.005) message.
   - On modification of the connection state of the sections required by the AMM with the GB_WRITETAB_(COL).REQ (010.008) message.

- After an explicit request by the AMM GB_SET_CONN.REQ (004)

- After an explicit request by AMM, GB_CONNC_START (018.011), taking into account the enable /disable bit in the T_PRI.

2. on the single line in the following cases:

   - On the line of communication which has been requested by concentrator various activities that have encountered communication problems. CONN-C is scheduled in this case if and only if NRN(t) exactly matches the NRN in the T_ATT.

   - By the AMM on the line of communication after reconfiguration of some characteristics of a section belonging to the line.

On the line explicitly required by the AMM GB_SET_CONN.REQ (004).

The AMM should schedule CONN-C appropriately when making the following changes:

1. change to CE section assignment if CE is a master/vice-master (the CE's line of communication)
2. change to CE master/vice-master attribute (the CE's line of communication).
3. change to line table section/node attribute (the affected line of communication)
4. any change to the section table (the affected line of communication)
5. any change to the connection table (all lines of communication)

In this way the AMM must book CONN-C based on the changes it makes.

When a GB_SET_RESTART.REQ (018.255) message is received (it allows to perform a device restart equivalent to a Power Up), the CONN-C procedure has to be performed by the concentrator.

Notification to the AMM of CONN-C end

At the end of a CONN-C (in all the cases listed except "2.a") a GB…(019.001) state message has to be dispatched to the AMM with bit "F" of the State Word set to 1 (if enabled in T_TLC flag SPONT).

7.3.2.2 Unknown topology

This procedure has to be run to compute all the repeat paths. It also can be used to optionally determine the line of communication if this is unknown (value = 0) or the F(LDET) bit is set. It requires that a CE be acquired prior to using it as a repeater. It does the following steps for each CE.

- Attempt to find a primary repeat path.

- Once the CE is located, its line of communication has to be determined if it is either unknown (0) or the F(LDET) bit is set. If it is on the same line of communication as the repeater, the path has to be stored in the repeat table. Once the line of communication is determined, the F(LDET) bit is cleared.

- If a CE is discovered which still has its F(ACE) bit set, then it will be acquired so that it can be used as a repeater for other CEs.

- Once a primary path has been found for each CE, an attempt is made to find a secondary repeat path for each.

In general, for both cases (known/unknown) the following will be valid:

The CONN-C procedure will leave a repeat path as “-1” if a working one cannot be found. It does not distinguish between paths that have never been resolved vs. those that are newly unresolved. This is something the AMM can track.

In particular:

- If the CONN-C is running for the first time, then, in that case it sets the repeat path to -1 when it cannot reach the CE, as happens in the ACE proc.

- If the CONN-C run in other situation in the past and in case it cannot reach the CE after another attempt, then, it leaves for the master path the previous situation already existent (in the master path), while marks to another value (-2) the vice-master path, setting "usealt" (see PATH_ID) as master path.

In case of a “Stop Activity” command is sent during a CONN-C running, the concentrator shall suspend the current execution; then when it receives a “Start Activity” command, the CONN-C will continue the previous running from the break point.

7.3.3 Partial connection check Procedure (PCONN-C)

In relation to the DLC PROTOCOL value the concentrator can handle two different algorithm for PCONN-C procedure:

- DLC_PROTOCOL=0x00: ELPE algorithm for PCONN-C
- DLC_PROTOCOL=0x01: SITRED algorithm for PCONN-C
- DLC_PROTOCOL=0x02: M&M algorithm for PCONN-C

7.3.3.1 ELPE/SITRED

Having in mind the logic described for CONN-C (also for short/long messages handling), PCONN-C can work in two different scenarios:

- UNKNOWN TOPOLOGY: this procedure has to be run to compute unknown repeat paths. It is different from CONN-C only in that it does not re-compute all paths. Instead, it only attempts to resolve those that are still unknown. This can be used to try to finish work left undone by a CONN-C procedure that timed out, for example.

- KNOWN TOPOLOGY: this procedure can be run to compute unknown repeat paths. It attempts to resolve paths that are still unknown. It is used to process an enabled line of communication one time that has CONN-C requested via the T_LIN. It is also used one time when a line of communication belonging to an OK line is first detected to be KO by any line KO event generating procedure.

If a line is OK but has a KO section, CONN-R/C have to schedule PCONN-C only the first time the section is detected as KO.

Note: In case a “KO” condition occurs in one or more CEs, PCONN-C procedure must also behaves in the way described at subsection 4.4.3 of the present spec.

7.3.3.2 M&M

When for a meter, the NRN reaches the maximum, all the chain present in tab 121 will have ENABLE=2. The same thing for a meter not present in table 152 but present in table CE. All the meters with ENABLE=2 in tab 121 will be recovered via PCONNC. The ENABLE=2 is in every chain, but the PCONNC will rewrite only the chain number 3 in table 121.

There are two mechanism to work for PCONNC:

1. Meter already present in tab 152;

2. Meter not present in tab 152.

Case 1):

If a meter is already present in tab 152, the PCONNC starts trying to test a lot of paths taken from table 152. This number of chains tested (the PCONNC will stop at the first path that communicates with the target) is at most 10, but it is dynamic and it is possible to set this parameter in field #9 in table 50. Because of the mode to create paths (short, more recent or more quality but all as short as possible) it is possible to choose the algorithm writing field #8 in table 50. The parameter of this field is:

- 1 for shortest paths;

- 2 for quality paths;

- 3 for most recent paths.

Obviously the PCONNC will try to create the paths with best quality, or most recent, as short as possible. This choose is demanded to field-study. In laboratory we found the best path using mode 3, most recent path.

As soon as a meter is discovered with a path found looking tab 152, the PCONNC try short/long message and immediately write the new path into chain 3. The PCONNC finishes immediately when the meter is discovered again. The PCONNC, as the recovery, refresh all the table 152. Every WEIGHT POSIX and ToTCALL when a meter is reached are refreshed.

The algorithm to recreate paths tries a way and explores that. If there is a fail the algorithm studies the response and change, if possible, the meter who fails. In this way, the PCONNC doesn't try paths nonsense but uses a criterion to arrive better to the meter. If a meter is no reachable using the paths into table 152, the algorithm starts to search the target from scratch. In fact, the procedure in this manner is like the REC_CE. Starting from scratch it will search the target trying in direct mode and after that using repeaters. The discovery from scratch uses and tries all phases.

Also from scratch, as soon as the meter is reachable, after short/long message, the new path is inserted in chain 3 of table 121. The ENABLE = 1 and other rows will have ENABLE = 0.

Case 2):

This is the case when a meter is inserted in T_CE even if it is not found by recovery. When the meter is not present in table 152, the PCONNC does not have way to test paths. If the meter is not present in tab 152 it means the meter never appear in this concentrator, never seen it in table 51, then no PCONNC will be performed. It's impossible then to have meters in T_CE commissioned if this meter is not present in tab 152, then it's impossible to communicate with it via power line, no NRN will start the procedure for this meter. It's a simplification to highlight and reuse the strong effort done by recovery CE. A PCONNC over this type of meter will means to perform another REC_CE, then it's better to start with a real Recovery procedure that performs better using every meter in the network.

Note that with DLC_PROTOCOL=0x02 (M&M), the CONN-C procedure shall not be handle by the system.

For further details, see [33].

7.3.4 Reduced connection check Procedure (CONN-R)

To detect the trip (disconnection) of the lines managed by the concentrator. To detect the state of the switch along the distribution line, taking into account the communication results coming from the procedure (CONN-C). This procedure has to be booked for the detected line of communication.

This procedure is not used for unknown topology.

The CONN-R is a background procedure. On each invocation it processes or the first section- lines of communication or even the last section lines of communication, too, depending on the “CONN-R_FIRST_ONLY” bit in T_LIN, of all lines of communication with the following exception:

- Any KO line in an OK line is skipped.
- If the line is KO, only the first section-lines of communication are checked.
- If the line has CONN-R_FIRST_ONLY set in the table, then only the first section-lines are checked.

Any section-lines of communication that are not enabled are skipped.

Algorithm

TRANSMISSION of the message “READ.REQ (status-word)" to CExs of the first section with at least one CE connected on the lines of communication.

IF CE_{XS} of the first section does not answer request CONN-C for that lines of communication (if CE_{XS} (Master and Vice) of the first section does not answer CONN-C for that lines is requested. At the beginning of CONN-R we try to contact the CE_{CS}. If after the "LV_RETRY" value the CE_{CS} doesn't answer the F(RGCS)=0 is set on the B(ST_SEZ) for that lines of communication, so, we have to try to contact the CE_{VCS}. If after the "LV_RETRY" value, even this CE doesn't answer the F(RGVC)=0 is set on the B(ST_SEZ) for that lines of communication. If all the lines of communication are in the same condition, the section will be declared "not reachable", see F(ST_SEZ) and this condition means that probably a line disconnection is occurred. At this point, CONN-R is requested).

IF CExs of the first section does not answer request CONN-C for that line of communication.

ELSE (CEcs answers)

IF CExs of section has ONSI bit high (no time) set relative flag on B(ST_SEZ) and on Buf_CE; for that section next have to request SINC procedure.

ENDIF

ENDIF

REPEAT for all the sections immediately before boundary points in at least one of the line of communication under exam.

SEND message "**READ.REQ (status-word)**" to CExs of the section.

IF CExs of the section does not answer books (CONN-C) for that detected line of communication.

ELSE (CExs answers)

IF CExs of section has ONSI bit high sets appropriate flag of B(ST_SEZ) and of Buf_CE for that section's next SINC.

ENDIF

If the CExs of the first section did not answer on each detected line of communication, all the three lines of communication in the line are “KO”. If the flag “events enabled” is set = 1, then for that line are enabled KO events for the passage of the line from OK to KO or vice versa. In this condition, if enabled in T_TLC, the GB_SPONT_LIN_KO (019.003) has to be delivered.

CONN-R is only to check the sections that terminate electrical topology branches, not sections that terminate repeating topology branches. CONN-R will not necessarily find all sections that are out of communication, only those that have electrical failure.

7.3.5 CONN-R/ CONN-C scheduling

Taking into account what is defined in the T_LIN and in T_SEZ, it is necessary to fix the following concepts:

- an “enabled section” is one which is connected based on the topology and has F(INTR) set to 1.
- an “enabled line” is one which has at least one enabled section.
- the “first section-lines of communication “in a line of communication are those section- lines of communication that have CEs, and are first encountered when moving away from the bus bar in the line topology.
- the “last section-lines of communication “in a line of communication are those section- lines of communication that have CEs, and are first encountered when moving from the end of the line topology towards the bus bar.
- the “first testable section-lines of communication ” are either the “first section-lines of communication ” if there is at least one enabled section in the set of the first section-lines or it is any of the last section-lines of communication, if any are enabled.
- an OK line becomes KO if all section-lines tested by a line verification procedure (those described in the PCONN-C/R sections) are KO.
- a KO line becomes OK if any of the “first testable section-lines of communication ” become OK.

7.3.6 Partial CONN-R Procedure (PCONN-R)

PCONN-R, this is used to process an enabled line of communication one time that has CONN-R requested via the T_LIN. It is also used one time when a line is first detected to be KO by any KO event generating procedure (CONN-R or CONN-C). Note that this one time execution of PCONN-R occurs even if the line is not normally qualified for CONN-R.

7.3.7 Clock synchronisation Procedure (SINC)

This procedure aligns all the CE clock. As answer each CE sends the State Word.

The synchronisation procedure is possible only if concentrator is provided with temporal reference.

For this procedures the following cases can be encountered:

- bit ONSI high on one or more CEXS
- bit ONSI high on one or more CE

This procedure is applied when:

- to all CE belonging to the sections supplied from the same concentrator and for which has been highlighted ONSI bit high;
- the procedure is done singularly for specific CE.

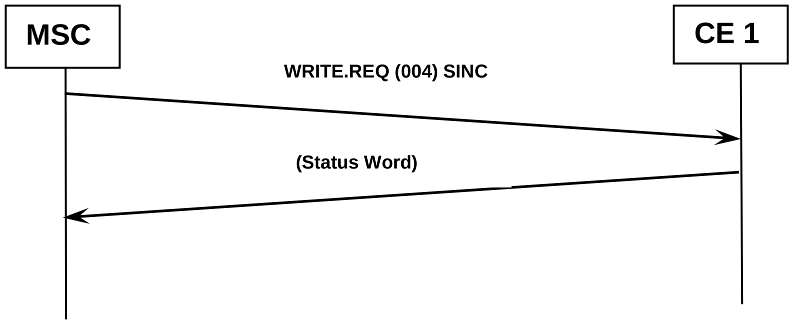
concentrator must send to involved CE the message WRITE.REQ (004) “SINC” (see ENEL DH 971K 2nd part) having as answer the Status Word.

If the difference of local clock is inferior to the maximum value admitted, CE aligns its watch, see ENEL DH 910K, otherwise synchronisation is not done and on CE the flag “not aligned watch” is activated (bit ORD on State Word).

<u>ASSOCIATED MESSAGES</u>

Transmission of date and hour **WRITE.REQ (004) SINC**

State Word as answer in normal format **Status Word**

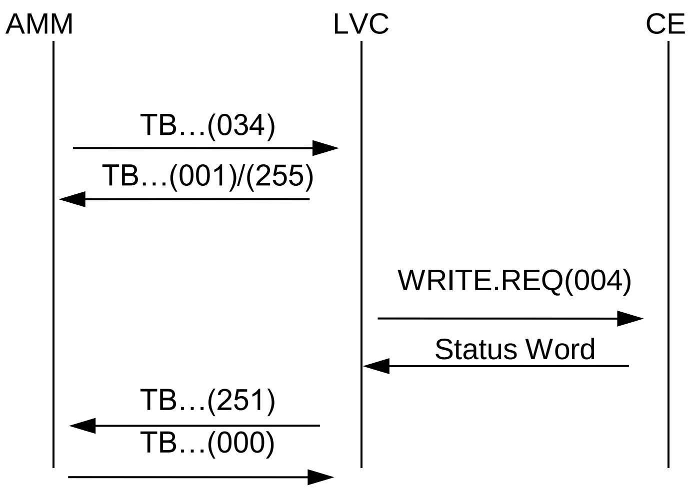


7.3.7.1 CE synchronisation by AMM (NSINC)

This procedure is requested by AMM with message TB_SINC.REQ (034).

Once received the request by AMM, concentrator must record transaction if it is correct, otherwise must send message TB…(255) to AMM.

Concentrator must send to CE message WRITE.REQ (004) requiring an answer; CE answers with Status Word. Upon reception of the State Word, concentrator considers that the transaction with CE is ended. If CE answers with a NACK message, the transaction has ended with a negative result and must be recorded in B-TRAPE.



7.3.7.2 CE synchronisation by AMM through access key (ASINC)

This activity has to be performed on CE that, due to have gone beyond the maximum temporal nonalignment admitted, (bit ORD of State Word high), cannot be synchronised with normal procedures.

The procedure is similar the previous one but it has access by key and it is subjected to a specific request by AMM.

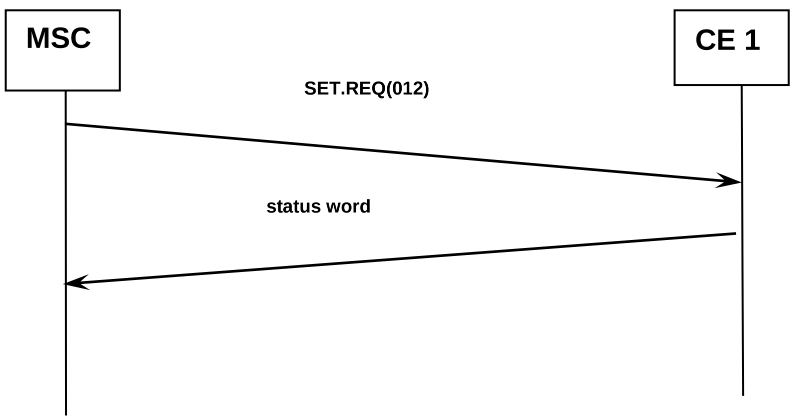
PURPOSE

Synchronisation in case of not alignment beyond allowed limit CE calendar/clock.

ASSOCIATED MESSAGES

Transmission of date and hour with access key **WRITE.REQ (104) SINC_AUT**

State Word as answer in normal format **status word**



7.4 IC UPDATING PROCEDURE

Updating of Customer interface must be executed with two different procedures:

- AG_IC “high frequency” procedure (about every 60 sec.) to supply IC with data oriented to load control (see ENEL DH 960K);
- AG_24 procedure, with lower frequency (about every 24 hours), to activate after BE and/or FATT procedure, finalised to transfer general consumption data on IC; e.g. consumption of previous day, counter for current and previous tariffs, etc.

The structure of two procedures is the same, there are differences only about type of transferred data and associated Time-out.

If CE has no answer from IC[26] the CE will respond with a CE NACK with the value "No answer IC".

In case of power-up, concentrator doesn't restart IC updating procedures, they are aborted.

If in the message IC-STATUS_WORD (251) coming from IC there are user alarm signalling, that are sent by CE to concentrator, they are transmitted to the AMM only in case of variation respect last signalling.

If concentrator has no answer from CE, it must store its condition. e.g. in NRN(t).

7.4.1 AG_IC Procedure (AG_IC)

By this cycle concentrator must acquire data from all CE associated with IC Customer Interface (CE table). The inquiry enables CE to dispatch its data to IC. It is possible in this way to transfer (to synchronise) to IC temporal parameters contained in tab. 62 (see ANNEX A at 14).

<u>PURPOSE</u>

IC updating with data coming from associated CE (relative to power, tariff bands, messages, etc.):

concentrator reads in the scheduling table AGST (defined in 9.1.3.3) which table CE must send to IC, and commands CE to send it.

Monitoring of necessity to dispatch inquiries, by IC, through analysis of IC State Word, finalised to gather information coming from Customers like:

[26] It is not necessary to associate to CE a time-out variable for answer from IC; it is sufficient a fixed time within which CE must receive IC address.

Data reading or alarms relative to services offered to Customer

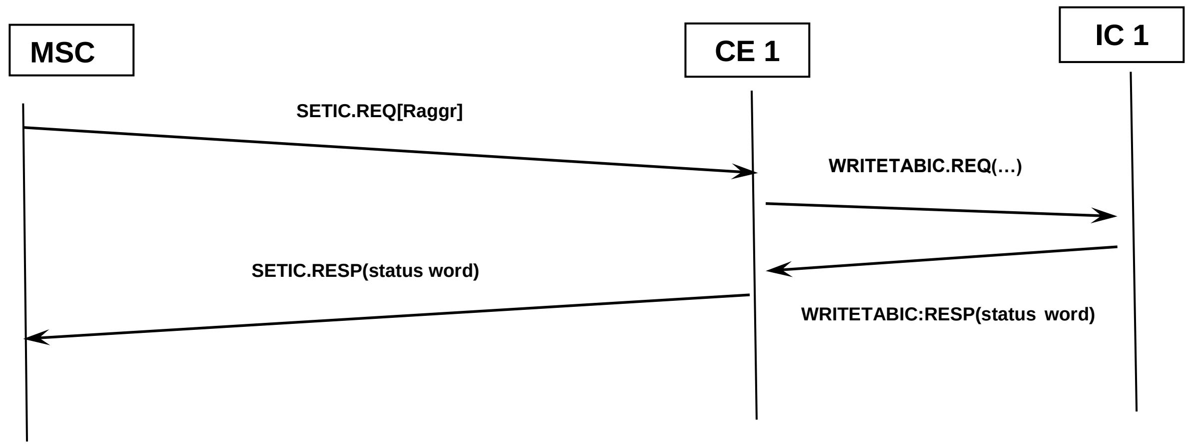
Data reading transmitted by Customer.

Necessity check to send IC more updating information after the IC power fail; this check must be done through analysis of IC State Word.

ASSOCIATED MESSAGES

Enable transmission data to IC	**SETIC.REQ (040)[Raggr]**[27]
Transmission of selected data from CE to IC	**WRITETABIC.REQ (042)(…)**
Generic answer from IC to CE	**(status word)**
Answer to concentrator after IC updating end	**(status word)**

Example of IC updating with AGIC procedure



7.4.2 AG_24 Procedure (AG_24)

By this cycle concentrator must acquire data from all CE associated with IC Customer Interface (CE table). The inquiry message enables CE to transmit data to IC; this procedure is similar to AG_IC except for type of data and quantity of data to transfer.

[27] parameter ”Raggr” spots set of data to transfer on IC.

Concentrator reads in the scheduling table AGST (defined in 9.1.3.3) which table CE must send to IC, and commands CE to send it.

ASSOCIATED MESSAGES

Enable transmission data to IC	**SETIC.REQ (040)[Raggr]28**
Transmission of selected data from CE to IC	**WRITETABIC.REQ (042…)**
Generic answer from IC to CE	**(status word)**
Answer to concentrator after IC updating end	**(status word)**

IC updating example with AG_24 procedure is the same as procedure AG_IC.

7.5 ENERGY BALANCE PROCEDURE (BE)

PRELIMINARY

In CE Table has been defined the CE-BE (meter installed in secondary substation).

concentrator must transmit, to each CE the message READ.REQ [eT(g-gp), or READTAB.REQ (006)

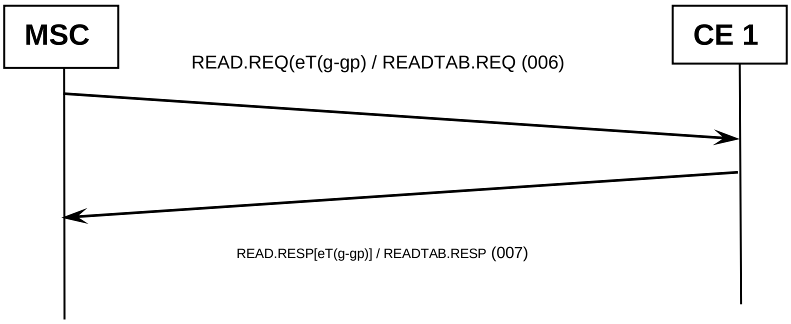
The parameters to inquiry are:

- State Word
- Energy consumption of the previous day eT(g-gp).

As answer, CE must transmit message READ.RESP [eT(g-gp)], or READTAB.RESP (007) in which it provides information relative to previous day consumption.

For all CE is executed:

[28] By the A parameter, data to transfer on IC are spotted.



ASSOCIATED PROCESSINGS:

At the end of the procedure, concentrator must store in a buffer all readings of CE and must execute Σ_n eT(g-gp) of all the reached CE, except for CE-BE; concentrator must update the array of variables

B-valid-n with the following criteria:

- B-valid_0 = 1 if all CE are reached by BE procedure
- B-valid_1 = number of CE not reached by BE
- B-valid_2 = number of CE with diagnostics in alarm
- B-valid_3 = 1 if CE-BE is with diagnostic in alarm
- B-valid_4 = 1 if BE procedure is not concluded (e.g. power fail)

For each CE, concentrator must perform all RAGG updating in BUFF_CE.

On request of AMM, (or by spontaneous if enabled), concentrator sends back the eT(g-gp) value of CE-BE, the Σ_n eT(g-gp) of all the CE and B_valid indicators.

7.6 IDENTIFICATION PARAMETERS PROCEDURE (IDEN)

The programming shown in this section have to be done using an authentication mechanism via password[29]

The AMM can require concentrator the following programming for CE:

• Programming/elimination IC address (in CE):	msg TB	
• Billing period identification parameters:	msg TB	PFATT.REQ (010)
• Supply contract identification parameters:	msg TB	(010)
• Customer identification and contract end:	msg TB	CESCONT.REQ (004)
• Public holiday :	msg TB	FESTINFRA.REQ (010)
• Data transfer, start/end daylight saving time to CE:	msg TB	DAYTIME.REQ (010)

The concentrator, once received the AMM request, must record transaction in BTRAPE.REQ and must dispatch to CE WRITE.REQ (or WRITETAB.REQ) messages, for programming. Example:

- Programming/elimination IC address:
- CE data programming for IC:
- Billing period identification parameters:
- Supply contract identification parameters:
- Customer identification and contract end:
- Public holiday:
- Data transfer, start/end daylight saving time to CE.

Anyway, if the CE has correctly programmed the parameter, it answers with the State Word message.

If concentrator receives a NACK from CE, the transition ends with a negative result.

[29] Authentication with MD5 algorithm

7.7 LOAD SHEDDING PROCEDURE (ALCA)

The AMM has to send to the concentrator the load modulation request TB…ALCA.REQ (040). Concentrator must memorise the request. The request can be of reduction (K<1) or restoration (K=1) with parameter TK=1.

CE belonging to Customers that cannot be “demand reduced” (CANNOT BE DISCONNECTED – see flag “DISI” meaning in tab. 13 of ENEL DH 910K) even after reception of the relative message, don’t do “load reduction” and answer with NACK.RESP for not manageable message.

At the end of the procedure (reduction or restoration) a transaction end message is sent to the AMM (if spontaneous is enabled).

Any procedure is required from concentrator for power-fail management about this activity.

To each of reachable sections CE, concentrator must send the message WRITETAB.REQ (110) for "load reduction", using as repeaters the respective CEcs.

For K restoration [required by the AMM with message TB…(040)], concentrator must send to each CE the message WRITETAB.REQ(110) with new value for K.

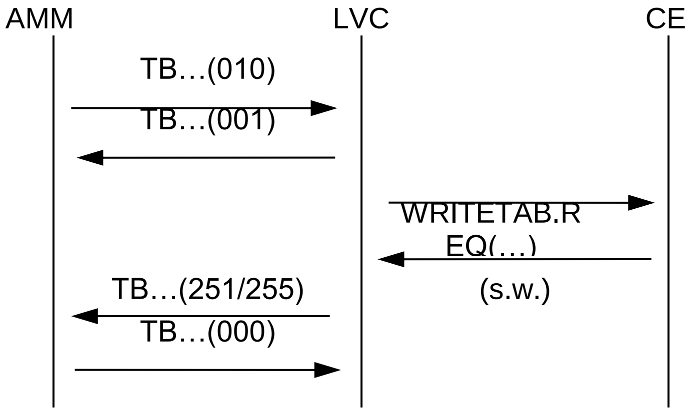
The transaction must end with the message TB…(251) with result =OK or TB…(255).

7.8 BAD PAYER PROCEDURE (PKM)

Concentrator, once received the request by the AMM with message TB_KMOR.REQ (010), must record the transaction.

Concentrator, to perform K variation, must send to CE the message WRITETAB.REQ (110) with TK = 2.

With reception of status word message by concentrator, the transaction towards CE is ended. If CE answers with a NACK message, transaction finishes with a negative result.



7.9 DISPLAY OF MESSAGES PROCEDURE (MESS)

The procedure is requested by the AMM and it differs according the type of message (fixed or variable content).

7.9.1 Display Message for single CE

The AMM sends concentrator the request with message:

TB…MESSAC.REQ (010)/(004)

TB_MESSAR.REQ (010)/(004)

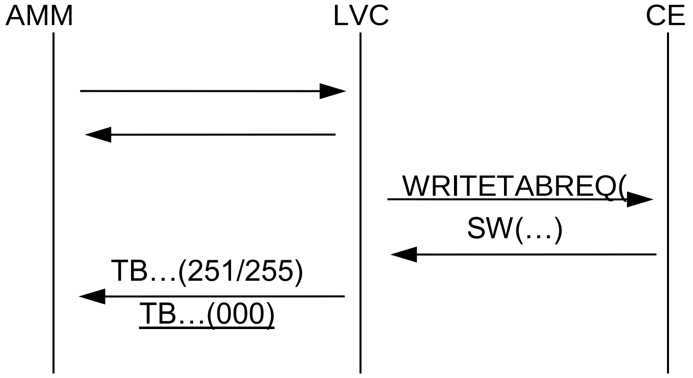
TB_MESSP.REQ (010)/(004)

TB_DISPLAY.REQ (010)/(004).

Concentrator, once received the AMM request, must record the transaction B(TRAPE.REQ).

Concentrator must dispatch to the CE - identified by the AMM - the WRITETAB.REQ (110)/(104) message for display.

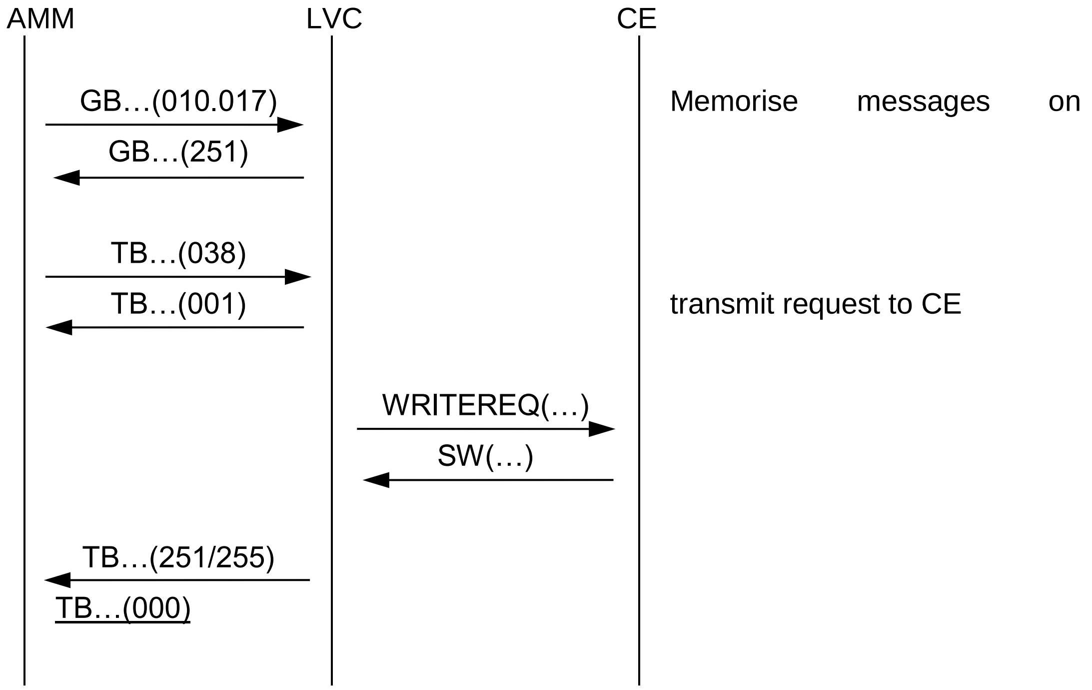
On reception of the Status Word message from the CE, concentrator must send to the AMM a message of transaction end with result.



7.9.2 Display Messages in the B_MESS

The AMM has to send to the concentrator a message GBWRITETAB_(MESS).REQ (010.017) containing the string of characters to be displayed. Concentrator must memorise the string in a dedicated memory area (B_MESS)..The AMM sends concentrator the request [TB…MESS.REQ (038)] to transmit memorised string towards CE. Concentrator, on request by the AMM, has to record the transaction. Then concentrator must send to the CE - identified by the AMM - the WRITE.REQ (004) message for the display with a variable contents requiring an answer.

At transaction completion, concentrator must transmit to the AMM a transaction end message.



7.10 GQBT-I Procedure (GQBT- I)

This section describes implementation and design of the concentrator procedure for the quality management of the electrical low-voltage network. The procedure must point out and archives inside the concentrator, information related to the voltage interruptions happened on the points of energy delivery and recorded on the individual single-phase or poly-phase CE. These information will be available to the central system (AMM) through the FTP channel. The procedure has to be compatible with two different kind of meter.

7.10.1 Description

For every CE is defined a FLAG to enable/disable GQBT-I procedure. For this procedure, bit 11 of the T_CE.IC_F(PROC) is used. This register has been renamed as VAS_F(PROC). The register has to be used with the conventional meaning shown. The structure, in which 10 bits are already allocated, will expect 11 bits (LSBs) allocated for IC and the remaining 4 for CE.

VAS_F(PROC)							Meaning
…	**b11**	…	**b3**	**b2**	**b1**	**b0**	
…	1	…	…	…	…	…	Enable CE to GQBT-I procedure
…	0	…	…	…	…	…	Disable CE to GQBT-I procedure

The handling of the bit 11 is in charge of the AMM, both for setting or resetting.

The procedure has to be able to point out the voltage interruptions with reference to temporal planned periods. The entire acquired period has to be saved in accordance to a defined format inside a ".dat" file.

For punctual relieves (ranks of some interruption), this activity is guided by AMM by mean the conventional TB procedures.

Due to the limited number of interruptions storable in the CE, it is necessary the procedure to acquire periodically these events with programmable scheduling.

The procedure has to queue the new events to those previously acquired inside of a different file for every CE.

Amplitude of the temporal interval to be acquired is specified from the parameter 'INTERVAL' sized 1 byte, having the meaning showed.

INTERVAL	Meaning
7	Interruptions occurred on a period of 7 days from the 1st day of the month and at ACTIVATION INSTANT(included) time stamp, have to be acquired

15	Interruptions occurred on a period of 15 days from the 1st day of the month and at ACTIVATION INSTANT(included) time stamp, have to be acquired
≥31	Interruptions occurred on a period of a whole month and at ACTIVATION INSTANT(included) time stamp, have to be acquired

ACTIVATION_INSTANT is the register found in T_PRI on the concentrator

Meaning of MIN ACTIVATION and MAX ACTIVATION parameters in T_PRI falls off for GQBT-I implementation and shall not be considered. ENABLE/DISABLE and PRIORITY registers have the meaning as usual.

It is defined an F_DETECT register, that indicates number of times inside of the period specified by INTERVAL in which the procedure has to be activated. The F_DETECT activations has to be distributed in the period of acquisition and has to be memorized in a non-volatile support, with requirement that the first activation has to happen the first day of the month and the last acquisition has to happen within a day from the expiration period. The acquisition begins to run at the time defined by 'ACTIVATION INSTANT' and subsequently, at the date calculated across F_DETECT. This means F_DETECT can have a minimum value equal to 2. If the procedure remains enabled, it re-starts a new period the 1st day of the next month. In the particular case of F_DETECT=2 the procedure starts only two times, the 1st day of the month and the day after the INTERVAL period expires. At the expiration of INTERVAL period all the files will be marked as 'closed' and no access will be allowed during the successive scheduling. In case of procedure with monthly INTERVAL, the opening has to happen always simultaneously and subsequently to the closing. CEs for which CPY_F[GQBT].i=1 have to be acquired.

<u>Example:</u>

Concentrator DATE 28.02.03

INTERVAL=31(monthly)

F_DETECT=4

ACTIVATION INSTANT=03:00

Let say, GQBT-I procedure first cycle to be starting at the 03:00 in date 01.03.03.

For the month for which is scheduled the acquisition there should be expected 4 cycles of acquisition fairly distributed in the period (e.g. every fix (31/4) =7 days) the last of which, the day after the expiration, that is 01.04.03 at 03:00.

Because the last activation is scheduled for the successive day with reference to the real one period, a filter is expected on the interruptions that fall outside it.

A spontaneous of 'procedure end' has to be placed at conclusion of an activation

[GB_SPONT_PROC_END(019.007), Proc Id=0x10, reason code 1].

A byte that indicates a progressive number useful in case of multiple activation of GQBT-I (see chapter 6.12.3) is expected and saved in a permanent memory support. Date of the last executed activation has to be memorized, as well.

In case of concentrator clock synchronization or others operation (see section 6.12.3.3) all of the files in course of acquisition, already 'open', have to be closed.

A spontaneous of 'procedure end' should be delivered at conclusion of a cycle if at least a file was 'closed'. This means to define a dedicated field in T_TLC for enabling/disabling spontaneous call-back.

NOTES: it is understood the single-phase/poly-phase CE handling, even if hereinafter not showed. For this purpose bit 3 of CESTATE of concentrator CE table with the meaning mentioned on this specification, has to be used.

The procedure has to be able to store in a state field the following anomalies:

- Case of empty file/CE never reached
- Cases of no answer or answer not correct from the CE
- Case of double closing of billing period happened between two activation (if required)
- Case of lost interruptions.
- Case of aborted procedure

Independently from the anomaly, for every CE involved in the GQBT-I always has to be produced a file according to the required format containing at least the ADCE identifier and the description of the anomaly if it exists.

AMM after the file has been read, should delete it from the file system.

7.10.2 General modality for acquisition

Below are described the main steps by mean GQBT-I must acquire the interruptions.

GQBT-I procedure has to be able to work according with two different CE Tab. 19 meters implementation P520/T520 and MM520. The P520/T520 meter stores the interruptions in two separate logs (current implementation), one for the “previous”, one for the “current” billing period. The MM520 meter stores interruptions in a single log, regardless previous or current billing period, using for it the “current” and “previous” interruption log registers as indicated. Notice that for both cases the CE still maintains counters of current and previous interruptions but the MM520 implements also a unique global interruption counter, sum of all type of interruptions not related to previous or current period. Both the described CE implementations could coexists under a given LV network.

In order to differentiate the two CE implementations, the concentrator has to checks the value of CS/VCS of Tab. 04 (T_CE) set by AMM during the commissioning phase:

Bit 7	Bit 6	Meanings
0	0	P520/T520 Meter
0	1	MM520 Meter
1	0	Available
1	1	Available

By reading the bit 6 and 7 of CS/CSV the concentrator has to virtually divide the network in two sub-network based each on the kind of CE installed (P520/T520 meter or MM520 one) and execute in parallel (or one procedure subsequently to the other), two different GQBT-I procedure GQBT-I_P520/T520 and GQBT-I_MM520 procedures on them. During the execution, the concentrator has to maintain two different setup, one for each GQBT-I procedure.

For each meter enabled to the GQBT-I procedure:

- If bit 6=0 and bit 7=0 then execute GQBT-I_P520/T520 procedure
- If bit 6=0 and bit 7=1 then execute GQBT-I_MM520 procedure

7.10.3 GQBT-I P520/T520

The procedure starts the 1st day of the month at the time specified by ACTIVATION INSTANT. At the start, N files one for every enabled P520/T520 CE to the procedure in IC_F(PROC).[GQBT_I] have to be created. Such files will result as ‘open’, initialized with default parameters (defined later) and with progressive equal to #PROG.

- It is carried out the copy of IC_F(PROC).[GQBT_I] in CPY_F[GQBT]
- If CPY_F[GQBT]=0 go to point 9
- Read the ‘End Billing Period’ value in the CE table 11

- Read NAVV, NLOV, NSHV, NTVD values from the CE table 19 for the current and the previous period and compute the sum. Handling for poly-phase case has to be expected.

- If it is the first reading (CE never reached or no interruption pointed out) then the current pointer to the CE interruptions log has to be calculated. Try to read the available interruptions from a period between start of procedure date-time and now , save them, update COUNT_INT_x , then go to the point 9

- If a closing of billing period is detected on the CE, then check if new interruptions have occurred in the previous period, read at them and update COUNT_INT

- Check if new interruptions have occurred in the current period, read them and update COUNT_INT_x

- If the acquisition period is ended, 'close' the current file

- If it is not the last one, go to the next CE and then to the point 1, otherwise the cycle is ended

7.10.4 GQBT-I MM520

The procedure starts the 1st day of the month at the time specified by ACTIVATION INSTANT. At the start, N files one for each enabled MM520 CE in IC_F(PROC).[GQBT_I] have to be created. Such files will result as in 'open' state, initialized with default parameters (defined later) and with progressive equal to #PROG (for #PROG means see chapter 4).

- It is carried out the copy of IC_F(PROC).[GQBT_I] in CPY_F[GQBT]

- If CPY_F[GQBT]=0 go to point 7

- If it is the first reading (CE never reached or no interruption pointed out) then the current pointer to the CE interruption log has to be calculated. Try to read the interruptions available from a period between start of procedure date-time and "now", save them update COUNT_INT, then go to the point 7

- Read the TOTAL_INT_x number of interruptions(x=R,S,T)

- Checks if new interruptions are present in the interruption log, read and save them. update COUNT_INT_x

- If the acquisition period is ended, 'close' the current file

- If it is not the last one, go to the next CE and then to the point 1, otherwise the cycle is ended

COUNT_INT register is the counter of interruptions stored in the output file for each phase (see the File format chapter) and it is used by central system (AMM) to understand the right number of rows of the logs interruption inside the file in case of poly-phase CE.

7.10.5 Case of no correct or no answer from the selected CE

As already mentioned, at each invocation of GQBT-I, a copy of IC_F(PROC).[GQBT_I] in CPY_ F[GQBT] for all the CEs in T_CE has to be done. A register PROC_RETRY sized 1 byte, indicates the number of times the procedure has to “cross again", after the default attempt, the CE still enabled that had a not correct or a missing answer. For example if PROC_RETRY=3, in total 4 max attempts should be carried out for reading the CE that didn’t answer correctly. These attempts has to be carried out after every entire reading cycle, independently from the table T_ATT L4_retry field.

It has to be followed the logic within the same activation:

1. In case of correct answer from the CE, CPY_F[GQBT]=0 and the CE will no longer be acquired with respect to the current activation.
2. In case of not correct answer, if PROC_RETRY>0 the procedure skips to the next CE leaving unchanged CPY_F[GQBT_I] value, otherwise if PROC_RETRY=0, GQBT_StW[3]=1 to indicate the anomaly. Go to the next CE.
3. At the end of the cycle (on all CEs)

   If PROC_RETRY>0, PROC_RETRY must be decremented and an entire cycle of readings is done again for the CE/interruptions not yet acquired,

   Otherwise if PROC_RETRY=0 the procedure closes the acquisition in course.

It is possible to send a spontaneous of ‘procedure end’ when PROC_RETRY=0.

7.10.6 Reset or concentrator Power Fail/Stop

In case a Reset, Power Fail or Stop Activity of the concentrator occurs when GQBT-I has already began an acquisition period (exist some ‘open file’), at the Power-up/Start some operations of restoration to avoid proliferation of files not congruent in the file system have to be expected.

In case during the Power down/Reset/Stop activity, T_DOWN hours are spent, or during the Stop activity parameter such as

- GQBT-INT Enable/Disable state
- GQBT-I table

It has changed, at Power-up/Start the current procedure is aborted, the CPY_F[GQBT] table of activation is deleted and all the files currently 'open' will be 'closed'. In this case the state word on the file and the spontaneous of 'procedure end' has to remark such anomaly condition [GB_SPONT_PROC_END (019.007), Proc Id=0x10, reason code 1 – bit 4=1 GQBT-I status word]. For the next month GQBT-I procedure (if enabled) starts normally.

In case that during a Power Fail/Reset/Stop Activity some activations are skipped, at the Power Up/Start if T_DOWN hours are not yet spent, the procedure must not start, but has to wait the next activation to collect entire not yet read period. If TDOWN=255 procedure doesn't take care of this timer after the Power-up/Start activity. In case of change to the register IC_F(PROC).[GQBT-I] when the procedure is active (i.e. there are opened files), shall not produce the abort of the procedure, regardless the change involves CEs referenced by the current activation or not. The changes to the register will be activated only at the next activation and not in the current (for example, monthly procedure, activation in April, change on April 14th, the changes will be effective in the next activation in May)

In case of CE "decommissioning" when the procedure is active (i.e. there are opened files), shall not produce the abort of the procedure, regardless the "decommissioning" involves CEs referenced by the current activation or not. In case the "decommissioning" involves CEs referenced by the current activation, the corresponding files will have to be closed signalling the condition through setting the bit 4 of GQBT-I status word to 1.

In case the GQBT-I procedure is active (for example, monthly activation, never ending periodicity) and the concentrator time reference is changed by local or by remote, the procedure must not abort and some operations need to be considered at the next activation depending on whether concentrator clock is moved in advance or in the past, with some subcases.

- If the concentrator clock is moved in advance but internally the "INTERVAL" period, the procedure must not abort and, at the next activation within the "INTERVAL" period, it will collect all the interruptions happened since the last activation (so no change is requested to current implementation except not aborting the procedure).

- If the concentrator clock is moved in advance but outside the "INTERVAL" period (for example monthly), the procedure will work as already described before for GQBT-I table. As an example, in case of procedure activation on a weekly base (1…7 of the current month) a change of time reference from 5 to 9 of the current month will produce the closing of the current opened file and sending of a spontaneous.

In case the GQBT-I procedure is active and the time reference is changed in the past further subcases are proposed:

- The concentrator clock is moved to a date earlier than the start date of the current active period (example monthly acquisition period, current date 23.10.2011, change of the date to 25.09.2011). The procedure must be aborted, the opened files must be closed and the 4th bit of the GQBT-I status word in the file must be set to 1 to signal the condition. At the next activation date, the procedure will restart with a new activation on new files.

- The concentrator clock is moved to a date earlier but after the start date of the current active period (example monthly acquisition period, current date 23.10.2011, change of the date to 05.10.2011). The procedure must not be aborted. At the next activation within the “open” period, in order to prevent possible misalignment of its RTC in respect to those of CEs on which the procedure is enabled, the concentrator shall only acquire those that are within the previous activation and the current one.

Activation of the procedure is executed only if date-time of activation has elapsed when the concentrator was in power-up state.

If the last activation of a period is skipped then at the Power-up/start the concentrator schedules both completion of the old period and closing of the ‘open file’ to be executed at the next (new) activation. At the next activation (new period) concentrator try to complete the previous period and to close the ‘open file’. If at the next activation concentrator is still in power-off/stop state again then at Power-up/start the procedure has to re-scheduling both completion and closing of the ‘open file’.

E.g. GQBT_I is scheduled with INTERVAL=15 F_DETECT=2 it starts e.g. (01.07.07 and 16.07.07) then a new period so new files the (01.08.07 and 16.08.07).

If the activation in the data 01.07.07 is skipped, then at the activation of 16.07.07 file are created, period is read, the files are closed.

If the activation of 16.07.07 is skipped (but not 01.07.07) then at the new period (01.08.07) open files are completed (period from 01 to 15.07.07) and closed. At the same time a new period starts so a new group of “open” files have to be created and data read.

Independently from the previous condition, it should also be expected a file rollback mechanism in case at the moment of the Power Fail/Reset/Stop is running an acquisition on a file.

7.10.7 GQBT-I Parameters

To set independent the current implementation from the CE memory amount allocated for the interruptions, it has to be possible to parameterize the number of interruptions available in the CE log, by means of the register LOG_ROWS sized 1 byte.

Furthermore, to set the elaborations of the pointer independent from the logical structure of the CE, logical addresses of Start and End of the interruptions log have to be parameterized. For this purpose 6 new registers, S_LOG_R, S_LOG_S, S_LOG_T, S_LOG_R_p, S_LOG_S_p, S_LOG_T_p are defined.

These registers identify the start address of log respectively for the phase R, S, T, for the current and previous period and have to be used with the ‘offset’ P_LOG_x_registers during the reading of Tab.19. Because the memory amount allocated for log (R, S, or T) is the same, it is sufficient to add the quantity LOG_ROWS to know the logical end address for each log. E.g. if S_LOG_R=0x1317 and LOG_ROWS=0x0A, the end address will be equal to

E_LOG_R=S_LOG_R+LOG_ROWS-1=0x1320

Same for E_LOG_S, E_LOG_T and for current and previous period

Note that for the new MM520 meter implementation the two period log, current and previous, represent jointly the entire buffer interruption (no current and previous need to be distinguished in the MM520 case) with the following logical structure:

S_LOG_x	Interruption Log entry #1
S_LOG_x+1	Interruption Log entry #2
S_LOG_x+...	Interruption Log entry #...
S_LOG_x+LOG_ROWS-1	Interruption Log entry #10
S_LOG_x_p	Interruption Log entry #11
S_LOG_x_p+1	Interruption Log entry #12
S_LOG_x_p+...	Interruption Log entry #...
S_LOG_x+LOG_ROWS-1	Interruption Log entry #20

Summarizing what above described, the new table GQBT-I will be structured as shown.

Tab. 39 - GQBTI Table

Field ID	Field Name	Size	Meaning
0x27000101	INTERVAL	1	Acquisition period of GQBT (monthly, weekly, bi-weekly)
0x27000102	F_DETECT	1	Number of expected GQBT activation within INTERVAL (2, at least)
0x27000103	PROC_RETRY	1	Number of times that procedure has to be repeated, within the same activation (default=0x02, see the document)
0x27000104	LOG_ROWS	1	Number of max interruption logged by CE per phase (default=0x0A)
0x27000105	S_LOG_R	2	Logical address of START log -phase R, current period (default=0x1317)
0x27000106	S_LOG_S	2	Logical address of START log -phase S, current period (default=0x1357)
0x27000107	S_LOG_T	2	Logical address of START log -phase T, current period (default=0x1397)
0x27000108	S_LOG_R_p	2	Logical address of START log -phase R, previous period (default=0x1337)

Tab. 39 - GQBTI Table

Field ID	Field Name	Size	Meaning
0x27000109	S_LOG_S_p	2	Logical address of START log -phase S, previous period (default=0x1377)
0x2700010A	S_LOG_T_p	2	Logical address of START log -phase T, previous period (default=0x13B7)
0x2700010B	T_DOWN	1	Number of hours of power down/stop that induces open file to be closed (default=0xFF). For special value 0xFF see the document

It is understood that 'default' are intended value written in flash memory during manufacturing process. Empty values have to be write as default during the boot of system in case of upgrade of the concentrator SW with implemented the GQBT-I procedure.

7.10.8 File name

The file name must have the following format ('&' concatenation operator) and extension

- File Completed ('Closed')

"GQI"& T & NEURON_ID & "_" & DATE & "_"& #PROGR& ".dat"

- File under acquisition ('Open')

"_GQI"& T & NEURON_ID & "_" & DATE & "_"& #PROGR& ".dat"

Where:

- **T** → CE type 'S' or 'P' (Single-phase, Polyphase);
- **DATE** → (Theoretical) Start date of the acquisition period;
- **#PROG** → a "zero based" counter sized 1 byte used for files distinction in case of presence of files referred to the same CE, on different periods. In case of overflow the counter begins again from 0. It is suitable that central system (AMM) handles the file system in order that for the same CE would not exist two identical #PROG, even if distinguished by the DATE field, even if this condition is rare to happen.

Files having the same detection date have to be compressed using the 'gzip' method and archived in the 'tar' format, having in mind that the maximum number of files in each meta-file is 103. The maximum number of meta-file is 25. After this, the result filename is in the follow:

"GQI" & DATE & "_" & #PROGR2& ".tar.gz"

Where:

- **#PROGR2** → progressive number “zero based” to be incremented each N files members of the same detection date.

Example of 5 enabled CEs that had 3 complete periods of GQBT-I of which the last it is in course of survey:

GQI010902_0.tar.gz file with inside:
GQIS000234439932_010902_1.dat
GQIS000205365464_010902_1.dat
GQIS012324324323_010902_1.dat
GQIP000234223999_010902_1.dat

GQI011002_0.tar.gz file with inside:
GQIS000234439932_011002_2.dat
GQIS000205365464_011002_2.dat
GQIS012324324323_011002_2.dat
GQIP000234223999_011002_2.dat

_GQIS000234439932_011102_3.dat
_GQIS000205365464_011102_3.dat
_GQIS012324324323_011102_3.dat
_GQIP000234223999_011102_3.dat

Files must be saved in the concentrator directory “/disk/ftp/pub/gqbti”

7.10.9 GQBT-I File Structure

The files generated by GQBT-I must be structured as shown. Note that a different record format for single-phase and poly-phase CE is shown.

Field Name	Size	Meaning
NEURON_ID	6	
LVC_DT	6	LVC Date Time
INTERVAL	1	Period of acquisition
GQBT_ST_W	1	GQBT state word
END_BP_DT	6	Date-Time of the last End Billing Period (if required)

SUM_R*	2	Number of interruptions+power fail current period (phase R for poly-phase only)
P_LOG_R	1	Pointer at the CE current log interruptions -phase R
SUM_S*	2	Number of interruptions+power fail current period-phase S (poly-phase only)
P_LOG_S	1	Pointer at the CE current log interruptions-phase S
SUM_T*	2	Number of interruptions+power fail current period- phase T (poly-phase only)
P_LOG_T	1	Pointer at the CE current log interruptions -phase T
COUNT_INT_R	1	Global number of interruptions+power fail (phase R for poly-phase only) in the “interval” period
INT_LOG_R	N1	Interruptions/power fail log phase R (Time, date and duration)
COUNT_INT_S	1	Global number of interruptions+power fail on phase S (poly-phase only) in the “interval” period
INT_LOG_S	N2	Interruptions/power fail log phase S (Time, date and duration, (poly-phase only)
COUNT_INT_T	1	Global number of interruptions+power fail on phase T (poly-phase only) in the interval period
INT_LOG_T	N3	Interruptions/power fail log phase T (Time, date and duration, (poly-phase only)

LVC_DT is the date when the most recent data was collected.

PLOG_x is a pointer that specify the next row on the CE interruptions log that concentrator will read, at the present or at the next activation (see flow-chart). The file is used to memorize temporarily this value but, for AMM side, the pointer has not meaning when the file is received.

SUM_R, SUM_S,SUM_T, are used only for service purpose and corresponding to the sum of registers NAVV_x+NLOV_x+NSHV_x+NTVD, in case of T520 procedure, instead correspond to the TOTAL_INT_x interruption register from Tab.19 in case of MM520 procedure (‘x’ is indicative of phase R, S, T).

As before specified, COUNT_INT register represents the interruptions counter occurred in the INTERVAL period for each phase and it is used by the central system (AMM) to understand the right number of rows inside the logs interruption file in case of poly-phase CE.

7.10.10 GQBT-I State Word

Shown is the structure of the State Word that is associated to every file of GQBT-I

#bit	Value and meaning
0	Available
1	1 -Empty file/ CE never reached
2	1 -Interruptions loss
3	1 -Some responses not occurred
4	1 -Procedure aborted
5	Available
6	1 -Double ‘End BP’ occurred
7	Available

For additional detail and flow chart see “DMI 0 33015 II GQBT-I CBT MM520”

7.11 GQBT-V Procedure (GQBT- V)

This section describes the implementation and the design of the concentrator procedure for the quality management of the electrical low-voltage net voltage variations. The procedure must point out and to file inside the concentrator, information relative to the voltage variation happened on the points of energy delivery and recorded on the individual single-phase or poly-phase CE according to the set values inside the CE. These information will be available to the central system (AMM) throughout the FTP channel.

7.11.1 Description

For every CE is defined a FLAG to enable/disable GQBT-V procedure. The bit 13 of the tabCE.IC_F(PROC) register is used with the conventional meaning shown below. This register is named as VAS_F(PROC) in this version. The structure, in which 10 bits are already allocated, will expect 12 bits (LSBs) allocated for IC and the remaining 4 for CE

VAS_F(PROC)							Meaning
…	**b12**	…	**b3**	**b2**	**b1**	**b0**	
…	1	…	…	…	…	…	Enable CE to GQBT-V procedure
…	0	…	…	…	…	…	Disable CE to GQBT-V procedure

The handling of the bit 12 is in charge of the AMM, both for setting or resetting.

Two register are defined in dedicate concentrator structure, PVT sized 1 byte and START_DATE sized 3 bytes. The procedure is able to point out voltage variations with reference to temporal periods explained in days by PVT.

The acquisition starts at the time specified by ACTIVATION_INSTANT found in T_PRI, when concentrator DATE is equal to the date made adding multiple of PVT to the START_DATE.

If ACTIVATION_INSTANT=00.00.00 GQBT-V must run immediately, regardless what above mentioned. The procedure starts one times only in this particular case.

The follows registers from previous log area of CE Tab.20 for single-phase or poly-phase type of CE are collected (for all phase):

ΣVT_KO	ΣVT_OK	Vmin	Vmax

All the acquisitions come out from enabled CEs, are saved in accordance to a defined format inside a single ‘gzip’ compressed file.

Meaning of MIN ACTIVATION and MAX ACTIVATION parameters in T_PRI falls off for GQBT-V implementation and shall not be considered. ENABLE/DISABLE and PRIORITY registers have meaning as usual.

Example:

PVT=7 (weekly) from GQBT_V table

START DATE=01.01.01 from GQBT_V table

LVC DATE= 07.02.03

ACTIVATION INSTANT=03:00.00 from T_PRI table

Let say, GQBT-V procedure scheduling date are:

Date	Time
10.02.03	03:00.00
17.02.03	03:00.00
24.02.03	03:00.00
03.03.03	03:00.00
10.03.03	03:00.00
…	…

A byte that indicates a progressive number useful in case of multiple activation of GQBT-V) is expected and saved on permanent memory support.

A spontaneous of 'procedure end' has to be placed at conclusion of a activation [GB_SPONT_PROC_END (019.007), Proc Id=0x19, reason code 1].

The procedure has to be able to store in a state field anomalies regarding not reachability state of CE. For this purpose a RAG field sized 1 byte inside the file is used with values

RAG=1 in case of CE reachable

RAG=0 in case of CE not reachable

For poly-phase CE case, RAG=1 means that one phase has been read at least.

In any case, for every CE involved in the GQBT-V a record is produced according to the required format containing header parameters consisting in START_DATE, PVT, LVC DATE TIME and for each row the ADCE and RAG (default=0) field. For example if PVT=7, stored LVC DATE TIME indicates at the file reader, that the file contains the past week period concluded at the LVC DATE-1.

AMM after the file of profile reading, should to delete this from the file system.

7.11.2 Case of wrong or no answer from the selected CE

A register PROC_RETRY sized 1 byte, indicates the number of times the procedure has to “cross again", after the default attempt, the CE still enabled that had a wrong or missing answer. For example if PROC_RETRY=3 in total 4 max attempts should be carried out for reading the CE that didn’t answer correctly. These attempts has to be carried out after every entire reading cycle, independently from the table T_ATT LV_RETRY field.

It is possible to send the spontaneous of ‘procedure end’ when PROC_RETRY=0

7.11.3 Concentrator Power Fail, Reset or Stop

In case a Reset, Power Fail or Stop of the concentrator occurs, some operations of restoration are expected. In such occasion to avoid proliferation of files not congruent in file system, at the Power Up/Start, if GQBT-V is enabled, the procedure has to wait next scheduled date.

It is also designed a file rollback mechanism in case at the moment of the Power Fail/Reset/Stop is running an acquisition on a file. In this case, if day in course (acquisition day) is spent from the Power Fail/Reset/Stop, the procedure must recovery incomplete file (in state ‘open’) with CE not yet acquired. If day in course (acquisition day) is spent from the Power Fail/Reset/Stop the file will be ‘closed’ and the spontaneous of ‘procedure end’ has to be sent.

Summarizing, the new table GQBT-V will be structured as follows.

Tab. 44 – GQBTV Table

Field ID	Field Name	Size	Meaning
0x2C000101	START_DATE	3	Date of CE starting of voltage variations logging (default value 01.01.01)
0x2C000102	PVT	1	Number of days of logging period (default value 0x07)
0x2C000103	PROC_RETRY	1	Number of times that procedure has to be repeated, within the same period of acquisition. See the document (default value 0x02)

Note that in case of START_DATE, PVT table registers changes, the START_DATE, PVT on CE Tab.20 has to be changed first.

7.11.4 File name

The file name has the following format ('&' concatenation operator)

- In course of acquisition:

"_GQV"& "_" & DATE & "_" #PROGR & ".dat"

- Closed:

"GQV"& "_" & DATE & "_" #PROGR & ".gz"

Where:

- **DATE →** Start date of acquisition, stored also inside the file.
- **#PROG →** a "zero based" counter sized 1 byte used for files distinction in case of presence of files referred to the same date. In case of overflow the counter begins again from 0. It is suitable that central system (AMM) handles the file system in order that for the same CE would not exist two identical #PROG, even if distinguished by the DATE field, even if this condition is rare to happen.

Example of 'close' file name is:

"GQV_080403_0.gz"

Files must be saved in the concentrator directory "/disk/ftp/pub/gqbtv".

7.11.5 File structure

The file generated by GQBT-V must be structured as shown below. Note that a different record format for single-phase and poly-phase CE is shown.

	Name	Size	Meaning
Header	START DATE	3	See GQBT_V table
	PVT	1	See GQBT_V table
	LVC_DATE_TIME	6	Date time of the MLVC at the procedure activation instant
Record Structure	AD CE	6	CE AD CE
	CE_DATE_TIME	6	CE Date-time when the V_(R)mis(t) was collected
	ΔTx	2	Vmis(t) average time period (CE address 0x1405)

CE_TYPE	1	Single-phase(0x01); Poly-Phase(0x02)
RAG	1	Record state (0x00,0x01)
ΣVT_KO ΣVT_RKO	2	Count of the samples for the period PVT for which the voltage fell outside the limits in the previous period (phase R or single-phase, logical CE address 0x1421)
ΣVT_OK ΣVT_ROK	2	Count of the samples for the period PVT for which the voltage fell with the limits in the previous period (phase R or single-phase, logical CE address 0x1420)
Vmin V_Rmin	2	Minimum average voltage in the previous period (phase R or single-phase, logical CE address 0x1422)
Vmax V_Rmax	2	Maximum average voltage in the previous period (phase R or single-phase, logical CE address 0x1423)
Vmis(t) V_Rmis(t)	2	Instantaneous value of the voltage measured during ΔTx (phase R or single-phase, logical CE address 0x1407)
ΣVT_SKO	2	Count of the samples for the period PVT for which the voltage fell outside the limits in the previous period(phase S, logical CE address 0x1441)
ΣVT_SOK	2	Count of the samples for the period PVT for which the voltage fell with the limits in the previous period(phase S, logical CE address 0x1440)
V_Smin	2	Minimum average voltage in the previous period(phase S, logical CE address 0x1442)
V_Smax	2	Maximum average voltage in the previous period(phase S, logical CE address 0x1443)
V_Smis(t)	2	Instantaneous value of the voltage measured during ΔTx (phase S, logical CE address 0x1408)
ΣVT_TKO	2	Count of the samples for the period PVT for which the voltage fell outside the limits in the previous period(phase T, logical CE address 0x1461)
ΣVT_TOK	2	Count of the samples for the period PVT for which the voltage fell with the limits in the previous period(phase T, logical CE address 0x1460)
V_Tmin	2	Minimum average voltage in the previous period(phase T, logical CE address 0x1462)
V_Tmax	2	Maximum average voltage in the previous period(phase T, logical CE address 0x1463)
V_Tmis(t)	2	Instantaneous value of the voltage measured during ΔTx (phase T, logical CE address 0x1409)

7.12 QVI Procedure (QVI)

By the Quality Voltage Variation and Interruption Procedure "**QVI**" the concentrator collects and provides to the central system the weekly data related to the voltage variation and the voltage interruption recorded in the meter.

7.12.1 QVI configuration

It shall be possible to enable the **QVI** procedure in T_PRI with procedure number 36 (0x24) and it uses the following flags in T_CE for single meter activation:

- **F(GQBT-V)** for Voltage Variation acquisition
- **F(GQBT-I)** for Voltage Interruption acquisition

There isn't any dependence from GQBTV or GQBTI procedure; QVI uses the "min" and "max" activation instant fields, into the T_PRI, like others cyclical procedures.

Once started, the procedure searches in T_CE the involved meter previously marked with the T_CE flags, **F(GQBT-V)** and/or **F(GQBT-I)**, in order to activate the voltage and/or interruption data downloading; then it starts to read the required data from the meter via power line and, at the end, a zip file will be available for central system purpose. The procedure algorithm is composed by two internal step; first of all, it will be downloaded the voltage variation and then the voltage interruption; in any case there isn't any dependence between the two above flags settings but only a procedure downloading sequence. Both data, voltage and interruption, can be activated in independent way.

7.12.2 QV Table {T_QV} - Tab. 44

The QVI is supported by Table 44 for voltage variation, T_QV configuration table:

Tab. 44 – GQBTV Table

Field ID	Field Name	Size	Meaning
0x2C000101	START_DATE	3	Date of CE starting of voltage variations logging (default value 01.01.01)
0x2C000102	PVT	1	Number of days of logging period. For example, with START_DAY=01.01.01 and PVT=0x07 means that every Monday at 00:00:00 the meter swaps the variation data from the current period to the previous one.

			(default value 0x07)
0x2C000103	PROC_RETRY	1	Number of times that procedure has to be repeated, within the same period of acquisition. (default value 0x02)

7.12.3 QV Algorithm

There are two fundamental steps in the QV algorithm: the alignment and the update one.

The alignment step occurs at the first procedure running after the meter swapping from the current to the previous period of the voltage variation logging. The concentrator uses the field “**START_DATE**” and “**PVT**“ set in T_QV to calculate the day in which performing the alignment step; for example with the default value it happens at the first execution starting from every Monday. In relation of that, the concentrator provides a weekly procedure activation in order to collect the voltage variation data of the “freezing” period saved in the meter.

The QV algorithm is composed by the reading of the voltage variation data meter by meter, if a meter is suddenly not reachable, the concentrator switches in reading another one. At the next attempt, the concentrator will try to read the missing part and so on until the retries ending. There is not retry for a single reading, but only a procedure retry, in order to optimize the global time; the number of procedure retries are set in the T_ATT.

In the normal operation, the meter can be unreachable and the required data could be incomplete. If after all the retries the data are still incomplete for some meter, the concentrator saves in a zip file the reading until that time. During the next activation, the concentrator starts the update step in order to try to complete the missing reading until the end of the “PVT” period. The “QV_STATUS” of the control table is like an incremental procedure status in order to trace which reading have been already done in the current PVT period or not for each meter. It means that when some data are already saved, at the next running only the remaining ones shall be required and provided in the zip file. When the “PVT” period ends, the concentrator deletes the related fields of the control table in order to be ready for a new “PVT” alignment.

If a new flag **F(GQBT-V)** in T_CE is set inside a PVT period executions, the voltage variation data for that meter shall be collected at first QV running.

If a flag **F(GQBT-V)** in T_CE is disabled, a meter is deleted from the T_CE or a CE_ID in a row is changed, at the next procedure starting the QV shall zeroed the correspondent fields row of the control table.

In case of a “Stop Activity” command is sent during a QVI running, the concentrator shall close all the open files, including zip files, and generate the GB(019.007)_PROC_END reporting the “abort” condition in the reason code field.

If the free memory becomes less than 1MB, the concentrator shall close all the open files, including zip files, and generate the GB(019.007)_PROC_END reporting the "abort" condition in the reason code field.

7.12.4 QI Table {T_ QI} - Tab. 39

The QI is supported by Table 39, T_QI configuration table:

Tab. 39 – GQBTI Table

Field ID	Field Name	Size	Meaning
0x27000101	INTERVAL	1	Acquisition period of GQBT (Not used by QVI)
0x27000102	F_DETECT	1	Number of expected GQBT activation within INTERVAL (Not used by QVI)
0x27000103	PROC_RETRY	1	Number of times that procedure has to be repeated, within the same activation (default=0x02)
0x27000104	LOG_ROWS	1	Number of max interruption logged by CE per phase (default=0x14)
0x27000105	S_LOG_R	2	Logical address of START log -phase R, current period (default=0x13C1)
0x27000106	S_LOG_S	2	Logical address of START log -phase S, current period (default=0x13D5)
0x27000107	S_LOG_T	2	Logical address of START log -phase T, current period (default=0x13E9)
0x27000108	S_LOG_R_p	2	Logical address of START log -phase R, previous period (default=0x1337)
0x27000109	S_LOG_S_p	2	Logical address of START log -phase S, previous period (default=0x1377)
0x2700010A	S_LOG_T_p	2	Logical address of START log -phase T, previous period (default=0x13B7)

0x2700010B	T_DOWN	1	Number of hours of power down/stop that induces open file to be closed (default=0xFF). (Not used by QVI)

Note that MM520evo meter keeps just a buffer for each phase of 20 entries.

7.12.5 QI Algorithm

There are two fundamental steps in the QI algorithm: the alignment and the incremental one.

The alignment step occurs just in case a new meter is commissioned or a new **F(GQBTI)** flag is set. At that point, the concentrator shall read before the meter software version in order to know if the "**TOTAL_INT_x"** field is handled or not.

Meter MM520evo implements an index of the voltage interruption buffer in order to improve the QVI performance by reducing the power line frames. That index, named "**TOTAL_INT_x**", is a 2 bytes field, that increments every time the meter saves a new event in the buffer. The concentrator shall read that field in order to know the number of events to be read and their position in the meter buffer.

During the first alignment the entire meter buffer will be read if the "**TOTAL_INT_x**" is ⩾ 20, otherwise just the real number of events present in the buffer.

On the other hand, during the incremental step, the concentrator will require the voltage interruption buffer reading only if the "**TOTAL_INT_x"** is incremented for a specific meter in relation to the previous running. In case of the "**TOTAL_INT_x"** value found it's the same of the previous running, the concentrator doesn't require the voltage variation buffer reading for that specific meter. On the contrary, if for example the "**TOTAL_INT_x"** was 25 and it becomes now 27**,** only two events will be downloaded.

The above rules are true for MM520evo meter, and for other meter types, all the voltage variation buffer will be read and recorded in the output zip file for every procedure execution.

If the meter is suddenly not reachable the concentrator switches in reading another meter. There is not retry for a single reading, but only a procedure retry, in order to optimize the global time; the number of procedure retries are set in the T_ATT table.

In the normal operation, the meter can be unreachable and the required data could be incomplete. If after all the retries the data are still incomplete for some meter, the concentrator saves in a zip file the reading until that time. During the next activation, the concentrator starts the update step in order to try to align its "**TOTAL_INT_x"** to that one read from the meter.

If a new flag **F(GQBT-I)** in T_CE is set, the voltage interruption data for that meter shall be collected at first QI running in alignment mode.

If a flag **F(GQBT-I)** in T_CE is disabled, a meter is deleted from the T_CE or a CE_ID in a row is changed, at the next procedure starting the QI shall zeroed the correspondent fields row of the control table.

In case of a “Stop Activity” command is sent during a QVI running, the concentrator shall close all the open files, including zip files, and generate the GB(019.007)_PROC_END reporting the “abort” condition in the reason code field.

If the free memory becomes less than 1MB, the concentrator shall close all the open files, including zip files, and generate the GB(019.007)_PROC_END reporting the “abort” condition in the reason code field.

7.12.6 Control Table format

The table is linked to the T_CE table, each row is composed by the following info:

Tab. 66 - QVI Control Table

Field ID	Field Name	Size	Meaning
0x42YYYY01	CE_SW	6	Meter software version
0x42YYYY02	QVI_STATUS	1	Status of the QVI reading during each weekly activation.
0x42YYYY03	METER_TOTAL_INT_R	2	Phase R totalizer read from the meter during the alignment step
0x42YYYY04	METER_TOTAL_INT_S	2	Phase S totalizer read from the meter during the alignment step
0x42YYYY05	METER_TOTAL_INT_T	2	Phase T totalizer read from the meter during the alignment step
0x42YYYY06	LVC_TOTAL_INT_R	2	Index of the last phase R voltage interruption event read from the meter
0x42YYYY07	LVC_TOTAL_INT_S	2	Index of the last phase S voltage interruption event read from the meter
0x42YYYY08	LVC_TOTAL_INT_T	2	Index of the last phase T voltage interruption event read from the meter

Note that table will be updated during the development step.

Table shall be considered only for development use, central system can discard it during its normal operation

7.12.7 GZIP Files

The concentrator handles two zip files for the central system at the end of each running, one is related to the voltage variation data freezing in the meter previous period and another one with voltage variation event saved in the meter buffer. Note that file has a different record format between Single-Phase and Poly-Phase meter, the first one keeps only the phase R record

Here an example of the zip records file of the voltage variation data:

	Field Name	Size	Description
LVC Header	LVC_DATE_TIME	4	LVC time POSIX at procedure starting
	LVC_SW	3	LVC software version
	START_DATE_ LVC	3	See T_QV Table
	PVT_LVC	1	See T_QV Table
Record Structure (One row for each CE)	CE_ID	6	Meter ADCE address
	CE_SW	6	Meter software version (0x0C0E for MM520evo, 0x0C08, 0x0C05 for P520 – T520 meter)
	CE_DATE_TIME	4	Meter time POSIX at first reading
	CE_STATUS	1	DST CE [0] → 1 if CE_DATE_TIME is in DST Reserved [1] Reserved [2] CE_BE [3] → 0 Normal meter, 1 BE meter (see T_CE) CE TYPE [4] → 0 Single-Phase, 1 Poly-Phase (see T_CE)
	PVT_CE	1	Period for calculation of voltage variations on CE (0x1402)
	DATE_VT_CE	3	Date of starting of voltage variation parameter (0x1406)
	ΔTx	2	Vmis(t) average time period (0x1405)
	ΣVT_R_OK(p)	2	Counter for number of intervals TVT with voltage variations within the limit in previous period PVT on phase R. (0x1420)
	ΣVT_R_KO(p)	2	Counter for number of intervals TVT with voltage variations outside the limit in previous period PVT on phase R. (0x1421)
	ΣVT+R_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S+ΔVT and S2+ΔVT in previous period PVT. (0x1424)
	ΣVT-R_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S-ΔVT and S2-ΔVT in previous period PVT. (0x1425)

Field Name	Size	Description
ΣVT2+R_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2+ΔVT in previous period PVT. (0x1428)
ΣVT2-R_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2-ΔVT in previous period PVT. (0x1429)
V_R_MIN(p)	2	Minimum average voltage measured during ΔTx on phase R in the previous period. (0x1422)
V_R_MAX(p)	2	Maximum average voltage measured during ΔTx on phase R in the previous period. (0x1423)
V_R_MIS(t)	2	Instantaneous value of the voltage measured during ΔTx on phase R. (0x1407)
ΣVT_S_OK(p)	2	Counter for number of intervals TVT with voltage variations within the limit in previous period PVT on phase S. (0x1440)
ΣVT_S_KO(p)	2	Counter for number of intervals TVT with voltage variations outside the limit in previous period PVT on phase S. (0x1441)
ΣVT+S_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S+ΔVT and S2+ΔVT in previous period PVT. (0x1444)
ΣVT-S_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S-ΔVT and S2-ΔVT in previous period PVT. (0x1445)
ΣVT2+S_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2+ΔVT in previous period PVT. (0x144E)
ΣVT2-S_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2-ΔVT in previous period PVT. (0x144F)
V_S_MIN(p)	2	Minimum average voltage measured during ΔTx on phase S in the previous period. (0x1442)
V_S_MAX(p)	2	Maximum average voltage measured during ΔTx on phase S in the previous period. (0x1443)
V_S_MIS(t)	2	Instantaneous value of the voltage measured during ΔTx on phase S. (0x1408)
ΣVT_T_OK(p)	2	Counter for number of intervals TVT with voltage variations within the limit in previous period PVT on phase T. (0x1460)
ΣVT_T_KO(p)	2	Counter for number of intervals TVT with voltage variations outside the limit in previous period PVT on phase T. (0x1461)

Field Name	Size	Description
ΣVT+T_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S+ΔVT and S2+ΔVT in previous period PVT. (0x1464)
ΣVT-T_KO(p)	2	Counter for number of intervals (TVT) with voltage variations between the limit S-ΔVT and S2-ΔVT in previous period PVT. (0x1465)
ΣVT2+T_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2+ΔVT in previous period PVT. (0x14AC)
ΣVT2-T_KO(p)	2	Counter for number of intervals TVT with voltage variations out of the limit S2-ΔVT in previous period PVT. (0x14AD)
V_T_MIN(p)	2	Minimum average voltage measured during ΔTx on phase T in the previous period. (0x1462)
V_T_MAX(p)	2	Maximum average voltage measured during ΔTx on phase T in the previous period. (0x1463)
V_T_MIS(t)	2	Instantaneous value of the voltage measured during ΔTx on phase T. (0x1409)

Note that fields in orange are handled only by MM520evo meter from version 11.09.09. In case of the meter doesn't manage that above additional field, they will be not present in the output file.

When the QV ends a zip file is created with the voltage variation data.

Example:

"**QV_5201276A_N.dat.gz**"

Where:

QV is a standard prefix for Voltage Variation data

5201276A is the file Posix time creation in Hex format

N is a identifier sequential number (0 - 999)

dat.gz is the standard suffix

When a zip file is created, it's made available in /disk/ftp/pub/gqbtv in the concentrator file system. There is one QV zip file for each procedure activation.

Here an example of the zip records file of the voltage interruption buffer:

	Field Name	Size	Description
LVC Header	LVC_DATE_TIME	4	LVC time POSIX at procedure starting
	LVC_SW	3	LVC software version
Record Structure (One row for each reading)	CE_ID	6	Meter ADCE address
	CE_STATUS	1	R - BUFF [0] → 0 disabled, 1 SQ_BUF_IR S - BUFF [1] → 0 disabled, 1 SQ_BUF_IS T - BUFF [2] → 0 disabled, 1 SQ_BUF_IT CE_BE [3] → 0 Normal meter, 1 BE meter (see T_CE) CE TYPE [4] → 0 Single-Phase, 1 Poly-Phase (see T_CE) X - BUFF Loss [5] → 0 ok, 1 at least one interruption is lost due to a SQ_BUF_Vx overflow
	TOTAL_INT_x	2	Total number of interruptions in the meter on phase x (0x14xx)
	INT_x	1	Number of voltage interruption events in the row on phase x
	SQ_BUF_Ix	INT_x*8	SQ_BUF_Ix voltage interruption buffer samples for x phase
	…	…	…

Where each **SQ_BUF_Ix** is composed by the following structure:

4 Bytes	4 Bytes	4 Bytes	4 Bytes	4 Bytes	4 Bytes	…	4 Bytes	4 Bytes
SQ_BUF_Ix1		**SQ_BUF_Ix2**		**SQ_BUF_Ix3**		**…**	**SQ_BUF_IxN**	
ITIMEj_POSIX	DITIMEj	ITIMEj_POSIX	DITIMEj	ITIMEj_POSIX	DITIMEj	**…**	ITIMEj_POSIX	DITIMEj

When the QI ends a zip file is created with the voltage interruption data.

Example:

"QI_B_5201276A_N.dat.gz"

Where:

QI_B is a standard prefix for Voltage Interruption buffer

5201276A is the file Posix time creation in Hex format

N is a identifier sequential number (0 - 999)

dat.gz is the standard suffix

When a zip file is created, that one is made available in /disk/ftp/pub/gqbtv in the concentrator file system. There is one QI_B zip file for each procedure activation.

7.13 DIAGNOSTIC PROCEDURE (DIAG)

The execution of the procedure is requested by the AMM with message TB_DIAGN.REQ (002) for the status word in normal format or with message TB_DIAGE.REQ (002) for the state word with diagnostic extension.

Concentrator, on request by the AMM, has to record the transaction.

Concentrator must send to CE - identified by the AMM - the message READ.REQ (002) (State Word "request" message).

On reception of answer READ.RESP from CE, concentrator must insert in B(TRAPE.RESP) the transaction result.

The AMM can send or not the request of Reset of the involved CE's State Word with message TB… RESETDIAG.REQ (018.001/2/3).

7.14 READING PROCEDURE (LETT)

The procedure must be EXECUTED for CE belonging to sections that “can be inquired”.

The general procedure for data reading on AMM request is the following:

- The AMM sends concentrator a data reading request message TB…(006) specifying the code that identifies data to read
- Concentrator must record the request
- Concentrator must send to CE involved reading request READTAB.REQ with codes relevant data table request
- CE can answer:

  with a message READTAB.RESP that carries the read data. These data are inserted in B(TRAPE.RESP) to be transmitted to AMM

  with a NACK. In this case the code in NACK message is inserted in B(TRAPE.RESP) and it has to be transmitted to AMM

  if CE does not answer, concentrator - once finished the foreseen retries - must end transaction and insert in B(TRAPE.RESP) the negative result relative to “CEs not reachable”

  if CEcs, used as a repeater towards CE does not answer, concentrator - once finished the foreseen retries - must end transaction and insert in B(TRAPE.RESP) the negative result with code “Section not reachable for transaction purpose”

(error recovery information that is not specific to this procedure is intended in the generic sense)

For the complete table of codes for CE registers reading, see ENEL DH 960K and ENEL DH 910K)

7.15 LOAD PROFILE PROCEDURE (PLOAD)

The load profile data has to be read from the CE into the concentrator using the ENEL DH-910K table reading protocol.

To detect the PLOAD end it has been defined the TLC bit with value 20 that will manage the procedure end event upon completion of PLOAD.

If PLOAD terminates due to a flash full condition and is unable to process all CEs marked with the LVC_CE_PROC_PLOAD bit in the T_CE.F(PROC) flags, AMM will still get a normal procedure end event. Assuming the AMM then reads (and deletes) the load profiles via FTP, then the next time PLOAD is normally scheduled, it will resume with the remainder of the CEs.

All load profiles are stored in compressed (gz) format. This format can be decompressed with the current version of winzip.exe, for example.

The concentrator file system is flat. Thus all files are at the root.

Load profiles have to be stored in the form "pro<id>.dat.gz" where <id> is the CE_ID in hex. For example, if the CE_ID is 0x000481789600, then the file name is pro000481789600.dat.gz. The gz format is the zip format as described in RFC 1951 and RFC 1952.To be agreed with the manufacturer.

Files must be saved in the concentrator directory “/disk/ftp/pub/pload”.

Note that AMM can also decide to run an evolution of PLOAD procedure (new implementation) with the rules described at T_CE.EXT_F(PROC) register.

Actual implementation, above described, will continue to be supported as is in the next concentrator’s SW versions, as well.

7.16 EXTENDED LOAD PROFILE PROCEDURE (NPLOAD)

The procedure is able to pick out, for the selected CEs, a combination of the following profiles:

- Virtual active energy profile
- Virtual reactive energy profile
- Negative active energy profile
- Negative inductive reactive energy profile
- Positive capacitive reactive energy profile
- Negative capacitive reactive energy profile

Profiles to be read are selected according to the structure shown, with the followings meanings and values:

EXT_F(PROC)									Meaning
b15	**…**	**b6**	**b5**	**b4**	**b3**	**b2**	**b1**	**b0**	
…	…	0	0	0	0	0	0	…	No PLOAD has to run
…	…	0	0	0	0	0	1	…	Virtual Active profile has to be read
…	…	0	0	0	0	1	0	…	Virtual Reactive profile has to be read
…	…	0	0	0	1	0	0	…	Negative Active profile has to be read
…	…	0	0	1	0	0	0	…	Negative inductive Reactive profile has to be read
…	…	0	1	0	0	0	0	…	Positive capacitive Reactive profile has to be read
…	…	1	0	0	0	0	0	…	Negative capacitive Reactive profile has to be read

7.16.1 P-Load Table {T_PLOAD} - Tab. 38

A period of time within the PLOAD processing has to be active has to be defined. In order to do so, two new registers are defined: DATE_START, DATE_END. Respectively, START DATE and END DATE of the process; each one is 3 bytes long.

Activation of the bits shown in figure takes effect for the entire period within the START and end DATE. It will be in charge of AMM the handling of these bits, both for the set condition both for the reset condition.

The procedure is designed in way to allow the load profile's portion reading with reference to pre-fixed temporal programmable periods. The range of those periods is evaluated with a resolution expressed in "days".

In order to do so, a new register "INTERVAL" defined in "days" sized as 1 byte, is defined. The meanings this field can assume, are so defined:

INTERVAL	Meaning
0	Special case-load profile of the current day has to be detected (0<hh<24)
1	Load profile of the previous day has to be detected
2	Load profile of the last two previous days has to be detected
3	Load profile of the last three previous days has to be detected
…	…
…	…
60	Load profile of the last 60 previous days has to be detected (MAX VALUE)
246	Special case-the whole content of the circular buffer has to be detected
248	Special case- Load profile of the previous month has to be detected handling the "end of month"
252	Special case- Load profile of the previous two months has to be detected handling the "end of month"
255	Special case- Load profile of the CE_INTERVAL period stored in the T_CE for each meter has to be detected

For what concern exact relieves (range of some samples) to be executed on the profiles, such activity is remitted to AMM by means of the usual TB procedure.

On request, in the period defined with DATE_START/DATE_END, the procedure has to run periodically, e.g. daily, monthly, etc.

For this reason, a new register "PERIODICITY" is defined. It is defined in "days" sized as 1 byte with the following meaning:

PERIODICITY	Meaning
0	PLOAD is executed one time within DATE_START DATE_END period at 'ACTIVATION INSTANT' value in T_PRI

1	PLOAD runs each time from the 'ACTIVATION INSTANT' value (included) within DATE_START-DATE_END period
2	PLOAD runs every two days from the 'ACTIVATION INSTANT' value (included) within the DATE_START-DATE_END period
…	
7	PLOAD runs one time per week from the 'ACTIVATION INSTANT' value (included) within the DATE_START-DATE_END period
…	
…	
60 MAX value	MAX value-PLOAD runs every 60 days from the 'ACTIVATION INSTANT' value (included) within the DATE_START-DATE_END period
…	
…	
252	Special case- PLOAD runs with monthly periodicity (end of month handled by the concentrator) from the 'ACTIVATION INSTANT' value (included) within the DATE_START-DATE_END period
255	Special case- PLOAD runs with two months periodicity (end of month handled by the concentrator) from the 'ACTIVATION INSTANT' (included) within the DATE_START-DATE_END period

It will be in charge of AMM the handling of the overlapping between acquisition temporal bands (INTERVAL) and periodicity (PERIODICITY).

In case of re-programming of the concentrator's clock, for the calculus of the periodicity, it has to be considered the existent value of "ACTIVATION INSTANT".

Meaning of MIN ACTIVATION and MAX ACTIVATION parameters in T_PRI falls off for PLOAD implementation, so they have not to be considered. ENABLE/DISABLE and PRIORITY registers have the usual meaning.

Physical addresses of the energy buffers are parameterized so, 14 new registers are defined. The first 12 of them, detect, for each energy profile, the addresses of start and end row of the part of CE's memory.

The 13th register "SAMPLE_FOR_ROW" specifies the number of samples memorized for each row.

The 14th register "OFF_ROW" is used when the number of total samples the buffer can contain, is not an entire division vs "SAMPLE_FOR_ROW". In this case, "OFF_ROW" shows how many samples in the last row have to be not considered.

Finally, a PROC_RETRY register, sized as 1 byte, shows how many time procedure has to run again on the CE in T_CE, in case of incorrect answer or no answer to the data request over the default attempt.

For example, if PROC_RETRY=3, this means that in total, four attempts have to be executed.

That, independently from L4_Retry value in T_ATT. Summarizing what above described, the structure of PLOAD table is as shown.

The procedure is able to handle and eventually shows in a “status” field the following anomalies:

- CE not reachable
- Cases of no answer or incorrect answer from the CE
- Number of requested days that overflows the buffer capacity vs actual T.
- Number of requested samples that overflows the collected samplings value NUM_VALID.
- In Case of Start-up or long power failure the procedure has to detect the partial available profile.

Independently by the anomalies above mentioned, for each involved CE in PLOAD, a file implementation is done in accordance to the requested format, containing at least, the CE identifier and the description of the anomaly (see chapter 4).

Tab. 38 – PLOAD Table

Field ID	Field Name	Size	Meaning
0x26000101	DATE_START	3	(DD/MM/YY) from when procedure has to be active
0x26000102	DATE_END	3	(DD/MM/YY) to when procedure has to be active
0x26000103	PERIODICITY	1	Defines periodicity activation of the PLOAD, in days (daily, weekly, monthly, etc.).
0x26000104	INTERVAL	1	which period has to be detected in days
0x26000105	PROC_RETRY	1	Number of time in an activation range in which procedure has to be repeated (See the document)
0x26000106	START_ADDR_VA	2	Physical address START virtual active buffer (default=0x0504)
0x26000107	END_ADDR_VA	2	Physical address END virtual active buffer (default=0x057D)
0x26000108	START_ADDR_VR	2	Physical address START virtual reactive buffer (default=0x057E)

0x26000109	END_ADDR_VR	2	Physical address END virtual reactive buffer (default=0x05F7)
0x2600010A	START_ADDR_A-	2	Physical address START negative active buffer (default=0x1201)
0x2600010B	END_ADDR_A-	2	Physical address END negative active buffer (default=0x127A)
0x2600010C	START_ADDR_Ri-	2	Physical address START negative inductive reactive buffer (default=0x127B)
0x2600010D	END_ADDR_Ri-	2	Physical address END negative inductive reactive buffer (default=0x12F4)
0x2600010E	START_ADDR_Rc+	2	Physical address START positive capacitive reactive buffer (default=0x1D01)
0x2600010F	END_ADDR_Rc+	2	Physical address END positive capacitive reactive buffer (default=0x1D7A)
0x26000110	START_ADDR_Rc-	2	Physical address START negative capacitive reactive buffer (default=0x1D7B)
0x26000111	END_ADDR_Rc-	2	Physical address END negative capacitive reactive buffer (default=0x1DF4)
0x26000112	SAMPLE_FOR_ROW	1	Sample for load profile row (default=30)
0x26000113	OFF_ROW	1	Samples offset for last load profile row (default= 0x0C)
0x26000114	START_ADDR_DC1_C1	2	Physical address start DC1_C1 buffer (default=0x5201)
0x26000115	START_ADDR_DC2_C1	2	Physical address start DC2_C1 buffer (default=0x5241)
0x26000116	START_ADDR_DC3_C1	2	Physical address start DC3_C1 buffer (default=0x5281)
0x26000117	START_ADDR_DC4_C1	2	Physical address start DC4_C1 buffer (default=0x5301)
0x26000118	START_ADDR_DC5_C1	2	Physical address start DC5_C1 buffer (default=0x5341)
0x26000119	START_ADDR_DC6_C1	2	Physical address start DC6_C1 buffer (default=0x5381)

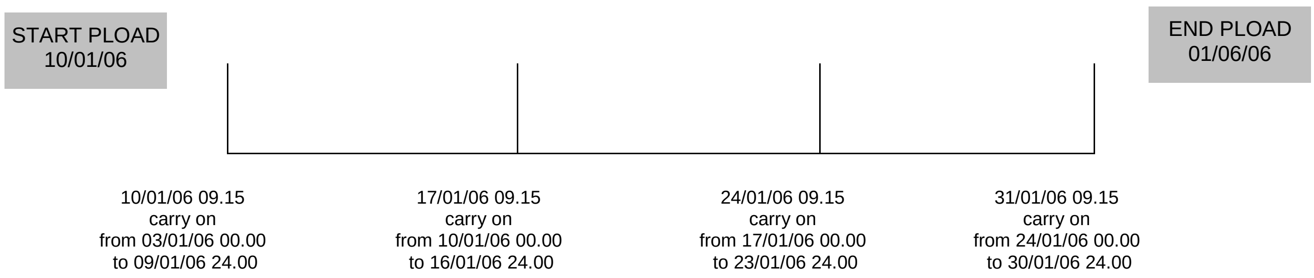
0x2600011A	START_ADDR_DC1_C2	2	Physical address start DC1_C2 buffer (default=0x5401)
0x2600011B	START_ADDR_DC2_C2	2	Physical address start DC2_C2 buffer (default=0x5441)
0x2600011C	START_ADDR_DC3_C2	2	Physical address start DC3_C2 buffer (default=0x5481)
0x2600011D	START_ADDR_DC4_C2	2	Physical address start DC4_C2 buffer (default=0x5501)
0x2600011E	START_ADDR_DC5_C2	2	Physical address start DC5_C2 buffer (default=0x5541)
0x2600011F	START_ADDR_DC6_C2	2	Physical address start DC6_C2 buffer (default=0x5581)
0x26000120	DC_BUFFER_ROWS	1	Number of rows for daily closures profiles (default=0x40)

Below is shown an example of procedure execution with weekly PERIODICITY and INTERVAL

INTERVAL=7

PERIODICITY=7

ACTIVATION INSTANT=09.15



For each CE is produced a compressed file. A distinct file is produced for each profile, as specified on EXT_F(PROC) register. Each file contains the information necessary to handle possible anomalies occurred during procedure running.

Furthermore, two fields are implemented respectively, for the “Normal Status Word” and for the “Extended Status Word” of the involved CE. The “Extended Status Word” has to be read and carried on only in case at which the PAD bit of the “Normal Status Word” would be set (=1). On the contrary the foreseen field on the file will be 0x0000.

AMM, after each reading of the profile's buffer, has to foresee, their deletion from the file system.

INTERVAL= from sample 4 to sample 66

ACHIEVED SAMPLE=63

SAMPLE_FOR_ROW=15

1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	15	.	.	.	.	.	.	.	.	.	.	.	.	.	29
3	30	.	.	.	.	.	.	.	.	.	.	.	.	.	44
4	45	.	.	.	.	.	.	.	.	.	.	.	.	.	59
5	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74

Handling order for each CE, is implemented in order to detect the active energy profiles and the related saving first, then, the detection and saving of the reactive energy profiles.

In data packaging in the file, samples not useful for the involved period and eventually contained in the initial and final rows of the detected profile, are excluded.

For example, see fig. 6, it is considered the case for which it is necessary to detect 63 samples from one of the profiles.

In this case, only the gray highlighted samples are memorized in the file. In case a reset or power fail occurs on the concentrator during execution of a PLOAD cycle, the procedure re-starts for the CEs not yet detected.

7.16.2 Output File

The output filename has the following format for the final file, understood as strings concatenation.

"PL" & EE & ADCE & "_" & DATE & "_" & #PROGR

Where:

"**&**": concatenation string symbol;

EE: 2 characters showing the kind of profile in the file:

"A1" virtual active,

"A2" negative active,

"R1" virtual inductive,

"R2" negative inductive reactive,

"R3" positive capacitive reactive,

"R4" negative capacitive reactive

DATE: date of detection

#PROGR (1 byte): a progressive number "zero based" associated to the same CE in case of successive PLOAD activation on identical CEs.

Files having the same detection date are stored inside a unique .zip meta-file. Numbers of file inside has to be N (to be defined). Filename of the meta-file is:

"PL" & DATE & "_" & #PROGR2.tar.gz

The procedure has to pack the output files in the following way:

Each tar.gz file will contain max 25 CE file strictly related to the TABCE index. If a single execution run in a day, #PROGR2 goes from 0 to 40

E.g.:

"PL" & DATE & "_" & "0" contain the CE index from 1 to 25

"PL" & DATE & "_" & "1" contain the CE index from 26 to 50

And so on

If a second execution run on the same day, then #PROGR2 will go from 41 to 81 and so on in case of an extra execution run on the same day.

Formally:

#PROGR2= CE_group + (maxtar * RunIndex)

Where:

CE_group can have a value of 0 to 40 and for each value it is strictly associated with 25 CE of the T_CE so that:

CE_group=0 index from 1 up to max 25

CE_group=1 index from 26 up to max 50

CE_group=2 index from 51 to 75

…

Maxtar=41

RunIndex=Count of previous PLOAD execution on the same date (0 at the first execution). If PLOAD is re-executed on a given date, then RunIndex has to be incremented. RunIndex has to be reset to 0 each day.

DATE represents the date of the first procedure activation

Files must be saved in the concentrator directory "/disk/ftp/pub/pload".

For each CE on which it has been started a PLOAD cycle, the output file has the following record lay-out.

The LAST_INDEX field allows to detect the next row to read in case of file already saved following the not answer from the CE or in any case to prosecute by AMM, the manual reading of the missing rows.

The 'data profile' field represents the data composing the requested load profiles. For what above stated, in case of rows partially used, only the necessary content has to be saved in the file.

Field Name	Size	Description
CE_ID	6	Meter ADCE address
ENERGY TYPE	1	Energy type in the "DATA PROFILE" field. The mask bit of EXT_F(PROC) is used
CE NORMAL STATUS WORD	2	
CE EXTENDED STATUS WORD	2	0x0000-default
ACTIVATION INSTANT	3	
LVC DATE-TIME	6	
CE DATE-TIME	6	
INTERVAL	1	See the document

NUM_VALID	2	Number of valid samples on the CE
LAST_INDEX	2	Index to the last detected sample
TIME_END	5	See the document
T	1	See the document
SAMPLE_FOR_ROW	1	See the document
TOTAL SAMPLE	2	Total samples for buffer
TOTAL ACHIEVED SAMPLE	2	Requested samples for the profile
TOTAL READ SAMPLE	2	Total read samples
FIRST SAMPLE	2	The first sample that has been read
PLOAD STATUS WORD	1	PLOAD Status Word
DATA PROFILE	n	

Where the PLOAD Status Word has the following format:

#bit	Meaning
0	1 Number of sampled data not sufficient for the current profile (rule 5)
1	1 No available samples for the achieved period (rule 4)
2	1 Buffer not sufficient for the current profile (rule 6)
3	1 Some samples not present due missing or not correct response
4	1 CE not reachable (no responses next to the TB)
5	Not used
6	Not used
7	Not used

7.16.3 GB Message for PLOAD fetching

In addition to the above described procedure, AMM can optionally handle PLOAD samples of a single CE by using the GB_READREQ (040) message.

Such message allows to read (based on “date start” and “date end” parameters included in the GB message), portion of CE’s profiles data inside the “dat.gz” file previously stored by the PLOAD procedure in the concentrator. As AMM delivers the GB (040) message, if transaction correctly succeeds, concentrator will reply with one or more GB_READRESP (041) message (depending from the size of DATA field) carrying out required data of the CE, otherwise, it will reply with the proper GB_NACK (255) message with the error code # 12.

Once concentrator receives the GB (040) message, it has to:

- check the correctness and congruence of “date” registers defined in the message (e.g. “date start” <= “date end”, “date end” – “date start” < 4 days)
- select files with “filename” ADCE=ADCE inside GB message
- select, from files at previous point, with the entire period of data

(DATE DETECTION > DATE END) AND (INTERVAL>=DATE DETECTION-DATE START)

DATE DETECTION is derived from the filename

INTERVAL is inside the file

- Open the previous selected file(s) and by means of TIME_END, FIRST SAMPLE, LAST INDEX compose the GB responses with the requested data profile.

7.17 FAST LOAD PROFILE PROCEDURE (N2PLOAD)

By the fast Load Profile Procedure (N2PLOAD) it is possible to have the following enhancements:

- All the load profiles (a copy of each meter load profile table under a concentrator) into the concentrator flash disk
- A dynamic depth of each load profile (in the original load profile the maximum allowed depth is limited to 3648 samples) is stored into the concentrator flash disk
- All the daily closures profiles (a copy of each meter daily profile table under a concentrator) into the concentrator flash disk
- A dynamic depth of a single daily profile (in the original daily profile the maximum allowed depth is limited to 64 samples)
- All the Instantaneous Daily Power Maximum Demand profiles (IDPMD, a copy of each meter profile table under a concentrator) coupled with the corresponding timestamp (TS_IDPMD) are stored into the concentrator flash disk
- For each tariff, Average (in Tmd) Daily Power Maximum Demand (ADPMD) of the current billing period (only Active components) stored into the concentrator flash disk
- A dynamic version to create or enhance the zip files available for AMM is available

Thanks to GB (042) it is possible to have:

- Downloading of the load profile samples values through a GB message
- Up to 250 samples of a single load profile in one GB response
- A smart algorithm to search samples into a load profile

Thanks to GB (044) it is possible to have:

- Downloading of the daily closure samples values through a GB message
- Up to 32 samples of a single daily closures profile in one GB response
- A smart algorithm to search samples into a daily closures profile

7.17.1 N2PLOAD Table {T_N2PLOAD} - Tab. 63

It shall be possible to enable the N2PLOAD in T_PRI with procedure number 34 (0x22) and it uses the following flags in T_CE:

- F(PL_x) of EXT_F(PROC) for Load Profile
- According to the value of the register [DAILY_BUF_CONF] F(DCx_C1) and F(DCx_C2) of EXT2_F(PROC) for Daily Closures, IDPMD and ADPMD.

There isn't any dependence from the fields PLOADA and PLOADR in the same CE table. The N2PLOAD uses the "min" and "max" values, into the T_PRI, like others cyclical procedures.

The N2PLOAD is supported by Table 63, N2PLOAD configuration table:

Tab. 63 - N2PLOAD Table

Field ID	Field Name	Size	Meaning
0x3F000101	START_ALIGNEMENT	4	The start time for first N2PLOAD alignment. Default=0x00000000
0x3F000102	ENABLE_GZIP_FILE	1	Flag to enable or disable the zip generation for load profile and daily closures profile. See below Default=0x00
0x3F000103	NUMBER_OF_SAMPLES	2	Number of samples for each Load profile table in the concentrator disk. Default=0x0E40
0x3F000104	ALL_SAMPLES	1	Flag to resume all samples for each Profile Default=0x00
0x3F000105	NUMBER_OF_CLOSURES	2	Number of samples for each daily closures profile table in the concentrator disk. Default=0x0040
0x3F000106	N2PLOAD_STATUS	1	Procedure status; it will be updated during the N2PLOAD process. See below Default=0x00
0x3F000107	STATUS_DT-POSIX	4	POSIX Time related to N2PLOAD_STATUS updating. Default=0x00000000
0x3F000108	STATUS_EN	1	Flag to enabled or disabled the N2PLOAD Control Table and its zip creation, Default=0x00
0x3F000109	LC_TIME_GZIP	3	Time in hh:mm:ss in which every day the concentrator shall create the file PLOAD_RF_<posix>.tar.gz and DAILY_RF_<posix>.tar.gz. For further details refer to 8.2 and 8.3. Default=0x00000

Tab. 63 - N2PLOAD Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x3F00010A	LP_RETRY	1	Number of retries during the LP acquisition cycle; The total number of attempts shall be LP_RETRY*(LV_RETRY+1). At the ending of LP_RETRY if the LP profiles are not align for a meter, the DC_RETRY will not be executed for that specific meter. Default=0x08
0x3F00010B	DC_RETRY	1	Number of retries during the DC acquisition cycle; The total number of attempts shall be DC_RETRY*(LV_RETRY+1) Default=0x04

In relation to ENABLE_GZIP_FILE field, the following values are handled:

b7	…	b3	b2	b1	b0	Meaning
…	…	…	…	…	1	Zip file enabled for LP received by N2PLOAD via PLC
…	…	…	…	1	…	Zip file enabled for DC profile received by N2PLOAD via PLC
…	…	…	1	…	…	Daily “gz” file enabled for LP and DC profile received by lastcall procedure via RF. For further details refer to 8.2 and 8.3.

In relation to ALL_SAMPLES field, the following values are handled:

b7	…	…	b1	b0	Meaning
…	…	…	0	1	Resume all samples for all Profiles

In relation to N2PLOAD_STATUS field the followings codes are handled:

N2PLOAD_STATUS CODE			DT-POSIX_STATUS
Value	**Meaning**	**Description**	**Meaning**
0x00	Not Used	…	…
0x01	Running	N2PLOAD starts	N2PLOAD starting
0x02	Done	N2PLOAD ends	N2PLOAD ending
0x03	Stop Activity	N2PLOAD is aborted due to a Stop Activity command	N2PLOAD ending
0x04	Disk Full	N2PLOAD ends but disk full condition happens	N2PLOAD ending
0x05	EB Failure	N2PLOAD ends but a failure on EB occurs	N2PLOAD ending
0x06	Proc Timeout	N2PLOAD ends due to procedure timeout	N2PLOAD ending
0x07	Priority	N2PLOAD is suspended by another procedure with higher priority	N2PLOAD suspension
0x08	LV-Net	Communication disabled on LV network	N2PLOAD ending

In relation to STATUS_EN field, the following values are handled:

b7	…	…	b1	b0	Meaning
…	…	…	0	1	T_NPLOADC handling
…	…	…	1	0	Zip file handling

7.17.2 N2PLOAD Algorithm

At the start, the procedure searches in T_CE to select only the required tables for each meter involved. It uses the fields above mentioned and it starts to read the entire tables required from the selected meter via power line. The entire table is copied row by row. After that, all the required tables are copied into the concentrator flash disk and stored in "/disk/n2pload/" and "/disk/n2pdaily/" of the Linux file system. Each table follows a simple mechanism for its own identification.

For example, the load profile PL_VA for the meter with ADCE: 010203ABCDEF is saved with the following name:

LP1_010203ABCDEF.dat

LP is a prefix that is the same for all the tables. After the prefix there is a symbol for the specific load profile, according to the following table:

Profile	Symbol	Code for GB(042)	Meaning
F(PL_VA)	1	0x02	Virtual Active profile
F(PL_VR)	2	0x04	Virtual Reactive profile
F(PL_NA)	3	0x08	Negative Active profile
F(PL_NIR)	4	0x10	Negative inductive Reactive profile
F(PL_PCR)	5	0x20	Positive capacitive Reactive profile
F(PL_NCR)	6	0x40	Negative capacitive Reactive profile

Then there is the **ADCE** address and the "**.dat**" suffix.

With the same rule, the Daily Closure profile DC1_C1 for the meter with ADCE: 010203ABCDEF will be saved with the following name:

DC1_C1_010203ABCDEF.dat

DC is a prefix that is the same for all the tables. After the prefix there is a symbol for the specific daily closure profile, according to the following table:

Profile	Symbol	Code for GB(044)	Meaning
F(DC1_C1)	1_C1	0x0002	DC and maximum powers for the positive active component
F(DC2_C1)	2_C1	0x0004	DC for the positive inductive-reactive component
F(DC3_C1)	3_C1	0x0008	DC and maximum powers for the negative active component
F(DC4_C1)	4_C1	0x0010	DC for the positive capacitive-reactive component
F(DC5_C1)	5_C1	0x0020	DC for the negative capacitive-reactive component
F(DC6_C1)	6_C1	0x0040	DC for the negative inductive-reactive component

It is worth noting that the ADPMD only consider the active components (positive ADPMD_W+ and negative ADPMD_W-) for each tariff.

Then there is the **ADCE** address and the "**.dat**" suffix.

The size of each Load Profile table is dynamic. It is possible to set the width of the tables in the concentrator by a specific field in Table 63. This field, called NUMBER_OF_SAMPLES, sets the max number of samples stored in each Load Profile table. For example if AMM needs the same size present in a meter, it has to set "NUMBER_OF_SAMPLES = 3648" (default). Otherwise if AMM sets "NUMBER_OF_SAMPLES > 3648", the concentrator maintains an historian of each meter for the samples prior to 3648. AMM can also set the width of the Daily Closures table by means the "NUMBER_OF_CLOSURES" field (default value 64). This field is also used to set the width of the IDPMD and ADPMD.

When the concentrator sends requests for reading daily closures, the meters can return different data, according to the value of the register [DAILY_BUF_CONF] (0x52C2) inside the meter. Each row of the meter circular buffers returned for the daily closure request is structured as shown below:

DC 28 Bytes							IDPMD 2 Bytes	TS_IDPMD 4 Bytes	ADPMD 12 Bytes
Field1	**Field2**	**Field3**	**Field4**	**Field5**	**Field6**	**Field7**	**Field 8**	**Field 9**	**Field 10**
Total energy	Energy in T1	Energy in T2	Energy in T3	Energy in T4	Energy in T5	Energy in T6	Instantaneous Daily Power Maximum Demand (IDPMD) of the energy component stored in the circular buffer	Timestamp in posix notation of the instant in which the IDPMD is happened	Average (in Tmd) Daily Power Maximum Demand (ADPMD) for each tariff of the current billing period (or the previous one if the closure has been done immediately after the billing period closure
The structure of the circular buffers have to include or not the last two fields, depending on the value of the register [DAILY_BUF_CONF]									

The meter uses the register [DAILY_BUF_CONF] in order to configure the management of daily closures for Contract#1 and Contract#2 (Only value 0x00, 0x01, 0x05, 0x08, 0x0B are handled):

- [DAILY_BUF_CONF] = 0x00 or 0x01 -> the meter has to manage 64 daily closures only for Contract#1 not including in the structure of each row the fields 8, 9 and 10.
- [DAILY_BUF_CONF] = 0x02 -> the meter has to manage 64 daily closures only for Contract#2 not including in the structure of each row the fields 8, 9 and 10 (Predisposition).

- [DAILY_BUF_CONF] = 0x03 -> the meter has to manage 32 daily closures for Contract#1 and 32 daily closures for Contract#2 not including in the structure of each row the fields 8, 9, and 10 (Predisposition).
- [DAILY_BUF_CONF] = 0x05 -> the meter has to manage 64 daily closures only for Contract#1 including in the structure of each row the fields 8 and 9.
- [DAILY_BUF_CONF] = 0x06 -> the meter has to manage 64 daily closures only for Contract#2 including in the structure of each row the fields 8 and 9 (Predisposition).
- [DAILY_BUF_CONF] = 0x07 -> the meter has to manage 32 daily closures for Contract#1 and 32 daily closures for Contract#2 including in the structure of each row the fields 8 and 9 (Predisposition).
- [DAILY_BUF_CONF] = 0x08 -> the meter has to manage 64 daily closures only for Contract#1 including in the structure of each row the field 10, whether for positive or negative active power.
- [DAILY_BUF_CONF] = 0x09 -> the meter has to manage 64 daily closures only for Contract#2 including in the structure of each row the field 10 (Predisposition), both for positive and negative active power.
- [DAILY_BUF_CONF] = 0x0A -> the meter has to manage 32 daily closures for Contract#1 and 32 daily closures for Contract#2 including in the structure of each row the field 10 (Predisposition), whether for positive or negative active power.
- [DAILY_BUF_CONF] = 0x0B -> the meter has to manage 64 daily closures only for Contract#1 including in the structure of each row the fields 8, 9 and 10, whether for positive or negative active power
- [DAILY_BUF_CONF] = 0x0C -> the meter has to manage 64 daily closures only for Contract#2 including in the structure of each row the fields 8, 9 and 10 (Predisposition).
- [DAILY_BUF_CONF] = 0x0D -> the meter has to manage 32 daily closures for Contract#1 and 32 daily closures for Contract#2 including in the structure of each row the fields 8, 9 and 10 (Predisposition).

Here below a schematic representation of what discussed considering only contract#1

Below the sequence in magnitude acquisition, if a magnitude is not enabled shall be skipped by the algorithm:

	LP						DC					
	A+	L+	A-	L-	C+	C-	A+	L+	A-	C+	C-	L-
Meter 1	↓	↓	↓	↓	↓	↓	→	→	→	→	→	→
Meter 2	↓	↓	↓	↓	↓	↓	→	→	→	→	→	→
Meter 3	↓	↓	↓	↓	↓	↓	→	→	→	→	→	→
…	↓	↓	↓	↓	↓	↓	→	→	→	→	→	→

Meter n	↓	↓	↓	↓	↓	↓	→	→	→	→	→	→

It means that the DC profiles shall be acquired as soon as the last LP profile has been collected.

There are two fundamental steps in the N2PLOAD: the alignment and increment.

7.17.2.1 Alignment

For each meter served, the concentrator should have a dedicated table containing the load profiles of each day. If for the meter managed the concentrator doesn't have the required table, a new table is allocated according to the value reported in the "**NUMBER_OF_SAMPLES"** register. Thus, the table fields are set to zero; then the concentrator aligns its table with the table present in the selected meter. At the end of the operation, for that table, the concentrator has a copy of the selected profile in the meter. When this operation ends, the concentrator can read another table. If the meter is suddenly not reachable the concentrator can switch to read another meter. There is not retry for a single table read, but only a procedure retry, in order to optimize the time for reading all the tables.

When a concentrator is replaced (or for a different reason) it can also start the alignment from a specific time reference to create the PL*/DC* Tables. The POSIX start time is available in the Concentrator Table 63, on field "**START_ALIGNMENT**" and it is set by AMM, see below for values and meaning:

START_ALIGNMENT	Meaning
0	Load profile alignment starting from the current day
1	Load profile alignment starting from the previous days
2	Load profile alignment starting from the last two previous days
3	Load profile alignment starting from the last three previous days
…	…
…	…
120	Load profile alignment starting from the last 120 previous days (MAX VALUE)
246	Whole content of the circular buffer

With the above value described for "START_ALIGNMENT", the time is always refer to 00:00:00.

7.17.2.2 Increment

In this case the table is already present in the concentrator and new samples can be appended. This operation is faster than alignment step. In the normal functionality the alignment is executed only as a first operation during the installation of the concentrator. After that, every time the N2PLOAD restarts, only the increment step is executed.

The number of retries of the procedure are indicated in the T_ATT table.

In the normal operation, the meter can be unreachable, then the table can be incomplete. If after all the retries have been performed the table is still incomplete the concentrator saves the samples read until this time. At next start, the table will be completed when the meter will be reached.

7.17.2.3 File system and table deleting

To avoid file system saturation, when the available space is less than 5 MB of the total disk, the concentrator cannot perform some operation. When this limit is reached the event GB (019.012) shall be generated, if enabled. The concentrator can align the table already present in the database, but it cannot generate zip files or create new tables (for example for a new meter inserted in the concentrator database). It will be possible operate with GB (042) or GB (044) to read the samples.

If the fields in CE table F(PL_x), F(DCx_C1), F(DCx_C2) are disabled at the next start of the procedure the N2PLOAD deletes the correspondent tables from the file system.

When a meter is deleted from the CE table (or a CE_ID in a row of the CE table is changed) all the tables before stored are deleted. In this way it is impossible to have old tables unused.

A .dat table is deleted also if the “NUMBER_OF_SAMPLES” or “NUMBER_OF_CLOSURES” changes in run time. In this case at the next step for N2PLOAD, the concentrator restarts in alignment mode for the specific profile.

If there are .zip files associate to the meter deleted (or for a specific load profile) these files will be renamed. The new name is explicate in the following section.

In case of a “Stop Activity” command is sent during a N2PLOAD running, the concentrator shall suspend the current execution; then when it receives a “Start Activity” command, the N2PLOAD will continue the previous running from the break point.

7.17.2.4 Realignment

When a meter restarts to store the load profile from scratch (due for example to a authenticated SINC-T), the N2PLOAD starts a new alignment. Its C_num_valid stored up to this point is deleted. The C_num_valid restarts from scratch. The realignment, like the alignment, follows the “START_ALIGNMENT” field, in the Concentrator Table 63. The concentrator, step by step, deletes the .dat internal table, and if present, creates the .zip backup (“OLD.zip”).

7.17.3 Table format in the concentrator

The table has a header of 65 bytes and a space for the samples (in this case 7385 bytes). Each sample requires two bytes. The header of each table is composed as follows:

Field Name	Size	Description
CeId	6	Meter ADCE address
Type	1	Load profile type
Status1	2	Status word 1
Status 2	2	Status word 2
Ext_Status1	2	Extended status word 1
Ext_Status2	2	Extended status word 2
Ext_Status3	2	Extended status word 3
Not_Status1	2	Notification status word 1
Not_Status2	2	Notification status word 2
Activate	3	Field used in the old pload, to future features
Lvc_date_time	4	Lvc posix, in the last reading taken
Ce_date_time	4	Meter posix, for the last sample
Interval	1	Field used in the old pload, to future features
Ss_snap	4	Such as SS_vw 0x05F9, SS_VQ 0x05FA
Num_valid	2	Valid samples in the meter
Last_index	2	Index of the last sample in the meter
Time_end	4	Time posix of the last sample in the meter table
T	1	Tlp (sampling time)
Sample_row	1	30
Total_sample	2	MAX SAMPLE COUNT, 3660
Total_achived_sample	2	Old procedure, to future features
Total_read_samples	2	Number of samples successfully read
First_sample	2	The first sample that has been read, old Pload

Field Name	Size	Description
Pload_status_word	1	Pload status word (old)
C_status	1	Internal table Sample_Status
C_last_index	2	Index that follows the real meter table
C_num_valid	2	Number of valid samples that follow the real meter table
C_time_end	4	POSIX time of the last sample stored in the concentrator
Z_counter	2	Number of Samples to copy in the zip file
V_last_index	2	Index to manage the real table in the concentrator
V_num_valid	2	Number of valid samples saved in the concentrator

Table must be considered only for development use, AMM can discard it during its normal operation.

7.17.4 GZIP Files

The concentrator can create a gzip file for the AMM. The file has a reduced header followed by the samples of the load profile or daily closures profile.

The concentrator can operate in two ways: by updating a zip file already present in the system or by creating a new zip file. When the concentrator finishes to read the meter table, the zip enhance algorithm starts.

7.17.4.1 Gzip structure for load profile

The header of the zip file contains:

Field Name	Size	Description
CE_ID	6	Meter ADCE address
TYPE	1	Load profile type
NORMAL_STATUS_1	2	Normal Status Word 1 (0x1601)
EXTENDED_STATUS_1	2	Extended Status Word 1 (0x1701)
EXTENDED_STATUS_2	2	Extended Status Word 2 (0x1702, only MM520evo meter, see T_CE)
EXTENDED_STATUS_3	2	Extended Status Word 3 (0x1703, only MM520evo meter, see T_CE)
LVC_SW	3	LVC software version

Field Name	Size	Description
CE_SW	6	Meter software version (0x0C0E for MM520evo, 0x0C08, 0x0C05 for P520 – T520 meter)
LVC_DATE_TIME	4	LVC POSIX at first meter reading
CE_DATE_TIME	4	Meter POSIX at first meter reading (0x0A23 for MM520evo, 0x0A01, 0x0A02, 0x0A0A, for P520 - T520 meter)
SAMPLE_STATUS	1	DST CE [0] → 1 if CE_DATE_TIME is in DST DST ZIP [1] →1 if TIME_END is in DST Reserved [2]
NUM_VALID	2	Valid samples in the meter (0x0503)
LAST_INDEX	2	Index of the last sample in the meter (0x0503)
TIME_END	4	Time POSIX of the last sample in the zip file
T_{LP}	1	Meter sampling time (0x05F8)
TOTAL_SAMPLES	2	Size meter in term of Number of sample that can store (3648)
VALID_INTERNAL_SAMPLES	2	Number of valid samples present in the concentrator disk for a specific profile type (Valid samples in the internal table)
TOTAL_READ_SAMPLES	2	Number of samples in the zip file
TOTAL_INTERNAL_SAMPLES	2	Maximum Number of samples in the concentrator disk for a specific profile type (Internal table dimension)
PLOAD_STATUS_WORD	1	PLOAD Status [0] → 0 aligned, 1 not aligned
DATA	N	Load Profile Samples

The Data field is composed from the sequences of samples.

2 Bytes	2 Bytes	2 Bytes	2 Bytes	2 Bytes	…	2 Bytes
Sample1	**Sample2**	**Sample3**	**Sample4**	**Sample5**	**…**	**SampleN**

The concentrator can operate in two ways: by updating a zip file already present in the system or by creating a new zip file. When the concentrator finishes to read the meter table, the zip enhance algorithm starts.

7.17.4.2 Gzip structure for daily closures and instantaneous power maximum demand profile

The header of the zip file contains:

Field Name	Size	Description
CE_ID	6	Meter ADCE address
TYPE	2	Daily profile type. See below
NORMAL_STATUS_1	2	Normal Status Word 1 (0x1601)
EXTENDED_STATUS_1	2	Extended Status Word 1 (0x1701)
EXTENDED_STATUS_2	2	Extended Status Word 2 (0x1702, only MM520evo meter, see T_CE)
EXTENDED_STATUS_3	2	Extended Status Word 3 (0x1703, only MM520evo meter, see T_CE)
LVC_SW	3	LVC software version
CE_SW	6	Meter software version (0x0C0E for MM520evo, 0x0C08, 0x0C05 for P520 – T520 meter)
LVC_DATE_TIME	4	LVC POSIX at first meter reading
CE_DATE_TIME	4	Meter POSIX at first meter reading (0x0A23 for MM520evo, 0x0A01, 0x0A02, 0x0A0A, for P520 - T520 meter)
SAMPLE_STATUS	1	DST CE [0] → 1 if CE_DATE_TIME is in DST DST ZIP [1] →1 if TIME_END is in DST IDPMD [2] → 1 if Instantaneous Daily Power Maximum Demand enabled DAILY_BUF_CONF=0x05 or 0x0B (0x52C2) ADPMD [3] → 1 if Average Daily Power Maximum Demand enabled i.e. DAILY_BUF_CONF=0x08 or 0x0B (0x52C2, only Active components)
NUM_VALID	1	Valid daily closure in the meter (0x52C1)
LAST_INDEX	1	Index of the last daily closure in the meter (0x52C1)
TIME_END	4	Time POSIX of the last daily closure in the zip file
TOTAL_SAMPLES	2	Size meter in term of Number of daily closures that can store (0x20 or 0x40)
VALID_INTERNAL_SAMPLES	2	Number of valid daily closures present in the concentrator disk for a specific buffer type (Valid samples in the internal table)
TOTAL_READ_SAMPLES	2	Number of daily closures in the zip file
TOTAL_INTERNAL_SAMPLES	2	Maximum Number of daily closures in the concentrator disk for a specific profile type (Internal table dimension)
PDAILY_STATUS_WORD	1	Daily Closures Status [0] → 0 aligned, 1 not aligned
DATA	N	Samples

The Data field is composed from the sequences of DC samples in case of IDPMD [2]=0 and ADPMD [3]=0 in the SAMPLE_STATUS:

28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	...	28 Bytes
DC Sample1	**DC Sample2**	**DC Sample3**	**DC Sample4**	**DC Sample5**	**DC Sample6**	**DC Sample7**	**DC Sample8**	**...**	**DC SampleN**

The Data field is composed from the sequences of DC samples and instantaneous daily power maximum demand samples in case of IDPMD [2]=1 and ADPMD [3]=0 in the SAMPLE_STATUS:

28 Bytes	2 Bytes	4 Bytes	28 Bytes	2 Bytes	4 Bytes	...	28 Bytes	2 Bytes	4 Bytes
DC Sample1	**IDPMD Sample1**	**TS_IDPMD Sample1**	**DC Sample2**	**IDPMD Sample2**	**TS_IDPMD Sample2**	**...**	**DC SampleN**	**IDPMD SampleN**	**TS_IDPMD SampleN**

The Data field is composed from the sequences of DC samples and average daily power maximum demand samples in case of DPMD [2]=0 and ADPMD [3]=1 in the SAMPLE_STATUS:

28 Bytes	12 Bytes	28 Bytes	12 Bytes	...	28 Bytes	12 Bytes
DC Sample1	**ADPMD Sample1**	**DC Sample2**	**ADPMD Sample2**	**...**	**DC SampleN**	**ADPMD SampleN**

The Data field is composed from the sequences of DC samples, instantaneous daily power maximum demand samples and average daily power maximum demand samples in case of DPMD [2]=1 and ADPMD [3]=1 in the SAMPLE_STATUS:

28 Bytes	2 Bytes	4 Bytes	12 Bytes	...	28 Bytes	2 Bytes	4 Bytes	12 Bytes
DC Sample1	**IDPMD Sample1**	**TS_IDPMD Sample1**	**ADPMD Sample1**	**...**	**DC SampleN**	**IDPMD SampleN**	**TS_IDPMD SampleN**	**ADPMD SampleN**

It is worth noting that the ADPMD only consider the active components (positive ADPMD_W+ and negative ADPMD_W-) for each tariff.

7.17.4.3 Creating a new zip file

When the concentrator finishes to read a table from a meter (the table can be not complete) it creates a zip file with profile values. These values are available for AMM. The name for a single zip file depends on the ADCE, the type of profile and the time when the file is created.

Example:

“LP1_010203ABCDEF_5201276A_N.dat.gz”

Where:

LP is a standard prefix for Load profile

1 is the type of load profile:

Profile	Type of LP
LP1	VA
LP2	VR
LP3	NA
LP4	NI
LP5	PC
LP6	NC

010203ABCDEF is the ADCE address

5201276A is the POSIX time creation in Hex format

N is a identifier sequential number (0 - 999)

dat.gz is the standard suffix

When a zip file is created, it is made available in /disk/ftp/pub/pload in the concentrator file system. There is one zip file for each load profile; the internal .dat file shall be named in the same way.

Example:

“DC1_C1_010203ABCDEF_5201276A_N.dat.gz”

Where:

DC is a standard prefix for Daily closures profile

1_C1 is the type of Daily Closures profile:

Profile	Type of DC

DC1_C1	1_C1
DC2_C1	2_C1
DC3_C1	3_C1
DC4_C1	4_C1
DC5_C1	5_C1
DC6_C1	6_C1

010203ABCDEF is the ADCE address

5201276A is the POSIX time creation in Hex format

N is a identifier sequential number (0 - 999)

dat.gz is the standard suffix

When a zip file is created, it is made available in /disk/ftp/pub/pdaily in the concentrator file system. There is one zip file for each load profile; the internal .dat file shall be named in the same way.

7.17.4.4 Updating a zip file

This way is used if the file zip already exists in /disk/ftp/pub/pload or /disk/ftp/pub/pdaily.

For example: table 1, meter: 010203ABCDEF.

The zip file "**LP1_010203ABCDEF_POSIX.dat.gz**" is moved into /disk/ftp/pub/tmp and it is modified by incrementing the data load profile and changing the entire header. When the file is completely modified it is moved into /disk/ftp/pub/pload with a new timestamp.

The ftp server (Enel-FTP) installed in the concentrator keeps copying even if the file is moved, so that there isn't any problem if the file is moved while it is being copied from the AMM. Every time a zip file is modified, its suffix is changed.

The N increases when a new file is created. If the zip operation is an enhancement of an existent file, this field doesn't increase. When the AMM deletes a .zip file, the next one will have "N+1" suffix, and so on. The range is 0 – 999. The same rules have to be applied to zip file related to daily closure profile.

See document: [ZipFileCreation_NT267.pdf].

7.17.4.5 Recovery all samples

It is an exceptional way to use this procedure. If the field "ALL_SAMPLES" in Table 63 is different by zero, for each profile, the N2PLOAD provides all samples and stores them in the corresponding zip file. If there is already a zip file for a profile, it will be renamed in old and a new one will be created with all the samples stored in the internal table (see OLD.zip file management). If the file zip is not yet present for a load profile, a new file zip will contain all samples read by N2PLOAD.

Being an exceptional method, for concentrator security, this flag will be set to zero when the procedure N2PLOAD ends. This mechanism works if also the flag "ENABLE_GZIP_FILE" is set.

The gzip creation, or gzip update, is an important step that occupies free space in concentrator disk. If the concentrator is running out of file system space it is up to AMM to delete old unused data in order to free space. Furthermore a different procedure can be used to collect profile data. For example if AMM have all collected most of the samples, then it can collect the last samples through a GB (042) and GB (044); in this case the procedure that updates or creates the gzip files can be disabled. Through a flag "ENABLE_GZIP_FILE", it is possible to enable or disable the manipulation (creation or update) of the gzip files. This flag is in Concentrator Table 63. At the end of the N2PLOAD procedure this flag will be not set. Only the AMM can set this one.

If a meter is deleted from the CE table and a .zip file is present in the "ftp" directory, the file .zip is renamed.

Example:

LP1_010203ABCDEF_5201276A_N.dat.gz

It is renamed in

OLD_LP1_010203ABCDEF_5201276A_N.dat.gz_75BCD15

Where:

OLD: is a prefix

75BCD15: is the data POSIX of the backup .zip file creation

The concentrator can have a lot of OLD.zip file in the "ftp" directory for one meter, but only one normal .zip file for the same meter. It's recommend to delete the OLD file to avoid the file system saturation.

The concentrator generates an "OLD.zip" file for a ".zip" present also if this last table is deleted from CE table. Another reason, for an "OLD.zip" generation from a ".zip", can be a misalignment in the .dat internal table when the N2PLOAD reads the meter parameter. The concentrator never creates a backup of .dat tables, only for an existent .zip file.

7.17.5 GB (042) Message

In addition to the above described procedure, AMM can optionally handle N2PLOAD samples of a single CE by using the GB_READREQ (042) message. Such message allows to read a portion (max 255 samples) of the CE's load profile data inside the ".dat" file previously stored by the N2PLOAD.

As AMM delivers the GB (042) message, if the transaction correctly succeeds the concentrator replies with one GB_READRESP (043) message carrying out the required data of the CE. On the contrary, if the transaction fails, it replies with the proper GB_NACK (255) message with the error code number 12:

- offset = 0 if the parameters of the request are wrong;
- offset = 1 if there isn't the load profile file;
- offset = 2 if the time request is from solar time to daylight saving time and vice versa.

7.17.5.1 FRAME GB (042)

1 byte	1 byte	2 bytes	2 bytes	1 byte	12 bytes
MSG_TYPE	**MSG_CODE**	**LENGTH**	**TRANS_ID**	**STEP**	**DATA**

The data field contains:

6 bytes	1 byte	4 byte	1 byte
ADCE	**TABLE TYPE**	**TIME STAMP**	**NUM SAMPLES**

Code: The number of the GB (042)

ADCE: Meter address

Table Type: Load profile type to read:

Profile	Table Type	Meaning
PL1	0x02	Virtual Active profile

PL2	0x04	Virtual Reactive profile
PL3	0x08	Negative Active profile
PL4	0x10	Negative inductive Reactive profile
PL5	0x20	Positive capacitive Reactive profile
PL6	0x40	Negative capacitive Reactive profile

Time Stamp: Time to start the download

Num. Samples: Numbers of samples to download from concentrator

7.17.5.2 FRAME GB (043)

1 byte	1 byte	2 bytes	2 bytes	1 byte	Variable
MSG_TYPE	**MSG_CODE**	**LENGTH**	**TRANS_ID**	**STEP**	**DATA**

The data field contains:

6 bytes	2 bytes	2 bytes	2 bytes	2 bytes	1 byte	1 byte	4 bytes	Variable
ADCE	**NSW1**	**ESW1**	**ESW2**	**ESW3**	**TABLE TYPE**	**T_{LP}**	**TIME STAMP**	**SAMPLES**

ADCE: Meter address

NSW1: Last meter status word 1

ESW1: Last extended meter status word 1

ESW2: Last extended meter status word 2 (Only MM520evo, see T_CE)

ESW3: Last extended meter status word 3 (Only MM520evo, see T_CE)

Table Type: Load profile type read:

Profile	Table Type	Table Type	Meaning

PL1	0	0	0	0	0	0	1	0	0x000002	Virtual Active profile
PL2	0	0	0	0	0	1	0	0	0x000004	Virtual Reactive profile
PL3	0	0	0	0	1	0	0	0	0x000008	Negative Active profile
PL4	0	0	0	1	0	0	0	0	0x000010	Negative inductive Reactive profile
PL5	0	0	1	0	0	0	0	0	0x000020	Positive capacitive Reactive profile
PL6	0	1	0	0	0	0	0	0	0x000040	Negative capacitive Reactive profile

T$_{LP}$: Sampling time

Time Stamp: Timestamp for the first sample in the "Samples" field

Samples: Portion of load profile required, as follows:

The Data field is composed by the sequence of the requested samples.

2 Bytes	2 Bytes	2 Bytes	2 Bytes	2 Bytes	…	2 Bytes
SAMPLE1	**SAMPLE2**	**SAMPLE3**	**SAMPLE4**	**SAMPLE5**	**…**	**SAMPLEN**

7.17.6 GB (044) Message

As for GB (042), AMM can optionally handle N2PLOAD daily closures and power maximum demand profile of a single CE (Only MM520evo, see T_CE) by using the GB_READREQ (044) message. Such message allows to read a portion (max 32 samples) of the CE's daily profile data inside the ".dat" file previously stored by the N2PLOAD.

As AMM delivers the GB (044) message, if the transaction correctly succeeds the concentrator replies with one GB_READRESP (045) message carrying out the required data of the CE. On the contrary, if the transaction fails, it replies with the proper GB_NACK (255) message with the error code number 12:

- offset = 0 if the parameters of the request are wrong;
- offset = 1 if there isn't the load profile file;
- offset = 2 if the time request is from solar time to daylight saving time and vice versa).

7.17.6.1 FRAME GB (044)

1 byte	1 byte	2 bytes	2 bytes	1 byte	13 bytes

MSG_TYPE	MSG_CODE	LENGTH	TRANS_ID	STEP	DATA

The data field contains:

6 bytes	2 bytes	4 bytes	1 byte
ADCE	**TABLE TYPE**	**TIME STAMP**	**NUM SAMPLES**

Code: The number of the GB (044)

ADCE: Meter address

Table Type: Daily profile type to read:

Profile	Table Type	Meaning
DC1_C1	0x0002	DC and maximum powers for the positive active component
DC2_C1	0x0004	DC for the positive inductive-reactive component
DC3_C1	0x0008	DC and maximum powers for the negative active component
DC4_C1	0x0010	DC for the positive capacitive-reactive component
DC5_C1	0x0020	DC for the negative capacitive-reactive component
DC6_C1	0x0040	DC for the negative inductive-reactive component

Time Stamp: Time to start the download

Num. Samples: Numbers of samples to download from concentrator

7.17.6.2 FRAME GB (045)

1 byte	1 byte	2 bytes	2 bytes	1 byte	variable
MSG_TYPE	**MSG_CODE**	**LENGTH**	**TRANS_ID**	**STEP**	**DATA**

The data field contains:

6 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	4 bytes	variable

ADCE	NSW1	ESW1	ESW2	ESW3	TABLE TYPE	TIME STAMP	SAMPLES

Where:

ADCE: Meter address

NSW1: Last meter status word 1

ESW1: Last extended meter status word 1

ESW2: Last extended meter status word 2 (Only MM520evo, see T_CE)

ESW3: Last extended meter status word 3 (Only MM520evo, see T_CE)

Table Type: Load profile type read:

Profile	Symbol	Table Type								Table Type	Meaning
F(DC1_C1)	1_C1	ADPMD	0	0	0	0	0	1	DPMD	0x0002	DC_1 of Contract_1
F(DC2_C1)	2_C1	ADPMD	0	0	0	0	1	0	DPMD	0x0004	DC_2 of Contract_1
F(DC3_C1)	3_C1	ADPMD	0	0	0	1	0	0	DPMD	0x0008	DC_3 of Contract_1
F(DC4_C1)	4_C1	ADPMD	0	0	1	0	0	0	DPMD	0x0010	DC_4 of Contract_1
F(DC5_C1)	5_C1	ADPMD	0	1	0	0	0	0	DPMD	0x0020	DC_5 of Contract_1
F(DC6_C1)	6_C1	ADPMD	1	0	0	0	0	0	DPMD	0x0040	DC_6 of Contract_1

Time Stamp: Time stamp for the first sample in the “Samples” field

Samples: Portion of daily closures profile required:

If the IDPMD and the ADPMD bit of “Table_Type” field is zero, the Samples field is composed by the sequence of DC samples:

28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	28 Bytes	...	28 Bytes
DC Sample1	**DC Sample2**	**DC Sample3**	**DC Sample4**	**DC Sample5**	**DC Sample6**	**DC Sample7**	**DC Sample8**	**...**	**DC SampleN**

If the IDPMD bit of "Table_Type" field is one and the ADPMD bit is zero, the Samples field is composed by the sequences of DC samples and instantaneous daily power maximum demand samples:

28 Bytes	2 Bytes	4 Bytes	28 Bytes	2 Bytes	4 Bytes	...	28 Bytes	2 Bytes	4 Bytes
DC Sample1	**DPMD Sample1**	**TS_DPMD Sample1**	**DC Sample2**	**DPMD Sample2**	**TS_DPMD Sample2**	**...**	**DC SampleN**	**DPMD SampleN**	**TS_DPMD SampleN**

If the IDPMD bit of "Table_Type" field is zero and the ADPMD bit is one, the Samples field is composed by the sequences of DC samples and average daily power maximum demand samples:

28 Bytes	12 Bytes	28 Bytes	12 Bytes	...	28 Bytes	12 Bytes
DC Sample1	**ADPMD Sample1**	**DC Sample2**	**ADPMD Sample2**	**...**	**DC SampleN**	**ADPMD SampleN**

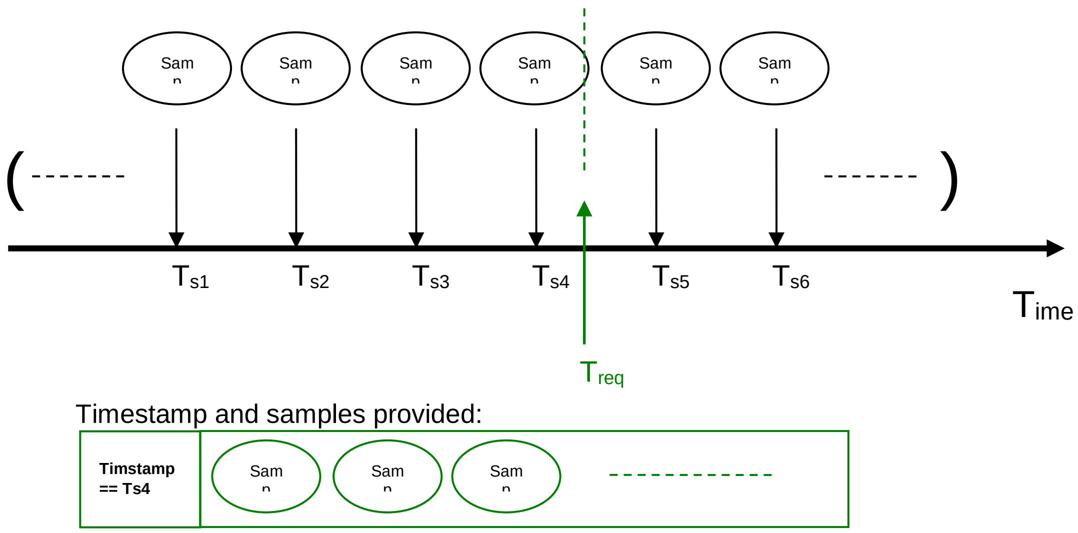
If the IDPMD bit of "Table_Type" field is one and the ADPMD bit is one, the Samples field is composed by the sequences of DC samples, instantaneous daily power maximum demand samples and average daily power maximum demand samples:

28 Bytes	2 Bytes	4 Bytes	12 Bytes	...	28 Bytes	2 Bytes	4 Bytes	12 Bytes
DC Sample1	**IDPMD Sample1**	**TS_IDPMD Sample1**	**ADPMD Sample1**	**...**	**DC SampleN**	**IDPMD SampleN**	**TS_IDPMD SampleN**	**ADPMD SampleN**

It is worth noting that the ADPMD only consider the active components (positive ADPMD_W+ and negative ADPMD_W-) for each tariff.

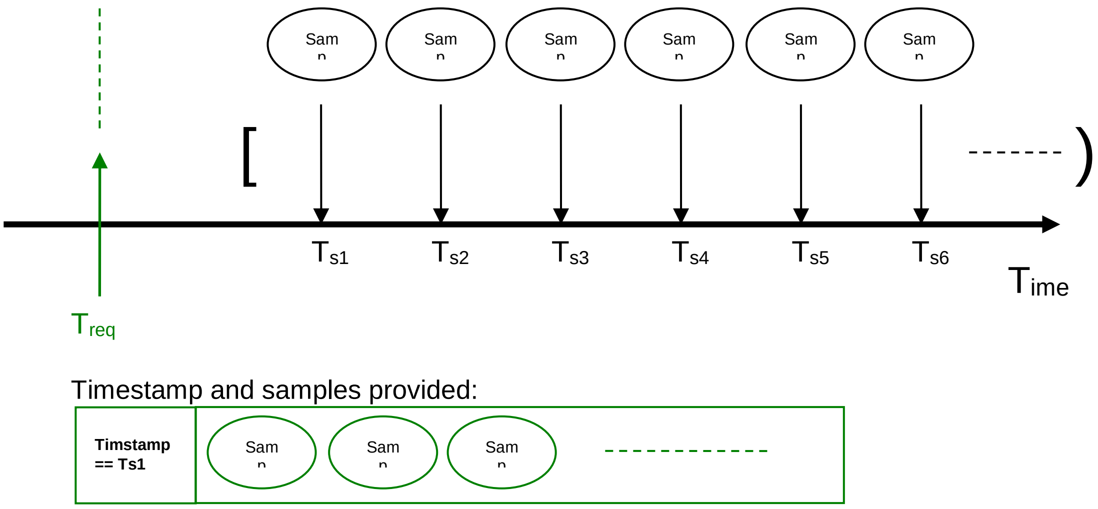
7.17.7 Use Cases

Case 1: The time request (T_{req}) has a timestamp between two samples, for example between T_{s4} and T_{s5}. The concentrator provides the first timestamp value, T_{s4}, and the relative samples until the "Numb. sample" is given.



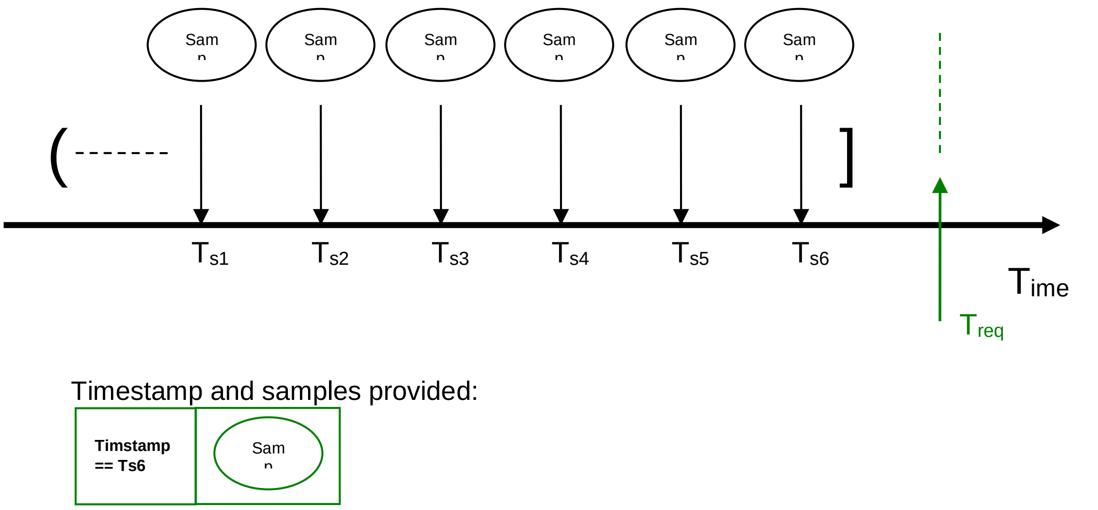
[CASE 1]

Case 2: The time request (T_{req}) has a timestamp before the first valid sample in the table. The concentrator starts to provide samples from the first valid sample.



[CASE 2]

Case 3: The time request (T_{req}) has a timestamp after the last valid sample in the table. The concentrator provides the last sample with relative timestamp.



[CASE 3]

7.17.8 N2PLOAD Control Table {T_N2PLOAD_C} - Tab. 68

By this control table is possible to trace the N2PLAOD process for each meter loaded in T_CE, it contains:

Tab. 68 - N2PLOAD CONTROL Table (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x44000101	PL_VA_STATUS	1	PL_VA status during N2PLOAD
0x44000102	PL_VR_ STATUS	1	PL_VR status during N2PLOAD
0x44000103	PL_NA_ STATUS	1	PL_NA status during N2PLOAD
0x44000104	PL_NIR_ STATUS	1	PL_NI status during N2PLOAD
0x44000105	PL_PCR_ STATUS	1	PL_PC status during N2PLOAD
0x44000106	PL_NCR_ STATUS	1	PL_NC status during N2PLOAD

The field PL_x_STATUS must be updated during the N2PLOAD process with the following values:

PL_x_STATUS CODE		
Value	**Meaning**	**Description**
0x00	Target Disabled	N2PLOAD starts and F(INTR)=0 in CE_Table
0x01	Load Profile Disabled	N2PLOAD starts and F(PL_x)=0 in CE_Table
0x02	To Do	N2PLOAD starts and F(PL_x)=1 in CE_Table
0x03	In Progress	During profile acquisition
0x04	Done Aligned	Acquisition completed with profile aligned
0x05	Done Not Aligned	Acquisition completed with profile not aligned
0x06	Done Aligned Disk Full	Acquisition completed with profile aligned but the disk full condition has been detected
0x07	Done Not Aligned Disk Full	Acquisition completed with profile not aligned but the disk full condition has been detected
0x08	Internal Table Not Created Disk full	Acquisition fails due to internal table not created for disk full condition
0x09	ONSI	CE in ONSI condition has been detected
0x0A	CE Not Reachable	Trama_1 or Trama_2 fails
0x0B	Diagnostic problem (SGR)	CE replies toTrama_1 or Trama_2 with a Nack

All the fields are readable but not writeable, each row is linked to T_CE in order to keep CE_ID association.

In case of decommissioning or if a T_CE entry is deleted then the concentrator must erase the linked row.

The zip file of T_N2PLOAD_C control table, if enabled, must be saved in /disk/ftp/pub/log. In order to avoid file system saturation the same rules described for N2PLOAD zip generation have to be applied. Table will be saved with the following naming:

tab_n2ploadc.fdb_5201276A.gz

where **5201276A** is the creation date in POSIX notation

The table has to be stored in the no-volatile memory of concentrator.

7.18 UPDATE OF CE SOFTWARE (CEDWLD)

The following chapters describe the application download process for the CE. This download process has to be implemented by the concentrator (or HHU). The primary goal behind this feature is to provide a means for doing secure, multicast downloads (from concentrator) so that downloads can be done in a reasonable amount of time.

This description covers the download protocol between the concentrator and the meter via PLC and the same procedure shall be used via RF, for details see 8.4. It also describes the control mechanism used by the AMM to control the concentrator behaviour.

As above mentioned, the CE software is downloadable. Specifically, a portion of the application program running on the meter host processor can be downloaded.

The meter download process has to be controlled by a ENEL DH-910K table and a unique ENEL DH-960K message (program data write or PDW). The table has to contain control information for the download process. The table is authenticated and thus is handled individually by target (unicast messaging). The actual program contents have to be loaded by a distinct ENEL DH-960K message that can be broadcast to the targets (See ENEL DMI 1 98904 for P520 project).

7.18.1 Meter Download Control Table

The meter download control table (DCT) provides the following control parameters:

SWITCHOVER TIME: this provides a 6-byte date/time that designates when the switchover is to occur. This enables all meters to switch at close to the same time. A time in the past indicates that the switchover should be immediate. A value of all zeroes has to indicate no switchover is pending. The meter will set the Switchover Time to all zeroes when a STARTLOAD command is received (see below).

DATE/TIME: this is the date/time as assigned to the file by the AMM. The CE does not validate the Date/Time in any way. It is only provided as a way of externally determining the date of the program loaded into a given meter.

PROGRAM DIGEST: this is an 8-bytes digest composed of the least significant 64 bits of the MD5 digest computed over the following data:

CE Sub-Section	CE Progressive	PDW data	Date/Time

See ENEL DH 960K at chapter 13

The switchover can occur only if the digest of the above matches that provided in the DCT. The digest has to protect against PDWs sent by intruders as well as PDWs corrupted but still passing CRC. Note that the bits of CE Subsection/CE progressive registers of the node address have to be equal 1. Even if the file is downloaded to a single CE using unicast messages, the CE Sub-Section/CE progressive of the node is still 0/0. Also note that unlike normal two-way authenticated messages, the Date/Time is not part of the incoming data stream but instead comes from the DCT.

CONTROL WORD: this location is used to direct the meter and also to provide feedback on the load. The write function and read functions are distinct (i.e., written values are “commands” and cannot be read back).

Write Values**:**

0xCA02[30] : **STARTLOAD**; Starts a load process

Sets the INPROGRESS bit.

Clears all other Control Word read bits.

Sets the Packet Status and Switchover Time to all zeroes.

0x1234 : **ABORTLOAD**; Aborts a load process

Clears all Control Word read bits.

Read Values: (bit mask with some combination of the following):

0x0001 : **INPROGRESS**; Indicates a load is in progress.

Set when STARTLOAD is received.

Cleared when an ABORTLOAD is received or after SWITCHREADY is set.

0x0002 : **RECEIVEDALL**; Indicates all PDWs have been received

Set when all Packet Status bits up to Final Packet Number are set.

Cleared when STARTLOAD or ABORTLOAD is received.

0x0004 : **DIGESTERR**; Indicates a digest error was detected

Set after RECEIVEDALL set and digest mismatches.

Cleared when STARTLOAD or ABORTLOAD is received.

0x0008 : **SWITCHREADY**; Indicates ready for switchover.

Set after RECEIVEDALL set and digest matches.

[30] Note that the STARTLOAD value of 0xCA02 is specific to the single phase mono directional T520 meter (0xCAA3 is specific for single phase bi-directional T520 meter). Each device type that has a unique load image type can specify a unique STARTLOAD code. This code is encoded into the image file itself. This ensures that devices of type X don’t accidentally get images for devices of type Y. ("In case of DWLD on a CE (both poly phase, both single phase), if in the "image file" there is not any value for START LOAD (e.g. x CA02 for s.p. meter and x CB02 for pp mono directional meter), the MSC must not use any default value. It has then to deliver the GB 019.007 with reason code = 1 (aborted) to AMM").(0xEB03 is used for MSC’s Ex. Board)

Cleared when STARTLOAD or ABORTLOAD is received or upon attempting a switchover.

0x0010 : **SWITCHDONE**; Indicates switchover completed successfully.

Set after SWITCHREADY and switchover time expiration.

Cleared when STARTLOAD or ABORTLOAD is received.

0x0020 : **SWITCHFAIL**; Indicates switchover was attempted but failed.

Set after SWITCHREADY and switchover time expiration.

Cleared when STARTLOAD or ABORTLOAD is received.

FINAL PACKET NUMBER (FPN): this is the packet number in the final PDW message. PDWs have packet numbers ranging from 0..FPN.

PACKET STATUS: this is a 1024 bit array of packets received. Given a PDW size of 60 bytes, this allows for a 60K download. The Packet Status has to be initially set by the meter to all zeroes on receipt of a STARTLOAD command from the concentrator. As PDW messages are received, the meter sets the corresponding bit in the Packet Status. PDW 0 corresponds to the most significant bit of the first byte of Packet Status.

ADDITIONAL STATUS: this must contain the flash programming state and a retry count.

PSTTBASE: It is the Offset for PSTTS1 used for "extended" download procedure.

PSTTS conveys the status of a contiguous series of up to 1024 packets (60 bytes long). In order to support downloads of more than 1024 packets, the PSTTBASE field is used to indicate the packet number associated with the first bit of the PSTTS. Thus, the download procedure may require multiple passes of sending packets and reading status to complete the entire download.

Concentrator downloads all the download packets, then asks for PSTTBASE and PSTTS. The CE responds inserting in PSTTBASE the first packet not correctly received, and in PSTTS every bit set for every bad packet (the first packet corresponding with the most significant bit of first byte) starting from that packet.

The Download Image File will have the same header as the CE, but the rest of the file may have a different internal format; the internal format is transparent to the concentrator.

To simplify the implementation, even in respect of the base concepts defined above, we will use only steps of 1024 packets at time. The register PSTTBASE will be set with multiple values of 1024 (0, 1024, 2048..) in many steps of the procedure. The value 0xFFFF means "all packets received".

- **PSTTBASE on CE side**

To guarantee compatibility with previous version of concentrator SW, the use of the parameter PSTTBASE is managed by CE in this way.

If packets number to download is less than 1024 the PSTTBASE parameter will be set to 0, and not used.

The packets number is sent by concentrator before start of download (field FRFPN, 0x1C04).

If parameter FRFPN is set to a value bigger than 1023, then the CE uses PSTTBASE.

The packets with index less than 1024 will be managed with PSTTBASE = 0.

The PSTTBASE is recalculated by the CE when all packets managed in PSTTS streams are correctly received (first 1024 packets correctly received).

If first 1024 packets are correctly received, CE sets PSTTBASE = 1024. After that the PSTTS bits frame will point to packets more 1024.

The PSTTBASE parameter will be managed by CE, it is only readable for concentrator.

The PSTTBASE parameter will be reset to 0 by the CE with the same commands that reset all fields PSTTS (with ABORTLOAD, STARTLOAD commands).

When CE has received all packets of the file, CE sets control word to “RECEIVEDALL” and PSTTBASE = 0xFFFF

- **PSTTBASE on Concentrator side**

The concentrator, upon activation of CE download, reads the file and calculates the number of packets to send to CEs.

If the packets number is less than 1025, then the procedure will be executed not using PSTTBASE. The procedure “download1” will be executed.

If packets number is more than 1024, it must read the parameter PSTTBASE from CE.

If CE manages the field it responds with the data. If CE is an old (GEM, GISM) CE, and it does not manage the parameter, it responds NACK, not existing field.

Download procedure:

a) If the FW to download is bigger than 1024 packets, any attempt to download it on a CE that does not support PSTTBASE aborts. If CE supports PSTTBASE, the procedure “Download2” will be executed;

b) If FW is smaller than 1025 packets, the download is made in any case using “Download1”.

The download procedure is now:

Download1:

<u>Step1:</u>

For T520 mode: If CE ADBR section is not the same of T_ATT concentrator, set the ADBR section on CE (3 bytes).

Read CE Tab 28: REPROGRAMMING_DATE, FINAL_PACKET_NUMBER, CONTROL_WORD (rows 0x02, 0x03 and 0x04)

Write ABORTLOAD

Write new values for STARTLOAD (rows 0x02, 0x03 and 0x04)

<u>Step2:</u>

Start sending packets

<u>Step3: (repeat until all packets received)</u>

Read CONTROL WORD (row 0x03), PSTTSs (rows 0x02, 0x05, 0x06, 0x07 and 0x08)

Resend packets not correctly received

<u>Step4:</u>

SWITCHOVER

The download of a big FW program for concentrator procedure is modified in this way.

Download2

<u>Step1:</u>

For T520 mode: If CE ADBR section is not the same of T_ATT concentrator, set the ADBR section on CE (3 bytes).

Read CE Tab 28: REPROGRAMMING_DATE, FINAL_PACKET_NUMBER, PSTTSBASE (rows 0x02, 0x03, 0x04 and 0x20), if response is NACK:

It is an old CE, DWLD then aborts

Write ABORTLOAD (PSTTBASE reset)

Write new values for STARTLOAD (rows 0x02, 0x03, 0x04) (PSTTBASE reset)

<u>Step2:</u>

<u>Repeat for every 1024 packets block (For K = 0 to Nblocks -1):</u>

Sending packets k * 1024 + i(0-1023)

<u>Step2.1: (repeat until all packets of the block are received)</u>

Read CONTROL WORD (row 0x03), PSTTSs (rows 0x05, 0x06, 0x07, 0x08) and PSTTBASE (0x20)

Resend packets not correctly received

<u>Step3:</u>

SWITCHOVER

7.18.2 Program Data Write Message

This message has to be an unauthenticated ENEL DH-960K message with the following format:

101 (1 byte)	Packet Number (2 bytes)	Program Data (60 bytes)

101 (1 byte)	Packet Number (2 bytes)	Program Data (72 bytes)

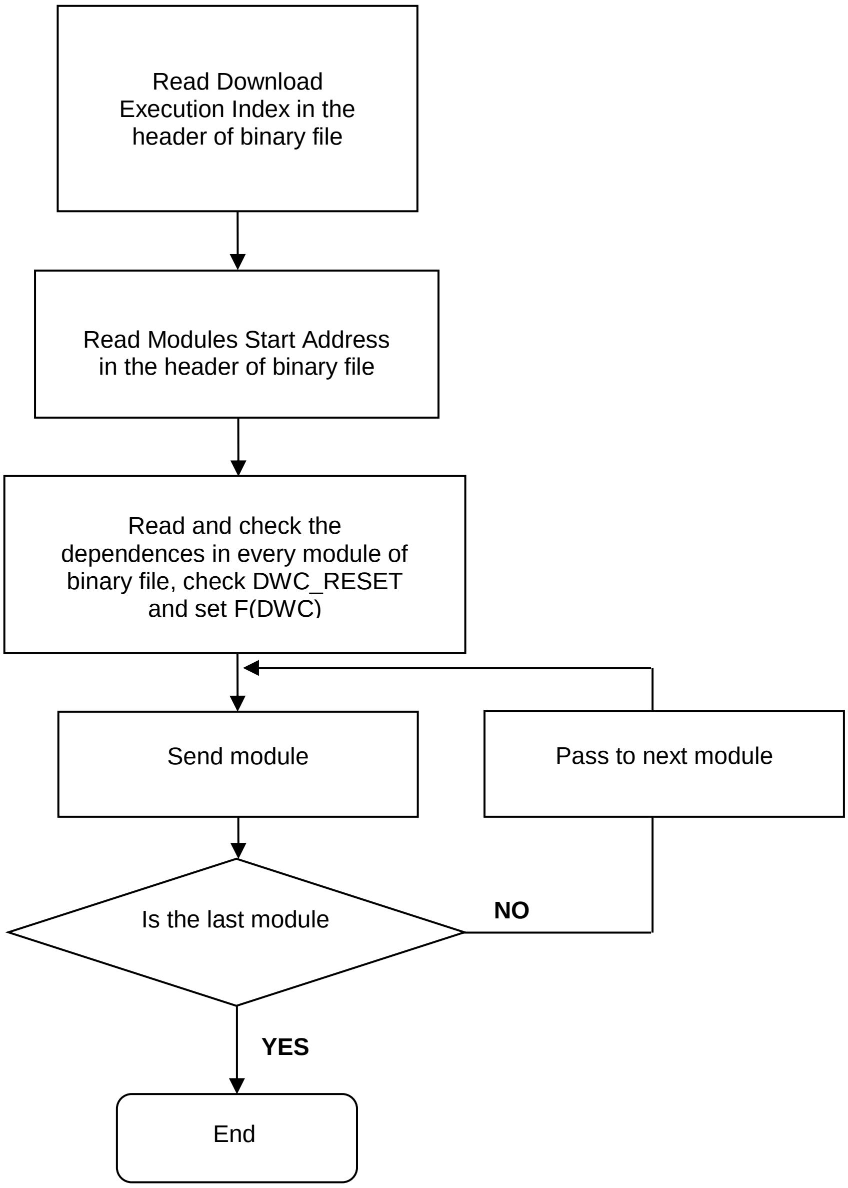
7.18.3 Device Loading Control

Concentrator device loading has to be controlled via a combination of the DWLD bit in the T_CE and the download control table. The DWLD bit has to be set to indicate that a specific meter should be downloaded.

7.18.4 Download Procedure

The download procedure has to be a multiple step procedure controlled by the concentrator. In this procedure, since multipart download can only be performed sequentially and guarantee that each image is activated before sending the next one, the SWOT of the download sent to the meter must be immediate.

The following flow chart describes the download process of a binary file.

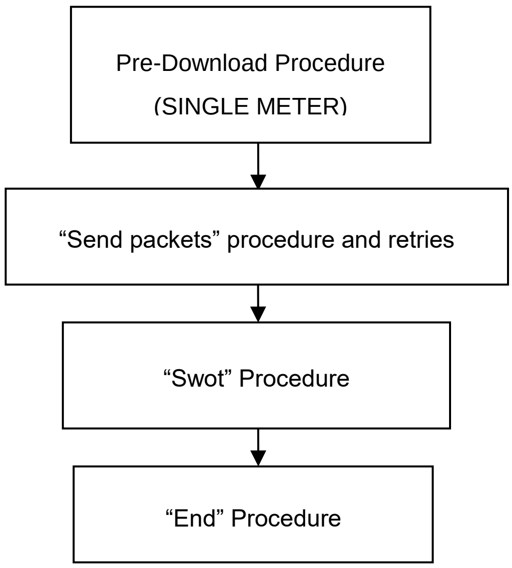


The first step of the download process is the reading of download execution index for application 1 module, application 2 module and modem\ Application 4 module in the header of downloadable binary file.

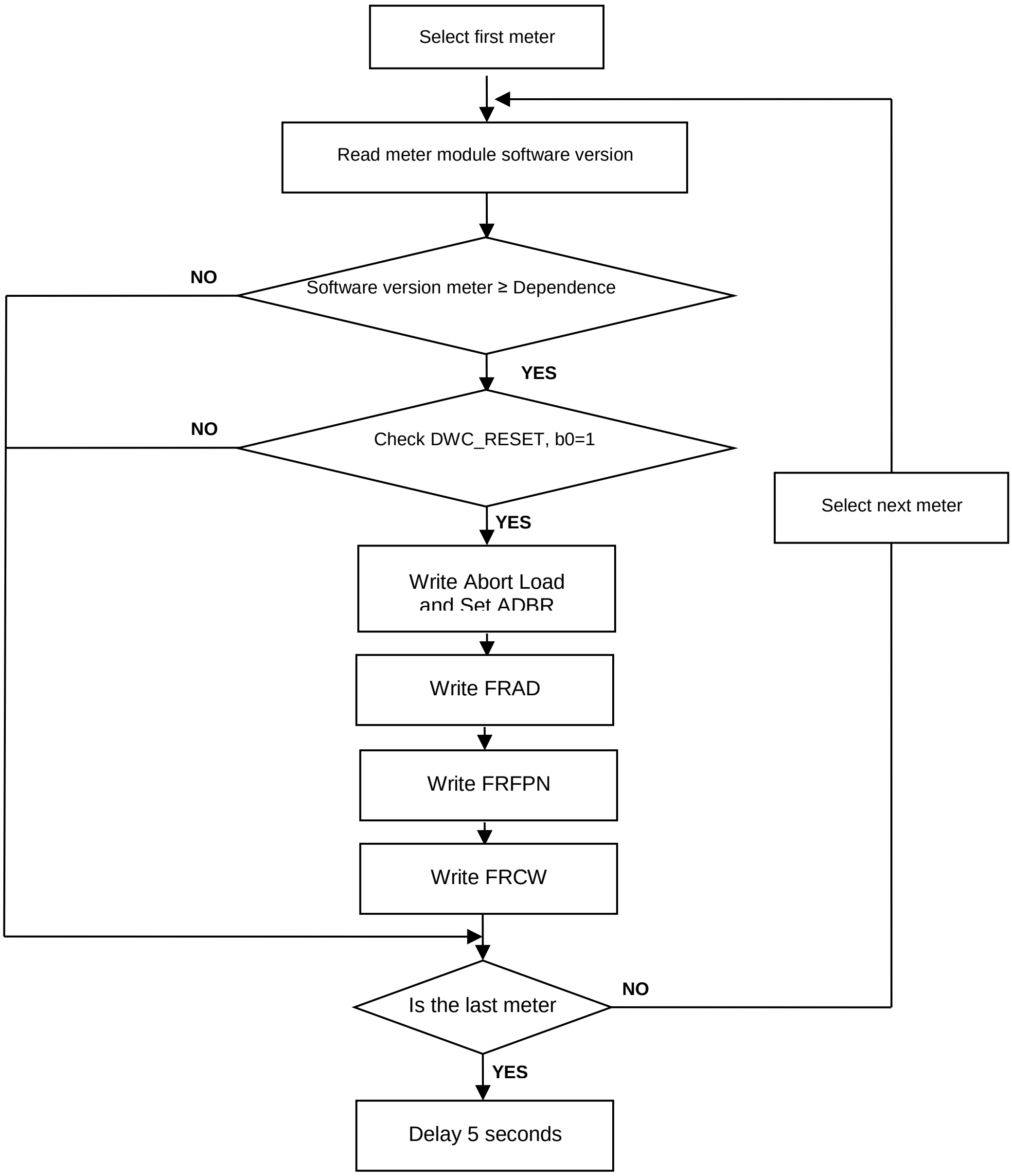
After the storage of this sequence which will define the order of modules download, the LCV/HHU has to read the start address of every modules. The LCV/HHU has also to read the software version and the dependences that are stored after the module name in the header of binary file for every single file module (for Application 4 LCV/HHU has not to read the software version and the dependences).

The concentrator/HHU has to check the rules to verify the consistence of the downloadable code (view previous chapter) and digest verify. The download of the current module hasn't to be performed when the rules, on this module, are not matched. Next figure describes the "Send Module" step of the previous Flow chart.

Send Module



Pre-Download Procedure (Stage 1)



The first step is “Select first meter” and to check the Software Dependency ID with the dependences. The following rules must be observed (for the Application 4 these rules hasn’t to be considered):

- Software Dependency ID Application1 (Meter) >= Dependence Application 1 (Application 2)
- Software Dependency ID Application1 (Meter) >= Dependence Application 1 (Modem)
- Software Dependency ID Application2 (Meter) >= Dependence Application 2 (Application 1)
- Software Dependency ID Application2 (Meter) >= Dependence Application 2 (Modem)
- Software Dependency ID Modem (Meter) >= Dependence Modem (Application 1)

- Software Dependency ID Modem (Meter) >= Dependence Modem (Application 2)

Concentrator has to send “Abort Load” (Code: 0x1234) to cancel a possible previous incomplete download process.

After this the concentrator has to write in the meter the last programming date, time and digest value for the last program code data packets (FRAD), the final packet number of downloadable file (FRFPN) and the control word for the reprogramming process (FRCW).

This procedure has to be performed for all meter.

Send packets procedure (Stage 2) and retries (Stage 3)

“Send packets” procedure and retries

The packet download process, composed by “Send packets” procedure and retries, has to be perform by concentrator in multicast mode (Broadcast) on the meters

A PDW broadcast entails sending the message down every repeat path in a way that it causes each repeater along the repeat path to first send the message and then to relay it to the next repeater. The discipline regulating the messages transmission in this phase are those defined by the protocol and applications described in ENEL DATA COMMUNICATION PROTOCOL ON LOW VOLTAGE NETWORK – APPLICATION LAYER. When a meter receives a PDW, it has to commit it to non-volatile memory and then sets the corresponding Packet Status bit. When a meter sees that it has received all PDW messages (all bits in Packet Status up to the Final Packet Number are set), then it computes its own version of the Program Digest based on the loaded program contents. If that digest does not match the Program Digest, then the appropriate bit in the Control Word is set. When the concentrator sees this condition, it will re-write the Control Word in order to re-initiate a load.

On the first pass, this will be all packets. On subsequent passes, it will be just those packets that were not receive by one or more meters. The only time that this step will send out all packets again is if a digest error is detected on a meter, which also requires repeating of this step for that meter.

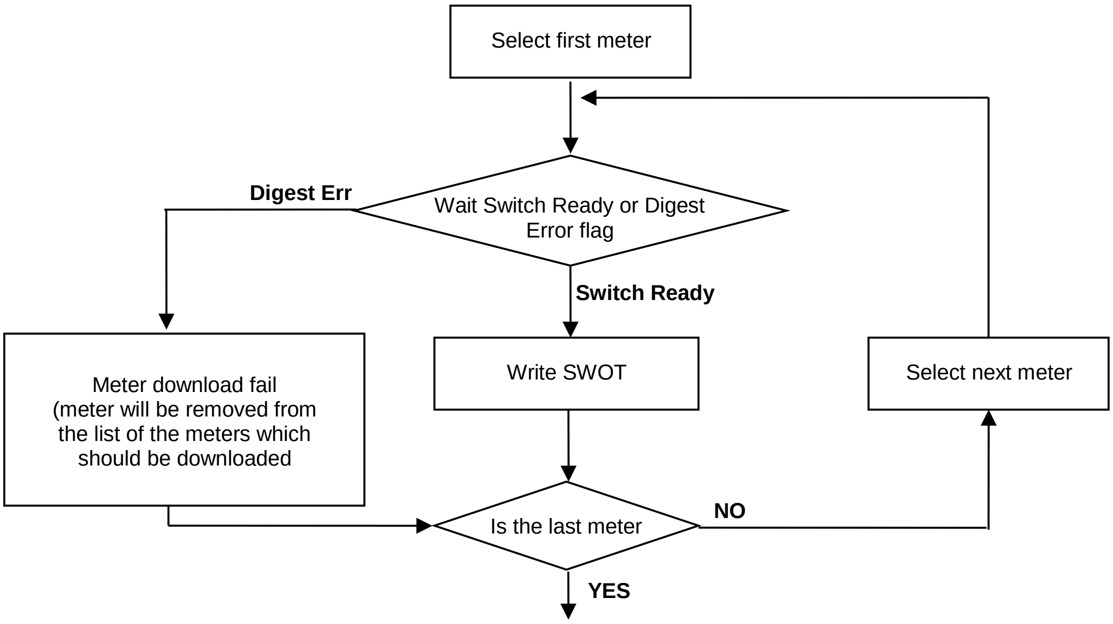
Before the Swot Procedure a step entails querying successive meters to determine whether the Control Word and Packet Status indicate that all packets were received. If a meter indicates that all packets were received, it has to be no longer polled. If any meter indicates that it didn’t receive all the packets, then the polling stops. The assumption here is that there is no need to poll everyone to get redundant information. If other progressive of the nodes have additional missed packets, they will get collected in the subsequent passes. Each step pass begins polling after the last progressive of the node from the previous step pass.

Once polling has completed, a check has to be made to see if any meters still have “holes” in their Packet Status. If so, send packets procedure is repeated. This process has a configurable limit of the number of times it can repeat. For example, it is conceivable that a progressive of the node might be able to respond to the table reads but, for whatever reason, continually fails to get all the PDW messages. Therefore, the AMM must provide the concentrator with an administrative limit on the number of consecutive non-progressing iterations. A progressing iteration is one in which at least one device received at least 20% of the packets sent in this iteration that it had missed in previous iterations. This is specified by the “LOOPLIMIT” field in the download control table.

It is unlikely, but possible that the download procedure could continually make progress but never complete. This could occur if every time a download completed in a meter, it resets its Packet Status due to a Program Digest mismatch. It should be exceedingly rare that this mismatch occurs and even rarer still that it would happen multiple times during a single load procedure. However, this could easily occur if an intruder were inserting bogus PDW frames into the system. The “LOOPLIMIT” field will also limit this condition. Also, there will be a way to terminate a download procedure (see Device Loading Control).

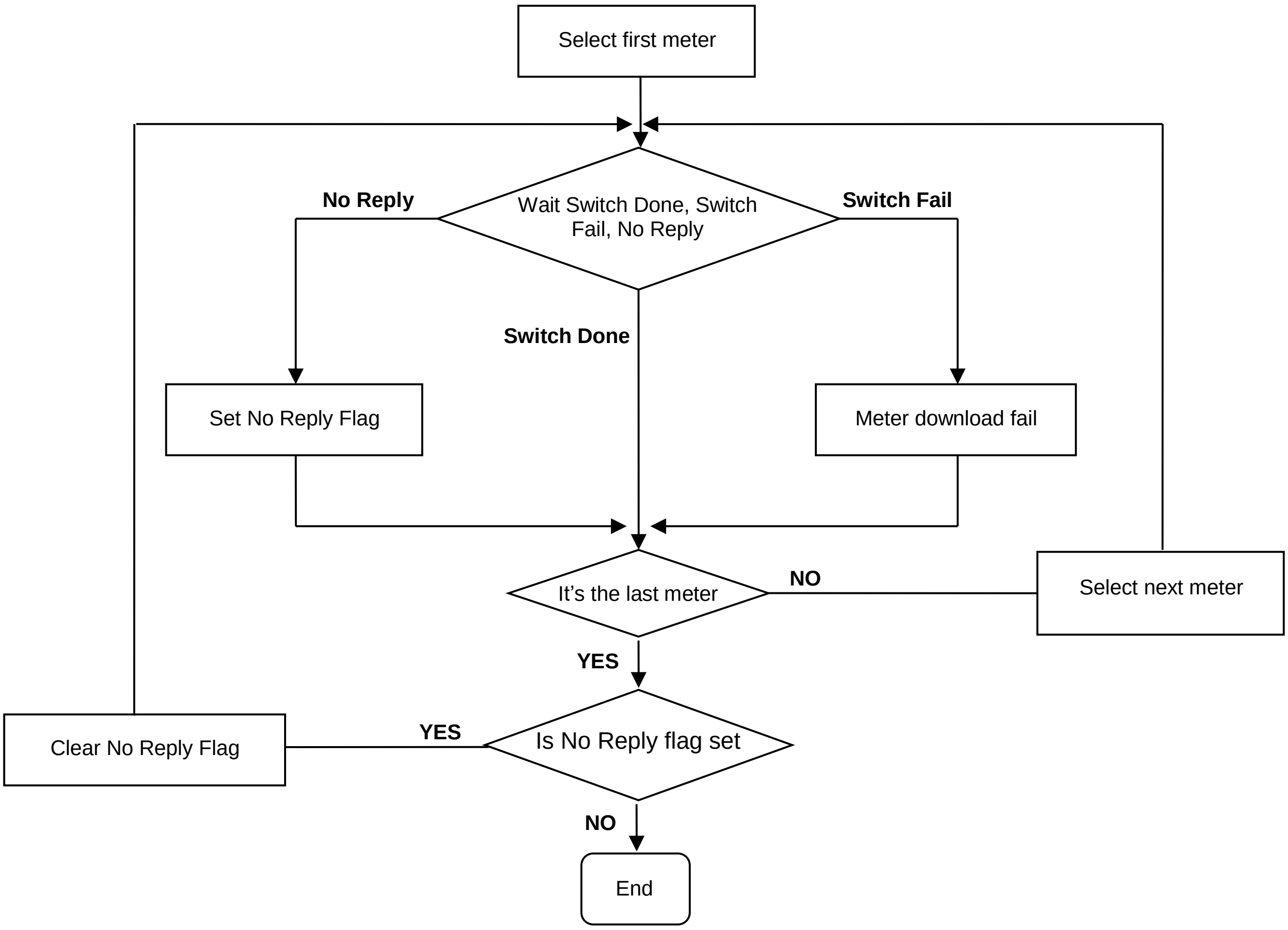
Swot Procedure (Stage 4)

The “Swot Procedure” step is described in next figure:



The concentrator sends the command SWOT (switchover time) if the download procedure is correctly performed, the meter replies with SWITCH READY flags, else the meter replies with DIGEST ERROR flags when the download process is failed.

End Procedure



The meter replies with SWITCH DONE flag if the "Swot" procedure is correctly performed else it replies with SWITCH FAIL flag if the procedure is not correctly executed. If the meter doesn't provide reply the No Reaply Flag has to be set so this procedure will be repeated at the end of process to resume the meter with this reply.

In either case, meters that are considered to have completed download of three images will have the F(DWLD) bit cleared from their CE table entry.

Finally, the concentrator download control table entry has to be cleared so that the download procedure will not run again (see below).

The concentrator does not maintain persistent state with respect to procedures in general. However, the download procedure will be handled specially. If a reset occurs while the concentrator has an active download in progress, then after a power cycle it will restart the download procedure. In this case, Pre-Download Procedure will include a read before write check of the DCT that will skip the initialization of the Packet Status in the event that the Date/Time, Program Digest and the Control Word already match the desired values.

The meter is presumed to store the PDW contents and the DCT in non-volatile memory. Therefore, a meter reset during any stage of the download process should be transparent (except for communication problems resulting from the outage).

If any meter fails to respond during any of the unicast stages, the concentrator will follow the normal error handling process, which may schedule the CONN-C (the CONN-C procedure hasn't to start, in case we have fails to respond) in case of fail to respond it has to be increment the NRN(t)_and generate appropriate spontaneous response messages. However, the download procedure will proceed, despite the error.

Note: if a CE is disabled (F(INTR) = 0) and a download is initiated, that CE will not be downloaded.

7.18.5 Download Image File for MM520 and MM520evo Meter (Multi-Part DWLD)

The multipart binary file can be produced from the analysis of file .hex (Intel Hex-record format) produced by the compiles.

It is composed by two parts:

- Header (128 Byte)
- Downloadable code (Size is multiple of 72 Byte eventually padded with 0xFF)

<u>Header</u>

Header contains the necessary information to recognize the type of file to be downloaded into the meter.

The following table reports the header description.

Location	Length	Object	Object Description
0x00	57 Byte	Title and Description	Title and description of the downloadable binary file.
0x39	1 Byte	Header Type	Type of header (Type = 0 old file format, Type = 1 multipart file format)
0x3A	1 Byte	Application 1 Download Execution Index	Index of download execution for application 1 module (0x00 means that module should not be downloaded)

Location	Length	Object	Object Description
0x3B	1 Byte	Application 2 Download Execution Index	Index of download execution for application 2 module (0x00 means that module should not be downloaded)
0x3C	1 Byte	Modem\Application 4 Download Execution Index	Index of download execution for Modem\Application 4 module (0x00 means that module should not be downloaded)
0x3D	4 Byte	Offset Application 1	Application 1 module start address (this value is relative to the header end location 0x80)
0x41	4 Byte	Offset Application 2	Application 2 module start address (this value is relative to the header end location 0x80)
0x45	4 Byte	Offset Modem\Application 4	Modem\Application 4 module start address (this value is relative to the header end location 0x80)
0x49	12 Byte	Output File Name Prefix Info field	Original name of the file (Just for reference use) (ASCII format).
0x55	4 Byte	Binary File Timestamp POSIX	Timestamp of binary file (Date of creation)
0x59	1 Byte	Digest Precomputed	If Digest Precomputed is non-zero, then the digest fields have to be used for the Image digests. If it is zero, the loader must compute the digests. Default value: 01
0x5a	2 Byte	Digest Year	Year, month, day, hour, minute, second of binary file expiration (Hexadecimal format). The last byte is daylight saving time.
0x5c	1 Byte	Digest Month	
0x5d	1 Byte	Digest Day	
0x5e	1 Byte	Digest Hour	
0x5f	1 Byte	Digest Minute	
0x60	1 Byte	Digest Second	
0x61	1 Byte	Digest Daylight	
0x62	8 Byte	Digest Application 1	The Digest code is used to verify the consistency of downloadable binary file

Location	Length	Object	Object Description
0x6A	2 Byte	Start Load Application 1	This code is sent by concentrator during downloading process in order to start download and used by the meter to recognize which, if any, image has to be updated
0x6C	8 byte	Digest Application 2	The Digest code is used to verify the consistency of downloadable binary file.
0x74	2 byte	Start Load Application 2	This code is sent by concentrator during downloading process in order to start download and used by the meter to recognize which, if any, image has to be updated
0x76	8 byte	Digest Modem\Application 4	The Digest code is used to verify the consistency of downloadable binary file.
0x7E	2 Byte	Start Load Modem\Application 4	This code is sent by concentrator during downloading process in order to start download and used by the meter to recognize which, if any, image has to be updated.

The header contains three type of digest (Digest Application 1, Digest Application 2, Digest Modem\Application 4) because the downloadable code is composed from three modules (Application 1, Application 2, Modem\Application 4). The digests are used to verify the consistency of three downloadable part and they must be calculated on modules in the same way and then brought into the header.

Digest codes are calculated with MD5 algorithm on arrays composed by the following parts:

00	00	Downloadable Code (Application 1, Application 2 or Modem\Application 4)	Digest Date (4 Byte)	Digest Time (3 Byte)	Digest Daylight (1 Byte: “00” or “01”)

The start of each downloadable module can be extracted from the header file looking the fields Offset Application1, Offset Application2, Offset Modem\Application 4 and the download process must be performed following the download execution index of each module.

The value of fields Offset Application 1, Offset Application 2 and Offset Modem\Application 4 can be 0xFFFFFFFF, in this case the download process has to perform the download skipping the modules with this offset and following as always the execution index.

The index value of download execution for each module can be 00,01,02,03.

Download execution index	Description
01	The module has to be download at first
02	The module has to be download at second
03	The module has to be download at third
00	The module has not to be download

The example can be shown in the following table:

Application 1 Download Execution Index	**00**
Application 2 Download Execution Index	**02**
Modem\Application 4 Download Execution Index	**03**

The application 1 has not to be download, the application 2 has to be download at first and the Modem\Application 4 has to be download at second.

The same behaviour has to be obtained with the following configurations

Application 1 Download Execution Index	**00**
Application 2 Download Execution Index	**01**
Modem\Application 4 Download Execution Index	**02**

Application 1 Download Execution Index	**00**
Application 2 Download Execution Index	**01**
Modem\Application 4 Download Execution Index	**03**

The field Binary Field Timestamp is the creation date in POSIX format (the number of seconds elapsed since midnight of January 1, 1970) of binary downloadable file. Output File Name Prefix together with Binary File Timestamp POSIX will compose the binary file name.

The Header Type value shows if the header type is referred to the downloadable binary file for T520, P520 project or to the downloadable binary file for the project LP620.

<u>Downloadable code for Application 1, Application 2, Modem</u>

The "downloadable code" is the code that is loaded in the meter microprocessor memory for management of functionality. It is composed from three modules every of which is usually padded with "0xFF" in order to have a downloadable code size multiple of the data transmission packet (72 byte).

This padding is performed because the dimension of the downloadable code must be multiple of the data transmission packet (72 byte).

Every module has the following format:

Internal Digest (16 Byte)	Module Length Little Endian (4 Byte)	Module Name (1 Byte)	Software Version and Dependences (6 Byte)	Module Code	Padding with 0xFF

The binary file padding is performed on this format file

Internal Digest (16 Byte)	Module Length Little Endian (4 Byte)	Module Name (1 Byte)	Software Version and Dependences (6 Byte)	Module Code

The Internal Digest is calculated with MD5 algorithm on array (which length is given by Module Length field) composed by the following parts:

Module Name (1 Byte)	Software Version and Dependences (6 Byte)	Module Code	Padding

and it is used to verify the consistency of single module.

The module length is calculated on the same array used to calculate the internal digest.

The following table presents the Module Name value for every module:

Module	Module Name Value
Application 1	0xA1
Application 2	0xA2
Modem	0xA3

The Software Version and the Dependences are stored after the module name and they change the position depending on the type of module considered.

These arrays explain the sequence of each field (software version or dependence) for every module and the rules to verify the consistence of the downloadable code.

Application 1
Software version Application1
Dependence Application 2
Dependence Modem

Application 2
Dependence Application 1
Software version Application2
Dependence Modem

Modem
Dependence Application 1
Dependence Application 2
Software version Modem

The following rules must be guaranteed inside a downloadable file; the packing tool should check for this consistency.

- Software version Application1 >= Dependence Application 1 included into “Application 2”
- Software version Application1 >= Dependence Application 1 included into “Modem”
- Software version Application2 >= Dependence Application 2 included into “Application 1”
- Software version Application2 >= Dependence Application 2 included into “Modem”
- Software version Modem >= Dependence Modem included into “Application 1”
- Software version Modem >= Dependence Modem included into “Application 2”

Downloadable code for Application 1, Application 2, Application4

The “downloadable code” for Application 1, Application 2, Application 4 has got the same structure of the “downloadable code” for Application 1, Application 2, Modem described in the previous paragraph. The only difference is the format of Application 4 downloadable code.

The meter implements a function in order to allow the reprogramming of a set of registers by means of a transactional operation. The transaction is considered as a set of WRITE.REQ commands downloaded to the meter in a single package. The WRITE.REQ commands will be executed only when the full package has been downloaded and verified by the meter (authenticity and integrity).

Application 4 contains these transactional operations and this module has the following format:

Internal Digest (16 Byte)	Module Length Little Endian (4 Byte)	Module Name (1 Byte)	Skip Policy (1 Byte)	Free space (1 byte)	Transaction number (2 byte)	Free space (2 byte)	Module Code	Padding with 0xFF

The Skip_Policy field provides the skip policy for WRITE.REQ commands.

The Transaction number provides the total number of WRITE.REQ

The binary file padding is performed on this format file

Internal Digest (16 Byte)	Module Length Little Endian (4 Byte)	Module Name (1 Byte)	Skip Policy (1 Byte)	Free space (1 byte)	Transaction number (2 byte)	Free space (2 byte)	Module Code

The Internal Digest is calculated with MD5 algorithm on array (which length is given by Module Length field) composed by the following parts:

Module Name (1 Byte)	Skip Policy (1 Byte)	Free space (1 byte)	Transaction number (2 byte)	Free space (2 byte)	Module Code	Padding with 0xFF

and it is used to verify the consistency of single module.

The module length is calculated on the same array used to calculate the internal digest.

The following table presents the Module Name value for every module:

Module	Module Name Value
Application 1	0xA1
Application 2	0xA2
Application 4	0xA4

The content of the Module code for Application 4 is a set of WRITE.REQ commands:

- Maximum of 128 bytes for each WRITE.REQ command
- Maximum number of WRITE.REQ commands equal to 512
- Maximum number of bytes encoded in the main section of Module code equal to 32768

This allows to define 512 WRITE.REQ commands that are 64 bytes long or 256 WRITE.REQ commands that are 128 bytes long.

Each WRITE.REQ command included in module code has got a specific separator byte located at the beginning of each command. This byte represent the length in bytes of the command to be executed.

Before starting the processing of the download scenario, the meter checks that all the WRITE.REQ messages have been formatted in the right way and that data to be stored in registers are coherent with the meter tables.

7.18.6 Download Image File for P520/T520 meter (Single-Part DWLD)

The download file (e.g., "CeAppSingle.bin") will have the following format:

Copyright Header	(100 bytes)
Software Version	(2 bytes)
Digest Precomputed	(1 byte)
Date/Time Stamp	(8 bytes)
Digest	(8 bytes)
STARTLOAD Value	(2 bytes)
MBZ	(7 bytes)

Image	(up to 60*1024 bytes)

The Copyright and Software Version are not used by the concentrator. They are for documentation purposes only. If Digest Precomputed is non-zero, then the Digest field has to be used for the image digest. If it is zero, the loader must compute the digest. In any case, the resulting digest is merged with the Date/Time Stamp and these 16 bytes are written to the date/time/digest item in CE table 28. Values have to be stored in this header in big-endian format. This affects the Date/Time Stamp (year field) and the STARTLOAD Value.

7.19 ST_STAT PROCEDURE (ST_STAT)

The ST_STAT procedure has to check the "health" of all CE's modem (Not used in P520 project). This includes checking the current status (node is configured and online, error log is clear). Any problems will result in a SPONT message.

Regarding this procedure, it is a TB procedure. The CE's modem has to return certain information that can be useful for fault isolation. The concentrator has to send the TB_ST_STAT message to the specified CE. The ST_STAT would retrieve this information and then clear it.

The information is:

xmit_errors;
transaction_timeouts;

rcv_transaction_full;
lost_msgs;

missed_msgs;
reset_cause;
node_state;
version_number;

error_log;
model_number;

Note: The definitions of such procedure and the items it would carry on, have to be agreed with the manufacturer.

AMM in order to manage this procedure, has to send to the concentrator the message TB_ST_STAT.REQ (052); the concentrator will answer with the message TB_ST_STAT.REQ (053), see ENEL DH 971K 2nd part.

7.20 CE ACQUISITION PROCEDURE (ACE)

In relation to the DLC PROTOCOL value the concentrator can handle two different algorithm for ACE procedure:

- DLC_PROTOCOL=0x00: ELPE algorithm for ACE
- DLC_PROTOCOL=0x01: SITRED algorithm for ACE
- DLC_PROTOCOL=0x02: M&M algorithm for ACE

7.20.1 ELPE/SITRED

This procedure does the following steps for each CE with either the F(ACE) or F(ACIC) bit set and the F(INTR) bit set in the T_CE:

- If there is no known path to a CE, a path is found using the CONN-C algorithm (although the algorithm is run from within the context of this procedure).
- The CE is acquired if the F(ACE) bit is set in the T_CE. See Appendix A for details on the acquisition process. If the acquisition succeeds, the bit is cleared.
- The IC is acquired if the F(ACIC) bit is set in the T_CE. If the acquisition succeeds, the bit is cleared.
- Generation or Regeneration of initial "dynamic" DIGEST.
- Assign the line of communication of Ce in its own T_CE data base.

The ACE procedure will not set time; this will be left to the SINC-T procedure.

It is necessary to have a F(ACxx) bit to control acquisition in case the AMM wants to force acquisition even when no change was made. This can be used to re-synchronise the network with the database if there is any doubt about their consistency. Also, if the concentrator were to simply acquire CEs that had a certain table state (such as cdKey not equal to Key) this would not cover all the cases. For example, this check does not cover the following cases:

- Only the SubSection/progressive of the node changes.
- The IC SubSection/progressive of the node changes. A CE is replaced with a CE which already has the Key.
- The concentrator Section changes.

The concentrator upon detecting any T_CE or T_ATT change which requires a re-acquisition will automatically set the appropriate F(ACE) or F(ACIC) bit in the T_CE for each affected CE. If the AMM wants to make CE or ATT table changes but have acquisition occur later, it can do this by disabling the AC procedure.

Changes to the following will result in the F(ACE) bit being set for a particular CE:

- T_CE ident
- T_CE SubSection
- T_CE progressive
- T_CE icSubSection
- T_CE icprogressive
- T_CE F(intr)

Note that changing T_CE.cdKey alone will not result in an acquisition. This is because the desired key for a CE is always the T_ATTKey. So changing just the cdKey is not meaningful unless it is to correct the initial key value of a CE that has failed to acquire.

Changes to the following will result in the F(ACIC) bit being set for a particular CE:

- T_CE icident
- T_CE icSubSection
- T_CE icprogressive

Changes to the following will result in the F(ACE) bit being set for all CEs:

- T_ATT Key

Changes to the following will result in the F(ACE) and F(ACIC) bit being set for all CEs:

- T_ATT Length
- T_ATT Concentrator SubSection

If the F(ACE) bit is set, then other procedures are not prevented from operating on that CE. However, those procedures will use another (– tbd - see ADCE in DH 910K) addressing instead of concentrator SubSection/ CE-progressive. If a CE cannot be acquired, the AMM must disable it to completely prevent it from being used by other procedures.

The following describes some change scenarios:

- **CE Replacement –** this covers the replacement of a faulty CE or the upgrading of a CE (e.g., single to polyphase). In this case the T_CE.ident is changed from the old CE ident to the new. Also, almost certainly the T_CE.cdKey is changed to match the CE key (it might not change if the old and new CE both already had the Key, for example).
- **CE Addition** – a new CE is added to the concentrator. The entry changes from an empty entry to non-empty.
- **CE Re-connection** – a CE is disconnected from one concentrator and connected to another due to line switch opening/closure. In this case, the AMM marks the CE as disabled in the "from" concentrator. The concentrator takes no other action. The AMM marks CE as enabled (F(INTR) = 1) in the "to" concentrator. The "to" concentrator will commission the CE.

- **CE Permanent Removal** – the CE entry is deleted. The concentrator will attempt one time to de-acquire the CE (see DACE procedure below).

Appendix A – Acquisition Process (See ENEL DMI 1 98904 for P520 project)

The acquisition process for a CE entails the following steps. If any step fails, then the process is aborted. The acquisition process for an IC is analogous to this.

- A WRITETAB.REQ (110) message has to be sent to the CE to configure its concentrator section[31], CE SubSection and CE progressive registers (see ADBR at ENEL DH 910K Tab. 6). If authentication is required, then it is at this step that the concentrator attempts to learn the key of the CE. It tries the following keys until it finds the one that works:
    - T_CE.cdKey
    - T_ATT.Key
    - Old keys used by concentrator in previous commissioning for the same CE

  Note: If none of the above keys match, concentrator shall abort the commissioning for the current meter skipping it immediately from the algorithm.
- The CE's key has to be updated using an increment key message in order to set the key to the T_ATT. Key value. The T_CE.cdKey field is updated to reflect this change. Thus, if the acquisition has commenced as far as this step, then the cdKey will match the key. However, this is not sufficient to determine that all the steps have completed (this is determined by the fact that the F(ACE) bit is cleared).
- The IC address table entry has to be updated using an update address command for address table index 0 based on the section/progressive address of the IC. If there is no IC assigned to the CE, the address table entry is cleared.(UNDER DISCUSSION)

The initial state of the not acquired CE has to be defined; in this case, when polled, the CE has to reply with a NACK message containing information of "incorrect (wrong) DIGEST", see Enel DH 960K and Enel DH 939K.

Note: even for ACCE procedure is valid what stated at 7.3.2 for repeaters selection (short/long message handling).

In case of a "Stop Activity" command is sent during ACE, the concentrator shall suspend the current execution; then when it receives a "Start Activity" command, the ACE will continue the previous running from the break point.

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[31] Initial value of "Key" field in T_ATT table has to be equal at 0 in order to not modifying the CE keys.

If AMM wants to change the initial value of "Key" register, it can do that by adding at this one a Δ value ≠ 0. In this case, CE's ΔK1 register will be updated of consequence (see Enel DH 910K Tab. 6 description)

7.20.2 M&M

This procedure does the following steps for each CE with either the F(ACCE) or F(ACIC) bit set and the F(INTR) bit set in the T_CE.

- If there is no known path to a CE, a path is found using the CONN-C algorithm (although the algorithm is run from within the context of this procedure).
- The CE is commissioned if the F(ACCE) bit is set in the T_CE. See Appendix A for details on the commission process. If the commission succeeds, the bit is cleared.
- The IC is commissioned if the F(ACIC) bit is set in the T_CE. If the commission succeeds, the bit is cleared.
- Generation (or Regeneration) steps of Encryption and Authentication.
- Assign the line of communication of CE in its own TAB-CE data base according the setting of the "LV network configuration" parameter in the Virtual table of the concentrator.

It is necessary to have a F(ACxx) bit to control acquisition in case the AMM wants to force acquisition even when no change was made. This can be used to re-synchronise the network with the database if there is any doubt about their consistency. Also, if the concentrator were to simply acquire CEs that had a certain table state this would not cover all the cases. For example, this check does not cover the following cases:

- Only the SubSection/progressive of the node changes.
- The IC SubSection/progressive of the node changes. A CE is replaced with a CE which already has the Key.
- The concentrator Section changes.

The concentrator upon detecting any T_CE or T_ATT change which requires a re-acquisition will automatically set the appropriate F(ACCE) or F(ACIC) bit in the T_CE for each affected CE. If the AMM wants to make CE or ATT table changes but have acquisition occur later, it can do this by disabling the AC procedure.

Changes to the following will result in the F(ACCE) bit being set for a particular CE:

- T_CE - CE_ID
- T_CE - CE_SubSection
- T_CE - CE_Progressive
- T_CE - IC_SubSection
- T_CE - IC_progressive

- T_CE - F(INTR)

Note that changing T_KW_KR keys alone will not result in an acquisition. This is because the desired keys for a CE is always the T_ATT Key. So changing just the KW / KR keys is not meaningful unless it is to correct the initial key values of a CE that has failed to acquire.

Changes to the following will result in the F(ACIC) bit being set for a particular CE:

- T_CE - IC_ID
- T_CE - IC_SubSection
- T_CE - IC_Progressive

Changes to the following will result in the F(ACCE) bit being set for all CEs:

- T_ATT - Key

Changes to the following will result in the F(ACCE) and F(ACIC) bit being set for all CEs:

- T_ATT - Length
- T_ATT - SubSection

If the F(ACCE) bit is set, then other procedures are not prevented from operating on that CE. However, those procedures will use CE_ID addressing (see Enel DMI 078620) instead of concentrator SubSection / CE-progressive. If a CE cannot be acquired, the AMM must disable it to completely prevent it from being used by other procedures.

The following describes some change scenarios:

- **CE Replacement** – this covers the replacement of a faulty CE or the upgrading of a CE (e.g., single to polyphase). In this case the T_CE.ident is changed from the old CE ident to the new. Also, almost certainly the T_KW_KR keys are changed to match the CE keys
- **CE Addition** – a new CE is added to the concentrator. The entry changes from an empty entry to non-empty.
- **CE Re-connection** – a CE is disconnected from one concentrator and connected to another due to line switch opening/closure. In this case, the AMM marks the CE as disabled in the “from” concentrator. The concentrator takes no other action. The AMM marks CE as enabled (F(INTR) = 1) in the “to” concentrator. The “to” concentrator will commission the CE.
- **CE Permanent Removal** – the CE entry is deleted. The concentrator will attempt one time to de-acquire the CE (see DACE procedure below).

Appendix A – Acquisition Process

The acquisition process for a CE entails the following steps. If any step fails, then the process is aborted. The acquisition process for an IC is analogous to this.

- To read protection status of CE

  It is always possible to do this using a not protected READ operation (“06” command) on the address 0x003F, even if CE requires protection. The response gives the complete set of CE’s Status Words.

  It is possible to read CE status, then to decide if it is necessary to use protection in Read and Write operation, (second Status Word bits 6, 7).

  This READ operation is used to acquire phase, too.

- LMON Synchronization.

  If CE requires protection (default) to execute the same request using Protected READ (106) with KR.

  The CE replies with a digest error.

  Recover digest and retry.

- Write Delta K1 and Delta K2

  The CE’s keys have to be updated using an increment key message in order to set the keys to the T_ATT. Using actual KW_CE write ΔK1 and ΔK2 with one single command.

- Write SCA

  Using new K1 write SCA.

If the CE_NACK is received from a meter during the commissioning procedure (ACE), at the end of the retries with the known keys, the concentrator has to skip that meter for the current procedure activation.

The initial state of the not acquired CE has to be defined; in this case, when polled, the CE has to reply with a NACK message containing information of "incorrect (wrong) Encryption and Authentication”, see ENEL DATA COMMUNICATION PROTOCOL ON LOW VOLTAGE NETWORK – APPLICATION LAYER.

If a node in the chain is not configured, or it is configured under a different section of other CEs it must be addressed with CE_ID, then all the chain must be addressed with CE_ID addressing. The concentrator will use CE_ID addressing mode if even only a CE of the chain is not addressable in SCA mode.

It is accepted that ACE procedure will be done in CE_ID addressing.

For multicast addressing (network management addressing of the repeater chain in Recovery CE) it is not possible to use SCA addresses, because the last repeater must send the message on a section that is not its section (generally section 000000, not the section of concentrator). At beginning also because the CEs are not commissioned, but also after the first big Recovery procedure, searching new CEs by repeaters.

SCA addressing is generally usable in multicast messages without response (download CEs). In this case all CEs must be commissioned and on the same section, and multicast will be done on the section of the concentrator (valorized one, not 00000)

Note: Initial value of "Key" field in T_ATT table has to be equal at 0x00…00 in order to not modifying the CE key W and key R provided by the manufacturer.

If AMM wants to change the initial value of "Key" register, it can do that by adding at this one a Δ value ≠ 0. In this case, CE's ΔK registers will be updated of consequence (see Enel DMI 078620 Tab. 6 description) by adding the same Δ value at the initial parameter. The KW_CE and the KR_CE will be modified at the same way as well.

For further details, see [33].

7.21 CE LINE DETECTION PROCEDURE (LDET)

For every CE that has the LDET bit set in the T_CE.PROCS byte or has unknown line of communication, attempt to detect the line. If there is already a repeat path defined for the CE, assume it still correct and try that. However, if that path does not work or the CE turns out to be on a line that differs from that of the repeater in that path, then a new path must be found (either using the known or unknown topology rules). Also if the CE has the ACE bit set, it will be acquired.

The concentrator can also dispatch the READ.REQ [CE identifier - FI(k)] to the CE in order to detect its line of communication (see Enel DH 960K). The message has to be sent as required to guarantee the accuracy of the data (See ENEL DMI 1 98904 for P520 project)

Furthermore, it will be in charge of the concentrator to convert the FI(k) data for the handling of the T_CE bits 0,1,2,3,7 of "Line of Communication" byte field, to reflect the detected line of the CE(s). In this way, in fact, it will be also possible to read information about the CE' s "Line of Communication" field, by mean the TB_ LREQ (050) message structured as specified in Enel DH 971K.

The behaviour of LDET procedure described below, applies to the ACE procedures and to the CONN-C procedure (unknown topology), both of which honor the LDET bit.

Also, the LDET procedure must actively measure the signal of the CEs belonging to a section-line and choose a master from those CEs.

There must be a distinction between a known network topology and an unknown topology.

7.21.1 Known topology

The line of communication detection of a CE must happen “automatically” once the relative flags has been “set” in Tab-CE with GB_WRITETAB_(CE).REQ (010.004) message. Once the CE is located, its line of communication has to be determined if it is either unknown (0) or the F(LDET) bit is set. If it is on the same line of communication as the repeater, the path is stored in the repeat table. Once the line is detected, the F(LDET) bit is cleared.

If the CE is a master or vice master and its line of communication has changed, then it will no longer be a master or vice-master of its former section-line of communication. If its new section-line of communication still needs a master or vice-master, it may be assigned that role on its new section-line of communication. This will happen regardless of whether the master/vice-master attribute was set by the AMM or concentrator.

After the CE’s line of communication detection, concentrator must update the "marked line" assigned to CE in its own T_CE database.

The concentrator will be in charge of picking the CEcs, by following its internal algorithm in signal attenuation measuring.

It is suitable the concentrator not to choose the CE with the more fair attenuation value (to be agreed).

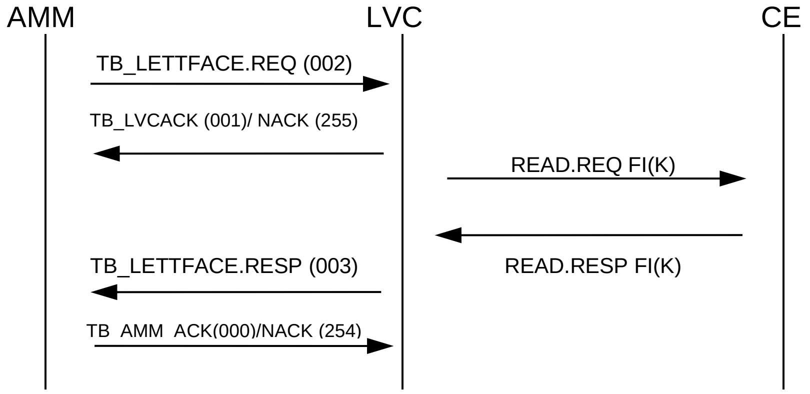
The READ.REQ FI(k) message above mentioned has to be transmitted:

- directly
- in case of no answer, repeating it on the CEcs, of the same section;
- in case CEcs is not yet existent, repeating on it on a CEcs before.

In the three cases above mentioned, concentrator must select a line of communication to transmit on. If there is no answer, it must go on another line of communication and so on.

CE which is to be polled answers with a READ.RESP message containing FI information.

Concentrator must compare the received FI value, determining to which line of communication CE belongs. If CE does not belong to the same line of communication by which concentrator has transmitted to the acquisition message, the message received has to be properly handled. If the CE is in the FI (K) =1 o FI (K) =432 (for detailed description see Enel DH 910K § 9.8 and DH 960K) line, concentrator must dispatch the message for the second time, in order to avoid possible mistakes in the determination during the line detection; if CE answers with the same FI (K), concentrator must assign the detected line of communication to that CE (in Tab. CE).



7.21.2 Unknown topology

The concentrator in order to detect the line of communication must try to reach directly the CEs of T_CE with F(LDET) enabled. Must try to reach the remaining CE, using the Partial CONN-C Procedure. This procedure can be run to compute all the repeat paths. It also can be used to optionally detect the line of communication if it is unknown (value = 0) or the F(LDET) bit is set.

Continue to attempt to discover other CEs that have not been located but using only the newly discovered CEs as repeaters. This process is repeated recursively for any newly discovered CEs until no new CEs are discovered.

[32] FI=4 = Inverted line

If all the CE have been reached, the procedure ends. The illustrated algorithms must be executed for each line of communication.

7.22 RECOVERY CE PROCEDURE (REC_CE)

In relation to the DLC PROTOCOL value the concentrator can handle two different algorithm for ACE procedure:

- DLC_PROTOCOL=0x00: not used
- DLC_PROTOCOL=0x01: SITRED algorithm for REC_CE
- DLC_PROTOCOL=0x02: M&M algorithm for REC_CE

7.22.1 SITRED

This procedure delivers, when enabled, through each path that the concentrator has detected during the ACCE procedure (starting from the direct paths), the "READ" command of the ADCE register signed as 0x0601 (see Enel DH 910 K – tab. 6 structure) using as communication address the default ADBR address (0x000000000003).

The request above described is performed with the maximum time out ratio.

In case a meter, known for example to be supplied by another secondary substation, replies instead to the concentrator requests, this one stores in the BTRAPE.RESP the TB 057 message (see Enel DH 971K 2nd part) carrying on the meter's ADCE parameter.

When the meter receives a message with ADBR=0x000000000003 selects a random time slot (1 to 5). If it is equal 1, the CE has to reply immediately; if the value is 2 the CE has to wait the time needed to transmit a message and then deliver the answer.

In case the related T_TLC "Spont" flag is enabled, the concentrator will place the spontaneous call back to AMM in order to notify the event and in order to allow AMM to run the proper handling of the new (unexpected) CE.

7.22.2 M&M

The following chapters describe the architecture of the Recovery CE (REC_CE) procedure to be implemented inside the concentrator SW.

REC_CE_E will replace the “elementary” recovery CE procedure already implemented inside the concentrator SW.

It is then to AMM to properly schedule or invoke each of the procedures depending from the scenario on LV network that it is necessary to manage. Choising the elemetary ACE or the extended REC_CE will depend from the information AMM will got from other sub-systems concerning the ties between a set of CEs to a given concentrator.

In case it exists a precise scheme of the LV network that ensures sicures ties between concentrator and subtended CEs then, it is suitable to AMM to schedule the elementary procedure ACE instead of the REC_CE_E, that will be properly scheduled in case the LV network scheme with the attached node is completely or partially unknown.

This procedure will be scheduled and handled at the same way of the others already implemented and will follow the rules defined and described for Priority Table items handling.

The following chapters describe the procedures implementation and the changes/upgradings to be done at some of the table’s items.

7.22.2.1 Recovery CE Table {T_REC_CE} – Tab. 50

A table for REC_CE_E execution has to be implemented. The table, ID 50 in concentrator data base, is composed by the following items:

Tab. 50 – RE_CE Table

Field ID	Field Name	Size	Meaning
0x32000101	SEC_ADD	3	Concentrator Section Address (FFFFFF, or 000000, or XXXXXX) Default=0x000000

Tab. 50 – RE_CE Table			
Field ID	**Field Name**	**Size**	**Meaning**
0x32000102	RTT	1	Retries when receiving 0 CE found. After RTT consecutive “0 CE found” then next step of the procedure will start Default=0x03
0x32000103	PROG	1	In order to make the REC_CE_E procedure run dynamically, this register allows to control the steps of the procedure in order to reach the best efficiency in meters acquisition. For “Prog” parameter settings and meanings please refer to the table below described. Each attempt the procedure does according “RTT” parameter, it will be always executed with the defined fixed values. If the “Prog” parameter is =1, then the procedure starts to run according the “SlotD/R” parameters and it has to evolve following a dynamic evolution; default=1. Programming a value different from those defined, then a GB NACK 255.051 will be generated.
0x32000104	TCT	1	Silencing Level Parameter (RespLevel or LT) Default=0xF0 (240)
0x32000105	SLOT_D	1	Starting Slot number for direct request (see Enel LV data-link Protocol and Physical Protocol) Default=0x40 (64)
0x32000106	SLOT_R	1	Starting Slot number for repeater request (see Enel LV data-link Protocol and Physical Protocol) Default=0x10 (16)

Tab. 50 – RE_CE Table

Field ID	Field Name	Size	Meaning
0x32000107	CE_LIST	1	It indicates if the procedure has to fill-in the discovered meters in Tab. 51 or not: • 0x00 → Updating of tab. 51 is handled during procedure execution • 0x01 → Updating of tab. 51 is not handled during procedure execution Note: Value 0x01 has to be used only for testing purpose Default: 0x01
0x32000108	PATH_MODE	1	It indicates the modality to search the path during the PCONN-C. • 0x01 → for shortest paths • 0x02 → for quality paths; • 0x03 → for most recent paths
0x32000109	PATH_RETRY	1	It indicates the number of paths to be tested during the PCONN-C.

The meaning of PROG parameter is defined as follow:

Prog	Description
1	It uses parameters of the table. It does not change them at the end. In this case, it is more important the number of discovered CEs that the time spent in researching at them.
2	It uses parameters of the table. It does not change them at the end. In this case, it is more important the time needed to discover the CEs that the number of found CE.

This means that the procedure allows to perform the following tasks:

- ToCompileFoundCETable(): Construction of a detailed table with many connection paths. It will be used later for the computing of the repeater table.
- ToOptimizeSlot() : It changes research "Slot" parameters with the purpose to optimize research time, and does not lose CEs.
- ToCalculatePath(): It calculates the best paths for CE handling.

- ToCalculateParameters(): if set, it recalculates parameters in Broadcast table.

Example:

The procedure can evolve as follow: after the first step at which the procedure starts with a time slot =64, following a defined algorithm, the procedure has to try to detect further unknown meters by using slot number at lower level, e.g. 32, then 16 and at last 8.

The choice in the time slots selection to be used after the first one, will be done by the algorithm that has to consider the number of CEs found out at the first cycle of the procedure.

AMM can access REC_CE_E table by means of the normal (WRITE/READ) GB messages (see Enel Exchanged information and linking procedures between concentrator and AMM).

Each time the procedure has to work cyclically (e.g. twice a day), it will behave according to the values assigned to the T_PRI (priority table of the concentrator's procedures) items.

A dedicated GB 018.023 command has to be implemented on the concentrator, as well. This would allow to start the procedure immediately, if enabled, using the last programming of the Broadcast Table.

7.22.2.2 T_CE handling

No changes for the CEs table inside the concentrator. The only constraint concerns the F(ACCE) setting in T_CE - F(PROC) byte.

Once the REC_CE_E procedure has finished, in case it discovered un-commissioned or unknown CEs (see description of the procedure below), it is in charge of the AMM to transfer data of such meters inside the T_CE of the concentrator for the commission process; at this time, for each individual CE, concentrator will set the proper F(ACCE) bit to enable commission process of the nodes.

It is then to AMM to schedule commissioning procedure following the consolidated rules. The flag can be cleared by concentrator, after commission process, if succeeds. For each individual meter, AMM can also clear such bit in case it is necessary or requested to not commission the node after the T_CE loading.

7.22.2.3 Modulation Mode in Recovery CE procedure

The Power Line module can use more modulation mode in more frequencies.

Example B-PSK, B-PSK coded, Q-PSK, 8-PSK and so on, frequencies 86, 82, 76, 66 kHz.

They will be selected 2 modulation mode (every one with a defined frequency) and it will be possible to use both mode.

M1: Modulation mode 1 (generally the faster of the two selected modes)

M2: Modulation mode 2 (generally the more “robust” else if slower of the selected modes)

The complete procedure will be executed in M1, then the procedure will be replied in M2 (with all found CEs silenced at LTPar level (SlotD = 32, SlotR = 8, RTT=2).

7.22.2.4 Extended Recovery CE (REC_CE_E)

This interruptible procedure serves to:

- The acquisition (automatic detection) of the subtended (unknown or un-commissioned) meters
- The recovery of the meters missed at the first running of the procedure
- Recover the meters detected at the first turn, but resulting no more reachable after a given time (like PCONN-C do).

Having in mind the above assumption, it is necessary to define the following items that define the broadcast address (SCA) of the CE, whose structure is as follow:

SCA STRUCTURE

LSB

CE address					CE (node) length
concentrator section			CE SubSection	CE progressive	concentrator section length
			Values: from 0 to 255	Values: from 0 to 255	Fixed bits: 1 1 .. ..
lsb	lsb	lsb	Lsb	lsb	lsb
First Tran s. Bit ↑					
First transmitted byte	2nd byte	3rd byte	4th byte	5th byte	Last transmitted byte

- **Concentrator Section** address or **SecAdd** (see Broadcast Table and T_ATT concentrator Section parameter, alias domain, 3 bytes of CE SCA address)

- **CE SubSection** of the node, one byte of the CE SCA address, see DMI 078620, CE's tab. 6
- **CE Node**, 1 byte, progressive of the node, see DMI 078620, CE's tab.6

The values concentrator Section **(SecAdd)** can assume are:

- Concentrator **Section =FF FF FF**. This value allows a total research of the subtended CEs (e.g. never commissioned or previously commissioned by another concentrator and then, for any reason, moved to another secondary substation and no more reachable by the "native" concentrator).
- **Concentrator Section =XX XX XX,** where XX XX XX is a section valid address. This value can be used for PCONN-C execution in order to recover/re-compute the path to the missed CEs. Such value, could also represent the concentrator Section ID of a bordering secondary substation. In this case, depending form the scenario, it can be used to try the recovery of the CEs supposed to be moved from a secondary substation to another one.
- **Concentrator Section =00 00 00**. This value can be used in case it is needed to search CEs never installed before (alternatively to FF FF FF) for the first commissioning avoiding the crossing of the limit imposed by the concentrator Section.

The combination of the values this register can assume with the possible values of the "**SubSection**" and "**Node**" of CE allow to run:

- An "**absolute multicast**" with the following construction 03 FF-FF FF-FF-FF
- A "**partial multicast**" limited to the concentrator section with the following construction 03 FF-FF XX-XX-XX

and so on with the other combination.

When running the steps of REC_CE_E procedure, activity (replies to the concentrator multicast messages) of subtended nodes is regulated by a "Silencing Level", **TCT** (also named LT, or RespLevel, see Enel LV data-link Protocol and Physical Protocol) function.

The Response Level or TCT, is a parameter that defines the behavior of the Network Management Module (NMM) of the CE.

Such function, makes the meter "deaf" to the request messages that uses higher LT values. This allows to avoid replies from nodes already detected (from a previous step of the procedure). In this way there will be no overlapping with the replies of the nodes eventually to be discovered.

If the meter is not polled for a given time, defined in a configurable parameter identified as "P_LCK-TCT", 2 bytes long (in minutes), defined inside the meter (0x0624 see Enel DMI 78620) by any of the procedures of the concentrator (e.g. due to a change of the LV network), the LT value of the meter will automatically be reset to a value = 255

Such value always allows the CE to reply to multicast messages delivered by any concentrator near the node to be recovered.

This will allow the concentrator to detect only the “moved” node at the time REC_CE_E is running cyclically on the subtended LV network. Similarly, it will be adopted a different philosophy to make the CE able to be detected by a given concentrator if are met the conditions above described; this would consist in reset the SCA.LVCSection register of the CE to 00 00 00 if this one has resulted no more reachable by the concentrator at which it was initially linked. Even in this case, a configurable parameter, “P_LCK-SCA”, 2 bytes long (in minutes), defined inside the meter (0x0623 see Enel DMI 78620) will be used. The expiration of this value will allow to re-connect the meter to the concentrator at which it effectively belongs as result of the REC_CE_E procedure running at a given moment on that concentrator.

The LT (TCT) parameter is defined in CE’s tab as register 0x0622 (see Enel DMI 078602) and are programmed inside the meter by means of a unicast message defined in the ENEL DATA COMMUNICATION PROTOCOL ON LOW VOLTAGE NETWORK – APPLICATION LAYER - doc.

The command is not protected and it is sent by a net master to a node to define the Silencing Level (TCT) of the node. The command is normally sent in Request-Response mode (Discipline R) and is defined as TCT_SET.REQ (092).

At each step REC_CE_E proc discovers one or more CEs, concentrator has to program on such CEs LT parameter in order to “silence” at them at the step N+1 of the procedure. In this way, once discovered, the nodes will not reply to the multicast messages delivered by the concentrator during the procedure evolution.

It will possible to define a set of requests to the NMM. Such requests are associated to a Request Level (or TCR) defined by a register (see Enel DMI 078602) inside the request.

If the TCR of the request is less or equal of the programmed TCT, then the module is enabled to reply to multicast messages; on the contrary, it will not enabled to reply.

TCT and TCR parameters are 1 byte long (unsigned).

The following rules are applied:

If: TCT < TCR -→ Module not enabled to reply

If: TCT ⩾ TCR -→ Module enabled to reply

If: TCR = 0 The module will reply in any case

Default value of TCT = 255

The massages associated and used by the procedure are described in the Enel LV Data-Link Protocol and Physical Protocol. They are:

- TCT_SET.REQ (092) TCT setting

- ADDRESS.REQ (090) CE_ID request
- ADDRESS.RESP (091) CE_ID getting
- REQADDR.REQ (094) CE_ID request using repeaters
- REQADDR.RESP (095) Multiple CE_IDs getting

7.22.2.5 First acquisition of the unknown or un-commissioned CEs

This step is scheduled by AMM and will proceed in searching the meters in a scenario in which concentrator Section=FFFFFF or, in case CEs were never commissioned before, concentrator Section=000000 according to the rules above described.

7.22.2.6 Procedure description

For further details, see [33].

7.22.2.7 Output Information of REC_CE_E {T_ CE_ID_LIST} – Tab. 51

At the end of the steps of the REC_CE_E, concentrator will compute the complete list of the discovered CEs. Such list will be stored inside a table (ID 51, not volatile memory) sized as 2048 rows.

Tab. 51 - CE_ID_LIST Table (up to 2048 rows)

Field ID	Field Name	Size	Meaning
0x33000101	CE_ID	6	CE identification address
0x33000102	REACHABILITY_QUALITY	1	Indicator of the quality of meter reachability
0x33000103	TIMESTAMP	6	Data/Time related to meter discovery instant (same format of TRAPE tables)

The table will be filled by REC_CE_E procedure. At every run the procedure fills a row for each found CE. In case a CE is newly discovered and its identification address is already present in the table, the concentrator must update Reachability Quality Indicator and Time Stamp field in the same row of the old one.

"Reachability Quality Indicator" field must be defined by concentrator on the base of some parameters like number of involved repeaters and "%" reachability value (see Buff_CE entry).

The table can be read and written with the normal GB READ/WRITE commands.

To read and erase the rows of the table it is possible to use a GB(100) command.

Data of the discovered nodes will be transferred inside the concentrator's T_CE by AMM after accessing to the Tab. 51 by means of the proper GB 100 msg. Per the mechanism of the GB(100), once read, the entries in Tab. 51 will be automatically cleared.

For each discovered CE, concentrator has to store in a transparent buffer all the useful paths necessary to reach at it with the indicator of the number of requests succeeded and the requests done on that CE; such parameters have to be used to evaluate the goodness of the link. Chains in concentrator's repeater table will be computed taking into account such information picking up two of the paths among those detected at the previous point.

The complete list of the chains will live forever inside the concentrator; they will be refreshed each time CONN-C procedure is requested to run. In case of failure of the initially chosen path, the concentrator can use another one between those discovered by REC_CE_E proc.

AMM reads the tab. 51 and consequently updates the concentrator's T_CE, completing at it with the authentication keys of the CEs to be commissioned by the concentrator and with the subnet/node information.

EXAMPLE:

In case the first extended recovery procedure takes place on a LV network in which all the unknown/un-commissioned CEs have the "concentrator Section" in SCA parameter, set =00 00 00; this means that the section (or domain) that defines the network address is the same for all such CEs.

The concentrator delivers on the LV network to the CEs whose SCA is 03 FFFF 000000, separately on the three wires and at different time the specific multicast command (see Enel Data exchange between LV Concentrator and peripheral unit), TCT (RespLevel) 1.

Given that concentrator does not know the population of meters it effectively support, it will use the RC-C4 discipline (see Enel LV data-link Protocol and Physical Protocol) that means 64 time slot to be used.

LVC will expect a reply each 16 seconds.

If the percentage value of the CEs that reply to the command is less than the one expected, then concentrator will perform an attempt with RC-C3 discipline and so on.

A specific algorithm will handle such mechanism.

In case of success, concentrator will store all the addresses (CE_IDs) of the meters discovered on the network inside the Tab. 51 above mentioned.

It is then to AMM to complete the parameters loading for such CEs in order to run and to complete the commission process; particularly, AMM has to load the keys inside the rows of each individual CE.

If the CEs are not immediately commissioned by ACE procedure, concentrator sets a TCT value <255, in this way reply to "multicast request" will be disabled.

Once commissioned, the concentrator Section (three bytes) of the SCA address, initially set to 00 00 00, will be changed to the three MSB of the concentrator T_ATT domain parameters; in this way, all the discovered CEs will have the same concentrator Section (domain) information of the other eventually commissioned and they will not reply to further commands addressed to the nodes that have concentrator Section =00 00 00.

At the end of the CEs acquisition step, concentrator will deliver to each of these meters the "disabling multicast reply" command (see above steps); in this way, all the acquired CEs, if polled by a multicast message will not reply due to the value assumed by the concentrator Section bytes after the acquisition.

The step above described is valid for all the "directly" reached meters; an elaborated approach is used to discover further CEs that need repeaters to be reached.

At this step, concentrator delivers to each CE already detected at the previous step (TCT=250) the TCT_SET.REQ (022), setting TCT=251, etc.

Such command forces the CE to make a "broadcast" on the address 03 FFFF 000000 and to recover replies from the other meters, if presents.

The above mechanism does not silence the meters discovered to be replying; this allows to discover if the same meter is detected by other ones at the same level (250).

This operation is done by the concentrator on all CEs at LT 250 level, building a transparent buffer in which are stored, for each meter, the potentials repeaters that are needed to reach at it.

The discipline used (Try64, Try32, Try16 or Try8) will be established on the basis of the CEs discovered at the first level. It is to AMM to handle such values.

If the CEs at the first level are more than 64 for each phase, concentrator will start at slot 64, if number of CEs is between 32 and 64, will start at slot 32 and so on.

Two requests have to be done for each CE. If the CEs discovered by means of the second request are the same of those discovered at the first attempt, then it will be executed another attempt with a minor slot; if different the number of slot are not decreased.

At the end, as above stated, it will be available the information concerning the goodness of the repeaters.

X CEs will be used as repeaters for the 64 CEs of the first level, choosing the ones that are discovered to be reaching a major number of CEs.

At this point, TCT =20 has to be set to all CEs reached by means one repeater.

The same procedure is executed at level 3 and so on.

The end of procedure is announced by means of the proper spontaneous call-back, placed after the event generation inside the BTRAPE.RESP buffer.

The event has to be structured in order to carry on the information about the number of the acquired CEs, if presents.

Message : **SPONT**

GB_REC_CE_PROC_END (019.016)

By this message concentrator notifies to AMM the end of the REC_CE_E procedure.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	016 (GB_PROC_END)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
Number of nodes discovered by the proc	2	
Reason Code	1	0 = normal; 1 = aborted

Once AMM detects this event, it will access to tab. 51 in order to transfer CE_IDs information of the discovered meters inside the T_CE of the concentrator.

In case REC_CE_E is unable to detect any meter, the GB_REC_CE_PROC_END event (no meter found) will be generated only after the first turn. No events will be generated at the end of the following invocations.

As above stated, in order to run commission process on the discovered meters, AMM will also complete the T_CE entries with the authentication keys of each individual node.

7.23 CEDATA PROCEDURE (CEDATA)

The procedure below described serves to read a set of parameters from the CE subtended to a given concentrator and to store and to duplicate at them inside of this one.

Selection of parameters to read is programmable by the AMM by means of a proper setting of concentrator’ s Data Base.

Such procedure can be ran on request, by means of the proper GB 018.021 message command (see DH 971K 1st part) delivered by AMM, or it can run cyclically (e.g. once a day), based on the proper setting of T_PRI (procedures priority table of concentrator) parameters.

It serves to collect some particular data of the current and previous billing period, from the CEs connected to a given concentrator and to store at them inside the concentrator.

For each of the CE listed in the CEs table, concentrator has to store, depending on the type of CE, data of the registers listed in Table 42 in the way below described.

Once the procedure has been scheduled/invoked must evolve according the diagram shown below.

As concentrator receives the command from AMM, or schedules itself the procedure to run due to its own T_PRI configuration, it elaborates the messages to be delivered to all the subtended CEs.

Such messages, defined in DH 960K as “READTAB.REQ (006)” (reading message), are structured in order to keep information (coding [address of registers]) of the parameters that have to be read (message action) inside the meter’s table structures.

As the CE receives and process the message from concentrator, it then delivers to it the message containing the data of the parameters that have been read. Such message is defined in Enel specification as “READTAB.RESP (007)” (response message).

Number of “READTAB.REQ (006)” message that concentrator delivers to CE depends on the amount of parameters that have to be read inside the meter so, the above sequence can be repeated “n” time by the concentrator before CEDATA procedure end.

Given that the maximum size of data field that is carried out by the “READTAB.RESP (007)” message is 64 bytes, it is then to concentrator to handle the scenario in which CE data to be collected are greater than 64 bytes; if for example, the amount of data is 80 bytes, concentrator has to behave in way to get two replies from the CE: the first one will carry out the 64 bytes portion, the second one the remaining 20 bytes.

As stated above, CEs data read by the CEDATA procedures are stored inside a table structure of the concentrator (see Tab. 43). In order to read and properly handle such data, it is then to AMM to deliver to concentrator a set of messages that have the scope to carry out the parameters data read from the CE.

Such messages are defined in Enel specification as “GB_READ.REQ (002)”, “GB_READTAB.REQ (006.xxx)” or “GB_READTAB.REQ (008.xxx)”.

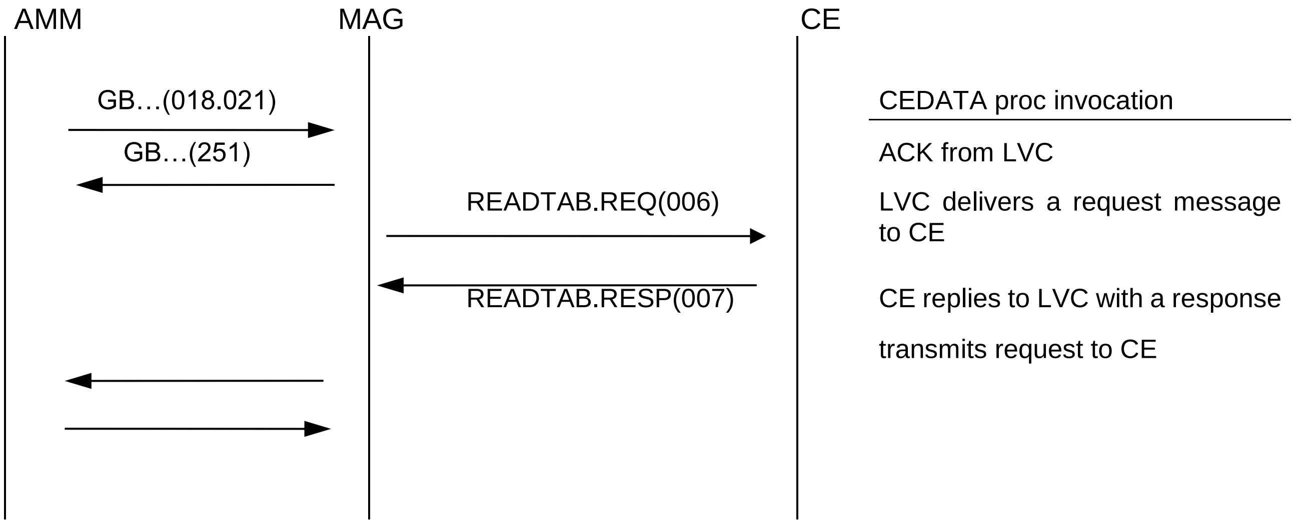
- 002 allows to read single items in the entire table
- 006 allows to read single rows/items of the entire table
- 008 allows to read the whole table
- xxx is the table’s identifier to read

Reply messages from concentrator will be respectively:

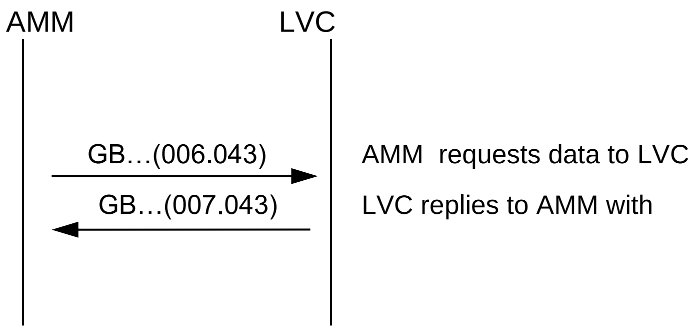
- “GB_READ.RESP(003)”
- “GB_READTAB.RESP(007.xxx)”
- “GB_READTAB.RESP(008.xxx)”

Just like other procedures (e.g. Commissioning of CE and CONN-C procs), CEDATA proc when running, can find CE that could not reply (e.g. due to a fault) to the concentrator, or CE with some anomalies in their Status Word. In this case, events of “CE not reachable” state (SPONT_CE_KO) or CE in “anomaly” (SPONT_STS_WORD) state can be generated (depending on the programming) by the concentrator.

7.23.1 Procedure invocation and scheduling



7.23.2 CE Data reading by AMM



After procedure running, AMM delivers GB_READTAB.REQ reading messages in order to collect CE data.

7.23.3 Table Structures for CEDATA Procedure

In order to handle CEDATA procedure, it is necessary to define and describe the table structures below described that will be implemented inside the concentrator.

As stated in Enel specification, the access and the writing to the tables entries are done by means of proper messages “GB_WRITETAB.REQ” writing messages.

Once AMM has programmed into the tables the CE’s parameters that are requested to be stored in the concentrator, CEDATA procedure, when running, will read all data related to such parameters.

Having in mind that other structures have been already defined with a proper identifier in the concentrator, tables used for CEDATA proc are:

Tab. 41 - CEDATA CE TYPE (up to 2048 rows)		
Field ID	**Field Name**	**Size (Byte)**
0x29000101	CE ID	6
0x29000102	CE Type	1

Where:

(6 bytes) **CE ID:** CE Identifier

(1 byte) **CE Type:** CE type as follow (till up 64 types):

ID	CE TYPE	Bit Sequence
1	CE single phase mono-directional	00000001
2	CE single phase bi-directional	00000010
3	CE polyphase mono-directional	00000011
4	CE polyphase bi-directional	00000100
…	…	….
64	CE …	….

The above structure allows to match for each of the CE loaded in the T_CE its own “Type” identifier. “CE Type” registers are used as entries in Tab. 42 (see below) in way to create and define for each type of CE a pre-configured string carrying the identifiers of the CEs parameters to read by the procedure.

Note: at the moment only CE type 1, 3, 4 are used.

Tab. 42 - CEDATA CE TYPE (up to 64 rows)		
Field ID	**Field Name**	**Size (Byte)**
0x2A000101	CE Type	1
0x2A000102	1st param	3

Tab. 42 - CEDATA CE TYPE (up to 64 rows)		
Field ID	**Field Name**	**Size (Byte)**
0x2A000103	2nd param	3
……	……..	3
……	……..	3
0x2A0001FF	254th param	3

Row num for CE type	Predefined String
1 (SP mono-dir)	
2 (SP bi-dir)	
3 (PP mono-dir)	
4 (PP bi-dir)	
…	
64 (…)	

Where:

(1 byte) **CE Type**: CE type as specified in Tab. 41

(254 x 3 bytes) **Predefined String**: 254 fields, each of them 3 bytes long (2 bytes indicating the register's coding, 1 byte indicating the size), defining which registers have to be read when CEDATA procedure is scheduled to run (e.g. "A+.Tot", "A+.T1", "A+.T2", "A+.T3", "A+.T4"). The default value for predefined string is 0x00

For what above, a typical string will be as follows:

CE Type	**1st param**			**2nd param**			**….**			**254th param**		
	coding		**size**	**coding**		**size**	**coding**		**size**	**coding**		**size**
n	byte	byte	byte	byte	byte	byte	byte	byte	byte	byte	byte	byte

Note: Coding and description of the registers are available in a separate documentation.

In this way, given the scenario it is possible to meet (handling of big amount of data), it is possible for each CE to select only the CE parameters it is necessary to read and to store inside the concentrator.

CE parameters selection is possible by properly handling Table 42 entries. Once has been defined and fixed the list of parameters that are requested to be stored in the concentrator for the different type of CE, selection of data is done by accessing the coding ID (for current billing period data and for previous billing period data) of parameters.

Once procedure has started and data collection has been done, concentrator has to store such information inside the following table structure:

CE ID	**Data (byte sequence)**								**DateTime parameters (byte sequence)**				
	Par 1	**Par**	**Par**	**…**	**Par**	**Par**	**Par**	**Par 249**	**datetime**	**datetime**	**datetime**	**datetime**	**datetime**
	value	value	value	…	value	value	value	value	value	value	value	value	value

Tab. 43 - CEDATA BUFFER (up to 2048 rows)		
Field ID	**Field Name**	**Size (Byte)**
0x2B000101	CE ID	6
0x2B000102	1st param	4
0x2B000103	2nd param	4
……	……..	4
0x2B0001FA	249th param	4
0x2B0001FB	250th param	6
……	……..	6
0x2B0001FF	254th param	6

Where:

(6 bytes) **CE ID:** CE Identifier

(249 x 4 bytes) **Data field**: Data field (byte sequence) for current and previous period values. Registers (249) in this field are collected according to Tab. 42 setting (see above). Each register is 4 bytes long.

(5 x 6 bytes) **DateTime parameters**: Date and time registers for events logging (e.g. date and time of last billing period, etc).

Rows of table 41 and 43 are mated tightly to the T_CE so, if for example, for a single phase CE, AMM just want to collect "**A+.Tot**", "**A+.T1**", "**A+.T2**", "**A+.T3**", "**A+.T4**" data, it is not necessary it to access, at each row of Tab. 41, the bytes sequence described above; it has just to enter one time such programming.

As stated above, it is then to AMM, by means of the "GB reading messages" to read CE data inside the concentrator.

Example

If AMM wants to read data (or a part of them) collected by procedure in Tab. 43 e.g. "**A+.Tot**", "**A+.T1**", "**A+.T2**", "**A+.T3**", "**A+.T4**" related to the current period (and previous period, as well) of all single phase CEs, for what above it has to deliver a set of "GB reading messages".

e.g. If data collected have been stored inside the table as shown here below,

CE ID	**Data (byte sequence) current/previous period**							**DateTime parameters**				
	A+Tot value	**A+T1 value**	**A+T2 value**	**A+T3 value**	**A+T4 value**	**… value**	**Par 249 value**	**datetime value**	**datetime value**	**datetime value**	**datetime value**	**datetime value**

then, if AMM needs **"A+Tot"** value only, given the structure GB_READ.REQ (003) reading message:

ATTR.	IDEN1			IDEN2		
GB_READ.REQ (002)	yy	ww	zz	yy	ww	zz

where:

yy	table code	1 byte
ww	row number	2 bytes
zz	column	1 byte

It will be suffice to AMM, defines parameters of "IDEN 1" to read CE ID and "IDEN 2" to read (**"A+Tot"**); the reply will be a GB (003) with value of "PARAM1" that is "**CE ID**", value of "PARAM2" that is **"A+Tot"**:

ATTR.	Value	Value
GB_READ.RESP (003)	PARAM1	PARAM2

The same logic is adopted for the GB (006) and (008) messages (see DH 971K 1st part).

Registers in table 43 will be refreshed at each procedure invocation. If for any reason, a register is not updated by the procedure, it will preserve the value stored before procedure running.

The tables have to be stored in the no-volatile memory of concentrator.

7.24 PARTIAL SINC-T FOR CONNECTION CHECK (PSINC-T)

7.24.1 LV Network Monitoring

On the concentrator is already available a mechanism to be able to manage a full operational Management.

Such mechanism is known as "Known Topology".

This is a really complex algorithm suitable for the utilities which are able to manage and keep updated the physical topology of their LV network.

Since in the real case this is very uncommon and difficult to implement, a new more simple and light mechanism has to be implemented into the concentrator in order to monitor the network and to let the NMS know reachability issues which can be in some way related to the network layout.

To achieve this task a new procedure has to be designed (PSINC-T) in order to monitor a specific pool of "designated CE".

7.24.2 Implementation

As previously explained, the PSINC-T procedure must run on a restricted pool of nodes, this meaning that there must be a selection method that allows to activate particular meter for the PSINC-T (the "designated CEs").

To achieve this bit 7 of F(PROC) parameter of T_CE must be set

The AMM will then be able to configure a specific set of meters up to all meters to perform the PSINC-T procedure.

"Designated CE" selection criteria:

Up to now the T_CE parameters "CE Subsection" and "CE Progressive" have been only used for logical organization of nodes, but have no particular meaning from the topographic point of view.

To enforce the monitoring activity and relate information from the meter status to the health status of the network such parameters can be opportunely used.

In particular the "CE subsection" parameter can be used to identify a particular topographic area of the network, in this way a fault of one or more meter belonging to a particular subsection can be associated to a particular network area fault. Obviously the range of Subsection (0-255) is the one defined in DMI 1 98906 so up to 256 areas can be managed into the network layout.

For each area all three phases will be monitored separately, so if multiple meters on different phases belong to a specific area, it will be possible to address SEPARATELY status information of each line/phase for each area.

For this reason the AMM/NMS will need to know at least some topographic information (from other topology databases such as ENEL SIGRAF) related to the CEs to assign them to the proper physical area with a particular subsection association, while phase information could be gained directly from the ACE/CONN-C process.

In fact it's not necessary to map all the meters physical topography; only "Designated CEs" need to be properly identified and associated to particular areas (for example keeping into consideration particular buildings or street numbers ...).

In this way it's possible to identify hot point of the network which represent the overall network and can be monitored in order to detect network failures through the PSINC-T process.

7.24.3 PSINC-T

The PSINC-T is mainly a "partial" SINC-T process. So keeping into consideration the selection criteria defined above, the PSINC-T will be equivalent to a SINC-T process (with the same roles as defined in DH931K) which will only run on the meters that have been selected through the F(PSINC-T) bit of F(PROC) flag set ("Designated CE").

Since the PSINC-T will only run on a restricted pool of meters it will be very fast in its execution and promptly return an updated information of the network.

The PSINC-T can run only on the meters which have already been acquired, in fact the information of line/phase is essential for reporting the correct line/phase for each area (subsection) for which a fault has been detected; in addition to this a meter for which the repeater chain has not been specified, will not be processed by the PSINC-T procedure.

As for other procedures like CONN-C, it must be possible to start the PSINC-T through a specific GB command: GB 018.035; its structure will be as follows:

Message : **COMMAND**

By this message Back Office transmits to LVC to schedule the PSINC-T procedure.

GB_PSINC-T_START (018)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	018
Length	2	
Transaction Id	3	
Id command	1	035

7.24.4 Fault Detection

As in the case of SINC-T, the PSINC-T will process the collected information and generate the following events:

- CE status word anomaly
- Unreachability status of the single CE
- NACK from a CE
- Per phase Subsection reachability status information (OK , KO, WARNING).

While the first three point are deeply explained in the document and should be implemented accordingly, the last event is related to a new concept here explained:

Each meter belonging to each subsection is monitored and, keeping into consideration all “designated CE” of the same subsection, a statistic is generated on the subsection itself.

One single meter can be reachable, in such a case it will be placed into the list of reachable “designated CE”.

One single meter can be NOT REACHABLE.

If the reason for not reachability is that the meter is not reachable itself: it will be placed into the list of not reachable “designated CE” for such subsection.

If the reason for not reachability is that one of the repeater belonging to its repeater chain is not reachable: it will be discarded from the statistic calculation of that subsection.

From the previous roles: if more or equal than 50% of “designated CEs” of a specific phase of a subsection are not reachable the subsection phase status will be set to WARNING, if more or equal than 90% of “designated CEs” are not reachable the subsection phase status will be set to KO. In all other cases the status of the subsection phase will be set to OK.

Every time the status of each subsection changes a spontaneous message (and corresponding SNMP TRAP) is generated (all changes for each phase OK → KO, KO → OK, OK→ WARNING, WARNING → OK, KO → WARNING, WARNING → KO).

Message : **SPONT**

By this message LV-C must transmit to AMM the Sub Section status variations.

GB_SPONT_SSEC_STATUS (019.014)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	014 (GB_SPONT_SEC_KO)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Phase Status	1	Bit0 = Phase R KO Bit1 = Phase S KO Bit2 = Phase T KO Bit3 = Phase R WARNING Bit4 = Phase S WARNING Bit5 = Phase T WARNING
Sub Section ID	1	The section ID which changed status.

The GB (019.014) message will follow the same roles as the other spontaneous messages GB (019).

7.25 V-REG Procedure

See Enel DMI 0 90619

7.26 CONCENTRATOR FW CHECK

See Enel DMI 0 90620

7.27 SECTION REDEFINNING

The AMM can modify CE grouping sections on concentrator, according to communication or topological requirements.

8 RF PROCEDURES

Basically every procedure could run via PLC or RF communication, so in the following chapter are described just the different way to operate for the specific RF channel. Take into account that where not indicated, the same rules shall be applied for both channels, PLC and RF. In any case the two channels shall be handled simultaneously by concentrator and, for example, during a CONN-C procedure via PLC it can run also at the same time a TRF procedure via RF. As general rule if a PLC procedure needs a retry via RF to reach a meter while another procedure is running via RF, the last one has to be suspended until the end of the current RF retry of the PLC procedure.

The concentrator has to be able to communicate using the RF module according to the RF protocol defined through the parameter RF_PROTOCOL. If RF_PROTOCOL is set to the value 0x00, the meter has to implement the W_MBUS protocol at applicative level.

The payload of the messages has to be structured in according to the DH command but with a difference on the maximum length of each messages that can be higher than 60 bytes.

The protection of data messages has to be done according to Meters and More protocol with the difference that the LMON parameter has to be included, in non-protected way, in the first applicative bytes of the message.

The concentrator has to support, for every kind of RF communication (exception for spontaneous reception), the functionality called “Listen Before Talk” in section 5.1.1 of UNI TS 11291-11-4.

The LBT algorithm is used to back off and delay the RF transmission in case the channel is already occupied. If the channel is occupied (i.e. the RSSI value is above the threshold), the module will back off for some time, before doing a new attempt.

The LBT(*) algorithm us an exponentially increasing random back-off time, but with a flattening roof, with limited allowed maximum time delay, and with a maximum number of attempts. The algorithm may use LBT override if the maximum time or attempt limit is reached (configurable).

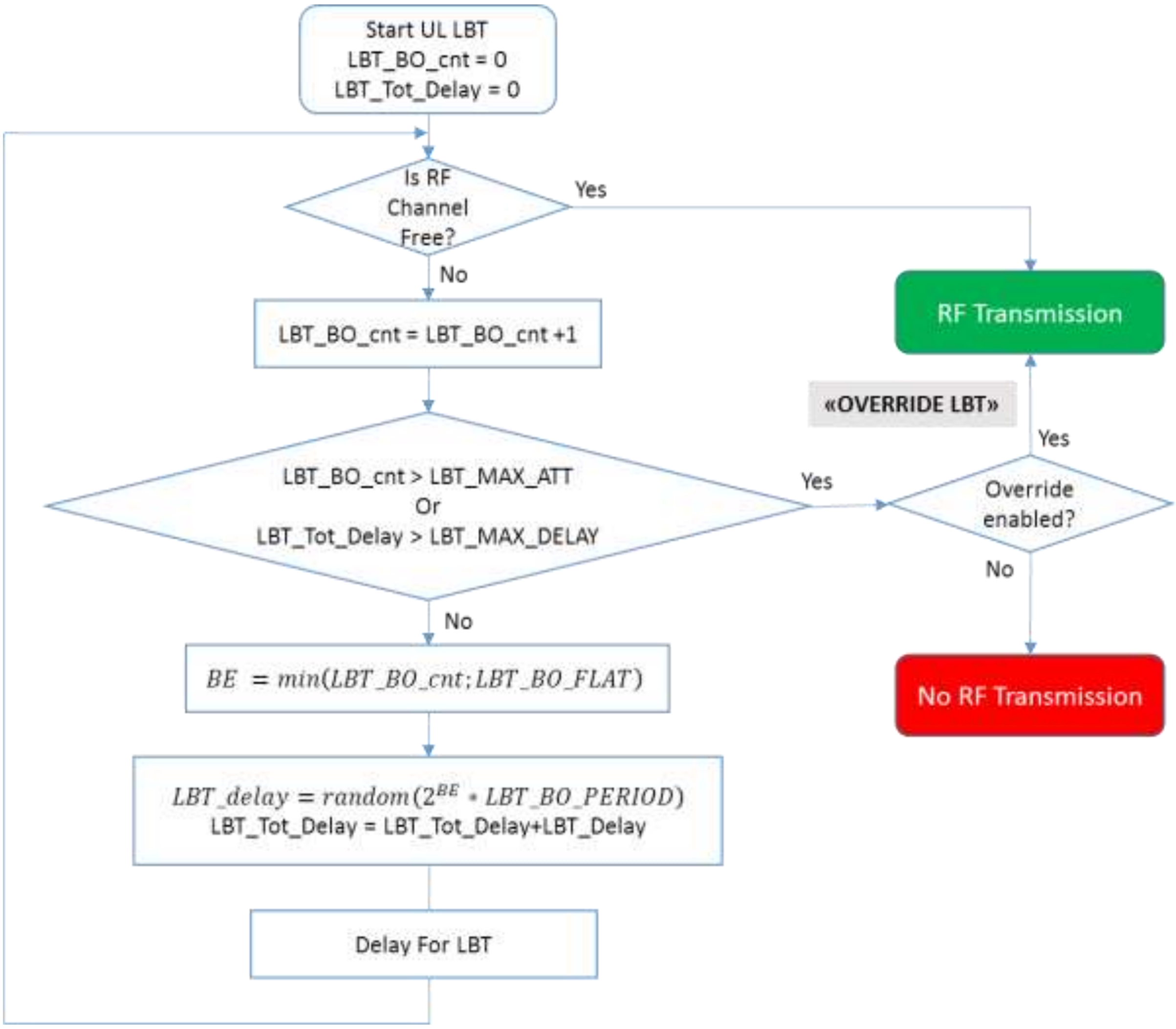
The concentrator has to implement, in tab. 100 the following parameters to configure the LBT algorithm:

- **LBT_ENABLE** – To enable/disable the LBT
- **LBT_RSSI_TH** – if the RSSI is above (stronger signal) than this threshold, the channel is considered occupied
- **LBT_MAX_ATT** – maximum number of attempts before giving up, or transmitting anyway (override)
- **LBT_BO_PERIOD** – the time used to calculate the back-off time
- **LBT_BO_FLAT** – a parameter to limit the exponential increase of back-off time
- **LBT_MAX_DELAY** – the maximum delay before giving up, or transmitting anyway (override)
- **LBT_OVERRIDE_DIS** – to disable the override

The algorithm is based on “LBT’s backoff” and “Total Delay” counters (LBT_BO_cnt, LBT_TOT_Delay), that start from 0. After the evaluation of the channel, if it is free, LBT succeeded and the message is sent, otherwise the counter of Backoff is increased by one and saved. If the value of this counter exceed LBT_MAX_ATT, or the total delay is higher than the maximum (LTB_MAX_DELAY) if the override is enabled, the meter performs an “Override LBT” and the message is sent in any case.

If the LBT backoff counter is not greater than the maximum allowed LBT backoff, the backoff exponent (BE) is updated with the new backoff value (with a limitation given by LBT_BO_FLAT). An LBT delay time is then calculated as a uniform random wait of 2 ^ (BE) times the LBT backoff period (= 2 ^ BE * [LBT_BO_PERIOD]). The new LBT time is added to the total delay time LBT. The meter then delays for the random LBT delay time. After the delay, the concentrator proceeds to re-evaluate the channel.

The following figure shows the flowchart of the LBT access process.



As general rule, in addition to the LBT, the concentrator has to implement an algorithm in order to reduce the collision and privilege in response concentrator with a high level of RSSI. To do that the timing in response will be different concentrator by concentrator in relation to the RSSI level of the incoming message, concentrator with a higher RSSI will reply before for example another one with a lower one.

The concentrator shall also be able to handle a RF module with multiple channels, including the updating.

The concentrator and the CE shall use the application messages that are specified in DH 960K in order to exchange user data, for details refer to [27].

The general structure of the application message is described in the following figure:

ATTR	Data
1 byte	

Application message structure (without authentication fields)

ATTR	Data	DATE-TIME	DIGEST
1 byte		8 bytes	8 bytes

Application message structure (with authentication fields)

where:

- **ATTR** indicates the type of command to application data;
- **Data** carries the registers IDs and application data when needed (for instance in case of writing operations, acknowledge codes, etc.);
- **DATE-TIME** carries the transmission timestamp of the message;
- **DIGEST** carries the truncated version of the message authentication code

In addition to the messages specified in DH 960K Issue VI, a further application message is defined:

DATASPONT 020/120, for spontaneous event data from CE

Message	ATTR
DATASPONT	020/120

The structure of the new message DATASPONT is described in the following figure:

ATTR	Event_ID	Event_TS_Posix	Event Code	Event Status
1 byte	2 byte	4 byte	1 byte	variable length

DATASPONT message structure

where:

- field **Event Code**, **Event_ID** and **Event_TS_Posix** are parameters that describe the event generated by the CE as specified in DMI A B 000096;
- field **Event Status** contains variable data related to the event specified by the field **Event Code**;

All the application messages transported over the WMbus lower layers shall be protected in terms of encryption and authentication. The concentrator and the CE shall apply the following protection algorithms, as specified in the specification NT0143, for details refer to [27]:

- AES 128 CTR, for user data and application commands encryption;
- AES 128 CMAC, for user data and application commands authentication.

8.1 TOTAL SYNCHRONISATION PROCEDURE (RF_SINC-T)

The meter can be configured in order to generate an RF spontaneous event “**No Synchronization Max Delay Reached**” (code event 0x47) when it detects that the clock synchronization is not yet performed according to the “**Sync_Max_Delay**” register (maximum number of day without synchronization command allowed). As soon as that frame is received from a concentrator, it has to generate a WMBUS frame “SND-UD2” in order to synchronize the meter. The concentrator will send the synchronization only if the RF_SINC-T procedure results enabled in T_RF_PRI.

The difference between the synchronization via PLC is that meter can receive in a protected way (with a protected applicative WMBUS message) both type of synchronization (called for PLC “not authenticated” and “authenticated”). So, the meter will have to manage it through the ATTR code of the DH message encapsulated inside the WMBUS message (004 for “not authenticated” sync and 104 for “authenticated” sync).

After receiving the synchronization, the meter must send a DH ACK message to the concentrator using a WMBUS frame “RSP-UD” and it must not consider any other synchronization command for the time necessary (if needed) to re-align its clock to the time provided by the concentrator.

Here the “data” field of the “No Synchronization max delay reached” spontaneous sent from the meter to the concentrator:

No Synchronization max delay reached	Event Register	E-G2
	Index number	Incremental value ($N_k = N_{k-1}+1$)
	Time stamp	Current time/date
	Code event	0x47
	Status event	[Sync_Rec_TS] (2 bytes) [IORL_Posix] (2 bytes)

	Description	It has to be generated if [Sync_max_delay] days have been passed from the [Sync_Rec_TS], or if [Sync_Max_Delay_Fast] days have been passed from the last generation of the event.

8.2 LAST CALL DUE TO LOAD PROFILE (RF_LC_LP)

If it is important for the central system to have the load profile each day, the meter has to generate the event 0x3F "**Load Profile Max Delay Reached**" when, after "**Lpi_Max_Delay**" hours after midnight, it doesn't have yet received complete read request of load profile of the previous day (it means that the meter has to generate the event also if at 20.20 of the previous day has sent the load profile because samples between 20.30 and midnight of the previous day are missing).

The meter has to consider the sending of the load profile the previous day as "completed", if the reading of the row of the load profile that includes the last sample of the day (so the midnight's sample) has been done after midnight.

The meter has to start to evaluate the time for the event's generation if, at midnight the number of valid samples of load profiles is higher or equal to 96. At the same time, if between midnight and the expected time for the generation of the event an authenticated synchronization of the clock has been done, the meter has to stop the evaluation of the time and wait a new situation in which at midnight at least 96 valid samples.

Load Profile Index Max delay Reached	Event Register	E-G2
	Index number	Incremental value (Nk= Nk-1+1)
	Time stamp	Current time/date
	Code event	0x3F
	Status event	Number of consecutive days (for each load profile) for which the meter has not received a read request of the load profile. Example: - 0x000001010001 It means that the reading of the LP1, LP3 and LP4 of the previous day have not been completed.
	Description	It has to be generated when the meter does not receive complete read request of load profile within LPI_Max_Delay after midnight.

"**LPI_Max_Delay**" is a 6 bytes register, in which each byte represent the max delay allowed for each load profile:

If one byte of the six is “0x00”, it means that the evaluation of the delay has to be disabled for this LP.

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
LPI_Max_Delay for LP6	LPI_Max_Delay for LP5	LPI_Max_Delay for LP4	LPI_Max_Delay for LP3	LPI_Max_Delay for LP2	LPI_Max_Delay for LP1
R-C	R+C	R-L	A-	R+L	A+

The Max value for each byte is 24.

For example, if LPI_MAX_DELAY = 0x0000 00 06 06 06, it means that the meter has to generate the event if at 6.00 a.m. it does not already received read request of load profiles LP1 and/or LP2 and/or LP3 of the previous day. For others Load profiles, the meter does not have to generate event.

If LPI_Max_Delay = 0x000000050707, the meter has to generate the event for LP3 at 5 a.m. and for LP1 and LP2 at 7 a.m.

Depending on the value of the “**SPONT_02**” (byte 23) meter register (the one associated with the event 0x3F), the occurrence of the event “**Load Profile Max Delay Reached**” can produce a number of spontaneous radio messages from the meter. In particular, two spontaneous messages will be generated for each load profile not read by the concentrator with the times defined below.

Considering what defined in [27], the “EVENT STATUS” of this kind of radio messages will contain the following information:

- Load profile identifier according to the following table
- Normal Status Word
- Extended Status Word 1, 2 and 3
- T_{LP}
- Timestamp in Posix of the last sample sent
- 48 samples of the previous day's curve.

The curve identifier is a 1 byte field that will be valorised to the following values based on the curve that the meter is sending:

MSb	…						LSb	HEX	Meaning
0	0	0	0	0	0	1	0	0x02	Load Profile A+ (LP1)
0	0	0	0	0	1	0	0	0x04	Load Profile R+L (LP2)
0	0	0	0	1	0	0	0	0x08	Load Profile A- (LP3)
0	0	0	1	0	0	0	0	0x10	Load Profile R-L (LP4)
0	0	1	0	0	0	0	0	0x20*	Load Profile R+C (LP5)*
0	1	0	0	0	0	0	0	0x40*	Load Profile R-C (LP6)*

* Only for polyphase meters.

Example

In the next table will be showed some examples of payload that has to be included in the load profile messages.

Load Profile A+ first message (110 bytes):

Load Profile identification	Normal Status Word	Extended Status Word	TLP	Time stamp last sample sent	Samples
1 byte	**2 byte**	**6 byte**	**1**	**4 byte**	**96 byte**
0x02	0x00C0	0x000000000000	0x0F	0x523AE741 (19/09/2013 12:00:00)	Samples 1÷48
0x02 00 C0 00 00 00 00 00 00 0F 52 3A E7 41 1° sample 2° sample… 48° sample					

Load Profile A+ second message (110 byte):

Load Profile identification	Normal Status Word	Extended Status Word	TLP	Time stamp last sample sent	Samples
1 byte	**2 byte**	**6 byte**	**1**	**4 byte**	**96 byte**
0x02	0x00C0	0x000000000000	0x0F	0x523B9001 (19/09/2013 24:00:00)	Samples 49÷96
0x 02 00 C0 00 00 00 00 00 00 0F 52 3B 90 01 49° sample 50° sample… 96° sample					

Please note that the event code and the time stamp of event generation have not to be included into the "**EVENT STATUS**" (please refer to [27]) because the same information are included into the application message DATASPONT 020/120.

If a meter is programmed in order to send all load profiles, the order of messages to be sent by the meter is the following:

- 1st message: first 48 samples of load profile A+;

- 2nd message: last 48 samples of load profile A+;
- 3rd message: first 48 samples of load profile R+L;
- 4th message: last 48 samples of load profile R+L;
- 5th message: first 48 samples of load profile A-;
- 6th message: last 48 samples of load profile A-;
- 7th message: first 48 samples of load profile R-L;
- 8th message: last 48 samples of load profile R-L;
- 9th message: first 48 samples of load profile R+C;
- 10th message: last 48 samples of load profile R+C;
- 11th message: first 48 samples of load profile R-C;
- 12th message: last 48 samples of load profile R-C;

If one load profile spontaneous message has not to be sent (because it is not required or because it has been already sent by PLC), the meter will skip the corresponding two messages and send the next load profile.

The meter will start to send the messages implementing LBT algorithm in a random instant included between the generation of the event 0x3F (t_{0x3F}) and the time instant $t_{0x3F} + \frac{[W\_LPDC\_SP]}{[N\_LPDC\_REP]}$, where "**W_LPDC_SP**" is a 1 byte register that define the duration of the temporal window (in minutes) in which the meter has to send for "**N_LPDC_SP**" times the entire sequence of messages.

Practically the meter will consider "**N_LPDC_SP**" time windows, each one with the duration defined through the ratio $\frac{[W\_LPDC\_SP]}{[N\_LPDC\_REP]}$. The meter will send in each time window, whitout repetition, the entire sequence of message starting every time in a random instant. The time distance between two messages of the same sequence is defined through the register "**SP_INTERVAL**" (1 byte – 0.1s).

Once received a DATASPONT(20/120) with Event Code 0x3F, the concentrator creates a ".dat.gz" file for any spontaneous profile received without sending any WMBUS acknowledge. The file has a reduced header followed by the samples of the LP profile:

Field Name	Size	Description
RF_CE_ID	8	Meter ADCE address
TYPE	1	Load profile type
NORMAL_STATUS_1	2	Normal Status Word 1 (0x1601)
EXTENDED_STATUS_1	2	Extended Status Word 1 (0x1701)
EXTENDED_STATUS_2	2	Extended Status Word 2 (0x1702)
EXTENDED_STATUS_3	2	Extended Status Word 3 (0x1703)

Field Name	Size	Description
LVC_DATE_TIME	4	LVC Time POSIX at spontaneous reception
CE_DATE_TIME	4	CE Time POSIX at spontaneous generation
SAMPLE_STATUS	1	DST CE [0] → 1 if CE_DATE_TIME is in DST DST ZIP [1] →1 if TIME_END is in DST
TIME_END	4	Time POSIX of the last sample in the zip file
T_{LP}	1	Meter sampling time
TOTAL_READ_SAMPLES	2	Number of samples in the zip file
DATA	N	Load Profile Samples

The Data field is composed from the sequences of samples (Es: for TLP=15).

2 Bytes	2 Bytes	2 Bytes	2 Bytes	2 Bytes	…	2 Bytes
Sample1	**Sample2**	**Sample3**	**Sample4**	**Sample5**	**…**	**Sample48**

Note that the TOTAL READ SAMPLES field will be 48 samples exception for the first LP part of the two DST transition days:

- DST 0 → 1 : TOTAL READ SAMPLES=44
- DST 1 → 0 : TOTAL READ SAMPLES=52

The name for a single “dat.gz” file depends on the RF_ADDR, the type of profile and the time when the file is created.

<u>Example</u>:

“LC_LP1_18A9010203ABCDEF_5201276A.dat.gz”

Where:

LC_LP is a standard prefix for Load Profile read via last call procedure

1 is the type of load profile:

Profile	**Type of LP**	**Code**

A+	1	0x02
R+L	2	0x04
A-	3	0x08
R-L	4	0x10
R+C	5	0x20
R-C	6	0x40

18A9010203ABCDEF is the RF_ADDRESS of the meter

5201276A is the POSIX time creation In Hex format

dat.gz is the standard suffix

When a "dat.gz" file is created, it is made available in /disk/ftp/pub/lastcall in the concentrator file system. There is one "dat.gz" file for each load profile. With similar rules the concentrator can create "dat.gz" file for load profile like described at [29].

According to the "**ENABLE_GZIP_FILE**" field in tab.63, the concentrator can create one daily "tar.gz" file at "**LC_TIME_GZIP** " including all the ".dat.gz" load profile generated until that time.

<u>Example</u>:

"PLOAD_RF_5201276A.tar.gz"

Where:

PLOAD_RF is a standard prefix for LP samples received via last call procedure

5201276A is the POSIX time creation In Hex format

tar.gz is the standard suffix

When a "tar.gz" file is created, it is made available in /disk/ftp/pub/lastcall in the concentrator file system. There is one "tar.gz" file for all the Load Profiles with the rules described in the following example:

Day 1:

- During the day the concentrator creates different “dat,gz” files for each LP profile received as RF spontaneous message. In the “lastcall” folder there will be different files named as “**LC_LPx_18A9010203ABCDEF_POSIX.dat.gz”**;

- At ”**LC_TIME_GZIP“** the concentrator performs a daily “tar.gz” file that contains all the “dat.gz” files created until that time. In the “lastcall” folder there will be the file “**PLOAD_RF_POSIXDAY1.tar.gz”**. If all the “dat.gz” files have been previously deleted from the central system, none daily file will be created.

Day 2:

- During the day the concentrator creates different “dat,gz” files for each LP profile received as RF spontaneous message. In the “lastcall” folder there will be different files named as “**LC_LPx_18A9010203ABCDEF_POSIX.dat.gz”**;

- At ”**LC_TIME_GZIP“** the concentrator performs a daily “tar.gz” file that contains the “dat.gz” files created until that time. In the “lastcall” folder there will be the file “**PLOAD_RF_POSIXDAY2.tar.gz”**. If the daily file of the previous day has not yet deleted from the central system, it will be also present in the “lastcall” folder and so on.

8.3 LAST CALL DUE TO DAILY CLOSURE (RF_LC_DC)

If it is important for the central system to have the daily closure each day, the meter has to generate the event 0x3B **“Daily Closure Max Delay Reached”** (if the event is enabled through the register SPONT_02) when, after ”**DC_Max_Delay**“ hours after midnight, it doesn’t have yet received complete read request of daily closure of the previous day.

Daily Closure Max delay Reached	Event Register	E-G2
	Index number	Incremental value (Nk= Nk-1+1)
	Time stamp	Current time/date
	Code event	0x3B
	Status event	Daily closure for which the meter has not received a read request for the previous day. Example:

	- 0x000001010001 It means that the daily closure of the previous day related to the circular buffer 1, 3 and 4 have not been read. Note: if a circular buffer is not read for more than one day, the same event will be generated for each day with the same Status event (it means that the meter has not to trace the number of consecutive days without daily closure's reading).
Description	It has to be generated when the meter does not receive read request of daly closure within DC_Max_Delay after midnight.

”**DC_Max_Delay**“ is a 6 bytes register, in which each byte represent the max delay allowed for each daily closure:

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
DC_Max_Delay for Circular Buffer 6	DC_Max_Delay for Circular Buffer 5	DC_Max_Delay for Circular Buffer 4	DC_Max_Delay for Circular Buffer 3	DC_Max_Delay for Circular Buffer 2	DC_Max_Delay for Circular Buffer 1
DC R-L	DC R-C	DC R+C	DC A-	DC R+L	DC A+

If one byte of the six is “0x00”, it means that the evaluation of the delay has to be disabled for this DC. The Max value for each byte is 24.

For example, if DC_MAX_DELAY = 0x000000080808, it means that the meter has to generate the event if at 8.00 a.m. it does not already received read request of daily closure for Circular Buffer 1 (DC A+) and/or CB2 (DC R+L) and/or CB3 (DC A-) of the previous day. For others daily closure, the meter does not have to generate event.

NOTE: If the value of the register “**DC_MAX_DELAY**” is the same of the register “**LPI_MAX_DELAY**” the meter has to generate the event 0x3F before than the event 0x3B. At the same time the RF spontaneous related to the event 0x3B will be postponed respect those related to the event 0x3F.

Depending on the value of the “**SPONT_02**” (byte 19) meter register (the one associated with the event 0x3B), the occurrence of the event “**Daily Closure Max delay Reached**” can produce a number of spontaneous radio messages. In particular, one spontaneous message will be generated with two circular buffer if at least one of them has not been sent.

Considering what defined, the “EVENT STATUS” of this kind of radio messages will contain the following information:

- Daily closures identifier according to the following table
- Normal Status Word
- Extended Status Word 1, 2 and 3
- Timestamp in Posix of the daily closure
- Daily Closure 1
- Daily Closure 2.

The dimension of the Daily closure (1 and 2) can be different depending on the value of the register Daily_Buf_Conf

Daily Closure identifier is a 1 byte field that can assume the following value:

MSb	…						LSb	HEX	Meaning
0	0	0	0	0	1	1	0	0x06	Daily Closure for A+ and R+L and the corresponding IDPMD (28 byte each, Circular Buffer 1 and 2)
0	0	0	0	0	1	1	1	0x07	Daily Closure for A+ and R+L and the corresponding IDPMD (34 byte each, Circular Buffer 1 and 2)
1	0	0	0	0	1	1	0	0x86	Daily Closure for A+ and R+L and the ADPMD for A+ (40 byte for A+ and 28 byte for R+L, Circular Buffer 1 and 2)
1	0	0	0	0	1	1	1	0x87	Daily Closure for A+ and R+L, the corresponding IDPMD and the ADPMD for A+ (46 byte for A+ and 34 byte for R+L, Circular Buffer 1 and 2)
0	1	0	0	1	0	0	0	0x48	Daily Closure for A- and R-L (28 byte each, Circular Buffer 3 and 6)
0	1	0	0	1	0	0	1	0x49	Daily Closure for A- and R-L and the corresponding IDPMD (34 byte each, Circular Buffer 3 and 6)
1	1	0	0	1	0	0	0	0xC8	Daily Closure for A- and R-L and the ADPMD for A- (40 byte for A- and 28 byte for R-L, Circular Buffer 3 and 6)
1	1	0	0	1	0	0	1	0xC9	Daily Closure for A- and R-L, the corresponding IDPMD and the ADPMD for A- (46 byte for A- and 34 byte for R-L, Circular Buffer 3 and 6)
0	0	1	1	0	0	0	0	0x30	Daily Closure for R+C and R-C (28 byte each, Circular Buffer 4 and 5)
0	0	1	1	0	0	0	1	0x31	Daily Closure for R+C and R-C and the corresponding IDPMD (34 byte each, Circular Buffer 4 and 5)
1	0	1	1	0	0	0	0	0xB0	Daily Closure for R+C and R-C (28 byte each, Circular Buffer 4 and 5)
1	0	1	1	0	0	0	1	0xB1	Daily Closure for R+C and R-C and the corresponding IDPMD (34 byte each, Circular Buffer 4 and 5)

If the Least Sensible bit (LSb) of the Daily Closure identifier field is set the message contains also the IDPMD.

If the Most significant bit (MSb) of the Daily Closure identifier field is set the message contains the active components of the ADPMD.

It is important to take in consideration that the association “circular buffer n” respect to the type of energy considered is different respect to the association done with the “load profile n”. For this reason, the message related to Daily closure A- and R-L has to refer to the circular buffer 3 and 6. In the following table a summarize (respect to the default value) is reported:

Load Profile	Energy
LP1	A+
LP2	R+L
LP3	A-
LP4	R-L
LP5	R+C
LP6	R-C

Circular Buffer	Daily Closure
DC1	A+
DC2	R+L
DC3	A-
DC4	R+C
DC5	R-C
DC6	R-L

Example

In the next table will be showed some examples of payload that has to be included in the daily closure messages.

Daily Closure A+ and R+L (69/77/81/87 byte):

Circular Buffer Identifier	Normal Status Word	Extended Status Words	Time stamp daily Closure	Daily Closure Circular Buffer 1	Daily Closure Circular Buffer 2
1 byte	**2 byte**	**6byte**	**4 byte**	**28 to 46 byte**	**28 to 46 byte**
0x06	0x00C0	0x000000000000	0x523B9001 (19/09/2013 24:00:00)	Total A+ A+ for each tariff Optional: IDPMD of A+ with Time stamp and/or ADPMD for each tariff	Total R+L R+L for each tariff Optional: IDPMD of R+L with Time stamp and/or ADPMD for each tariff
0x06 00 C0 00 00 00 00 00 00 52 3B 90 01 Daily Closure 1 Daily Closure 2					

Daily Closure A- and R-L (69/77/81/87 byte):

Circular Buffer Identifier	Normal Status Word	Extended Status Words	Time stamp daily Closure	Daily Closure Circular Buffer 3	Daily Closure Circular Buffer 6
1 byte	**2 byte**	**6 byte**	**4 byte**	**28 to 46 byte**	**28 to 46 byte**
0x48	0x00C0	0x000000000000	0x523B9001 (19/09/2013 24:00:00)	Total A- A- for each tariff Optional: IDPMD of A- with Time stamp and/or ADPMD for each tariff	Total R-L R-L for each tariff Optional: IDPMD of R-L with Time stamp and/or ADPMD for each tariff
0x48 00 C0 00 00 00 00 00 00 52 3B 90 01 Daily Closure 3 Daily Closure 6					

If a meter is programmed in order to send all daily closures, the order of messages to be sent by the meter is the following:

- 1st message: daily closure A+ and R+L;
- 2nd message: daily closure A- and R-L
- 3rd message: daily closure R+C and R-C;

If one message has not to be sent (because it is not required or because it has been already sent by PLC) the meter will move to the following message.

If the meter should not send one of the two daily closure of the couples above defined, but it has to send the other one, it will generate the spontaneous message including in any case both daily closure.

The meter will start to send the messages implementing LBT algorithm in a random instant included between the generation of the event 0x3B (t_{0x3B}) and the time instant $t_{0x3B} + \frac{[W\_LPDC\_SP]}{[N\_LPDC\_REP]}$ according to the same procedure (and parameters) described for load profile.

Once received a DATASPONT(20/120) with Event Code 0x3B, the concentrator creates a ".dat.gz" file for any spontaneous profile received without sending any WMBUS acknowledge. The file has a reduced header followed by the samples of the DC profile:

Field Name	Size	Description
RF_CE_ID	8	Meter ADCE address
TYPE	1	Daily Closure profile type
NORMAL_STATUS_1	2	Normal Status Word 1 (0x1601)
EXTENDED_STATUS_1	2	Extended Status Word 1 (0x1701)
EXTENDED_STATUS_2	2	Extended Status Word 2 (0x1702, only MM520evo meter, see T_CE)
EXTENDED_STATUS_3	2	Extended Status Word 3 (0x1703, only MM520evo meter, see T_CE)
LVC_DATE_TIME	4	LVC Time POSIX at spontaneous reception
CE_DATE_TIME	4	CE Time POSIX at spontaneous generation
SAMPLE_STATUS	1	DST CE [0] → 1 if CE_DATE_TIME is in DST DST ZIP [1] →1 if TIME_END is in DST IDPMD [2] → 1 if Instantaneous Daily Power Maximum Demand enabled DAILY_BUF_CONF=0x05 or 0x0B (0x52C2, see below) ADPMD [3] → 1 if Average Daily power maximum demand enabled DAILY_BUF_CONF=0x08 or 0x0B (0x52C2, see below)
TIME_END	4	Time POSIX of the last sample in the zip file
TOTAL_READ_SAMPLES	2	Number of samples in the zip file
DATA	N	Samples

The Data field is composed from the sequences of DC samples in case of IDPMD [2]=0 and ADPMD [3]=0 in the SAMPLE_STATUS:

28 Bytes
DC Sample1

The Data field is composed from the sequences of DC samples and instantaneous daily power maximum demand samples in case of IDPMD [2]=1 and ADPMD [3]=0 in the SAMPLE_STATUS:

28 Bytes	2 Bytes	4 Bytes
DC Sample1	**IDPMD Sample1**	**TS_IDPMD Sample1**

The Data field is composed from the sequences of DC samples and average daily power maximum demand samples in case of DPMD [2]=0 and ADPMD [3]=1 in the SAMPLE_STATUS:

28 Bytes	12 Bytes
DC Sample1	**ADPMD Sample1**

The Data field is composed from the sequences of DC samples, instantaneous daily power maximum demand samples and average daily power maximum demand samples in case of DPMD [2]=1 and ADPMD [3]=1 in the SAMPLE_STATUS:

28 Bytes	2 Bytes	4 Bytes	12 Bytes
DC Sample1	**IDPMD Sample1**	**TS_IDPMD Sample1**	**ADPMD Sample1**

The name for a single "dat.gz" file depends on the ADCE, the type of profile and the time when the file is created.

Example:

“LC_DC1_C1_18A9010203ABCDEF_5201276A.dat.gz”

Where:

LC_DC is a standard prefix for Daily Closure read via last call procedure

1_C1 is the type of daily closure profile:

Profile	Type of DC	Code
C1I_A(t): A+	1_C1	0x02
C1I_R(t): R+L	2_C1	0x04
C1E_A(t): A-	3_C1	0x08
C1E_R(t): R+C	4_C1	0x10
C1I_AR(t): R-C	5_C1	0x20
C1E_AR(t): R-L	6_C1	0x40

18A9010203ABCDEF is the RF_ADDRESS of the meter

5201276A is the POSIX time creation

dat.gz is the standard suffix

When a "dat.gz" file is created, it is made available in /disk/ftp/pub/lastcall in the concentrator file system. There is one "dat.gz" file for each daily closure profile. With similar rules the concentrator can create ".dat.gz" file for daily closure profile like described at [29].

According to the "**ENABLE_GZIP_FILE**" field in tab.63, the concentrator can create one daily "tar.gz" file at "**LC_TIME_GZIP** " including all the ".dat.gz" daily closure profile generated until that time.

Example:

"DAILY_RF_5201276A.tar.gz"

Where:

DAILY_RF is a standard prefix for DC samples received via last call procedure

5201276A is the POSIX time creation in Hex format

tar.gz is the standard suffix

When a "tar.gz" file is created, it is made available in /disk/ftp/pub/lastcall in the concentrator file system. There is one "tar.gz" file for all the Daily Profiles with the rules described in the following example:

Day 1:

- During the day the concentrator creates different "dat,gz" files for each DC profile received as RF spontaneous message. In the "lastcall" folder there will be different files named as "**LC_DCx_C1_18A9010203ABCDEF_POSIX.dat.gz"**;

- At "**LC_TIME_GZIP"** the concentrator performs a daily "tar.gz" file that contains all the "dat.gz" files created until that time. In the "lastcall" folder there will be the file "**DAILY_RF_POSIXDAY1.tar.gz"**. If all the "dat.gz" files have been previously deleted from the central system, none daily file will be created.

Day 2:

- During the day the concentrator creates different "dat,gz" files for each DC profile received as RF spontaneous message. In the "lastcall" folder there will be different files named as "**LC_DCx_C1_18A9010203ABCDEF_POSIX.dat.gz"**;

- At ”**LC_TIME_GZIP“** the concentrator performs a daily “tar.gz” file that contains the “dat.gz” files created until that time. In the “lastcall” folder there will be the file “**DAILY_RF_POSIXDAY2.tar.gz”**. If the daily file of the previous day has not yet deleted from the central system, it will be also present in the “lastcall” folder and so on.

8.4 UPDATE OF CE SOFTWARE (RF_CE_DWL)

The commands, rules and algorithm to perform the download through RF are the same of PLC with frame encapsulated in WMBUS Messages. Below are described only the difference from PLC procedure, for the completer DWL algorithm refer to 7.18.

In particular, the meter can receive from data concentrator two different type of WMBUS message depending on the phase of download:

Configuration: During the preliminary phase of the RF_CE_DWL, the concentrator will program with unicast messages the same fields used via PLC and two additional field:

ADBRRF: Broadcast RF, first two bytes are fixed to “0x18A9” (meter coding 0x0613).

BR_RF_KEY: Broadcast RF key for the protection of Broadcast messages (meter coding 0x0614).

This phase is performed in unicast way (so using for each meter its keyRF2) using “SND-UD2” frame (from Concentrator to meter) and “RSP-UD” frame (from meter to concentrator). The **ADBRRF** and **BR_RF_KEY** should be two random values calculated by the concentrator, in any case the same value shall be always set for each meters involved in the same RF_CE_DWL activation. On the contrary if a new RF_CE_DWL starts, for example after a RF_CE_DWL programming, a new random couple of values shall be set by concentrator.

Packets transmission: The packets transmission phase can be done or in unicast (using the keyRF2 of the meter) or in broadcast (using the BR_RF_KEY) using in both cases “SND-UD” frame with the control byte (CC-field) of the extended link layer settled in the way that Ack of the meter is not required. As done in PLC the broadcast transmission shall be used in order to improve the DWL performance.

As general rule the RF_CE_DWL follows the same algorithm used via PLC but in order to guarantee the duty cycle for hour of the RF 169 MHz band (10% with unicast message and 5% with broadcast message), two T_ATT fields shall be used:

- **RF_UNI_TIMER:** It's the spacing time in seconds in which the concentrator can send unicast messages via RF for each hour, default=0x0154 (340 seconds). At the end of the timer the concentrator shall stop to send unicast message until the next hour. The starting time of the unicast window shall be calculated in random way keeping into account its duration. It means that, for example with the default value, the maximum start time has to be at hh:54:20. The sending window could be suspended by another procedure that uses the RF channel, for example the TRF, but in any case the duration available for RF_CE_DWL shall be "**RF_UNI_TIMER**" seconds. The unicast messages should be avoid in some hours, for example during the window in which the meter is programmed to send the LP/DC as RF spontaneous messages. To do that two T_ATT fields "**RF_BLK_START**" and "**RF_BLK_TIMER**" are used.

- **RF_BR_TIMER:** It's the spacing time in seconds in which the concentrator can send broadcast messages via RF for each hour, default=0x00B4 (180 seconds). At the end of the timer the concentrator shall stop to send broadcast message until the next hour. The starting time of the broadcast window shall be calculated in random way keeping into account its duration. It means that, for example with the default value, the maximum start time has to be at hh:57:00. The sending window could be suspended by another procedure that uses the RF channel, for example the TRF, but in any case the duration available for RF_CE_DWL shall be "**RF_BR_TIMER**" seconds. The broadcast messages can be sent in relation to the T_RF_CE_DWL fields "**BR_START**" and "**BR_TIMER**". The broadcast messages should be avoid in some hours, for example during the window in which the meter is programmed to send the LP/DC as RF spontaneous messages. To do that two T_ATT fields "**RF_BLK_START**" and "**RF_BLK_TIMER**" are used.

As result of above, the RF_CE_DWL is not handled in a continuous way but in specific windows in relation to the type of messages to be sent during each procedure stage.

Below an example to better understand the procedure algorithm:

Concentrator RF_CE_DWL_CE set-up:

- ACT_INSTANT=0x0E0000 (14:00:00)
- RF_UNI_TIMER=0x0154 (340 seconds)
- RF_BR_TIMER=0x00B4 (180 seconds)
- RF_BLK_START=0x0F (15:00:00)
- RF_BLK_TIMER=0x03 (3 hours)
- BR_START=0x17 (23:00:00)

- BR_TIMER=0x02 (2 hours)

Stage1 (Unicast messages to program the meter)

14:00 → the concentrator calculates a random time to start the sending of the unicast messages to program each meter (from 14:00 to 15:00). The unicast windows will be long “RF_UNI_TIMER“ seconds. If the window is not enough to program all the meters, the concentrator waits the next hour. On the contrary, the concentrator is ready for stage2.

15:00 → the concentrator suspends the RF_CE_DWL due to the “RF_BLK_START” and “RF_BLK_TIMER”.

16:00 → the concentrator suspends the RF_CE_DWL due to the “RF_BLK_START” and “RF_BLK_TIMER”.

17:00 → the concentrator suspends the RF_CE_DWL due to the “RF_BLK_START” and “RF_BLK_TIMER”.

18:00 → the concentrator calculates a new random time to complete the sending of the unicast messages to program each meter (from 18:00 to 19:00). The unicast windows will be long “RF_UNI_TIMER“ seconds. If the window is not enough to program all the meters, the concentrator waits the next hour. On the contrary, the concentrator is ready for stage2.

19:00 → the same above step goes on until all the meters are programmed (or the retries are competed) and after that the stage2 (broadcast) starts. In any case the stage2 (broadcast) can start only if the stage1 (unicast) is completed. Note that if the stage1 is ongoing the broadcast windows will be used for the unicast messages of stage1.

Stage2 (Broadcast messages to send the DWL packets)

23:00 → the concentrator calculates a random time to start the sending of the DWL broadcast packets (from 23:00 to 24:00). The broadcast windows will be long “RF_BR_TIMER“ seconds.

00:00 → the concentrator calculates a new random time to go on the sending of the DWL broadcast packets (from 00:00 to 01:00). The broadcast windows will be long “RF_BR_TIMER“ seconds.

01:00 → the concentrator suspends the RF_CE_DWL broadcast step until the next 23:00. The same above step goes on until the end of the DWL broadcast packets using two hour windows day by day. In any case the next step3 (unicast) can start only if the stage2 (broadcast) is completed. Note that if the broadcast ends, for example in the first hour window, the second hour can be uses to start the step3.

Stage3 (Unicast messages to check the meter packet status)

01:00 → the concentrator calculates a random time to start the sending of the unicast messages to check for each meter the packet status (from 01:00 to 02:00). The unicast windows will be long "RF_UNI_TIMER" seconds. If the window is not enough to check all the meters, the concentrator waits the next hour. On the contrary, the concentrator is ready for stage4.

02:00 → the same above step goes on until all the meters are checked (or the retries are competed) and after that the stage4 (broadcast) starts. In any case the stage4 (broadcast) can start only if the stage3 (unicast) is completed. Note that if the stage3 is ongoing the broadcast windows will be used for the unicast messages of stage3. The packets to be sent in stage4 is the matching of the missing packets for all the involved meters.

Stage4 (Broadcast messages to send the missing DWL packets checked at the previous stage)

23:00 → the concentrator calculates a random time to start the sending of the missing broadcast packets (from 23:00 to 24:00). The broadcast windows will be long "RF_BR_TIMER" seconds.

00:00 → the concentrator calculates a new random time to go on the sending of the missing broadcast packets for the current window (from 00:00 to 01:00). The broadcast windows will be long "RF_BR_TIMER" seconds.

01:00 → the concentrator suspends the RF_CE_DWL broadcast step until the next 23:00. The same above step goes on until the end of the DWL broadcast packets using two hour windows day by day. In any case the next step3 (unicast) can start only if the stage4 (broadcast) is completed. Note that if the broadcast ends, for example in the first hour window, the second hour can be uses to start the step3. At the end of stage4 the concentrator comes back to stage 3 in order to check the packet status for each meter. The loop stage 4 * stage 3 shall be repeat "LOOP_LIMIT" times. At the end of the last loop only the meter that are received all the packet will go on with the stage5.

Stage5 (Unicast messages to send the swot command)

02:00 → the concentrator calculates a random time to start the sending of the unicast messages to write the swot instant for each meter (from 02:00 to 03:00). The unicast windows will be long "RF_UNI_TIMER" seconds. If the window is not enough to program all the meters, the concentrator waits the next hour. On the contrary, the concentrator is ready for stage6.

Stage6 (Unicast messages to send the swot command)

03:00 → the concentrator calculates a random time to start the sending of the unicast messages to read the final status of the download for each meter (from 03:00 to 04:00). The unicast windows will be long "RF_UNI_TIMER" seconds. If the window is not enough to read all the meters, the concentrator waits the next hour.

During all the process the concentrator shall update the filed RF_F(DWL) in T_RF_CE

What above described is an example of a single part download but in case of extended or multi-part download, the concentrator shall modify the algorithm as done via PLC.

For further information about the PLC algorithm refers to 7.18 and [27].

8.5 TRF PROCEDURE (TRF)

The concentrator shall provide the TRF functionality over all the meters present in T_RF_CE. A new CM code is used to generate a TRF command throw a meter.

8.5.1 TRF MESSAGES GENERAL ARCHITECTURE

The structure of TRF messages exchanged between AMM and concentrator for customer remote control is described in the following figure:

TM	CM	LCD	IT	AUTP	CEA	D

Header = 7 bytes | Data FIELD = 154 bytes

where:

TM : Filed Message Type of 1 byte with the code (from 0 to 255) identifying the service typology:

00000000:	not used	
00000001:	LVC pattern control	(GB-LVC)
00000010:	LV remote control of CE	(TB-CE)
…………..		
00001000:	RF remote control of CE	(TRF-CE)

The other values of this field are reserved or to be defined according to [5].

CM : Field Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included;

LCD : Field DATA Length of 2 bytes containing the Length in byte of the whole DATA Field;

IT : Field Transaction Id of 3 bytes identifying the transaction number;

Byte 1-2 identify the macro procedure while the byte 3 identifies the command of the single procedure

The numbers transaction ID range for byte 1-2 is:

AMM ⇒ LV-C	0 ⇒ 2047	FOR GB MESSAGE
	2048 ⇒ 9999	FOR TB/TRF MESSAGE
HHU ⇒ LV-C	10000 ⇒ 12047	FOR GB MESSAGE
	12048 ⇒ 19999	FOR TB/TRF MESSAGE
LV-C ⇒ AMM/HHU	20000 ⇒ 22047	FOR GB MESSAGE
	22048 ⇒ 29999	FOR TB/TRF MESSAGE
AMM ⇒ LV-C	30000 ⇒ 38195	FOR IC MESSAGE
HHU ⇒ LV-C	38196 ⇒ 46391	
LV-C ⇒ AMM/HHU	46392 ⇒ 48439	

AUTP : Field Protection/Priority of 1 byte. It is not present for TRF response messages.

When TM=8, field AUTP is:

- 0 for protection not required;
- 1 for encryption required;
- 2 for authentication required;
- 3 for encryption and authentication required.

CEA : Field RF Address of target CE of 6 bytes containing the WMBus A-field (see [DMI A B 000249] for RF address structure). The DC shall independently connect the corresponding WMBus M-field to the A-field before sending the WMBus frame to the target CE.

D : Field Message Data composed by an integer number of bytes. The maximum size of D is 147 bytes. The use of 80 bytes of Message data within the field D is recommended.

For the complete TRF command and code please refer to [28].

8.6 CE ACQUISITION PROCEDURE (RF_ACE)

In order to support the radio communication via RF modem, the meter implements the following register in its database:

- RF_Comm_Signal_Ac [RF_CoSi]
- RF_Comm_Per [RF_CoPe]
- RF_Comm_Rep [RF_CoRe]

In particular, the meter, as soon as the value of "**RF_CoSi**" is written to a value different from 0, it sends immediately the "SND-IR" and if it not receive a "CNF-IR" (confirmation Installation Request) from a data concentrator, repeat others "**RF_CoRe**" times the message. The time that it has to wait between each message is defined through the parameter "**RF_CoPe**" (in seconds).

The value of "**RF_CoPe**" can be chosen in the range 30÷60 seconds, while that of "**RF_CoRe**" in the range 1÷59.

The meter, if it not receive a "CNF-IR", it has to repeat the same procedure every day, choosing a random way the time instant to send the first SND-IR of the day (between 00.00 and 23.00).

It means that, if "**RF_CoSi**"=1, "**RF_CoPe**"=60 and "**RF_CoRe**"=29, the meter has to send the RF message specific for commissioning (if it does not receive "CNF-IR") for infinite days and every day it has to send 30 message (1 every 30 seconds).

The meter must stop sending SND-IR even if it receives an "ack" message (CNF-IR frame) as response to the "SND-IR" from a concentrator. In this case, the register "**RF_CoSi**" has to switch immediately to the value "0.

The above message triggers all the concentrators that are able to listen it to acquire the meter. Concentrator stores the complete meter RF address and RSSI information of the received RF message in the T_RF_NEIGH. In case of the meter is not present in T_NEIGH, the GB_SPONT_RF_NEW_NEIGH (039.023) shall be generated. Note that the GB_SPONT_RF_NEW_NEIGH (039.023) must be generated also if any protected or not message is received by the concentrator and it is the first communication from that specific meter.

As above described, after a "SNR-IR" reception, concentrator sends a specific WMBUS frame "CNF-IR". More than one concentrator can send the "CNF-IR" and, in order to reduce the collision, they have to reply in different timing in relation to the RSSI level of the received message. A concentrator with a higher RSSI will reply before for example another one with a lower level in order to privilege that ones with a good level of signal. More in general the above algorithm shall be used by the concentrator for any communication that needs a response to a meter (in addition to the LBT). When the meter receives a WMBUS frame "CNF-IR it stops the sending of the installation request. Starting from this moment the meter has to be considered as "listened" and it starts to send a protected periodical RF communication "**Ping_WD**" with a WMBUS frame "SNR-NR".

As soon as the value of the meter register "**RF_CoSi**" become 0, the meter starts to evaluate the time passed from the last radio communication via RF (message send by the meter). In particular, if, after "**Ping_WD**" days from the last "SND-IR" message no other RF communication has been done, the meter has to generate the event "No RF communication during last Week" (code event 0x3C) and, depending on the value of the register **SPONT_02**, an RF spontaneous message.

Of course, if the meter has regular RF communication (e.g network management is done through RF), this event has not to be generated. In fact this event has to be generated after "**Ping_WD**" days from the last generation of the event only if the meter does not receive/send in this period any RF message, otherwise the event has to be generated after "**Ping_WD**" days from the last RF message received/send.

By the T_NEIGH analysis, AMM can select one or more concentrators in order to manage a meter in the RF_T_CE by the following procedure.

Once started, the RF_ACE procedure does the following steps via RF:

- The CE will be acquired if the RF_F(ACE) is set to 0x01 in the T_RF_CE;
- Concentrator reads via RF in protected way the meter normal status words (meter coding 0x1601) with a (SND-UD2) message, the meter replies with a WMBUS frame "RSP-UD";
- Concentrator writes in protected way the meter "**RF_PROTECTION**" to 0x01 (meter coding 0x0696) with a (SND-UD2) message, the meter replies with a WMBUS frame "RSP-UD". In case of the meter requires the extended status words reading (meter coding 0x1701, 0x1702, 0x1703), it will be performed at this step; if the extended status words reading fails the meter shall be considered in any case like commissioned.
- If both messages are succeeded with authentication and encryption keys matching, so the meter has to be considered as "commissioned" and the RF_F(ACE) field is cleared; otherwise the RF_F(ACE) field shall to be valued as reported at 5.7.3.

The above RF_ACE unicast messages shall follow the same algorithm described in RF_CE_DWL (8.4) in order to guarantee the duty cycle for hour of the RF 169 MHz band (10% with unicast message).

During the RF_ACE procedure, the GB_RF_ACE_PROC_RES (039.012) is generated in order to inform AMM about the procedure results.

Changes to the following fields will result in the RF_F(ACE) setting (0x01) for the current CE:

- T_RF_CE_- [CE_ADDR]
- T_RF_KEY - [KEYRF1]
- T_RF_KEY - [KEYRF2]

If the AMM wants to make T_RF_CE changes without any meter acquisition, it can do this by disabling the RF_ACE procedure.

Depending on the configuration of the meter “**Ping_WD**” register, the meter has to send a “SND-NR” message after “**Ping_WD**” days without RF communication with a concentrator. Once received that “SND-NR” message, the concentrator shall update the T_RF_CE or T_RF_NEIGH fields like, more in general, for any RF message received from a meter.

No RF communication during last Week	Event Register	E-G2
	Index number	Incremental value (Nk= Nk-1+1)
	Time stamp	Current time/date
	Code event	0x3C
	Status event	Global Status Word (8 bytes)
	Description	This event has to be generated after [Ping_WD] day from the last RF message received/send or from the last generation of the event, if in that period no RF communication has been done.

Of course, if the meter has regular RF communication, the meter “**Ping_WD**” message will not be sent. In fact this message has to be sent only after “**Ping_WD**” days from the last RF message sent and not after the last Ping message.

The concentrator has to delete the T_RF_NEIGH entry for a specific meter in case of it doesn’t receive any communication from the meter after “**RF_DEL_NEIGH**” threshold days configured in T_ATT.

Once commissioned, AMM can optionally modify the two meter RF keys by means a write command of the meter field “**Δ KEY RF 1**” and “**Δ KEY RF 2**”. After that, it’s in charge to AMM to re-set the new keys in all the concentrators that handle the involved meter.

9 LV CONCENTRATOR DATA BASE FOR VAS

9.1 TABLES

Communication between concentrator and IC must happen with the same path used for the CE to which is connected.

If IC doesn't answer, the concentrator has to communicate, in case of known topology, by the master of the section and when necessary even by the CE to whom IC is associated

In this last case, if CE cannot be inserted as receiver for the number of repeaters equal to seven (maximum foreseen by LV protocol), the concentrator must not use Master Section of the section to which CE belongs with IC, but has to use the repeater of the previous section.

In case of unknown topology, and same path communication failure, it has to be used the CE to which the IC belongs, if CE cannot be inserted as receiver for the number of repeaters equal to seven (maximum foreseen by LV protocol), the concentrator has to use the CE repeater connected with.

In case of known topology the following conditions can be verify:

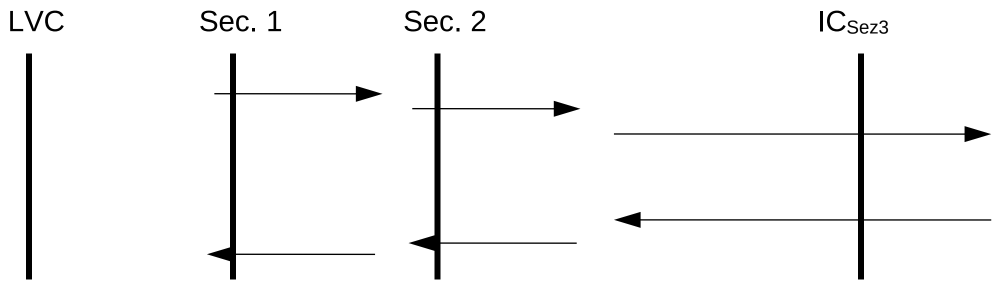


fig. a)

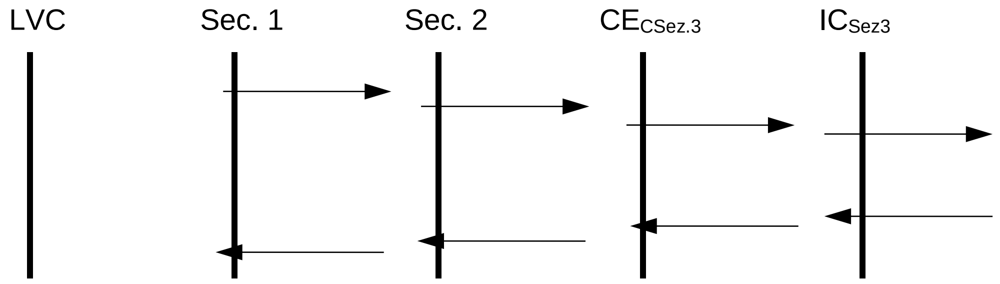


fig. b)

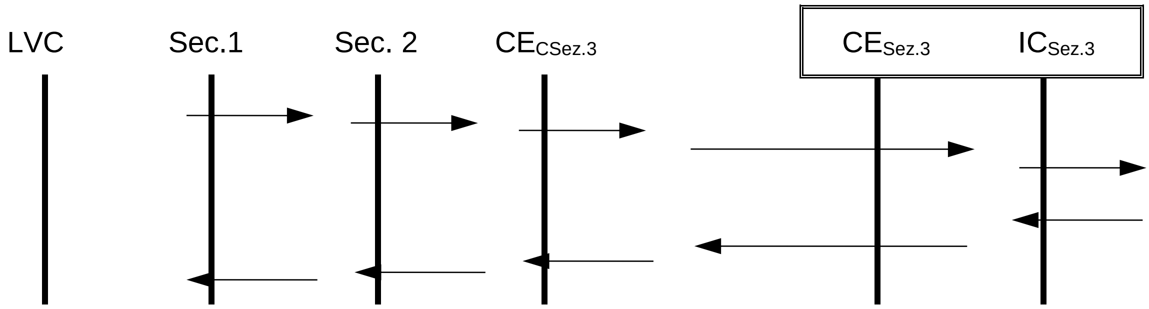


fig. c)

If the topology is unknown it has to be used the repeater paths (primary and alternate) for the repetition.

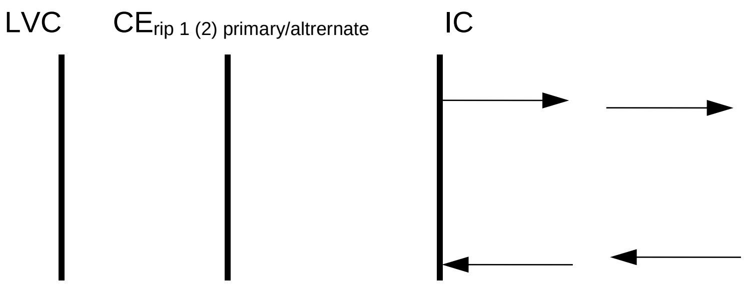


fig. d)

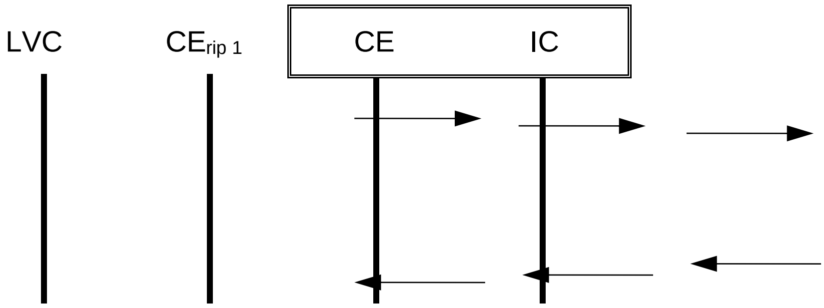


fig. e)

In this case the IC is reachable by mean the CE to which it belongs

Note: The IC has to inherit its repeat path from the CE. The repeat table has a "path id" flag that indicates whether to use the primary or alternate repeat path.

9.1.1 Inbound (downstream) messages tables

For inbound services realized with GB message type, due the complexity of the procedure, the concentrator receives from AMM the request to transmit data characterized to:

- Code of the service (comprising the protocol and the requested service)
- IC address
- Delivery Modality (broadcast, multicast, customer address)
- Length
- Contained of the message
- The maximum time of delivery

Because nearly all VAS services are subject to punctual invoicing (customer pays for that service only if it has been carried out in the established maximum times), it is necessary always to give back to AMM, at the end of the maximum time, or on complete delivery to all the addresses, the necessary information for the invoicing.

The concentrator database, relating to VAS, requests some comprises tables that assume the structure described in the following sections.

9.1.1.1 Buffer of long messages transmission request (LMESS_REQ)

The Structure of this buffer has to be as follow:

Id_IC	Id Trans	Sep	Prot_ cod	Prot_ res	Req_ time	Exp_ time	mess_ point	mess_ point_r	Num_ dest	Num_ bytes

Where:

SIZE PARAMETER

(6 bytes) **Id_IC**: IC identifier of IC. It is the address of IC.

(3 bytes) **Id Trans**: Id of the transaction requested (single o multiple). This field has to be taken from the message received by the AMM and given back as a check at the end of transaction.

(1 byte) **Sep**: It is the message identifier; managed by AMM. SEP is a parameter set (handled) by VAS Server, it is a cyclic counter 0-255 identifying the sequential message from VAS Server to IC. IC memorizes the parameter, if after the standard retransmission retry it is not able to send the message to the device in C band, it puts the SEP of that message in an ERROR table. It is transparent to the concentrator.

(1 byte) **Prot_code (Protocol code)**: It is a code used in order to identify the in home protocol and an IC multiprotocol.
Bit 0-3: protocol identifier: Code 1 = xxx
Code 2= Konnex
Bit 4-7: reserved to the protocol used and defined in the specification of C part.

(3 bytes) **Prot_res (Protocol reserved)**: These bytes are used by the protocol (xxx, Konnex). The use must be established in C part specification related to the specific protocol. E.G. used for the in home device address and the service. Vas service index.

(6 bytes) **Req_time (time of the request)**: Interval of time in which the demand occurs.

(6 bytes) **Exp_time (Expiration Time)**: Exp_Time is Date-Time at which expiration is to take place. For multicast, all members of group have the same expiration (the concentrator will assume, but not verify, that all the times are the same and use the time of the first member of the group (that with the lowest transaction ID) for the expiration time of the entire group).

(1 bytes) **Mess_point (pointer to the message table)**: It is the pointer to the table LMES_TAB, downloaded via GB_COMMAND. If the concentrator reads a value different from that specified for that structure (# 26 see Enel DH 971K 1st part) has to send a NACK (for multicast, all members of group have the same mess_point).

(2 bytes) **Mess_point_r (pointer to the message)**: It is the pointer to the row of the (256 bytes row) table LMES_TAB. It defines the number of row of the table at which the message starts (first row # 1). For multicast, all members of group have the same mess_point_r.

(2 bytes) **Num_dest (identifier of the destination of the IC nodes)**: If 1 the message is unicast, if > 1 the message is multicast. If the number is greater than one, then this number is the ID of the multicast group (2 – 255). So if the number is 2, then all the rows in this table with 2 in this field constitute a multicast group.

(2 bytes) **Num_bytes (number bytes of the message)**: It defines the number of bytes of the entire message. The concentrator must calculate the number of the packets to transmit. It is the field File length in FTP Control table. For multicast, all members of group have the same num_bytes.

Note: for mess_point, mess_point_r and num_bytes, the will assume (but not verify) that all the times are the same and use the time of the first member of the group (that with the lowest transaction ID) for the expiration time of the entire group.

The LMESS_REQ has to contain 2048 requests. The buffer has to be stored in the no-volatile memory of the concentrator.

Since LMESS_REQ contains transaction IDs, the semantics for transactions with steps are the same as for xTRAPE.REQ. In particular, do all the following apply:

a. When a transaction is requested to be reset (e.g., IC.042), all the steps for the transaction are removed.
b. When a step of a transaction fails, all the remaining steps automatically fail.

The C data structure for the buffer of long messages has to be done by manufactures in separate document: "Data structures of the concentrator messages".

9.1.1.2 Table of 64 Kbytes file structure (LMES_TAB)

This table is a 64 Kbytes structure, it is written by AMM and consists in 256 rows of 256 bytes. It has to contain the data files such as the publicity banners and it has to be structured as follow:

Data 1
Data 2
…
Data 256

The table is filled by AMM (VAS Server) with 256 bytes streams, it is sent to IC in 60 bytes streams (A band limit).

The C data structure for the table has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The table has to be stored in the no-volatile memory of the concentrator.

9.1.1.3 Buffer of IC opened transaction V (VTRAPE.REQ)

Like the “TRAPE.REQ” defined in section 4.4.6.1 in this document, it will be used the buffer B(VTRAPE.REQ). It is scheduled by IC-B (low priority).

This buffer must be used to contain transaction requests that the AMM dispatches to the concentrator for the activities to perform on the IC or inside the house devices. Each record of this buffer comes out from the explicit request that the AMM dispatches to the concentrator. The AMM can require to delete a specific transaction from the buffer through the message IC_ID_TRAS_RESET (032) or GB_RESET_ID (020).

The buffer must be able to contain at least 1024 transactions of IC type.

The loading of the transaction in B(VTRAPE.REQ) by the AMM, has to be done using suitable messages (see Enel DH 972K). If there are the right conditions, the concentrator must accept the request and records it in the buffer. While if the buffer maximum capacity has been already reached, at the following transaction request, the concentrator must answer with the message IC-239/249 o GB-255 relative, with the error code: ``B(VTRAPE.REQ) full''.

Eventual transaction requests with ``Id_Transaction'' and "step" already present in the buffer have to be refused with the diagnostic message IC-239/249 o GB-255 having the error code relevant to ``Id_Transaction already present in B(VTRAPE.REQ)."

When a transaction is completed, the transaction end message has to be dispatched to the AMM and the relate row of the transaction must set free the buffer.

DateTimeRCV	DateTimeSent	Msg type	Msg Code	Msg Length	Id Trans	Step	Data

(for request)

Where:

SIZE	PARAMETER
(6 bytes)	**DateTimeRCV:** the date and time the transaction was received from the AMM.
(6 bytes)	**DateTimeSent:** the date and time the transaction was initiated with the CE
(1 byte)	**Message Type:** FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See Enel DH 971K/972K.
(1 byte)	**Message Code:** FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See Enel DH 971K/972K.
(2 bytes)	**Message Length:** FIELD Data Length of 2 bytes containing the Length in bytes of the whole data FIELD (from xx to yyy). See Enel DH 971K/972K.
(2 bytes)	**Id Trans**: Id of the transaction requested (single o multiple). This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.
(1 byte)	**Step**: this is the step in the transaction. If any step fails, the entire transaction is considered to have failed and the transaction number and the failed step are reported to the AMM. No attempt is made by the concentrator to back out previous steps; the concentrator just scans ahead in the buffer to the next transaction number and begins a new transaction.
(71bytes)	**Data:** Data necessary for the completion of the transaction (variable in functionof the transaction). This field has to be sized on the longest set of data necessary for a transaction (the "Data" field includes the following format

- 64 bytes for data
- 1 byte for AUTP (authentication / priority)

- 6 bytes for CEA or ICA (CE/IC address)

see Enel DH 971K/972K.

The C data structure for the transaction buffer has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the no-volatile memory of the concentrator. If the concentrator reboots after the execution of a certain number of transactions, it has to take a "snapshot" after every message and thus no IC messages are repeated.

9.1.1.4 Buffer of IC opened transaction W (WTRAPE.REQ)

In this case, it is used the buffer B(WTRAPE.REQ). It is identical to VTRAPE.REQ but due to a priority requirement, it is scheduled by IC-A procedure (high priority).

The default buffer receiving IC requests is VTRAPE.REQ. The “AUT_P” field defined in the DH 972K and used for GB_TRAPE_STATE message, will be in charge to distinguish and to load in the expected buffer the relate request taking into account the different priority. The difference is that VTRAPE.REQ is scheduled by IC-B procedure, WTRAPE.REQ is scheduled by IC-A procedure. The two procedures as already stated, have different priority. The responses of both procedures will be located in the same buffer VTRAPE.RESP.

Fixing that IC-A must have higher priority (small priority code) respect the IC-B, the buffer WTRAPE.REQ must be able to contain at least 256 transactions of IC type.

The C data structure for the transaction buffer has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the no-volatile memory of the concentrator. If the concentrator reboots after the execution of a certain number of transactions, it has to take a "snapshot" after every message and thus no IC messages are repeated.

9.1.1.5 Buffer of IC closed transaction (VTRAPE.RESP)

In this case it is used the buffer B(VTRAPE.RESP). The buffer must be able to contain at least 1280 records (IC responses and GB spontaneous from GESIC or IC procedures. Note that, all GB_21.xx events go into the VTRAPE.RESP while all GB_19.xx events continue to go into the BTRAPE.RESP).

The concentrator must collect data requested by open transactions and stores the results in B(VTRAPE.RESP) buffer, waiting then to respond to the AMM for the completion of transactions.

DateTimeRCV	DateTimeSent	Msg type	Msg Code	Msg Length	Id Trans	Step	Data

(for response)

When the response buffer fills up, all procedures will enter the "stopped" state. It is then up to the AMM to resume procedure processing via a "start procedures" request after retrieving the responses.

Where:

PARAMETER

DateTimeRCV: the date and time the response was received from the CE

SIZE

DateTimeSent: the date and time the transaction was initially attempted to be sent to the AMM. This time is stamped at the beginning of the first

(6 bytes)

Message Type: FIELD Message Type of 1 byte with the code (from 0 to 255) identifying the service typology. See Enel DH 971K/972K.

(6 bytes)

Message Code: FIELD Message Code of 1 byte containing the code (from 0 to 255) identifying the Message content semantics and coding and the exchange procedure where it is included. See Enel DH 971K/972K.

(1 byte)

Message Length: FIELD Data Length of 2 bytes containing the Length in bytes of the whole data FIELD (from xx to yyy). See Enel DH 971K/972K.

(1 byte)

Id Trans: Id of the transaction requested. This field has to be taken from the message received by the AMM and given back as a check at the end of the transaction.

(2 bytes)

Step: The step of the transaction that corresponds to the returned data.

(2 bytes)

Data: Data: Data requested in the transaction. This field has to be sized on the longest set of data necessary for a transaction. In case of transaction failure the DATA field should contain the related NACK error (the “Data” field includes the following format (see see Enel DH 971K/972K)

(1 byte)

(71bytes)

- 64 bytes for data
- 1 byte for AUTP (authentication / priority, it is not included as part of the response
- 6 bytes for CEA or ICA (CE/IC address)

The C data structure for the transaction response has to be done by manufactures in separate document: "Data structures of the concentrator messages".

Note: For a given message buffer, there can be at most one outstanding req/resp/ack type transaction (TB.042, IC.042, GB.100). So, for example, the VTRAPE.RESP could have one of either a IC.042 or a GB.100 outstanding, but not both.

However, there could simultaneously be a GB.100 outstanding for both VTRAPE.RESP and MESS_REC and a TB.042 for TRAPE.RESP, for example.

In general:

- TB 042 is used to handle the TRAPE.RESP
- IC 042 is used to handle the VTRAPE.RESP
- GB 100 has to be used to handle TRAPE.RESP and/or VTRAPE.RESP

The buffer has to be stored in the no-volatile memory of the concentrator. If the concentrator reboots after the execution of a certain number of transactions, it has to take a "snapshot" after every message and thus no IC messages are repeated (only to avoid the repetition of the message that we know to be already sent).

The contents of the VTRAPE.RESP are delivered prior to the contents of the TRAPE.RESP.

So, the actual ordering is as follows:

- VTRAPE.RESP events (021.xxx) in FIFO order
- VTRAPE.RESP IC-B responses in FIFO order
- TRAPE.RESP events (019.xxx) in FIFO order
- TRAPE.RESP FATT and BE messages, generic TB and ALCA responses in FIFO order

When reading a VTRAPE.RESP or TRAPE.RESP via GB (100), the order will be the same as above. That is, all events in the table are returned first in FIFO order followed by all non-events in the table in FIFO order.

9.1.2 Outbound (upstream) messages table

9.1.2.1 Buffer of the received messages (MESS_REC)

The structure has to be as follow:

Id_IC	Prot_ code	Prot_res	Req_time	mess_point	mess_point_r	Num_bytes	diagnostic	IC-SW

Where:

SIZE PARAMETER

(6 bytes) **Id_IC**: IC identifier of IC. It is the address of IC.

(1 byte) **Prot_code (Protocol code)**: It is a code used in order to identify the in home protocol.

Bit 0-3: protocol identifier: code 1 = xxx
code 2 = Konnex

Bit 4-7: reserved to the protocol used and defined in the specification of C part.

(3 bytes) **Prot_res (Protocol reserved)**: These byte are managed by the protocol (xxx,Konnex..). The management must be established in C part of the specification related to the specific protocol.
e.g. used for the in home device address and service.

(6 bytes) **Req_time (time of the request)**: Interval of time in which the demand happens occurs. Req_time is the time at which GESIC_B begins reading the message from the IC.

(1 bytes) **Mess_point (pointer to the message)**: message pointer, points to the table MES_BUF.

(2 bytes) **Mess_point_r (pointer to the message)**: message pointer, points to the first row of the message table MES_BUF.

(2 byte) **Num_byte (number bytes)**: It is the byte number of the message inserted in the MES_BUF.

(1 byte) **Diagnostic (diagnostic code of the A band reading operation)**: If 0x00, reading operation succeeded.
Error code of ACK 251 will be used.

(2 byte) **IC-SW (Status Word of IC)**: It is the IC's status word (see Enel DH 920K).

The MESS_REC has to be able to contain almost 1024 requests. Furthermore in this structure have to be inserted the short messages, too.

For reading this structure, it is necessary to use the GB_READNER.REQ (100/101), with the exchanges described in the Enel DH 971K 1st part at chapter 6.

Note: For a given message buffer, there can be at most one outstanding req/resp/ack type transaction (TB.042, IC.042, GB.100). So, for example, the VTRAPE.RESP could have one of either a IC.042 or a GB.100 outstanding, but not both.

However, there could simultaneously be a GB.100 outstanding for both VTRAPE.RESP and MESS_REC and a TB.042 for TRAPE.RESP, for example.

In general:

- TB 042 is used to handle the TRAPE.RESP

- IC 042 is used to handle the VTRAPE.RESP
- GB 100 has to be used to handle TRAPE.RESP, VTRAPE.RESP and MESS_REC

The C data structure for the buffer of the received messages has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the no-volatile memory of the concentrator.

9.1.2.2 MESS_BUF Buffer

This buffer has to be used both in case the message size is greater than 64 bytes, both in case is less than that size. Since in the first case the message has to be split in defined part, in order to identify the relate part, it has to be used the pointer defined in the MESS_REC structure.

The structure of this buffer has to be as follow:

Data
Data
…
Data

Data : 256 bytes data streams.

The MESS_BUF structure must contain 200 Kbytes. Concentrator keeps a flag byte with each row indicating that this row is free. Flag is cleared when AMM reads the row. The flags for the data rows are all set when fills all of the rows for a particular message. This flag resides in an internal parallel structure and is not readable. The concentrator has to manage the rows of the buffer in the way to set free each row, as it is read.

The row number indicates the row number of the corresponding control entry in the LMESS_REC or MESS_REC (this scheme eliminates for the concentrator to have “hidden” flags to indicate empty for non-empty rows).

The conditions for stopping procedures due to MESS_BUF occur when any message cannot fit into the MESS_BUF. For example, if there are 5 rows left but a message requires 6 rows, then procedures have to be stopped. This means other messages that require 5 or less rows will have to wait even though there is room for them.

For reading this structure, it is necessary to use the GB_READTAB.REQ/RESP (006/007), with the exchanges described in the Enel DH 971K 1st part at chapter 6.

The C data structure for the message buffer has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the no-volatile memory of the concentrator.

9.1.2.3 LVC_ICCommStats

The IC buffer has associated a structure containing statistic indicators relative to messages that concentrator sends towards IC. In this structure the values relative to two following observation periods have to be kept separate, in particular they are indicated with the “t” extension the current meters and with “gp” referred to the previous day; at midnight the current value overwrites the data of the previous day and the current one is reset.

Iden-IC(t)	Direct(t)	Rip(t)	Csez(t)	Num(t)

Iden-IC(gp)	Direct(gp)	Rip(gp)	Csez(gp)	Num(gp)

Where:

SIZE PARAMETER

(6 byte) **Iden-IC** : IC identification.

(1 byte) **Direct**: OK messages in direct way (same path of associated CE).

(1 byte) **Rip**: OK messages through repetition. Rip field only counts when retries were required and the transaction succeeded. Number of times the transaction succeeded by using a non-zero number of LV retries.

(1 byte) **Csez:** OK messages when last repeater is section-line of communication master or vice-master in the same section-line of communication of the target. Number of times the transaction succeeded by using a repeater. Repeater is either the section master/vice-master of a CE (known topology only) or an IC's CE (either known or unknown topology) -tbd.

(1 byte) **Num**: total number of messages (number of transaction attempted). The maximum size of this field has to be 255. When this field reaches 255, it stops incrementing and all other counters or that CE also stop incrementing.

Note: Rip is incremented independent of whether is used an "associated CE as repeater". Note that the concentrator may conduct as many as four transactions when attempting to reach a device. For example, the 4 transactions would be:

a. Use primary path directly.
b. Use primary path with repeater.
c. Use alternate path directly.

d. Use alternate path with repeater.

So, this is valid for "LVCICCommStat" either on known or unknown topology (and for "LVCCECommStat" in case of known topology). For "LVCCECommStat" in case of unknown topology will be valid (a) and (c).

Thus, if all four of these failed, Num would be incremented by 4 and the others would remain unchanged.

The C data structure for these communication statistics has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the volatile memory of the concentrator.

9.1.2.4 BUFFER_IC

In order to identify some features relative to the communication ICs (as per the CE) the following structure has to be used:

Id_IC	F(RAG)	IRAG_D	IRAG_I

Where:

SIZE PARAMETER

(6 bytes) **Id_IC**: IC identifier

(1 byte) **F(RAG)**: If 1 IC not reachable.

(1 byte) **IRAG_D**: Reachability index in % statistical data. Percentage of reading in direct mode (with the same path of CE). Updated every communication with IC.
IRAG_D(i) = (IRAG_D(i-1)*99+ measurement)/100.

(1 byte) **IRAG_I:** Reachability index in % statistical data. Percentage of reading in indirect mode (with the CE as repeater). Updated every communication with IC.
IRAG_I(i) = (IRAG_I(i-1)*99+ measurement)/100.

Note: for both reachability indexes, the concentrator has to use floating point math and store a float result and round up/down internally and produce an integer result externally. In this case, then the percentage will move down much faster than it moves up.

Also, each reachability index is initialized to 100 on power up and after commissioning.

If CE does not has IC, the row is empty. The structure of the buffer has to match the T_CE structure.

The C data structure for the IC buffer has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The buffer has to be stored in the volatile memory of the concentrator.

9.1.3 Service tables

9.1.3.1 IC Configuration Table (IC_CONF)

The following table has to be used:

Id_IC	IC_ES	F(Indirect)	IC_F(INTR)	IC_lineof communication	typeId

Where:

SIZE PARAMETER

(6 bytes) **Id_IC:** IC identifier.

(4 bytes) **IC_ES:** IC enabled services (at the moment this field is managed only by AMM, not used by the concentrator).

(1 byte) **F(Indirect):** If 0 (default value), reachable with the same path of the CE; if 1 it has to be used the CE as repeater. When the F(INDIRECT) field is set in the IC_CONF table, the rules in known topology are:
The section master is used as a repeater.
If the IC CONF table has F(INDIRECT) set, then the IC will use the CE as a repeater using the same path that is currently indicated for the CE. If the communication reaches the CE but fails to reach the IC, then the alternate path is the same as the primary path. No memory of this switch occurs.

(1 byte) **IC_F(INTR):** DLC disabled (0=IC DLC disabled).

(1 byte) **IC_Line:** the detected Line for IC communication. The following rules are applied:

Bit 7 = 0 line OK
Bit 7 = 1 line OK
Bit 6, 5, 4 = MBZ
While for the Bit 3, 2, 1, 0:

Bit3	Bit2	Bit1	Bit0	
0	0	1	1	Mark line 3
0	1	1	1	Mark line 7
1	0	1	1	Mark line 11

(1 byte) **typeId:** It defines the IC type (it is transparent to the concentrator it has to match with the typeId in the IC_DWL).

Note: It is possible to have this condition:

- T_CE.identIc is non-zero
- T_IC_CONF.identIc is zero
- T_IC_CONF.fintr is one

In this case, the CE table indicates an IC and the IC Config table indicates the IC is enabled but the key is zero. This condition has to be handled as if the IC is disabled because the IC Config is "empty".

Similarly, if the T_IC_CONF has a key value of zero and an fintr value of zero. In other words, because the IC Config table key is "empty", this basically deletes the IC and its presence in the CE table is ignored.

If the IC_CONF table has an enabled IC but the corresponding CE table entry has a zero ID for the CE (i.e., is empty), then the IC_CONF table data will be ignored (as opposed to being treated as a "start" error).

The structure of the table has to match that defined for T_CE.

The C data structure for the IC configuration table has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The table has to be stored in the no-volatile memory of concentrator.

9.1.3.2 IC Download Table (IC_DWL)

This table and the relate structure are similar to those used for CE_DWLD.

The structure has to be as follow:

ImageId	typeId	Activate Dt	Do All	Loop limit	DT-DIGEST

Where:

SIZE PARAMETER

(8 bytes) **ImageId**: see CE_DWLD parameter at 4.3.7.

(1 byte) **typeId**: It defines the IC type (it is transparent to the concentrator and must only match the type ID field in the IC_CONF table).

(6 bytes) **Activate Dt**: see CE_DWLD parameter at 4.3.7.

(boolean) **Do All**: see CE_DWLD parameter at 4.3.7.

(1 byte) **Loop limit**: see CE_DWLD parameter at 4.3.7. The "loop limit" for the CE download procedure determines the number of times the download procedure will attempt to retry a non-progressing or failed load. For the IC, the loop limit will have the same meaning. The loop limit will determine the number of times a non-progressing load process is attempted, regardless of the number of packets that are sent. The manner in which the device groups the data it receives is not important to the concentrator. This means that the device will initially be sent all the packets and must record "missed" packet bits for every missed packet even though it can only report them in groups of 1024.

(16 bytes) **DT-DIGEST**: see CE_DWLD

Note: the DWLD procedure has to be performed in the way above described. The number of rows for this structure has to be defined as 4.

The C data structure for the IC DWLD Table has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The table has to be stored in the no-volatile memory of the concentrator.

9.1.3.3 AG_IC/24 Scheduling Table (AGST)

The structure of the AG_IC and AG_24 scheduling table has to be defined as follow:

Iden_CE	Def_Table	Sec_Table	ST_sched_Time	Def24_Table	S24_ Table	S24_sched_Time

Where:

SIZE PARAMETER

(6 byte) **Iden_CE** CE identification

(1 byte) **Def_Table** (Default table): It is a numeric code used in order to identify the table that concentrator commands CE to send to the IC in AG_IC procedure.

(1 byte) **Sec**_Table (Secondary table): It is the code of a secondary table in AG_IC. The concentrator commands CE to send to the IC that table, only in some circumstances regulated by the ST_sched_Time code. If 0, no secondary table does exist, ST_sched_time is not influent.

(1 byte) **ST_sched_time** (Secondary table scheduling time or condition in AG_IC): It is the code regulating the transmission of the Secondary Table instead of Default one in AG_IC procedure.
Code 1XX: every XX transmissions of Default table.
Secondary table will be transmitted as first one, instead Default_Table, at every restart of concentrator, or rescheduling of concentrator activities (e.g. Stop-start procedure sequence)

(1 byte) **Def 24_Table** (Default table in AG_24): It is a numeric code used in order to identify the table that concentrator commands CE to send to the IC in AG_24 procedure.

(1 byte) **S24_Table** (Secondary table in AG_24): It is the code of a secondary table in AG_24. concentrator commands CE to send to the IC that table only in some circumstances regulated by the S24_sched_Time code.
If 0, no secondary table does exist, S24_sched_time is not influent.

(1 byte) **S24_sched_time** (Secondary table scheduling time or condition in AG_24): It is the code regulating the transmission of the Secondary Table instead of Default one in AG_24 procedure.
Code XX (XX 1-99) : not used.
Code 1XX: every XX transmissions of Default table. If 100 secondary table will be transmitted every time it is transmitted the primary one. Two AG_24 will be done for that IC.
Code 200. At expiration of the billing period.

AGST must contain 2048 rows.

The table structures involved in the above described feature (S24_sched_time), are described in the Annex A.

NOTE:

The concentrator, executing AG_IC or AG_24 procedure, reads the AGST table and detects which CE's table must send to IC. The table must contain 2048 rows. The structure of the table has to match the T_CE. The concentrator will use the secondary table on the first invocation of an AG procedure after procedures start. So, not only after a reset but also after doing a stop/start procedures pair (this is valid for AG_IC procedure).

If the AGST row has an all zeroes CE ident, the concentrator will use the default values listed below:

Def_Table = 63

Sec_Table = 62

ST_Sched_table = 110

Def_24_Table = 58

S24_table = 61

S24_Sched_time = 200

If there is no priority table, then the concentrator creates a default table. This is straightforward because the table then can remain constant. However, the AGST table contains context dependent information. Specifically, it is dependent on the CE table. Therefore, it is not possible to populate at start up a "default" AGST table because there is not any CE identifiers. If the corresponding AGST row is empty, it is necessary use the value stated above. The table itself will not be modified.

The C data structure for the AG_IC/24 scheduling table has to be done by manufactures in separate document: "Data structures of the concentrator messages".

The table has to be stored in the no-volatile memory of the concentrator.

9.2 PROCEDURES FOR VAS

9.2.1 GESIC_A procedure

The concentrator with GESIC_A procedure sends long messages to ICs in unicast mode, multicast or broadcast.

Vas Server (through AMM) sends to the concentrator the message compiling the table LMESS_TAB using a set of GB_WRITETAB.REQ commands.

Vas Server (through AMM) fills the IC destination buffer LMESS_REQ using the foreseen IC command (IC_WRILMESS.REQ).

It sets Id_IC, SEP, Prot_code, Prot_res, Req_time, Exp_time ("exp_time" in LMESS_REQ is when if the current time exceeds "exp_time", then it has not to be delivered the message and will be generated a 251 ACK with a code indicating "message expired").

> Note: Since there is a relation between the “exp_time” and the “looplimit” field, a value of 0 will mean: no limit (it keeps to retrying forever) for IC DWLD and “never ending” for GESIC_A procedure.

Then the position of the data, Mess_point points for default to the LMESS_TAB, Mess_point_r point to the row (256 bytes rows) starting the message, Num_dest value is 1 for unicast transmission, a sequential (2-255) number setting the “receivers group” for the multicast messages, Num_bytes defines the size of the message.

LMESS_REQ entries in the same "group" are associated only by the num_dest field and not by transaction. In other words, LMESS_REQ entries can have the same num_dest field but different transaction IDs.

Two entries with the same "num_dest" field but different "id trans" fields will be considered to be in the same "group" as long as they are delivered consecutively and no entries delivered in the same second have intervening transaction IDs.

The concentrator has to require that all LMESS_REQ requests in the same group are submitted consecutively. In other words, if it is submitted a request for num_dest 2, then num_dest 3, then num_dest 2 again, the two entries that both have num_dest 2 would not be considered to be in a group together and thus would be sent the message in separate passes (In order for the example entries to be considered to be a group, they would need to be submitted num_dest 2, num_dest 2, and then num_dest 3).

AMM enables bit and priority code (normally 4) of GESIC_A in priority table (T_PRI), with the proper GB message to make the GESIC_A procedure run.
The concentrator reads in LMESS_REQ structure the number of ICs destinations and reads all the ICs to be reached.
Concentrator prepares for every IC the long message description (description of a file).
It sets the field SEP, Prot_code, Prot_res, Num_bytes read from the received request
It calculates the code “Session_ID” as a progressive number (0-127) incremented every message. It manage in the right mode authentication.

The concentrator sends to every destination IC, in unicast point to point mode, the description of the file to be received, compiling the right table inside IC.

Concentrator calculates the packets number, every packet structured as:

Code (101), Session_ID (1 byte), Packet counter (1 byte), data of the packet (54 bytes).

The concentrator has to find the best path and then begins to deliver message, only to the involved IC by using the transmission modality "like download" that uses the ENEL DH 960K without response message. If the requested transmission is a unicast one, the packets will be sent only to the involved IC. If the requested transmission is in multicast mode, the concentrator finds the best paths and delivers the message only to the involved sections.

After sent all the packets the concentrator asks to the destination ICs the status. If status is not RECEIVED ALL, it asks the list of the correctly received packets (Receive Mask). It repeats the operation for all IC. It repeats the transmission of non-received packets.

When all ICs have been reached, the concentrator is ready to transmit to AMM as many rows of VTRAPE.RESP for how many the involved ICs were and it has to send the relate set of IC_ACK for all the involved IC.

Every row filled in VTRAPE.RESP frees and clear a row in the requests table LMESS_REQ.

If GESIC_A in T_TLC "SPONT" is enabled, the concentrator has to send the GB_SPONT_PROC_END (021.007) .

GB_SPONT_BUFFER_FULL (021.006) in the case the buffer has already reached the “full” condition.

> Note: When the CE download procedure broadcasts, it sends messages out to every repeater in order to ensure every CE is reached. However, the repeater set includes only those repeaters in the repeat table.

Given that GESIC-A must do broadcasts (much more often than DWLD) and given that ICs can have repeaters in both known and unknown topology, GESIC-A will broadcast using repeaters.

The broadcast paths are chosen to cover all CEs. As stated in this chapter, the GESIC-A broadcasts is only sent to a subset of repeaters necessary to cover the devices receiving the specified message. As part of the performance enhancements for DWLD, the same rule will be applied to DWLD. Therefore, the DWLD and GESIC-A procedures will share the broadcast logic.

Note: If concentrator tries to send in unicast mode the message description, and the IC is busy, because it is sending a long message to an indoor device, message just arrived in the same buffer, IC responds to concentrator with a NACK BP (see DH 920K p 8.2.10).

The concentrator must wait 5 seconds before to retry the same request to the same IC.

If the IC responds again NACK BP, concentrator will retry again, waiting 5 seconds every time.

No action must concentrator do to AMM after the NACK BP (no any GB_SPONT_IC_NACK will be generate).

If, after 72 retries (360 seconds) The IC still responds NACK BP, then concentrator generates a IC.251.04 to AMM.

(If concentrator tries to write TABIBM and it receives a NACK-BP (buffer full): concentrator will try to write TABIBM of that FEI every 5 seconds for max 360 seconds. If after all the retries FEI responses NACK, the concentrator will insert in VTRAPE.RESP the response NACK, and will consider that FEI not able to receive that message).

9.2.2 GESIC_B procedure

The concentrator downloads with GESIC_B procedure all the data that ICs have to dispatch to AMM.

During AG_IC (and AG_24) procedure the concentrator reads status word of IC, detecting if IC has to dispatch data to AMM and which kind of data IC must deliver (how many bytes, the message code, and so on) (the concentrator runs GESIC_B at the end of AGIC or AG24 if the procedure saw an IC status word indicating an outbound message).

AG_IC (/24) stores the read Status Word in the BUFCE structure. The concentrator must then manages the higher priority requests before the less ones.

The concentrator sends to AMM, if GB spontaneous are enabled, a GB_SPONT_IC.RESP (021.022) stored in the VTRAPE.RESP buffer, for every node in a way to only generate the event when the IC SW changes from “no message” to “message ready”.

Two cases have to be distinguished:

a) GESIC_B not enabled
   The concentrator will log the event under the following conditions:
   1. Message ready condition changes to "message available" (MsgReady field of SW);
   2. the diagnostic bit changes to 1

It does not matter whether the status word change is detected by the AG-IC, AG-24 or some other procedure (such as IC-B).

b) GESIC_B enabled
   The concentrator will log the event under the following condition:
   1. the diagnostic bit changes to 1

Note that: procedure enabled = T_PRI bit Enable set for GESIC_B; GESIC_B procedure flag set in corresponding CE table entry = bit F(GESIC_B) in IC-F(PROC) in CE table set .

If GESICB is enabled, the concentrator executes requests of ICs.

GESIC_B:
Repeats for all IC requests starting from at higher priority ones (the IC status word priority field only indicates the order in which GESIC_B is to read messages and has no bearing on the GESIC_B procedure priority).
It has to evolve as follow:
If the message is a short one, the concentrator reads the number of attending bytes and sends a band A short message read request as defined in the Enel DH 960K spec.
It locates in MESS_REC table Id_IC, Prot_code and Prot_res, detected from the received message, and completes the row of the table (num bytes of the message, set diagnostic and mess_point as the pointer to the row in MES_BUF containing data). The concentrator locates the field "data" without the reported fields in the table MES_BUF.
If the message is a long message (more than 1 packet), the concentrator reads the message description in IC table TABOBM (Read request as defined in the DH 960K spec.)
The concentrator locates in the MESS_REC buffer Id_IC, Prot_code and Prot_res, and locates the field "data" without the reported fields in the MES_BUF. At the reception of all the packets, it completes the row of the table (num bytes, set diagnostic and mess_point as the pointer to the first row in MES_BUF containing data). If time out occurs and not all the packets have been received, it sets diagnostic error.
Concentrator, after read a message of a IC, sends to that IC a STATUSUPD.REQ command. This command renews and, if a new message is ready to start in the IC, locks IC Status Word.
If SW signals the presence of a new message concentrator reads the new message. If the concentrator fails to get a response to STATUSUPD.REQ, then it will record the message with a diagnostic code that indicates this (Code 14: “transaction incomplete”).
If the next message that is read is read without error, it will be recorded with a diagnostic code of 0, whether it is a duplicate or not (the concentrator can’t know for sure whether it is a duplicate or not). concentrator sends a new STATUSUPD.REQ command. It does not read the eventually signalled message this time.
That is: if a device has 3 messages pending, the next invocation of the GESIC_B procedure will read 2 of the messages and the remainder will be read on the subsequent invocation.

When all messages of all ICs have been read:
If an high priority message (telemetering equivalent priority code <3 - the IC status word has 4 priority values (0..3) but values 0..2 are all treated the same by the concentrator) has been received, the concentrator has to deliver a GB_SPONT_PRIOR(021.021) to AMM.
AMM then has to read the MESS_REC and MES_BUF by mean the foreseen GB commands. If necessary, it will send a GB_SPONT_BUFFER_FULL (021.006).

END

Errors are handled by GESIC_B. The following could be a possible scenario:

a. GESIC_B fails to read the complete message because the node is not reachable.
b. GESIC_B places an entry in MESS_REC for the target with a diagnostic code of "NODE NOT REACHABLE" with no data.
c. AG_IC runs again and sees the message indication in the SW again and GESIC_B is scheduled again.
d. GESIC_B runs again and fails to read the message again. The existing entry in MESS_REC from step (b) is updated with the current error value.
e. AG_IC runs again and sees the message indication in the SW again and GESIC_B is scheduled again.
f. GESIC_B runs again and successfully reads the message. The existing entry in MESS_REC is updated the proper message pointers and with a diagnostic code of 0.

This scenario assumes two rules as follows:

I. At most one entry is placed in MESS_REC for a given message and that entry is always for the most recent attempt.
II. When a partial read occurs, the partial data is not written to the MESS_BUF; only the diagnostic code is written to the MESS_REC.

Note: Each message read by GESIC-B needs to be done as an atomic operation (not interrupted by other procedures). Otherwise, there is the risk that another procedure, such as AG-IC could generate a message that changes the SW in the middle of the read operation.

9.2.3 IC_B procedure

The concentrator with IC procedures enabled executes AMM requests that involve directly IC.

AMM sends IC messages. The concentrator receives them, responds with an ACK and will fill the WTRAPE.REQ buffer.

- If procedure is enabled:
  - The concentrator reads the message “as is”, the DH 960K message is enveloped in the DH 972K format, executes the request and locates results in VTRAPE.RESP. It provides to authentication if requested. For multistep transaction (multipackets message) only one response will be sent to AMM (VAS server), targeted with the last step of the transaction.
  - The concentrator sends to AMM an IC_XXX.RESP (XXX corresponding with the request transaction) for every row of the table VTRAPE.RESP.
  - AMM WILL then respond with an ACK.
  - If IC spontaneous (in T_TLC) is enabled, at the end of procedure the GB_SPONT_PROC_END (021.007), will be delivered.
  - In necessary, the concentrator will send a GB_SPONT_BUFFER_FULL (021.006).
  - AMM reads VTRAPE.RESP.

This procedure is used to send short messages to IC, and middle size unicast messages (like SMS).

9.2.4 TIMETO procedure

TIMETO is an internal concentrator procedure.

If enabled and activated every "Maximum activation interval", it schedules the buffers:

VTRAPE.RESP, MESS_REC

If the buffers are not empty, it sends to AMM one (or more) GB_SPONT_TIME (021.020) with the code of the buffer as “not empty”.

TIMETO generates a GB 021.020 if there is any non-event entry in VTRAPE.RESP.

Given that: an event entry is sent as GB-021.xxx, a non-event entry is a response sent as IC-xxx. So, rule referred to a non-event entry, says that TIMETO would only signal the presence of responses in VTRAPE.RESP, not the presence of events. AMM will then reply with an ACK and will enable spont for the procedure managing the buffers or read them.

For some particular condition, the timer of the TIMETO has to restart after the end of a call by mean AMM.

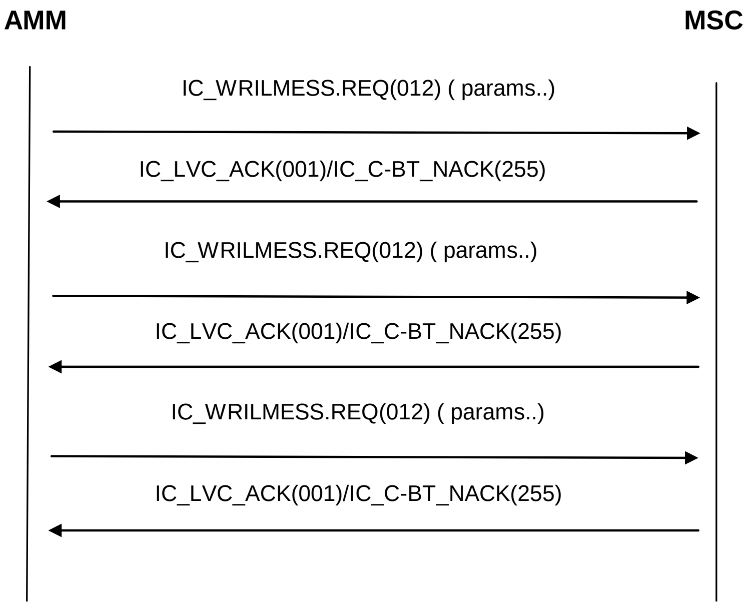
9.3 MESSAGES AMM → LVC → IC

9.3.1 Long messages transmission

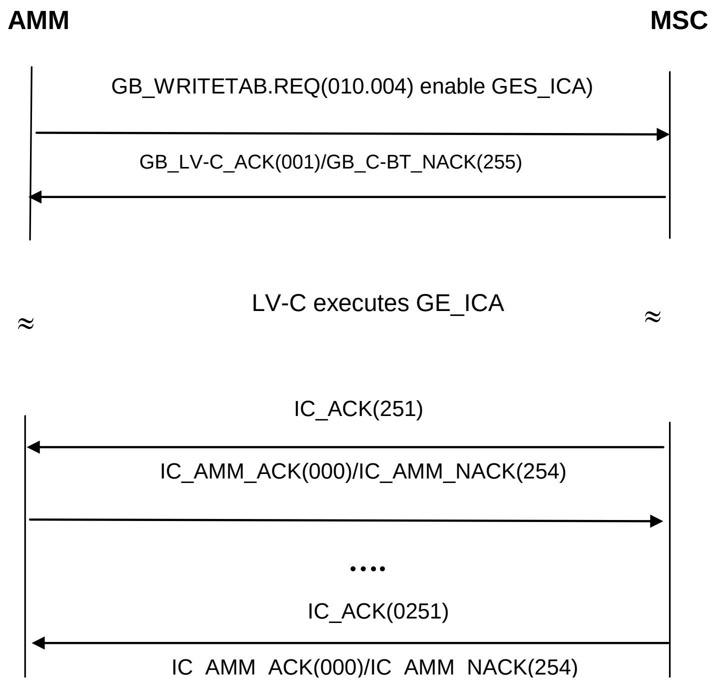
Since AMM can send a long message to a defined IC or a group of ICs, it is possible to distinguish the following steps:

Step 1: AMM sends to concentrator via a GB message a long message.

Step 2: AMM sets with an IC message (IC_WRILMESS.REQ 012), the rows of LMESS_REQ, after sending the foreseen “STOP” Activity command of the concentrator. It sets a row for every IC that has to receive the message (unicast, multicast, broadcast possibility) and consequently has to dispatch the “START” Activity command.


AMM
MSC
IC_WRILMESS.REQ(012) (params..)
IC_LVC_ACK(001)/IC_C-BT_NACK(255)
IC_WRILMESS.REQ(012) (params..)
IC_LVC_ACK(001)/IC_C-BT_NACK(255)
IC_WRILMESS.REQ(012) (params..)
IC_LVC_ACK(001)/IC_C-BT_NACK(255)

Step 3: AMM sets with the proper GB message the “enable” field of GESIC_A in T_PRI.



At the end of GESIC_A, the concentrator sends many IC_ACK(251) messages for how many IC were involved in step 2 from the special messages, with the same transaction number.

9.3.2 Middle size messages transmission

The typical max length of this kind of messages is about 200 bytes. It is sent to the concentrator a row of IC messages completing the messages which concentrator must send in LV net.

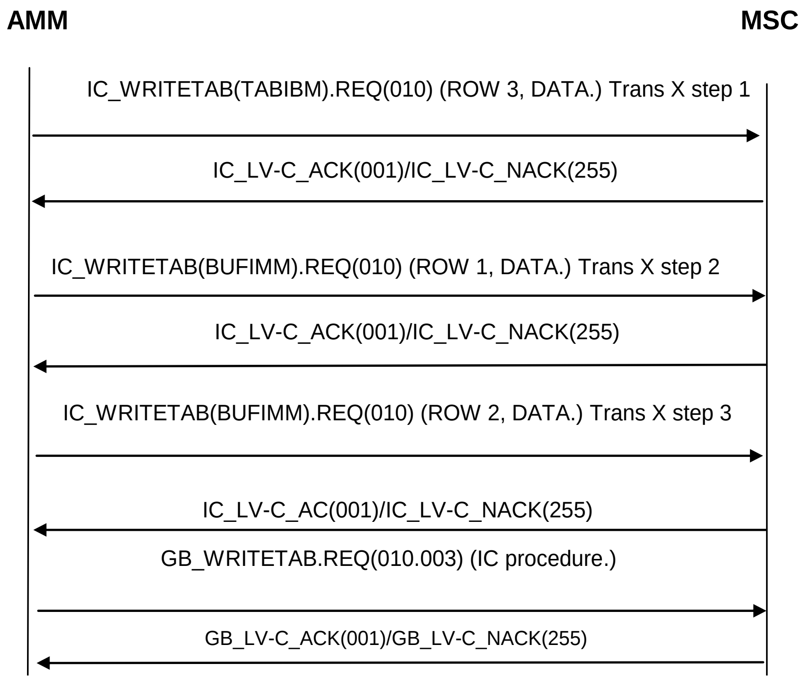
The operation is a single transaction with many steps.

9.3.2.1 Steps 1, 2, 3..

AMM sends to the concentrator an IC message [WRITETAB(TABIBM).REQ(010)] writing the IC TABIBM (inbound big message table) row 3.

AMM sends to the concentrator an IC message [IC_WRITETAB(BUFIMM).REQ(010)] for every row of data to locate in BUFIMM (inbound medium message buffer) IC table.

If the IC_B procedure is not enabled, AMM enables it by setting the bit in the concentrator priority table.



The activation of the IC procedure by mean the GB command must to be done only if the procedure is not still enabled.

At the end of the IC procedure, if the relate GB_SPONT_PROC_END (021.007) is enabled, the concentrator will deliver it to AMM. In normal operative condition, the concentrator has to dispatch an IC_ACK (251), corresponding to the enabled transaction.

9.3.3 Short message transmission

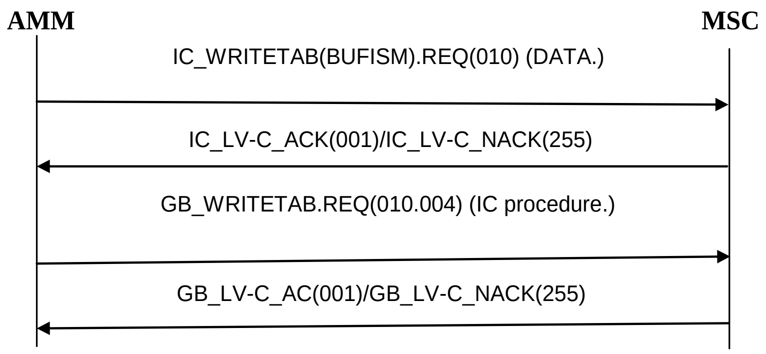
The typical max length of this kind of messages is 64 bytes. AMM sends to the concentrator an IC message completing the message which concentrator must send to IC in LV net.

The operation is a single transaction with only one step that consists in:

Taking into account the rules concerning the “STOP” and “START” activity command, for writing tables, AMM sends to the concentrator a WRITETAB(BUFISM).REQ(010) message writing the IC BUFISM (inbound small message buffer) .

If the IC procedure is not enabled AMM enables it by setting the bit in the concentrator T_PRI.

The activation of the IC procedure by mean the GB command must to be done only if the procedure is not still enabled.



At the end of the IC procedure, if the relate GB_SPONT_PROC_END (021.007) is enabled, the concentrator will deliver it to AMM. In normal operative condition, the concentrator has to dispatch an IC_ACK (251), corresponding to the enabled transaction.

9.3.4 IC table managing

Every IC table can be read or written by mean an IC_REATTAB.REQ, IC_READ.REQ, IC_WRITE.REQ messages and so on.

9.4 MESSAGES LVC → AMM

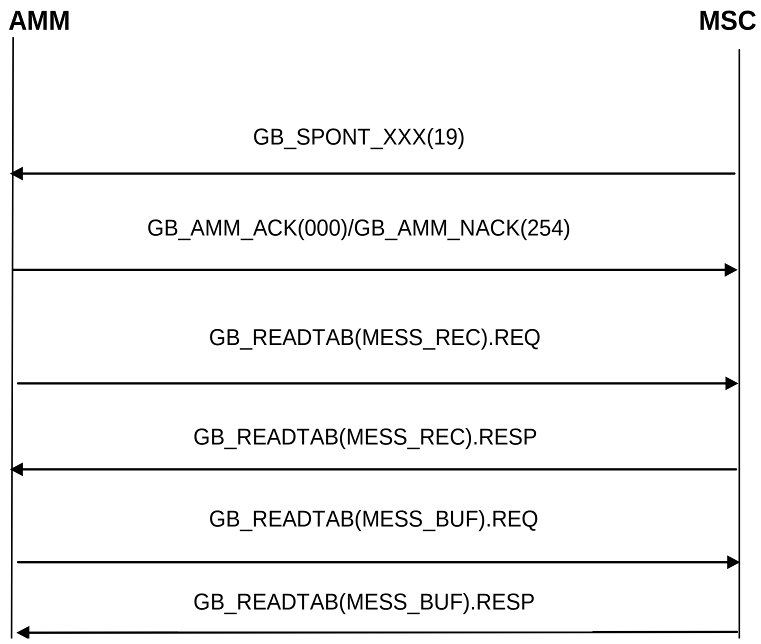
The concentrator executes AG_IC or AG_24. It sends then a GB_SPONT_IC.RESP (021.022) for every IC request.

Here below are shown two cases.

9.4.1 GESIC_B enabled

The concentrator schedules the SW readings starting from that with higher priority and executes the requests in GESIC_B procedure in priority order.

At the end of the procedure, if the is enabled, the and if an high priority message has been found the concentrator sends a GB_SPONT_PRIOR (021.021), else, at the right time a GB_SPONT_TIME (021.020).

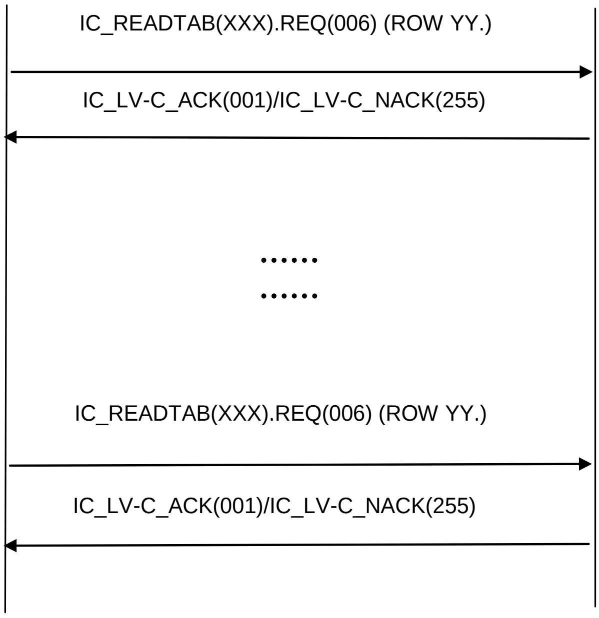


9.4.2 GESIC_B disabled

AMM receives the GB_SPONT_IC.RESP messages. AMM builds the path of IC messages solving the reading requests of ICs by mean the IC_READTAB(XXX).REQ(006) (ROW YY) messages.

It sends messages to the concentrator by enabling IC procedures.

The priority of the messages decides the priority to assign to the IC procedure, eventually both activated with different priority.



If the message is a short one the READTAB is a transaction with a single step:

READTAB.BUFOSM (outbound small message buffer).

If the message is a long one the READTAB is a transaction with a many steps:

READTAB.TABOBM (outbound big message table), READTAB.BUFOBM (outbound big message buffer), row 1,..n; the number of the row to read is shown in the status word.

The concentrator executes ICs procedures and sends READTAB.RESP with the same transaction number of the requests.

10 CALENDAR/CLOCK MANAGEMENT

Concentrator must manage clock function to compute the following temporal data: seconds, minutes, hours, day, week, month, year with daylight saving time and a four-year leap cycle.

In order to guarantee the functioning of this activity in case of primary power out, concentrator must be provided with a back-up device (e.g. super capacitor), capable to support time keeping with an autonomy over 72 consecutive hours and restore its capacity to give the same autonomy within 10 seconds at power restart.

Concentrator time keeping accuracy has to be such that a mistake in a month is less than 30 seconds.

Either during the installation phase, then after each lack of primary supply, apposite messages coming from the Centre and containing the information about year, month, day, minutes and seconds will provide to initialise or re-initialise of concentrator time keeping.

The AMM should perform, a regular synchronisation cycle (on a daily basis) of concentrator watches, based on transmission of a message containing temporal references.

When the clock is not initialised, the calendar has to be managed in a reduced way with time calculation starting from a moment of null reference, obtaining information on the time elapsed from the restart of activity (time counting function).

The calendar/clock functionality must send apposite indications (time based interrupts) that generate specific information processing activities by concentrator.

This chapter describes the two main aspects tied to concentrator clock management:

- Concentrator synchronisation
- Daylight saving time management

The “concentrator synchronisation” and “daylight saving time period programming” must be separately activated, but both of them have to satisfy the two requirements:

- End Date (DF) > Start Date (DI) > current time
- Solar hour > DF > DI
- DI < Daylight saving time < DF

The DI and DF programming has to be accepted if it satisfies the above said requirements, or if the concentrator is not synchronised; otherwise it has to be refused with the message GB…(255) with “DI/DF incongruent with concentrator hour” code.

10.1 CONCENTRATOR SYNCHRONISATION

The concentrator’s clock synchronisation is managed by the AMM by the following steps:

- The AMM, with a daily periodicity, asks concentrator its temporal reference GB SET.REQ (012). The message contains also the AMM' s temporal reference.
- Concentrator must answer with the message GB…(251)/GB…(255)
- In case there is a deviation beyond 1 minute or the concentrator is without temporal reference, the AMM dispatches to the device the message GB… GB_WRITESINC.REQ (004) for clock synchronisation.
- Concentrator must compare such messages with the GB…(251)/(255) and updates its own temporal reference and book SINC activity for all the subtended CE.

(The messages are transmitted with high priority).

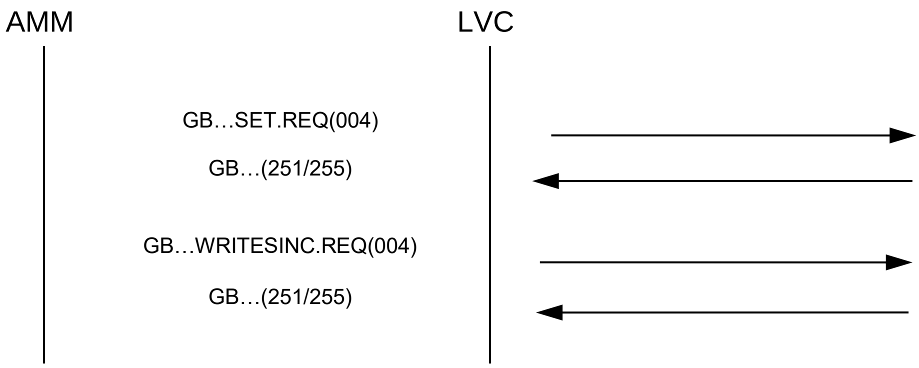
The AMM is provided with an official temporal reference (e.g. Institute G. Ferraris - Turin) that cannot be managed by the operator.

With this preamble, the only anomalous situation that has to be managed is that one regarding a concentrator with an incorrect temporal references for malfunction or violation.

This concentrator causes “ORD” alarm in all the subtended CEs, but does not modify the temporal references.

The AMM, by synchronising this concentrator, obtains indirectly the return of CE alarm conditions.

The anomaly detected for concentrator has to be notified to the AMM.



10.2 DAYLIGHT SAVING TIME MANAGEMENT

The data structure is contained in the tab T_ATT, the parameters illustrated characterise the start and end date for daylight-saving time, the start time of entering summer time (default 2:00) the end time of living summer time (default 3:00) and the amount of correction (default 60 minutes). If the parameters for daylight-saving time are not programmed, the concentrator must manage the daylight-saving time according to current European laws (start date = March last Sunday; end date = October last Sunday).

The day and the month of the start of the daylight-saving time (GI/MI) and the day and the month of the end of the daylight-saving time (GF/MF) fields, have to be codified in accordance with the following table, to allow its management on the basis of the EEC laws in force and to allow the calculation deactivate of the daylight-saving time, too, in the case on which it takes place definitively of the Greenwich mean time.

GI	GF	MI	MF	It uses not EEC programming dates (*)
0	0	MI	MF	GI and GF = last Sunday of the MI/MF months (*)
GI	GF	0	0	Daylight-saving time start month = March Daylight-saving time end month = October
0	0	0	0	March, last Sunday and October, last Sunday
31	31	0	13	31/0 and 31/13: it doesn’t execute daylight-saving time
GI	GF	0	13	GI/0 and GF/13: it doesn’t execute to return to solar time
GI	0	MI	13	It executes the daylight-saving time at GI/MI start; it’ll be MI=0 after its taking place

Where :

(*) $1 \leq MI \leq 12$

$1 \leq MF \leq 12$

The GI/MI and 0/13 codifies, respectively for the daylight-saving time start and end, show the daylight-saving time activation only one time at the beginning to the relative date of the year on which the programming is execute, or to the following if the programmed date is antecedent to that in course.

As the commutation to daylight-saving time has happened, GI/MI date has to be reset at GI/0 value, permitting that daylight-saving time will has long-lived effect.

The AMM programs the new daylight saving time regimen to concentrator with the message GB_WRITEDS.REQ (004) that recalls the start date/time (MM:gg:hh:mm) or (MM: day type) and daylight saving time end date/time. Concentrator must compare the message with GB…(255).

When the concentrator clock reaches one of the dates, at the expected time for the change, it must modify the internal clock, so that at the next CE synchronisation, its clock results aligned.

The AMM can read this programming through the message GB_READ.REQ (XXX) with answer GB_READ.RESP (XXX)

Concentrator must signal in the Status Word ("G" bit) if it has the daylight saving time start and end dates (bit "G" = 1). Concentrator must signal reapplication of solar hour after the end of the daylight saving time period, reinserting the Status Word information (bit "G"=0). This induces the system to reprogram on concentrator the eventual subsequent daylight saving time period if different.

When concentrator updates its clock, from solar time to daylight saving time, it must memorise the information “daylight saving time effective”, to manage correctly the same information in CE clock synchronisation message.

The CE synchronisation activity has not be performed in the following intervals:

- OA-15 minutes ÷ OL+15 minutes
- OD-15 minutes ÷ OS+15 minutes[33] (see ENEL DH 971K).

There is a black-out period during which “CE synchronisation activity” is not performed.

This refers to SINC-T, SINC procedures and generic TB procedure. If a TB message is requested to set time, then at the time it is to be sent, it has to be checked for the black-out window and send a NACK if it is in the window.

[33] Currently the European law defines OA = 02:00; OL=03:00; OD=03:00 e OS=02:00.

11 POWER FAIL REMOTE CONTROLLED MANAGEMENT PROCEDURES

No procedure has to be expected for power-fail and power-up concentrator management.

The reason to not foresee a SW power fail management in concentrator, is given by the from the assumption that the number of pending transactions required by the AMM, is normally null.

The general rule is that the AMM, not receiving an answer after a transaction request previously done, must foresee to renew the same request after a certain period (or at concentrator power-up, detected by Status Word reading).

At power-up, concentrator restarts. The only data to preserve are those contained in a not volatile memory.

Concentrator at restart must activate CONN-C and SINC-T procedures on all the configured lines, putting diagnostics of eventual sections/CE Not Reachable.

11.1 CONENTRATOR ACTIVITY AT RESET

At power-up the activities that concentrator must perform are listed below:

- In the state message it must “Set” the power-up bit and to disable spontaneous message;
- On the basis of LV net configuration – stored in a not volatile memory - it must carry out the procedure CONN-C/SINC-T, at the end of which the reachable state of CE sections managed by concentrator must be updated;
- Independently by the functioning modality (autonomous or managed by AMM) concentrator must not send diagnostics to the AMM till the “disable spontaneous” bit is set. The “concentrator State Message” , “CHANGE MODE”, “SPONT_ATT” can be excluded by this mechanism, which can be dispatched only after CONN-C completion.
- The AMM, detecting in the state message the power-up bit and bit the end CONN-C bit (“F”) can ask concentrator with GB…(006.007) / GB….(006.010) the reading section reachable state.
- When concentrator sends to AMM the CE/sections reachable state with GB…(007.007) / GB…(007.010), it “resets” the “disable spontaneous” bit (bit R”), that of “end CONN-C (bit “F”) and that of “power up” (bit “A”) (see notes in State Word): the AMM can reconfigure or confirm on concentrator the system parameters (enable spontaneous).

12 CONCENTRATOR RUNNNING STATES

There are two different functioning modalities as already mentioned:

- Concentrator managed by Remote Controlled AMM
- Concentrator autonomous, in absence of Remote Controlled AMM

The functioning modality has to be set in T_ATT (TLG bit); the default value is concentrator Remote Controlled.

In both cases it is possible to connect to a hand held unit (HHU) the apparatus, through ZVEI optical interface, see ENEL DH 980K.

The functions available on HHU depend on the concentrator functioning modalities.

If concentrator is in the “stand-alone” mode it must accept messages from the AMM for its configuration.

12.1 CONCENTRATOR RUNNING MODES VARIATIONS

The HHU must be able to modify concentrator functioning modality.

12.1.1 From "concentrator managed by Centre" to "concentrator stand alone"

The HHU sends to concentrator the message GB CHANGE_MODE.REQ (018.002) to modify the functioning modality.

The concentrator will answer with the GB_ACK (251).

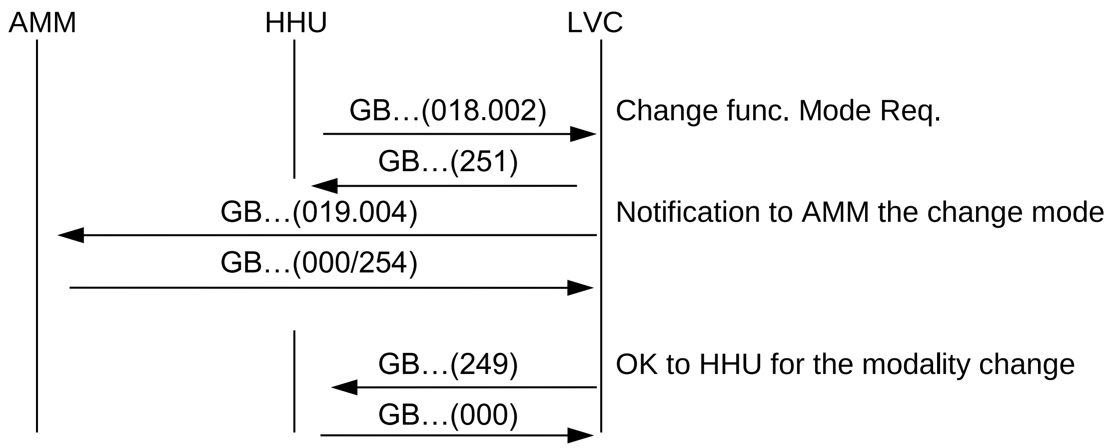
Afterwards, concentrator must notify the AMM if the request comes from HHU with the message GB_LOCAL_MOD (019.004).

The mode is only switched if the AMM replies with an ACK or the concentrator is unable to contact the AMM (at the end of a time out and relative expected retries expiry).

Concentrator must transmit to HHU, the answer reply CHANGE_MODE.RESP (249) to the modification request.

HHU as receives the GB…(249) will reply with the GB…(000).

The functions that HHU can require are those described in the chapter "Autonomous concentrator".



12.1.2 From "concentrator stand alone" to "concentrator managed by AMM"

The HHU or the AMM sends to concentrator the message GB GB_SOSP_ATT.REQ (018.003) to carry the apparatus in a particular state, of suspension of the current activities. In this state:

- communication with LV net is suspended;
- all the activities are suspended;

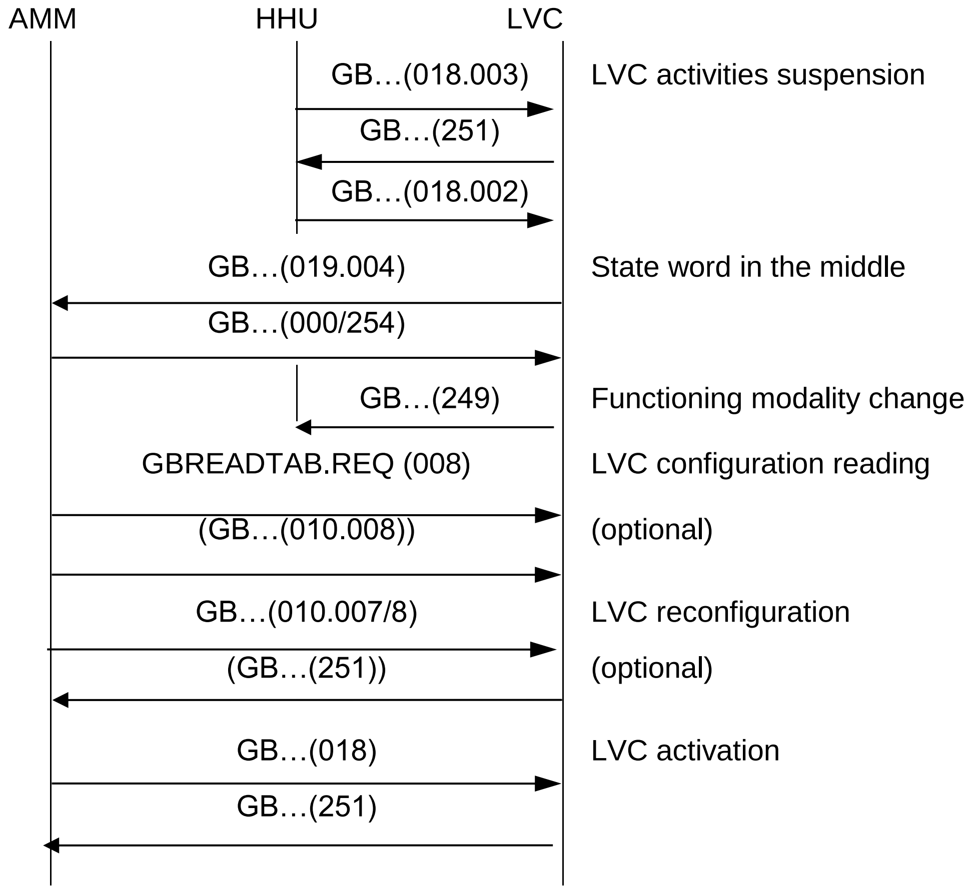
Only the current net configuration must remain valid.

As HHU receives the acknowledge (251) it transmits the GB…(018.002) to change is mode.

First of all the concentrator will reply to AMM with the GB…(251), then it will reply to AMM with the GB…(019.004).

Afterwards, at the AMM answer, GB(000/254), concentrator will transmit the GB…(249) message to HHU. This is to signal the modification of functioning modality – “from autonomous” to “managed by the AMM” and to allow the AMM, in a second time to read and eventually reload the subtended LV net, in order to avoid eventual not-alignments between the known DB to the AMM and the DB of concentrator. HHU will reply with the ACK (000).

The AMM will remove the concentrator suspension state, using the message GB…(018.004). Upon reception of the message GB(018.004) concentrator must remain in the state “spontaneous lock” till apposite programming is executed.



12.2 HHU FUNCTIONALITIES WITH REMOTE CONTROLL OF CONCENTRATOR

When concentrator functioning state is “concentrator managed by AMM”, the functions available to HHU have to be the following:

- Concentrator functioning modalities reading
- Configuration data reading
- Concentrator registers reading
- CE data-bases reading
- Concentrator functioning modalities variation

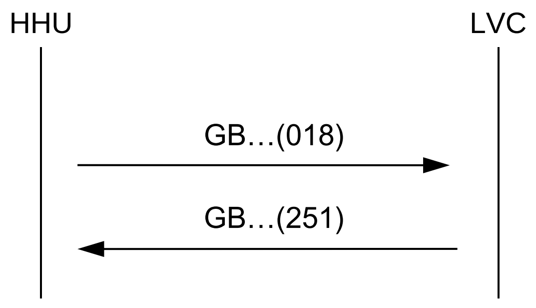
"HHU can issue any read requests (TB_READ..., GB_READ..., .). It cannot issue any write (GB 004, 010; TB 004, 010; 010), set (GB 012; TB 012, 014, 016), or command (GB 018, 020; TB 018, 032, 034, 036, 038, 040; IC 018, 032, 034).

The only exception is that it can issue the GB_CHANGE_MODE (018) command.

In order to make variations of CE configuration data, HHU must previously open a communication session with the Centre and notify it that request, HHU must be able to perform variations; at the end of this activity, concentrator must reply to the Centre the occurred variations.

12.2.1 Concentrator functioning modalities reading

Through HHU it should be possible to read the concentrator functioning modalities with GB_READ_CONF.REQ (018) and GB…(255) messages.



Configuration data reading.

12.2.2 Concentrator initialisation with HHU

Initialisation of the concentrator with HHU after its installation in the secondary substation to allow the communication with the AMM, consists in loading the T_ATT and T_TLC tables in the concentrator with the messages GB_WRITETAB.REQ (010.001) and GB_WRITETAB.REQ (010.002), then it is necessary to enable the concentrator to transmit spontaneous, managing the Bit 0 of the “Spont” field of the T_TLC table.

During this procedure this Bit is set on enable condition, Bit 0 = 1 (in this condition and with the others spontaneous disabled, this Bit remains enabled).

In this way, as the HHU closes the communication with the concentrator, spontaneous message GB_SPONT_ATT (019) from concentrator to AMM has to be transmitted.

When concentrator receives the ACK from AMM, this Bit has to be set = 0 (disable).

After AMM receives this message, it can be able to load other tables.

Note that it is advisable for the AMM to read the T_ATT before executing what above described; this is because it could be necessary to modify the TLG field ("from remote" to "stand-alone") in that table, to allow the communication between HHU and concentrator.

Then, after the transmission of the GB_SOSP_ATT (018) message, it is possible to proceed as described, taking into account that is necessary to reset the "TLG" field in T_ATT in "remote" condition.

12.2.3 Internal structures reading

The HHU must read concentrator data structures by the same procedures used by the AMM.

In these conditions, the section reachable state reading does not cause the "spontaneous lock" state.

12.3 CONCENTRATOR IN "STAND ALONE" MODE

In this functioning modality, the concentrator must perform the same functions described in the "Concentrator Remote Controlled" modality, it is to say that this functioning state can be assimilated to the "concentrator managed by the AMM" modality.

HHU can issue any supported request. All the transactions that can be done by the AMM, have to can be required by HHU through the local optical port; the answers normally provided by the AMM have to pass through HHU.

12.3.1 HHU functionality with concentrator "Stand-Alone"

When concentrator functioning state is "concentrator stand-alone", the functions available to HHU must be the following:

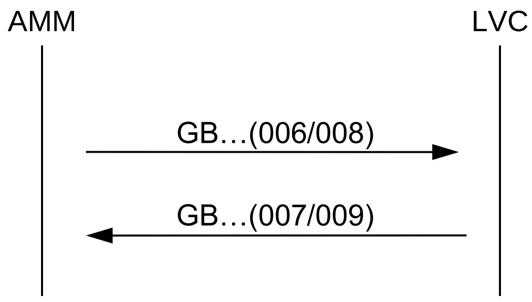
- Reading of concentrator functioning modality
- LV net configuration which the apparatus is connected
- Data configuration reading
- Data structure within concentrator reading
- Energy balance and billing
- Transactions requests (contractual variations, "load shedding", etc.):

The following functional character must be available:

- Concentrator functioning modality variation
- Activation and communication test with AMM

12.3.1.1 Concentrator functioning modalities reading

It is possible to read concentrator functioning modalities with the GB_READTAB.REQ (006/008.001).



12.3.1.2 Configuration of the LV net-connected to the apparatus.

When HHU connects to concentrator in stand-alone functioning, it must be possible to carry out the configuration by the modalities analogue to those used by the AMM and described in the relative chapter.

12.3.1.3 Data configuration reading

HHU can read concentrator configuration by the same procedures used by the AMM.

12.3.1.4 Concentrator data structures reading

It is valid as described about “concentrator managed by the AMM”.

12.3.1.5 BE and billing

It is valid what is described in case of "concentrator managed by the AMM”. The events (TB responses) logged by BE and FATT have not to be discarded in standalone mode. It has to be possible to read FATT and/or BE data by mean HHU, as well.

The HHU retrieve such responses having a category of response buffer entry called an unsolicited response that is delivered with this rule:

Route unsolicited responses to any open AMM response pipe, otherwise route to any open HHU response pipe.

Note that an ordering is necessary since the AMM and HHU response pipes can be open simultaneously so, AMM will have the priority.

Procedures that write responses to the TRAPE.RESP (such as TB, BE and FATT) will continue to do so but these do not produce a spontaneous call in “stand alone” mode.

12.3.1.6 Transactions requests

HHU can require all the transactions that are foreseen in “concentrator managed by the AMM”, using the same messages foreseen for dialogue with the AMM.

12.3.1.7 Concentrator functioning modality variation

Please refer to paragraphs (12.1.1 and 12.1.2).

13 LV NETWORK MANAGEMENT

The functions relative the LV net management are described below. LV net must be intended either as configuration of electric scheme, as CE management, because they are net communication progressive of the nodes.

13.1 LV NETWORK CONFIGURATION

This paragraph describes:

- net configuration functions
- communication activation/removal
- configuration of communication parameters

13.1.1 LV network software loading on concentrator

Concentrator must be configured by AMM or by HHU:

- on configuration variation to the concentrator subtended electric net AMM
- when the AMM or the HHU detects, from concentrator State Word, that the device is not configured

When the AMM detects, from the concentrator State Word, that the apparatus has changed from "concentrator stand-alone modality" to "concentrator managed by AMM", it can reconfigure the apparatus if it is necessary.

It is not necessary by the AMM to configure concentrator near a power-up, because the configuration information has to be stored in a not volatile memory.

The procedure consists in transmitting the following data to concentrator:

- lines data GB…(010.006)
- sections data GB…(010.007)
- connection data GB…(010.008)
- CE data GB…(010.004)
- AGQ data GB…(010.005)
- ….

AMM/HHU must activate the procedure through transmission of message GB…(018).

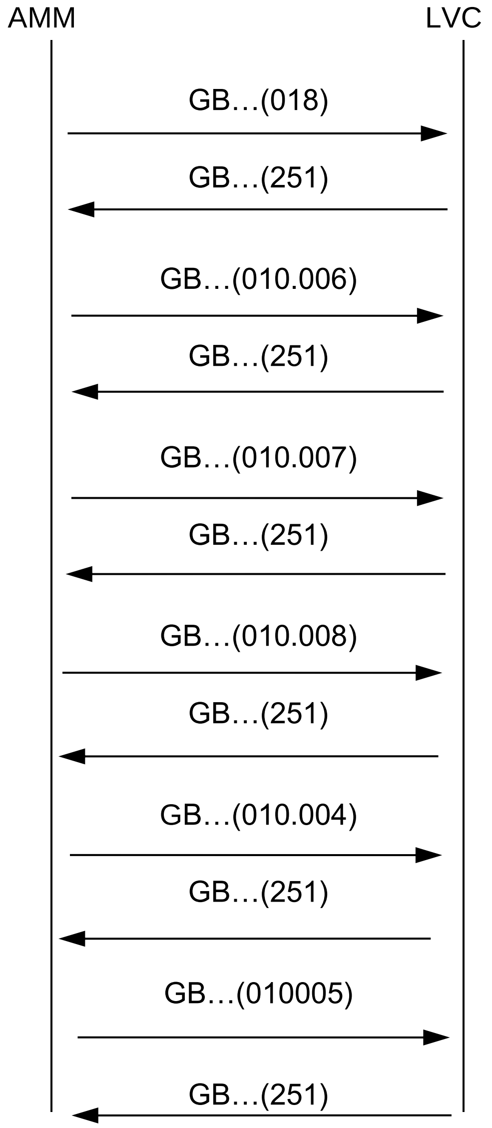
Concentrator must send to the AMM an answer message GB…(251/255).

The AMM sends to concentrator the configuration loading request message GB…(010.00X)

Upon reception of this message concentrator:

- must “reset” in the State Word the "D" bit as "not configured concentrator with LV network”
- must “reset” the data base previously configured
- must send to the AMM an answer message GB…(251)

When the AMM receives the message GB…(251), the loading procedure starts sending the messages GB…(010.006), GB…(010.007); GB…(010.008); GB…(010.004) and GB…(010.005). Concentrator must answer with the message GB…(251).
Each structure with configuration data could be sent with one or more messages.
The AMM must end the loading procedure with the message GB…(018).



GB…(018)

GB…(251)

During execution of loading procedures, the reception of eventual TB messages causes the dispatching to AMM an anomaly signalling (TB 255 with “not configured net” code). concentrator, with a GB different from those foreseen, must:

- answer by message GB…(255)
- interrupt procedure
- be in condition to accept a new loading request by LV network (GB…(018); …., GB....(010.00X)

Upon reception of the message GB…(018), the concentrator:

- must leave the LV communication state as it was before receiving the message GB…(018)
- must start CONN-C activity on all the configured lines

Since this moment, concentrator must be able to accept requests by AMM or by HHU

13.1.2 Concentrator’s LV network configuration reading

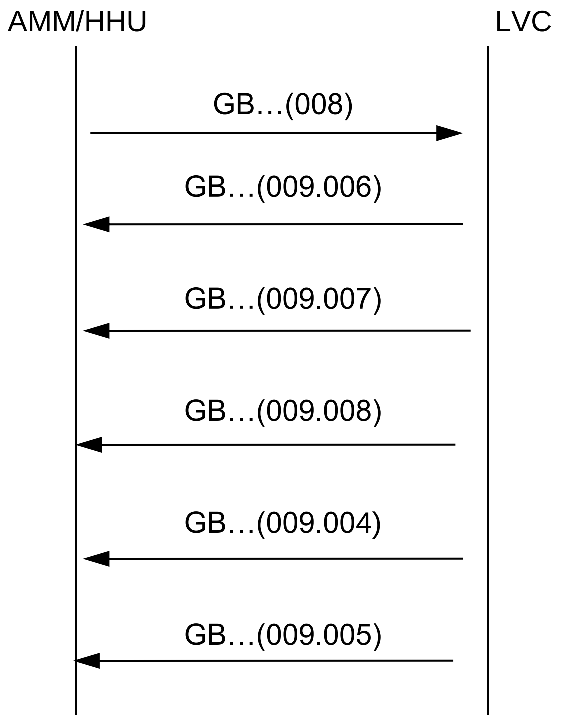
Concentrator’s LV net configuration reading procedure must allow reading the following data in the database:

- Lines data GB…(007/009.006)
- Sections data GB…(007/009.007)
- Connection data GB…(007/009.008)
- CE data GB…(007/009.004)
- AGQ data GB…(007/009.005)
- ….

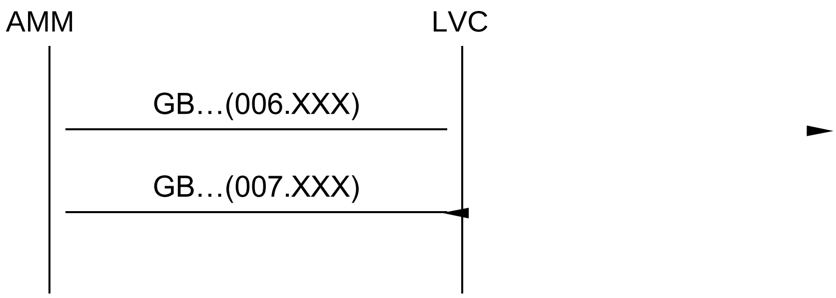
The AMM/HHU requires reading concentrator configuration through message GB…READTAB_(XXX).REQ (008).

Concentrator must answer with messages GB…(009.006); GB…(009.007); GB…(1009.008); GB (009.004) and GB…(009.005).

If concentrator is not configured, it must answer soon by the message GB…(255).



Each data structure can be singularly read by the AMM through the transmission of the message GB…(006) using a sub code.



14 CONCENTRATOR STATE MESSAGE

The concentrator State Word is divided into three bytes, STATE field of T_STATUS:

bit 0	A=1	Concentrator Power up;
bit 1	S=1	Concentrator functioning modality variation (from “stand alone” to “managed by the Centre”);
bit 2	T=1	Expired time-out communication with Centre;
bit 3	L=1	Tamper Detection;
bit 4	F=1	CONN-C procedure completion;
bit 5	U=1	Not used;
bit 6	X=1	RF Module detection;
bit 7	W=1	GPRS Module detection on COM2;
bit 8	C=1	Not used;
bit 9	M=1	RF_TRAPE.RESP data loss condition;
bit 10	H=1	Alarm SMS;
bit 11	I=1	Phase R missing, see Z bit for further clarifications;
bit 12	J=1	Phase S missing, see Z bit for further clarifications;
bit 13	K=1	Phase T missing, see Z bit for further clarifications;
bit 14	Y=1	Concentrator FW diagnostics, with the following meaning and values:

- A failure to read initial GB tables from flash or to write modified values to flash will cause the "Y" bit to be set and the concentrator to be "locked";
- There is a software diagnostic code in the virtual table to indicate the reason for the "Y" bit being set. It is cleared when the "Y" bit is cleared. Values are:
    - 1 - Repetitive reboots detected;
    - 2 - GB table flash failure.

bit 15 Z=1 Error in concentrator HW self-diagnostic (MSC)

The contents of the diagnostic HW_DIAG status word are:

PHASE_R_MISSING	0x0002	(phase R disconnected)
PHASE_S_MISSING	0x0004	(phase S disconnected)
PHASE_T_MISSING	0x0008	(phase T disconnected)
RTC_FAILURE	0x0020	
7582_FAILURE	0x0040	
UNKNOWN_FAILURE	0x0080	(unknown failure on extension board)
CLOCK_FAILURE	0x0200	
ZERO_CROSSING_FAILURE	0x0400	
MCU_FAILURE	0x0800	(uPSD not working)
CON_FAILURE	0x1000	(COM1 port i.e. console port failure)
MODEM_FAILURE	0x2000	(COM2 port i.e. modem connection port failure)
DLC_FAILURE	0x4000	(COM3 port i.e. power line carrier port failure)
FLAG_FAILURE	0x8000	(COM4 port i.e. FLAG port failure)

Note: The Z bit setting for code 0x0002, 0x0004, 0x0008 and its related combinations of bit I, J and K due to missing phase shall be considered reliable only in F-N 230 Volt scenario.

bit 15 Z=1 Error in concentrator HW self-diagnostic (LVM)

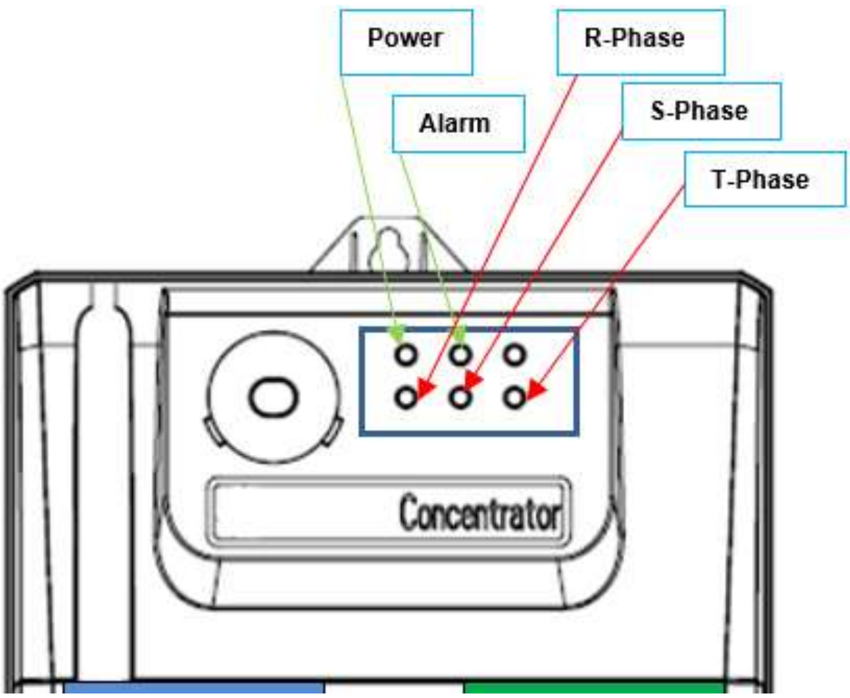
The contents of the diagnostic HW_DIAG status word are:

PHASE_R_MISSING	0x0002	(See table below)
PHASE_S_MISSING	0x0004	(See table below)
PHASE_T_MISSING	0x0008	(See table below)
RTC_FAILURE	0x0020	
PLC_FAILURE	0x0040	
WRONG PHASE SEQUENCE	0x0080	(See table below)
CLOCK_FAILURE	0x0200	
ZERO_CROSSING_FAILURE	0x0400	
MCU_FAILURE	0x0800	(uPSD not working)
CON_FAILURE	0x1000	(COM1 port i.e. console port failure)
MODEM_FAILURE	0x2000	(COM2 port i.e. modem connection port failure)
DLC_FAILURE	0x4000	(COM3 port i.e. power line carrier port failure)
FLAG_FAILURE	0x8000	(COM4 port i.e. FLAG port failure)

HW_DIAG details related to installation:

Supply	State Bits	HW_DIAG	Meaning
RSTN	----	0000	Ok
STN	Z-K	0002	R disconnected
RTN	Z-I	0004	S disconnected
RSN	Z-J	0008	T disconnected
RN	Z-J-K	000C	2 phases disconnected
SN	Z-J-K	000C	2 phases disconnected
TN	Z-J-K	000C	2 phases disconnected
RTSN	Z	0080	Wrong phase sequence
SRTN	Z	0080	Wrong phase sequence
TSRN	Z	0080	Wrong phase sequence
RSNT	Z	008E	T-N inversion
RNTS	Z	008E	S-N inversion
NSTR	Z	008E	R-N inversion

Led Behaviour:



Description	Power	Alarm	R-Phase	S_Phase	T-Phase
Initial Boot (first 60 sec after power on)	On	Off	Off	Off	Off
End of boot phase	Flashing	Flashing	Flashing	Flashing	Flashing
Normal operations	On	Off	Off	Off	Off
R & N swapped	On	Flashing	Flashing	On	On
S & N swapped	On	Flashing	On	Flashing	On
T & N swapped	On	Flashing	On	On	Flashing
N connection missed	Off	Off	Off	Off	Off
R connection missed	On	Flashing	Flashing	Off	Off
S connection missed	On	Flashing	Off	Flashing	Off
T connection missed	On	Flashing	Off	Off	Flashing
Wrong sequence	On	Off	Rotating flash		
Internal Alarm	On	On	Off	Off	Off

bit 16 D=1 Concentrator configured with known topology;

bit 17 B=1 Concentrator configured with T_CE parameters;

bit 18 O=1 Concentrator Synchronized;

bit 19 E=1 Communication active on LV network;

bit 20 G=1 Daylight saving time period configured;

bit 21 R=1 Reserved;

bit 22 V=1 Event Pipe open;

bit 23 P=1 Optical port locked (See 5.3.6)

For each state message bit, are defined the "set" and "reset" modalities. All of them are kept in not volatile memory.

After a reboot, concentrator set the “F” bit if the topology is unknown and concentrator clear the “F” bit if the topology is known. This way, in the unknown topology concentrator will always send a GB_STATE_MESS after a reboot. For the known topology, the clearing of the “F” bit will ensure that a GB_STATE_MESS has to be sent upon completion of the first CONN-C after a reboot (the concentrator always clear the “F” bit; in the case of unknown topology will immediately reset it. In the case of known topology will set that bit when the CONN-C procedures completes).

The following table defines the bit fields in the State Message item. The “Letter” column corresponds to the letter assigned to the bit while the “Spont” one defines whether the SPONT_STATE message is generated as a result of a transition of this bit from 0 to 1 exception for bit X and W that shall generate the SPONT_STATE message in both conditions.

Bit	Letter	Spont	Description	Set Condition	Clear Condition
0	A	No	Concentrator Power up	Whenever Concentrator executes Power Up	Reset GB message
1	S	Yes	Concentrator functioning modality variation (standalone/remote).	Upon receipt of GB_CHANGE_MODE (018.002) command	Reset GB message
2	T	Yes	Expired time-out communication with AMM	When unable to contact AMM, or AMM fails to respond to message sent by concentrator	When SPONT_STATE message is ACKed
3	L	Yes	Tamper Detection	Upon anti-tamper screw removal	Reset GB message
4	F	Yes	CONN-C procedure completion	At completion of CONN-C procedure	Reset GB message
5	U		Not used		
6	X	Yes	RF Module detection	When RF module is connected	When RF module is disconnected
7	W	Yes	GPRS Modem detection	When GPSR modem is connected on COM2	When GPSR modem is disconnected from COM2
8	C		Reserved		
9	M(*)	Yes	RF_Trape.Resp data loss condition	When the RF_Trape.Resp reaches the buffer full condition without disk space for zip creation	When at least an entry of the RF_Trape.Resp is empty
10	H	No	Alarm SMS	At delivery of alarm SMS	Reset GB message
11	I	Yes	Phase R missing	At fault	Power on
12	J	Yes	Phase S missing	At fault	Power on
13	K	Yes	Phase T missing	At fault	Power on
14	Y	Yes	Reserved for Concentrator diagnostics	N/A	N/A

Bit	Letter	Spont	Description	Set Condition	Clear Condition
15	Z	Yes	Error in concentrator self-diagnostics	N/A	N/A
16	D	No	Topology known	Topology tables loaded and valid	Topology tables not loaded or invalid
17	B	No	T_CE loaded	At least 1 entry in CE table	Zero entries in CE table
18	O	No	Concentrator Synchronised (with valid temporal reference)	When clock is set via GB (004) message	When the real time clock reports an error or has not been initialised
19	E	No	Communication active on LV net	GB (018.005) Open LV network	GB (018.006) Close LV network
20	G	No	Daylight saving time period configured	When DST parameters are set	When DST start/end time period expires
21	R		Not used		
22	V	No	Event Pipe status	Event pipe open	When Event pipe is closed
23	P	Yes	OLU	When the optical port is locked	When the optical port is unlocked due to automatic reset or after a reset GB message

The AMM can also clear all bits in one shot by sending the GB_RESET_STATE (018.012) command.

Bit mask:

<Byte 0>								<Byte 1>								<Byte 2>							
07	06	05	04	03	02	01	00	15	14	13	12	11	10	09	08	23	22	21	20	19	18	17	16
W	X	U	F	L	T	S	A	Z	Y	K	J	I	H	M	C	P	V	R	G	E	O	B	D

15 CONCENTRATOR SELF-DIAGNOSTIC

At each power-up, concentrator must run a self-diagnostic test on the main components. . If during the test the device has detected an error that might compromise the functions, it sets the state message “Z” bit and must go in a “locked" state, no performing any activity, except sending state message to AMM if possible.

If in the self-diagnosis an error is detected on the code area (checksum) or in the RAM area, concentrator must execute the restart procedure: if the error is still there after three attempts in succession, concentrator must enter into reduced functioning state and set proper information in the self-diagnostic word.

Self-diagnostic word contents:

- The POST result is not non-volatile. It only represents the result of the most recent POST.
- When the "Z" bit is set, all procedures are stopped (e.g., same as if the concentrator received a AMM_GB_CMD_SOSP_ATT command) and a spontaneous message is sent (AMM_GB_SPONT_STATE). This is called the "locked" state in the specification.
- The POST result is available in the virtual table and is cleared when the "Z" bit is cleared (e.g., via the AMM_GB_CMD_RESET_STATE command code).
- If the code area has a checksum error (in our case, an uncorrectable flash ECC error), then we restart and thus retry the boot. There is no limit on the number of times this is tried (and there is no possible recovery anyway).
- If the RAM fails, this is treated the same as all other POST failures. Thus, this will cause the "Z" bit to be set and thus we will immediately enter the "locked" state. There is no automatic restart in this case.

The POST result is available in the virtual table and is cleared when the "Z" bit is cleared (e.g., via the AMM_GB_CMD_RESET_STATE command code).

If the code area has a checksum error (in our case, an un-correctable flash ECC error), then we restart and thus retry the boot. There is no limit on the number of times this is tried (and there is no possible recovery anyway).

If the RAM fails, this is treated the same as all other POST failures. Thus, this will cause the "Z" bit to be set and thus we will immediately enter the "locked" state. There is no automatic restart in this case.

16 CE ACCESS BY AUTHENTICATION (dynamic digest)

The messages transmitted by the AMM “to be protected” for safety reasons, besides data will be provided with a dynamic Digest that allows peripheral its authentication (Only T520).

This argument is handled in Enel DH 939K specification.

17 ANNEX A (List of tables)

The following is the list of the identifier codes (ID) of tables and buffers of the concentrator. Accessing to each of the listed structure is done by means of the GB messages described in the Enel Exchanged Information and Linking Procedures between Concentrator and Back Office documentation.

Code of Concentrator's Tables

ID	Acronym
1:	T_ATT
2:	T_TLC
3:	T_PRI
4:	T_CE
5:	T_AGQ (predisposition)
6:	T_LIN
7:	T_SEZ
8:	T_COL
9:	Available
10:	B(ST_SEZ)
11:	B(CE)
12:	B(ST_LIN)
13:	B(NNRG)
14:	B(TRAPE.REQ)
15:	B(TRAPE.RESP)
16:	B(RF_TRAPE.RESP)
17:	B(MESS)
18:	B(CE_STAT) (t)
19:	B(CE_STAT) (gp)
20:	Reserved
21:	T_LVC_DWL
22:	T_CE_DWL
23:	T_HHU
24:	T_ KEY
25:	B(LMESS_REQ)
26:	LMES_TAB
27:	B(VTRAPE.REQ)
28:	B(WTRAPE.REQ)
29:	B(VTRAPE.RESP)
30:	B(MESS_REC)
31:	B(MES_BUF)
32:	B(IC_STAT) (t)
33:	B(IC_STAT) (gp)
34:	B(ST_IC)
35:	T_IC_CONF
36:	T_IC_DWL
37:	T(AGST)
38:	T_PLOAD
39:	T_GQBT-I
40:	Reserved
41:	T_CEDATACE_TYPE
42:	T_CEDATA_PREST

43: T_CEDATA_VAL
44: T_GQBT-V
50: Reserved
51: Reserved
52: Reserved
53: Reserved
60: Reserved
61: T_VREG
62: T_VREG_RESULT
63: T_N2PLOAD
64: Reserved
65: T_QI
66: T_QV
67: T_DWL_C
68: T_N2PLOAD_C
100: T_RF_PAR
102: T_RF_WL
103: T_RF_CE
104: T_RF_KEY
105: T_RF_NEIGH
109: T_RF_CE_NUM
110: T_RF_REACT_SPONT
112: T_RF_PRI
113: T_RF_CE_DWL_C
120: T_RPT
200: Reserved
201: Reserved
202: Reserved
203: Reserved
204: Reserved
205: Reserved
206: Reserved
207: Reserved
208: Reserved
209: Reserved
210: Reserved
211: Reserved
212: Reserved
213: Reserved
214: Reserved
215: Reserved
235: T_SMS
250: T_ETH
251: T_GPRS (COM1)
252: T_GPRS (COM2)
253: Reserved
254: T_STATUS

18 ANNEX B

18.1 Tab 32 single tariff billing period

	Value	Tab 0-31
TABLE COD	TTT=0x20	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
REACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$Ra_{T3}(p)$	01 13
MAXIMUM VALUE OF ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p\text{-}a)}$	09 13
RELATIVE VALUE OF REACTIVE POWER OF THE PREVIOUS PERIOD	$Q_{3(p\text{-}a)}$	09 17
USER IDENTIFICATION NUMBER	CODU	0D 13
NUMBER OF PROGRAMMING PARAMETERS VARIATIONS IN THE PREVIOUS BILLING PERIOD	VPP(p-a)	15 03
NUMBER COUNTER OF METER POWER FAIL IN THE PREVIOUS PERIOD	NTVD(p-a)	13 41
EXTENDED STATUS WORD	PDSE	17 01

18.2 Tab 33 double tariff billing period

	Value	Tab 0-31
TABLE COD	TTT=0x21	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
ACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$E_{T2}(p)$	01 0E
REACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$Ra_{T3}(p)$	01 13
REACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$Ra_{T2}(p)$	01 12
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p\text{-}a)}$	09 13
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{2(p\text{-}a)}$	09 12
RELATIVE VALUE OF T3 REACTIVE POWER OF THE PREVIOUS PERIOD	$Q_{3(p\text{-}a)}$	09 17
RELATIVE VALUE OF T2 REACTIVE POWER OF THE PREVIOUS PERIOD	$Q_{2(p\text{-}a)}$	09 16
USER IDENTIFICATION NUMBER	CODU	0D 13
NUMBER OF PROGRAMMING PARAMETERS VARIATIONS IN THE PREVIOUS BILLING PERIOD	VPP(p-a)	15 03
NUMBER COUNTER OF METER POWER FAIL IN THE PREVIOUS PERIOD	NTVD(p-a)	13 41
EXTENDED STATUS WORD	PDSE	17 01

18.3 Tab 34 (T3 + T2) multi tariff billing period

	Value	Tab 0-31
TABLE COD	TTT=0x22	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
ACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$E_{T2}(p)$	01 0E
REACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$Ra_{T3}(p)$	01 13
REACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$Ra_{T2}(p)$	01 12
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p-a)}$	09 13
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{2(p-a)}$	09 12
RELATIVE VALUE OF T3 REACTIVE POWER OF THE PREVIOUS PERIOD	$Q_{3(p-a)}$	09 17
RELATIVE VALUE OF T2 REACTIVE POWER OF THE PREVIOUS PERIOD	$Q_{2(p-a)}$	09 16
USER IDENTIFICATION NUMBER	CODU	0D 13
NUMBER OF PROGRAMMING PARAMETERS VARIATIONS IN THE PREVIOUS BILLING PERIOD	VPP(p-a)	15 03
NUMBER COUNTER OF METER POWER FAIL IN THE PREVIOUS PERIOD	NTVD(p-a)	13 41
EXTENDED STATUS WORD	PDSE	17 01

18.4 Tab 35 (T1 + T4) multi tariff billing period

	Value	Tab 0-31
TABLE COD	TTT=0x23	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
ACTIVE ENERGY IN T1 OF THE PREVIOUS PERIOD	$E_{T1}(p)$	01 0D
ACTIVE ENERGY IN T4 OF THE PREVIOUS PERIOD	$E_{T4}(p)$	01 10
REACTIVE ENERGY IN T1 OF THE PREVIOUS PERIOD	$Ra_{T1}(p)$	01 11
REACTIVE ENERGY IN T4 OF THE PREVIOUS PERIOD	$Ra_{T4}(p)$	01 14
MAXIMUM VALUE OF ACTIVE POWER T1 OF THE PREVIOUS PERIOD	$W_{1(p-a)}$	09 11
MAXIMUM VALUE OF ACTIVE POWER T4 OF THE PREVIOUS PERIOD	$W_{4(p-a)}$	09 14
MAXIMUM VALUE OF REACTIVE POWER T1 OF THE PREVIOUS PERIOD	$Q_{1(p-a)}$	09 15
MAXIMUM VALUE OF REACTIVE POWER T4 OF THE PREVIOUS PERIOD	$Q_{4(p-a)}$	09 18

USER IDENTIFICATION NUMBER	CODU	0D 13
NUMBER OF PROGRAMMING PARAMETERS VARIATIONS IN THE PREVIOUS BILLING PERIOD	VPP(p-a)	15 03
NUMBER COUNTER OF METER POWER FAIL IN THE PREVIOUS PERIOD	NTVD(p-a)	13 41
EXTENDED STATUS WORD	PDSE	17 01

18.5 Tab 36 Eplus tariff billing period

	Value	Tab 0-31
TABLE COD	TTT=0x24	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
Eplus1	Eplus1(p)	02 13
Eplus2	Eplus2(p)	02 14
Eplus3	Eplus3(p)	02 15
Eplus4	Eplus4(p)	02 16
Eplus5	Eplus5(p)	02 17
Eplus6	Eplus6(p)	02 18

18.6 Tab 37 T3 tariff current moment

	Value	Tab 0-31
TABLE COD	TTT=0x25	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
DATE CURRENT	DATE	0A01
TIME CURRENT	TIME	0A02
ACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$E_{T3}(t)$	01 05
REACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$Ra_{T3}(t)$	01 09
MAXIMUM VALUE OF ACTIVE POWER OF THE CURRENT PERIOD	$W_{3(t-p)}$	09 03
RELATIVE VALUE OF REACTIVE POWER OF THE CURRENT PERIOD	$Q_{3(t-p)}$	09 07
TOTAL ACTIVE ENERGY	E(t)	01 01
TOTAL REACTIVE ENERGY	Ra(t)	01 02

18.7 Tab 38 T3 + T2 tariff current moment

	Value	Tab 0-31
TABLE COD	TTT=0x26	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
DATE CURRENT	DATE	0A01
TIME CURRENT	TIME	0A02
ACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$E_{T3}(t)$	01 05
ACTIVE ENERGY IN T2 OF THE CURRENT PERIOD	$E_{T2}(t)$	01 04
REACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$Ra_{T3}(t)$	01 09
REACTIVE ENERGY IN T2 OF THE CURRENT PERIOD	$Ra_{T2}(t)$	01 08
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE CURRENT PERIOD	$W_{3(t-p)}$	09 03
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE CURRENT PERIOD	$W_{2(t-p)}$	09 02
RELATIVE VALUE OF T3 REACTIVE POWER OF THE CURRENT PERIOD	$Q_{3(t-p)}$	09 07
RELATIVE VALUE OF T2 REACTIVE POWER OF THE CURRENT PERIOD	$Q_{2(t-p)}$	09 06
TOTAL ACTIVE ENERGY	E(t)	01 01
TOTAL REACTIVE ENERGY	Ra(t)	01 02

18.8 Tab 39 T1 + T4 tariff current moment

	Value	Tab 0-31
TABLE COD	TTT=0x27	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
DATE CURRENT	DATE	0A01
TIME CURRENT	TIME	0A02
ACTIVE ENERGY IN T1 OF THE CURRENT PERIOD	$E_{T1}(t)$	01 03
ACTIVE ENERGY IN T4 OF THE CURRENT PERIOD	$E_{T4}(t)$	01 06
REACTIVE ENERGY IN T1 OF THE CURRENT PERIOD	$Ra_{T1}(t)$	01 07
REACTIVE ENERGY IN T4 OF THE CURRENT PERIOD	$Ra_{T4}(t)$	01 0A
MAXIMUM VALUE OF ACTIVE POWER T1 OF THE CURRENT PERIOD	$W_{1(t-p)}$	09 01
MAXIMUM VALUE OF ACTIVE POWER T4 OF THE CURRENT PERIOD	$W_{4(t-p)}$	09 04
MAXIMUM VALUE OF REACTIVE POWER T1 OF THE CURRENT PERIOD	$Q_{1(t-p)}$	09 05
MAXIMUM VALUE OF REACTIVE POWER T4 OF THE CURRENT PERIOD	$Q_{4(t-p)}$	09 08

TOTAL ACTIVE ENERGY	E(t)	01 01
TOTAL REACTIVE ENERGY	Ra(t)	01 02

18.9 Tab 40 Eplus tariff current moment

	Value	Tab 0-31
TABLE COD	TTT=0x28	ID (hex)
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
DATE CURRENT	DATE	0A01
TIME CURRENT	TIME	0A02
Eplus1	Eplus1(t)	02 0A
Eplus2	Eplus2(t)	02 0B
Eplus3	Eplus3(t)	02 0C
Eplus4	Eplus4(t)	02 0D
Eplus5	Eplus5(t)	02 0E
Eplus6	Eplus6(t)	02 0F

18.10 Tab 56 for IC to program on CE for AG_24 MULTI-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x38	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(t)	01 01
ACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$E_{T3}(t)$	01 05
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE CURRENT PERIOD	$W_{3(t-p)}$	09 03
ACTIVE ENERGY IN T2 OF THE CURRENT PERIOD	$E_{T2}(t)$	01 04
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE CURRENT PERIOD	$W_{2(t-p)}$	09 02
ACTIVE ENERGY IN T1 OF THE CURRENT PERIOD	$E_{T1}(t)$	01 03
MAXIMUM VALUE OF ACTIVE POWER T1 OF THE CURRENT PERIOD	$W_{1(t-p)}$	09 01
ACTIVE ENERGY IN T4 OF THE CURRENT PERIOD	$E_{T4}(t)$	01 06
MAXIMUM VALUE OF ACTIVE POWER T4 OF THE CURRENT PERIOD	$W_{4(t-p)}$	09 04

18.11 Tab 57 for IC to program on CE for AG_24 Double-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x39	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(t)	01 01
ACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$E_{T3}(t)$	01 05
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE CURRENT PERIOD	$W_{3(t-p)}$	09 03
ACTIVE ENERGY IN T2 OF THE CURRENT PERIOD	$E_{T2}(t)$	01 04
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE CURRENT PERIOD	$W_{2(t-p)}$	09 02

18.12 Tab 58 for IC to program on CE for AG_24 Single-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x3A	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(t)	01 01
ACTIVE ENERGY IN T3 OF THE CURRENT PERIOD	$E_{T3}(t)$	01 05
MAXIMUM VALUE OF ACTIVE POWER OF THE CURRENT PERIOD	$W_{3(t-p)}$	09 03

18.13 Tab 59 for IC to program on CE for AG_24 multi-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x3B	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(p)	01 0B
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p-a)}$	09 13
ACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$E_{T2}(p)$	01 0E
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{2(p-a)}$	09 12
ACTIVE ENERGY IN T1 OF THE PREVIOUS PERIOD	$E_{T1}(p)$	01 0D
MAXIMUM VALUE OF ACTIVE POWER T1 OF THE PREVIOUS PERIOD	$W_{1(p-a)}$	09 11
ACTIVE ENERGY IN T4 OF THE PREVIOUS PERIOD	$E_{T4}(p)$	01 10
MAXIMUM VALUE OF ACTIVE POWER T4 OF THE PREVIOUS PERIOD	$W_{4(p-a)}$	09 14

18.14 Tab 60 for IC to program on CE for AG_24 double-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x3C	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(p)	01 0B
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
MAXIMUM VALUE OF T3 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p-a)}$	09 13
ACTIVE ENERGY IN T2 OF THE PREVIOUS PERIOD	$E_{T2}(p)$	01 0E
MAXIMUM VALUE OF T2 ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{2(p-a)}$	09 12

18.15 Tab 61 for IC to program on CE for AG_24 single-tariff

	Value	Tab 0-31
TABLE COD	TTT=0x3D	Coding HEX
STATUS WORD	PDSN	16 01
TARIFF PROGRAMS	IPTS	0F 01
END DATE BILLING	DATE_F	0B 03
TOTAL ACTIVE ENERGY	E(p)	01 0B
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	$E_{T3}(p)$	01 0F
MAXIMUM VALUE OF ACTIVE POWER OF THE PREVIOUS PERIOD	$W_{3(p-a)}$	09 13

18.16 Tab 62 for IC to program on CE for AG_IC

	Value	Tab 0-31
TABLE COD	TTT=0x3E	Coding HEX
Tariff code	TarAt	0002
Instant power (in time T1m, default 2 minute)	PT1m	1A05
Instant power (in time T2m, default 30 minute)	PT5m	1A06
Time of alarm	Tall	1A09
Type of Alarm	TypAl	1A08
Px integer value of power over available power relating K	XX	001A
DATE CURRENT	DATE	0A01
TIME CURRENT	TIME	0A02

18.17 Tab 63 for IC to program on CE for AG_IC

	Value	Tab 0-31
TABLE COD	TTT=0x3F	Coding HEX
Tariff code	TarAt	0002
Instant power (in time T1m, default 2 minute)	PT1m	1A05
Instant power (in time T2m, default 30 minute)	PT5m	1A06
Time of alarm	Tall	1A09
Type of Alarm	TypAl	1A08
Px integer value of power over available power relating K	XX	001A

19 ANNEX C (New GB messages)

Message : **SPONT**

GB_SPONT_BUFFER_FULL (019.006)

By this message LV-C notifies to AMM the buffer transactions is almost full (10 empty entries remaining in the Buffer).

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	006 (GB_SPONT_BUFFER_FULL)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
table ID	1	ID of full table:
		Response buffer = 15 TRAPE.RESP

Message : **SPONT**

GB_SPONT_PROC_END (019.007)

By this message LVC notifies to AMM the end of procedures via PLC or both PLC and RF.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	007 (GB_SPONT_PROC_END)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Proc ID	1	= x CONNC = x TB_PROC = x ALCA = x ACE = x FATT = x BE = x GQBT-I = x PLOAD = x DWLD = x PCONNC = x GQBT-V = x REC_CE = x CEDATA = x PSINC-T = x NPLOAD = x N2PLOAD = x QVI
Reason Code	1	0 = normal; 1 = aborted.

Message : **SPONT**

GB_FSYS_FULL (019.012)

By this message LV-C notifies to AMM the file system full condition.

For "file system full", it has to be intended when the disk free space is 5 MB.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	012 (GB_SPONT_FSYS_ FULL)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year

Note: The message shall be generated when the free space became 5 MB regardless of which procedure is running. As this event happens, it shall be reported by the “aborted” condition in the reason code field of the GB (019.007)_PROC_END event of the current procedure.

Message : **SPONT**

By this message LVC notifies to AMM its power-off/on.

GB_SPONT_LVC_POWER_OFF/ON (019.018)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	018 (GB_SPONT_ LVC_POWER_OFF/ON)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Status	1	Power-off=1 Power-on= 2

Note: The event/spont must be generated as soon as the concentrator detects a power-Off/On. The power-off event/spont must be handled during the power-off cycle.

Message : **SPONT**

By this message LVC notifies to AMM the IMEI of the GPRS modem connected.

GB_SPONT_GPRS_IMEI (019.019)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	019
Length	2	
Transaction Id	3	
Spont ID	1	019 (GB_SPONT_GPRS_IMEI)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
IMEI	15	Modem GPRS IMEI
COM	1	1=COM1 2=COM2

Note: The event must be generated only when a new modem is connected and the GPRS_IMEI field in T_GPRS changes status.

Message : **SPONT**

GB_SPONT_RF_BUFFER_FULL (039.006)

By this message LVC notifies to AMM the RF_TRAPE.RESP buffer is almost full (10 empty entries remaining in the Buffer).

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	006 (GB_SPONT_RF_BUFFER_FULL)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year120
Table ID	1	ID of full table: response buffer = 16 RF_TRAPE.RESP

Message : **SPONT**

GB_SPONT_RF_PROC_END (039.007)

By this message LVC notifies to AMM the end of procedures via RF channel.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	007 (GB_SPONT_RF_PROC_END)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Proc ID	1	= x TRF = x ACE = x DWL
Reason Code	1	0 = normal; 1 = aborted.

Message : **SPONT**

GB_SPONT_RF_CE_KO (039.008)(*)

By this message LVC notifies to AMM the CE not reachable/reachable state via RF channel.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	008 (GB_SPONT_RF_CE_KO)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
RF_CE_ADRR	8	
State	1	(0= reachable 1= not reachable)

Note: The concentrator will generate the GB (039.008) spont event with "State=0" only if it has previously generated a corresponding event for the same device with "State=1". The State=1 event is not generated if the CE Buffer RF_NRN(t)<RF_NRN in T_ATT.

If, after reporting the GB (039.008) spont event with "State=1", the concentrator resets, and the CE becomes reachable, the new event ("State=0)" will not be generated unless the concentrator has detected and again reported the CE as unreachable after the reboot.

(*) Future predisposition

Message : **SPONT** By this message LVC notifies to AMM an anomaly of the Status Word received from RF channel

GB_SPONT_RF_STS_WORD(039.009)(*)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	009 (GB_SPONT_RF_STS_WORD)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
RF_CE_ADRR	8	
Status word	2	
Extended status word	2	
Extended status word_2	2	
Extended status word_3	2	

This event is generated each time the concentrator detects that any of the alarm states has changed (from set to clear, or clear to set). If the PAD bit is set, the device is queried for the extended status word 0x1701 or in addition 0x1702 and 0x1703 for meter set as MM520Evo in the field [CS/VCS] of T_CE. These data are included in the event that has different length in relation to the setting of that bit. There are no object-specific fields defined to control generation of this message. Whether this message will generate a call to the AMM is dependent upon the SPONT_STSCEAGQ (0x800) and SPONT_STSIC (0x400) flags in the [SPONT] field of T_TLC.

Name	Bit	Alarm Condition	Meaning
ORD	1	Set	Clock not aligned
ONSI	2	Set	CE without temporal reference
AFC	3	Set	Alarm communication phase
SGR	5	Set	Data segregated
SCE1, SCE2	6,7	Both clear	CE State
PAD	10	Set	Presence of diagnostic alarms (extended status)
FVP	15	Set	Programming parameters variations

Message : **SPONT**

GB_SPONT_RF_CE_NACK (039.010)(*)

By this message LVC notifies to AMM possible NACK from CE after a Background procedure via RF.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	010 (GB_SPONT_RF_CE_NACK)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
RF_CE_ADRR	8	
CE NACK	1	The COMM code corresponding to the CE NACK
Request Code	1	
Request Length	1	
Request Data	n	

(*) Future predisposition

Message : **SPONT**

TRF_READ.RESP (003)(*)

By this message LVC notifies to AMM the result of the TRF_READ.REQ (002).

FIELD	# Byte	CODIF/RANGE
Message Type	1	008
Message Code	1	003
Length	2	
Transaction Id	3	
CE_ADDR	6	
Message Action	1	
PARAM_1	n	
PARAM_2	n	
…		
PARAM_x	n	

(*) Future predisposition

Message : **SPONT**

TRF_READTAB.RESP (007)(*)

By this message LVC notifies to AMM the result of the TRF_READTAB.REQ (006).

FIELD	# Byte	CODIF/RANGE
Message Type	1	008
Message Code	1	007
Length	2	
Transaction Id	3	
CE_ADDR	6	
Message Action	1	
ID TAB	1	
Num.Row_1	n	
PARAM_1	n	
PARAM_2	n	
…		
PARAM_X	n	

(*) Future predisposition

Message : **SPONT**

TRF_READTAB.RESP (009)(*)

By this message LVC notifies to AMM the result of the TRF_READTAB.REQ (008).

FIELD	# Byte	CODIF/RANGE
Message Type	1	008
Message Code	1	009
Length	2	
Transaction Id	3	
CE_ADDR	6	
Message Action	1	
ID TAB	1	
Num.Row_1	n	
PARAM_1	n	
PARAM_2	n	
…		
PARAM_X	n	

(*) Future predisposition

Message : **SPONT**

This message shall be used by LVC to close in AMM any transaction toward CE's.

TRF_ACK (251)(*)

FIELD	# Byte	CODIF/RANGE
Message Type	1	008
Message Code	1	251
Length	2	
Transaction Id	3	
Transaction result	1	

(*) Future predisposition

Message : **SPONT**

This message shall be used by DC to reject the requests from AMM.

TRF_LVC_NACK (255)(*)

FIELD	# Byte	CODIF/RANGE
Message Type	1	008
Message Code	1	255
Length	2	
Transaction Id	3	

(*) Future predisposition

Message : **SPONT**

GB_SPONT_RF_PROC_RES (039.012)(*)

By this message LVC notifies to AMM the result of the RF_ACE procedure for the involved meters.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	012 (GB_SPONT_RF_PROC_RES)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Proc ID	1	RF_ACE = 9
RF_CE_ADDR	8	
Result	1	RF_F(ACE) for CE1.

The event shall be generated during the RF_CE_ACE procedure at the moment in which the meter goes out of the algorithm, in any cases of success or not.

(*) Future predisposition

Message : **SPONT**

GB_SPONT_RF_PROC_RES (039.012)(*)

By this message LVC notifies to AMM the result of the RF_CE_DWL procedure for the involved meters.

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	012 (GB_SPONT_RF_PROC_RES)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Proc ID	1	RF_CE_DWL = 18
RF_CE_ADDR	8	
Result	1	RF_CE_F(DWL)
CE_SW	6	Meter software version

The event shall be generated during the RF_CE_DWL procedure at the moment in which the meter goes out of the algorithm, in any cases of success or not.

Note that in case of the meter software version is unknown, for example due a reachability problem, the field should be zeroed.

(*) Future predisposition

Message : **SPONT**

By this message LVC notifies to AMM the termination of the concentrator's RF_XTRAPE.RESP unload.

GB_SPONT_RF_XTRAPE.RESP (039.013)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	013 (GB_SPONT_RF_XTRAPE.RESP)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year

Note: This spontaneous has to be delivered soon by the concentrator through the "RF_event pipe" without logs at it into its buffer. This way, in case a connection failure occurs, it’s possible to avoid that in the successive buffer's unload been present the event of "buffer unload termination" generated by the previous unloading operation.

Message : **SPONT**

By this message LVC notifies to AMM the serial of the RF module connected.

GB_SPONT_RF_SN (039.019)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	019 (GB_SPONT_ RF_SN)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
Serial	16	RF Serial Number

Note: The event must be generated only when anew RF module is connected and the RF_SN field in T_RF_PAR changes status.

Message : **SPONT**

GB_SPONT_RF_NEW_NEIGH (039.023)

By this message the Concentrator notifies to AMM the CE_RF RSSI value received from CE during the first transmission via RF

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	023 (GB_SPONT_ RF_NEW_NEIGH)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
CE_RF ADDR	8	
RSSI	1	

Message : **SPONT**

GB_SPONT_RF_DEL_NEIGH (039.036)

By this message the Concentrator notifies to AMM the RF address of the meter deleted from T_NEIGH

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	036 (GB_SPONT_RF_DEL_NEIGH)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
CE_RF_ADDR	8	

Message shall be generated when a row is deleted from T_NEIGH by concentrator in case it doesn’t receive any message from a meter after a specific timing [DEL_NEIGH] configured in T_ATT.

Message : **SPONT**

GB_SPONT_RF_RSSI_NEIGH (039.037)

By this message the Concentrator notifies to AMM the CE_RF RSSI level variation

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	037 (GB_SPONT_ RF_RSSI_NEIGH)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
CE_RF ADDR	8	
Level	1	0x01 = Up;
		0x02 = Down.
Previous RSSI value	1	
New RSSI value	1	

Message shall be generated if the RSSI calculated during the last RF communication is greater or lower than the previous one in relation to the threshold [RF_LEVEL_NEIGH_x] stored in T_ATT.

Message : **SPONT**

GB_SPONT_RF_CE_EVENT (039.034)

By this message the Concentrator notifies to AMM the spontaneous received from CE via RF

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	034 (GB_SPONT_RF_CE_EVENT)
Timestamp	6	1 byte hour
Date/time of event		1 byte minute
		1 byte second
		1 byte day
		1 byte month
		1 byte year
CE_RF_ADDR	8	
EG_ID	2	Index number of the event
EG_TS_POSIX	4	Time stamp at which the event has been generated
EG_COD	1	Code of the event
EG_STATUS	N	Status codes of the event

Message : **SPONT**

GB_SPONT_RF_ZIP_BUFFER (039.050)

By this message the Concentrator notifies to AMM the zip creation of the RF_Trape.Resp due to buffer full condition

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	039
Length	2	
Transaction Id	3	
Spont ID	1	050 (GB_SPONT_RF_ZIP_BUFFER)
Timestamp Date/time of event	6	1 byte hour 1 byte minute 1 byte second 1 byte day 1 byte month 1 byte year
Zip Name	4	Name of the zip file (POSIX time) created for the RF_Trape.Resp
Number of zip	1	Number of zip files present in the /ftp/pub/buffer folder

Message : **LVC_NACK** Error Message LVC ⇒ AMM

GB_LVC_NACK (255)

FIELD	# Byte	CODIF/RANGE
Message Type	1	001
Message Code	1	255
Length	2	
Transaction Id	3	
Message Code found	1	Not Used
Error code	1	Error code
Offset field in error	2	Field index for that an error is found

Note: Offset=0 ("Message Code"), unknown message.

Offset=i, On the "i-th" Field" and error was found.

Error codes and GB_NACK(255) default messages

GB_CBT_NACK (255) default message is used for anomalies notices on the messages received from CBT. The message must contain all the information necessary to detect the anomaly found.

Error code	Meaning
0	Available
1	Concentrator status not set up; such code must be transmitted through GB_LV-C_NACK (255) message, when a GB message must manage a request and finds the LV-C status not set up.
2	Buffer empty upon receipt a GB_READNER(100)
3	Available
4	Table not existing
5	Bad pointers in MESS_REC buffer
6	Detection of the communication line on the CE affected by a request for modification of some characteristics.
7	Incorrect message length
8	Error code showing that the hour range or the date suitability ,in GB_SET.REQ (012) or GB_WRITE.REQ (004) or GB_WRITETAB.REQ messages, are incorrect
9	Clock programming error; upon LV-C timing, the date validity must be checked, If correct, LV-C must execute the writing on RTC; afterwards a further check must be carried out between the checked date and the programmed date. If the dates are not congruent, a GB_LV-C_NACK (255) message must be transmitted to AMM

10	GB procedure (PLC or RF) not enabled or not implemented. Message operation is not implemented or allowed
11	Invalid section/node address of meter / B-NODE; both fields of the address must be non-zero
12	Delivered in case LVC is unable to reply with the proper GB 041 message
13 ÷ 14	Available
15	Message code unknown
16	Error condition found when GB_010.008 message is delivered (known topology scenario); when it is performed the storage of the connection state with GB_WRITETAB(COL).REQ (010.008) message, if for a section/node, a connection's sections are outside the limit or are identical or has no known path, the error must be notified. The anomaly is returned when validation fails in response to a "START" request
17 ÷ 19	Available
20	Error condition found in vertexes (known topology scenario) when GB_010.008 message is delivered; upon the connections storage, the addresses of the section "vertexes" of the connections, contained in the GB_WRITETAB(COL).REQ (010.008) message, must be checked. If the section "first vertex" should be unknown, the error rises up. This is also reported when a repeat section is disconnected. The anomaly is returned when validation fails in response to a "START" request.
21 ÷ 31	Available
32	Error condition found when loading LV network (known topology scenario); upon LV network loading or in consequence of its modification, the LV network scheme must be verified. If a close loop or two inter-connected busbar are detected, LV-C must notify the discrepancy
33 ÷ 37	Available
38	When AMM transmits to LV-C the date and the hour for the timing with GB_WRITESINC.REQ (004) message, if the transmitted hour is included between 2:00 and 3:00 of the start day of the daylight-saving time period, it must not be accepted (applies to to GB…REQ messages (004), (010) or (012).
39	Wrong message sub-code generated for a read request with bad row o table number
40 ÷ 44	Available
45	Transaction request on inexistent line (known topology scenario)
46	Buffer Full
47	Available
48	Error in the Function type in GB_WRITETAB (010.XXX) message, such as bad row id, bad Tab id, or table is read only.
49 ÷ 51	Available
52	Not acceptable request during the mode operations in progress for example writing a table other than Status Table while procedures are running.
53 ÷ 61	Available
62	Transaction ID repeated
63	Attempt to remove a transaction already in progress
64 ÷ 70	Available
71	Duplicate CE Sub Section/progressive IDs detected. The Nack massage is sent at table writing without saving the configurations, the Offset field indicates the duplicated row. The checking is done only at "node" field writing, it means that: - If a whole T_CE row is written in a single GB command the concentrator can manage the checking in order to evaluate the matching of the subnet/node couple value to be set

	- If the fields subnet and/or node are written in different GB commands the concentrator cannot manage the checking due to the partial configuration, and so the following procedure will be applied between concentrator and central system: 1. The central system has to write in sequence the subnet and then the node field 2. when the subnet is written the concentrator set to zero the node 3. when the node is written the subnet/node couple is checked by the concentrator
72	Invalid repeat table entry for meter
73	Concentrator section ID or length is invalid
74	PLC or RF Priority table entry is invalid. The Nack massage is sent at table writing without saving the configurations.
75	Cannot open app image file. The Nack massage is sent at table writing without saving the configurations.
76	Digest mismatch in image file. The Nack massage is sent at table writing without saving the configurations.
77	Request not allowed in current mode (stand alone / AMM – managed)
78	Download image file date/time has expired. The Nack massage is sent at table writing without saving the configurations.
79	HHU timer(s) out of range(s)
80	Mismatch between IDs in the meters and IC_CONF tables
81	Mismatch between IDs in the meters and AGST tables
82	Indicates that duplicate device identifiers were detected among the CE, RF_CE, IC_CONF and AGST tables. The Nack massage is sent at table writing without saving the configurations, the Offset field indicates the duplicated row.
83	Mismatch between meters and TABKEYAPT tables
84	Indicates an internal LVC error of unknown origin.
85	Bad GB-level authentication reply
86	Message discarded because socket connection on port 50010 has not yet been secured. Sender should wait until the connection is GB-level authenticated before sending messages
87	Bad GB-level authentication challenge (incoming challenge is identical to outgoing challenge)
88	Incorrect digest during GPRS authentication procedure
89	Delivered in case of tentative of exchange of data first that GPRS authentication procedure has been terminated
90	Concentrator does not accept FTP_USER / FTP_PASSWORD received within the GB(038) message
91	Delivered when GQBT "F_DETECT" > "INTERVAL"
92	There is not device associated to GB(048) request
93	The command GB(048.008) has been already sent and procedure is running
94	The command GB_READ_VER(050.002) is wrong
95	The command GB_READ_MD5(050.003) is wrong
96	The command GB_FW_GPRS(048.008) is wrong
97	Out of range during a field writing

GB_LVC_VER (050.002) Concentrator software version reading

Field	# Byte	coding	
Message Type	1	1	
Message Code	1	50	
Lenght	2	3	
Transaction ID	3	xx	
Device	1	2	
Mode	2	0	

GB_LVC_VER (051.002) Concentrator software version response, LVM:

Field	# Byte	coding	
Message Type	1	1	
Message Code	1	51 (0x33)	
Lenght	2	X	X=3+2+2+4+1+2+3+3+3+30+3
Transaction ID	3	Xx	
Param1	4	versions	MBApp (3bytes) WATCHDOG (2byte) EBApp (2byte) RTE (4byte) RF (HW 1byte, SW 2byte) FS LINUX (3byte) FS GREENGRASS (3byte) FS LVS (3byte) GPRS (30bytes) (eg."*VER: 01.19 CM_ME3620") FS CUSTOMER (3 byte)

If a module is not connected or it doesn't reply (for example due to a fault), its version shall be zero in the response

GB_LVC_VER (051.002) Concentrator software version response, MSC:

For compatibility with LVM, the GB 51 will answer with the same length string as before, but due to MSC hardware may have not the feature the relative versions is filled by zeros, as highlighted in the following table.

Field	# Byte	coding	
Message Type	1	1	
Message Code	1	51 (0x33)	
Lenght	2	X	X=3+2+2+4+1+2+3+3+3+30+3
Transaction ID	3	xx	
Param1	4	versions	MBApp (3bytes) WATCHDOG (2byte) EBApp (2byte) RTE (4byte) **– filled by zeros** RF (HW 1byte, SW 2byte) FS LINUX (3byte) **– filled by zeros** FS GREENGRASS (3byte) **– filled by zeros** FS LVS (3byte) **– filled by zeros** GPRS (30bytes) (eg."*VER: 01.19 CM_ME3620") FS CUSTOMER (3 byte) **– filled by zeros**

If a module is not connected or it doesn't reply (for example due to a fault), its version shall be zero in the response

MBApp (3bytes) is composed by:

YY_XX_ZZ where:

YY is the fixed version ("0A" for LVM and "07" for MSC)

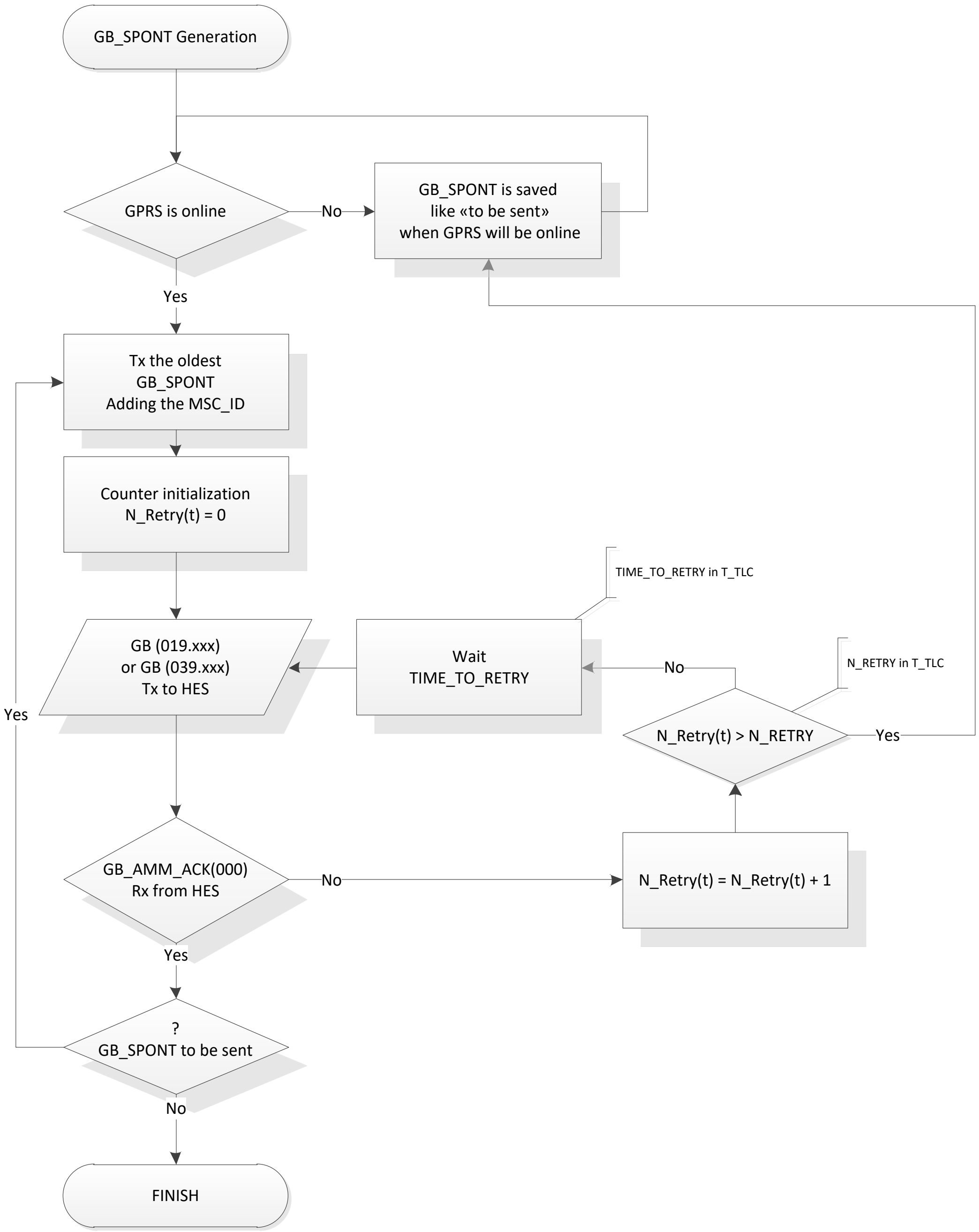
XX is the minor sub-version

ZZ is the major version

20 ANNEX D (Use cases)

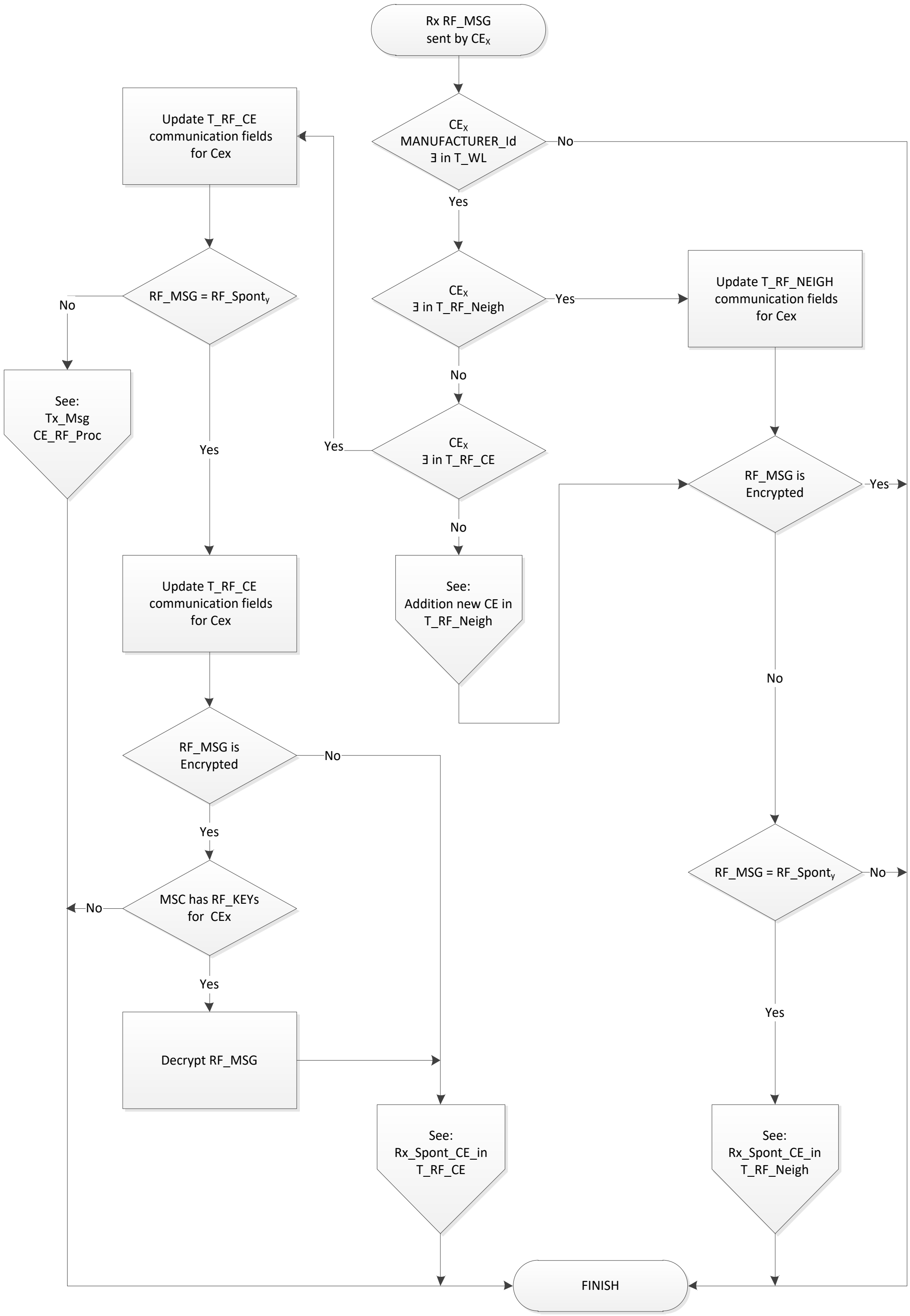
20.1 Tx_Spont_To_AMM

The flow chart below describes the behaviour of the concentrator when a GB SPONTANEOUS message has to be transmit via GPRS to AMM.



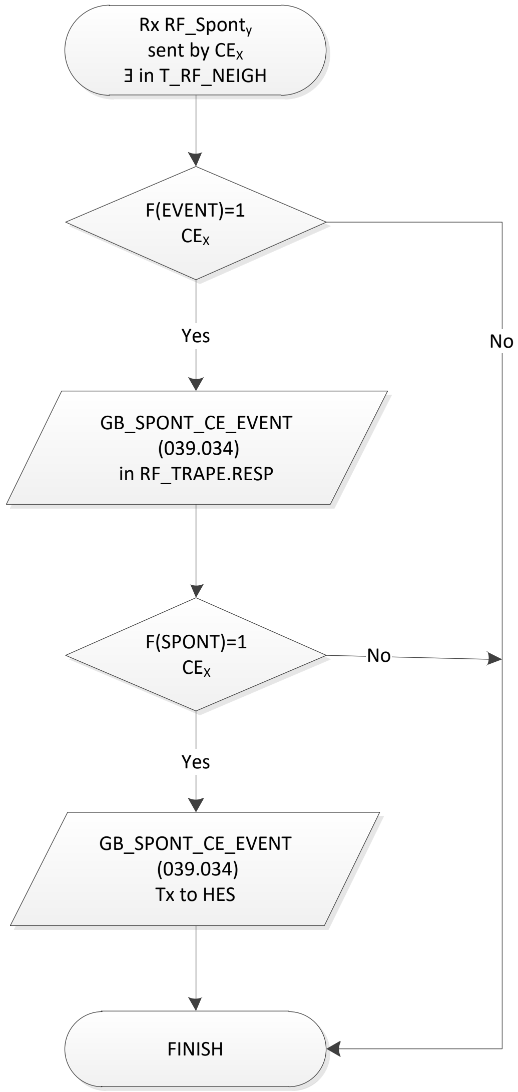
20.2 Rx_Msg_RF

The flow chart below describes the behaviour of the concentrator when a CE RF message is received.



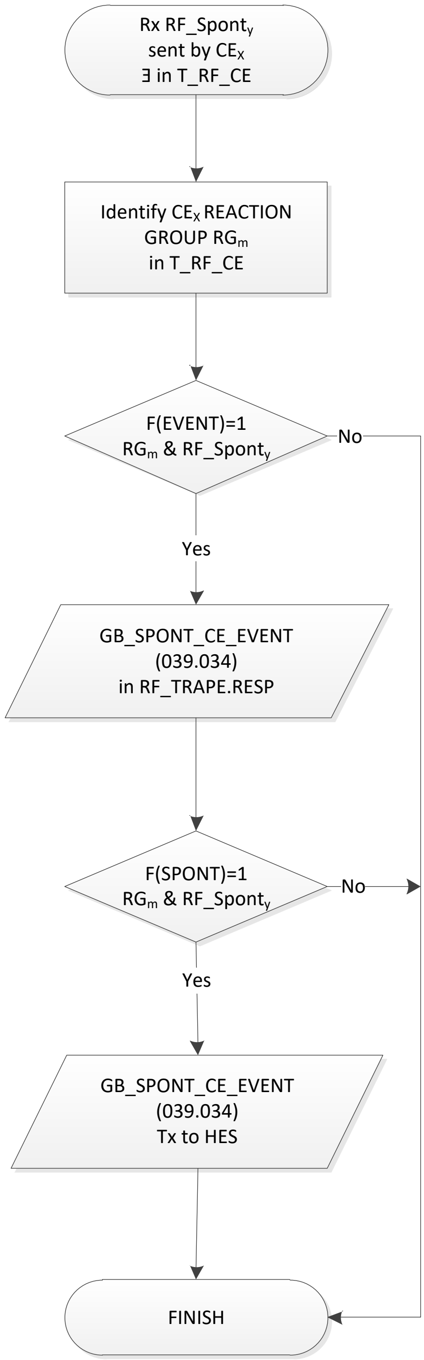
20.3 RF Rx_Spont_CE_in_T_RF_Neigh

The flow chart below describes the behaviour of the concentrator when a Spontaneous message, sent by a CE included in T_RF_NEIGH, is received via RF.



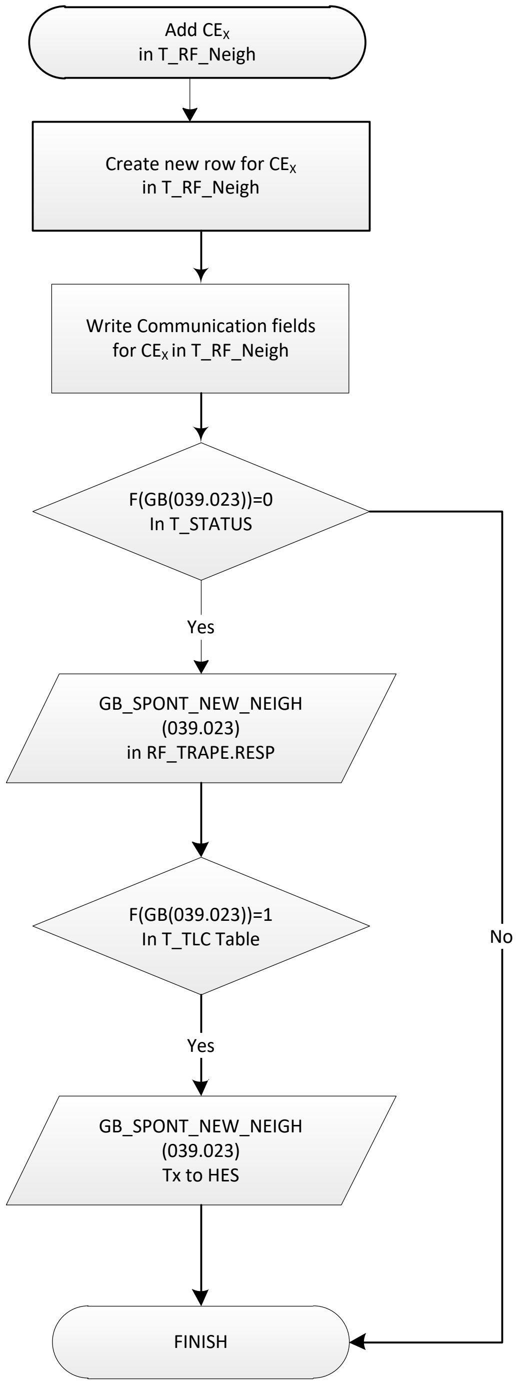
20.4 Rx_Spont_CE_in_T_RF_CE

The flow chart below describes the behaviour of the LVM when a Spontaneous message, sent by a CE included in T_RF_CE, is received via RF.



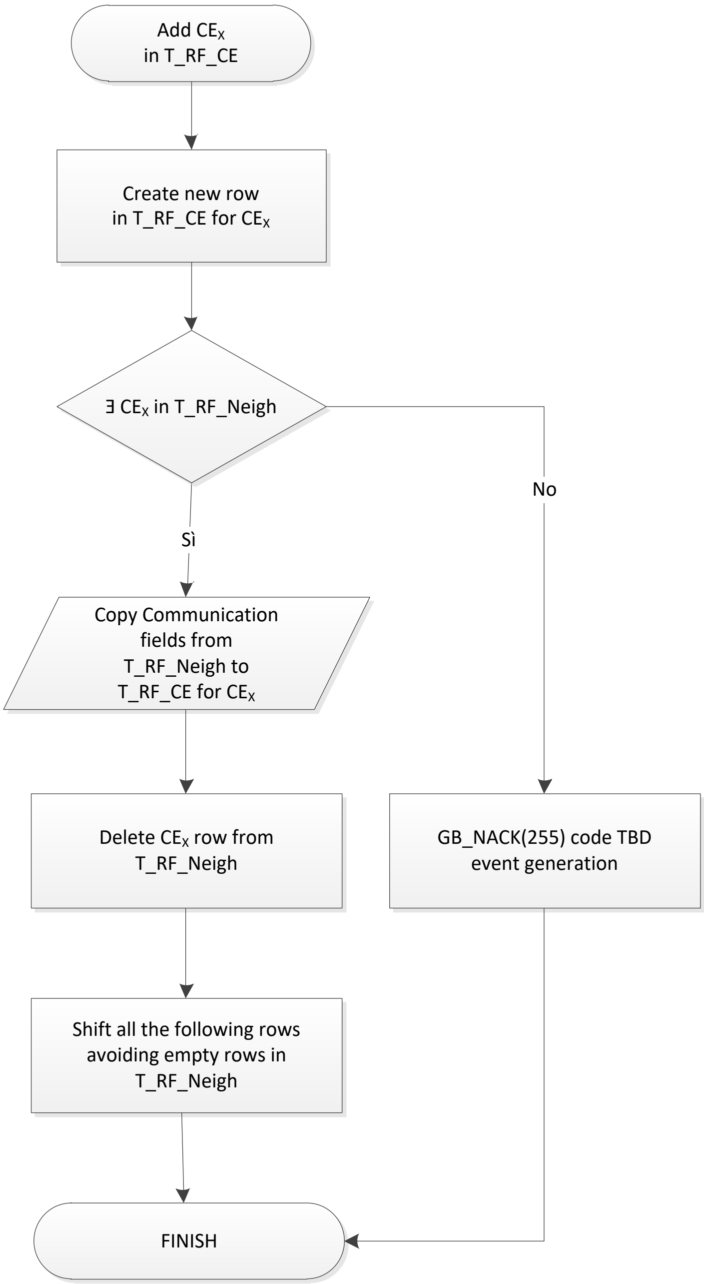
20.5 Adding_CE_in_T_RF_Neigh

The flow chart below describes the behaviour of the concentrator when a new CE is received and consequently added to the RF_Neighbour table.



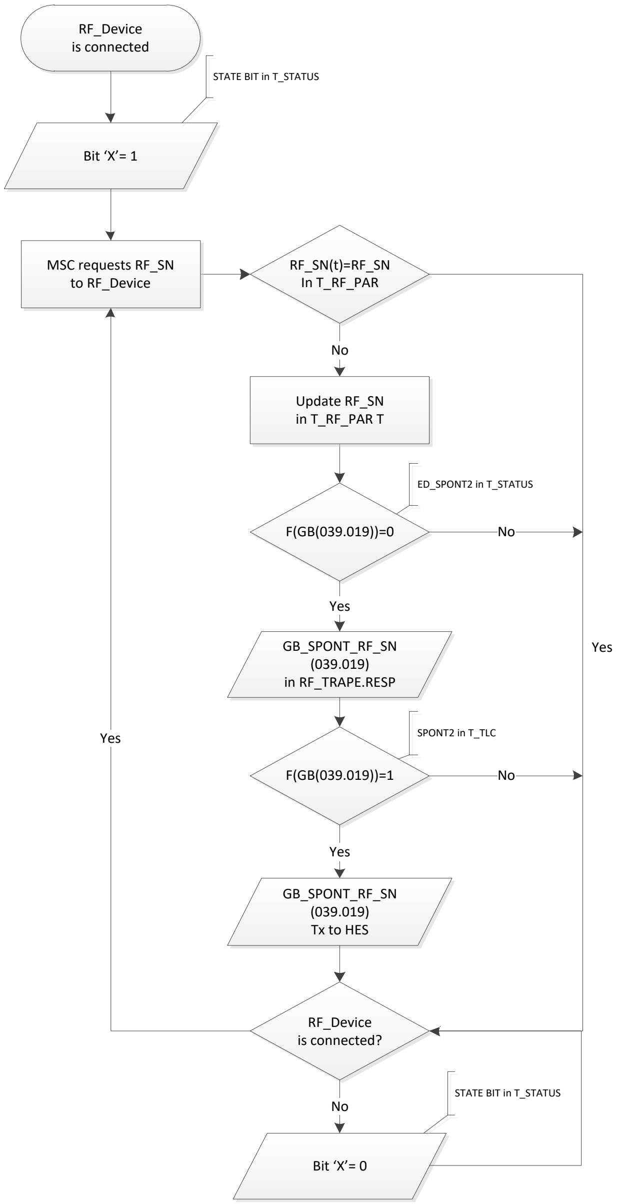
20.6 Adding_CE_in_T_RF_CE

The flow chart below describes the behaviour of the concentrator when a new CE is added to the RF_CE table.



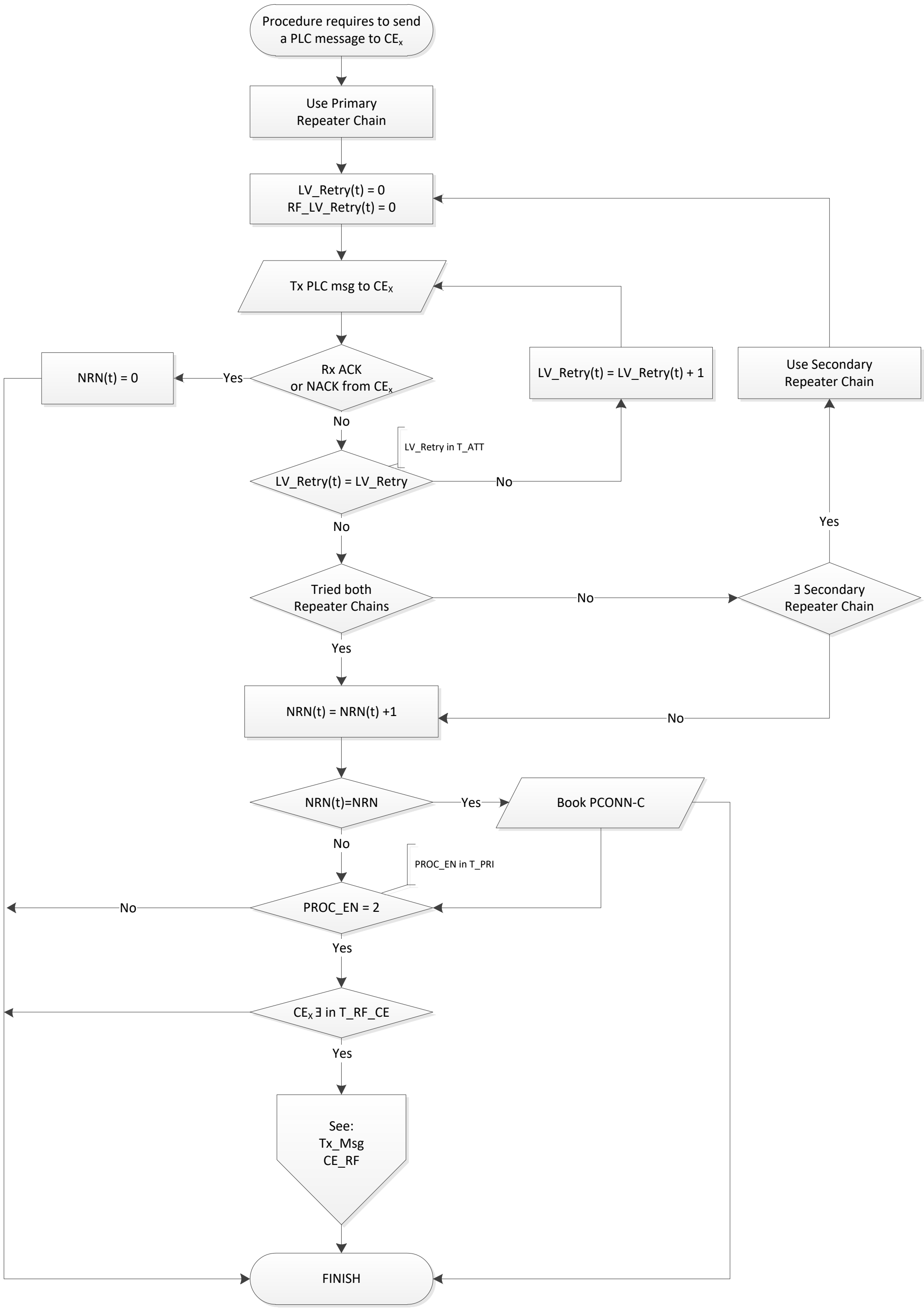
20.7 RF_Module

The flow chart below describes how the concentrator takes in to account the connection and disconnection of the RF module.



20.8 Tx_Msg_CE_PLC

Flow chart below describes the concentrator behaviour when a PLC Procedure requires to send a message to a meter. Except those PROC existing only on PLC: ACE, CONN-C, PCONN-C and RECOVERY_CE. For now the retry via RF described in the flow chart is valid only for TB procedure.



20.9 Tx_Msg_CE_RF

Flow chart below describes the concentrator behaviour when a RF procedure requires to send a message to a meter.