**Table 14 – Mapping IEC 61334-4-512:2001 MIB variables to
COSEM IC attributes / methods**

Name	Reference (unless otherwise indicated)	Interface class	class_id / attribute / method
S-FSK Physical layer management			
delta-electrical-phase	variable 1	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 3
max-receiving-gain	variable 2		50 / Attr. 4
max-transmitting-gain	–		50 / Attr. 5
search-initiator-threshold	–		50 / Attr. 6
frequencies	–		50 / Attr. 7
transmission-speed	–		50 / Attr. 15
MAC layer management			
mac-address	variable 3	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 8
mac-group-addresses	variable 4		50 / Attr. 9
repeater	variable 5		50 / Attr. 10
repeater-status	–		50 / Attr. 11
search-initiator time-out	–	S-FSK MAC synchronization timeouts (class_id = 52, version = 0)	52 / Attr. 2
synchronization-confirmation-time-out	variable 6		52 / Attr. 3
time-out-not-addressed	variable 7		52 / Attr. 4
time-out-frame-not-OK	variable 8		52 / Attr. 5
min-delta-credit	variable 9	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 12
initiator-mac-address	IEC 61334-5-1:2001 4.3.7.6		50 / Attr. 13
synchronization-locked	variable 10		50 / Attr. 14
IEC 61334-4-32 LLC layer management			
max-frame-length	IEC 61334-4-32:1996 5.1.4	IEC 61334-4-32 LLC setup (class_id = 55, version = 1)	55 / Attr. 2
reply-status-list	variable 11		55 / Attr. 3
broadcast-list	variable 12	–	–
L-SAP-list	variable 13	NOTE In DLMS/COSEM, L-SAPs of logical devices are held by a SAP Assignment object	
ACSE management			
application-context-list	variable 14	NOTE In DLMS/COSEM the Association objects play a similar role.	
Application management			
active-initiator	variable 15	S-FSK Active initiator (class_id = 51, version = 0)	51 / Attr. 2
MIB system objects			
reporting-system-list	variable 16	-FSK Reporting system list (class_id = 56, version = 0)	56 / Attr. 2

Name	Reference (unless otherwise indicated)	Interface class	class_id / attribute / method
		Other MIB objects	
reset-NEW-not-synchronized	variable 17	S-FSK Active initiator (class_id = 51, version = 0)	51 / Method 1
new-synchronization	IEC 61334-5-1:2001 4.3.7.6	–	
initiator-electrical-phase	variable 18		50 / Attr. 2
broadcast-frames-counter	variable 19	S-FSK MAC counters (class_id = 53, version = 0)	53 / Attr. 4
repetitions-counter	variable 20		53 / Attr. 5
transmissions-counter	variable 21		53 / Attr. 6
CRC-OK-frames-counter	variable 22		53 / Attr. 7
CRC-NOK-frames-counter	–		53 / Attr. 8
synchronization-register	variable 23		53 / Attr. 2
desynchronization-listing	variable 24		53 / Attr. 3

5.8.3   S-FSK Phy&MAC set-up (class_id = 50, version = 1)

NOTE 1   The use of version 0 of this interface class is deprecated.

An instance of the "S-FSK Phy&MAC set-up" class stores the data necessary to set up and manage the physical and the MAC layer of the PLC S-FSK lower layer profile.

S-FSK Phy&MAC setup		0…n	class_id = 50, version = 1			
Attributes		*Data type*	*Min.*	*Max.*	*Def.*	*Short name*
1. logical_name	(static)	octet-string				x
2. initiator_electrical_phase	(static)	enum	0	3		x + 0x08
3. delta_electrical_phase	(dyn.)	enum	0	6		x + 0x10
4. max_receiving_gain	(static)	unsigned				x + 0x18
5. max_transmitting_gain	(static)	unsigned				x + 0x20
6. search_initiator_threshold	(static)	unsigned			98	x + 0x28
7. frequencies	(static)	frequencies_type				x + 0x30
8. mac_address	(dyn.)	long-unsigned			FFE	x + 0x38
9. mac_group_addresses	(static)	array				x + 0x40
10. repeater	(static)	enum				x + 0x48
11. repeater_status	(dyn.)	boolean				x + 0x50
12. min_delta_credit	(dyn.)	unsigned				x + 0x58
13. initiator_mac_address	(dyn.)	long-unsigned				x + 0x60
14. synchronization_locked	(dyn.)	boolean				x + 0x68
15. transmission_speed	(static)	enum	0	6	3	x + 0x70
Specific methods		*m/o*				

Attribute description	
logical_name	Identifies the "S-FSK Phy&MAC setup" object instance. See 6.2.22.
initiator_ electrical_phase	Holds the MIB variable *initiator-electrical-phase* (variable 18) specified in IEC 61334-4-512:2001, 5.8.
	It is written by the client system to indicate the phase to which it is connected.
	enum: (0) Not defined (default), (1) Phase 1, (2) Phase 2, (3) Phase 3
	NOTE 2 This enumeration is different from that of IEC 61334-4-512.
delta_ electrical_phase	Holds the MIB variable *delta-electrical-phase* (variable 1) specified in IEC 61334-4-512:2001, 5.2 and IEC 61334-5-1:2001,3.5.5.3.
	It indicates the phase difference between the client's connecting phase and the server's connecting phase. The following values are predefined:
	enum: (0) Not defined: the server is temporarily not able to determine the phase difference, (1) The server system is connected to the same phase as the client system.
	The phase difference between the server's connecting phase and the client's connecting phase is equal to: (2) 60 degrees, (3) 120 degrees, (4) 180 degrees, (5) -120 degrees, (6) -60 degrees
max_ receiving_gain	Holds the MIB variable *max-receiving-gain* (variable 2) specified in IEC 61334-4-512:2001, 5.2 and IEC 61334-5-1:2001, 3.5.5.3.
	Corresponds to the maximum allowed gain bound to be used by the server system in the receiving mode. The default unit is dB.
	NOTE 3 In IEC 61334-4-512:2001, no units are specified.
	The possible values of the gain may depend on the hardware. Therefore, after writing a value to this attribute, the value should be read back to know the actual value.
max_ transmitting_gain	Holds the value of the *max-transmitting-gain*.
	Corresponds to the maximum attenuation bound to be used by the server system in the transmitting mode. The default unit is dB.
	The possible values of the gain may depend on the hardware. Therefore, after writing a value to this attribute, the value should be read back to know the actual value.
search_initiator_ threshold	This attribute is used in the intelligent search initiator process. If the value of the initiator signal is above the value of this attribute, a fast synchronization process is possible.
	The default value is 98 dBμV.

frequencies	Contains frequencies required for S-FSK modulation.
	
	frequencies_type::= structure
	{
	      mark_frequency: double-long-unsigned,
	      space_frequency: double-long-unsigned
	}
	The default unit is Hz.

mac_address	Holds the MIB variable *mac-address* (variable 3) specified in IEC 61334-4-512:2001, 5.3 and in IEC 61334-5-1:2001, 4.3.7.6. NOTE 4 MAC addresses are expressed on 12 bits. Contains the value of the address of the physical attachment (MAC address) associated to the local system. In the unconfigured state, the MAC address is "NEW-address". This attribute is locally written by the CIASE when the system is registered (with a Register service). The value is used in each outgoing or incoming frame. The default value is "NEW-address". This attribute is set to NEW: – by the MAC sub-layer, once the time-out-not-addressed delay is exceeded; – when a client system "resets" the server system. See the 5.8.4. When this attribute is set to NEW: – the system loses its synchronization (function of the MAC-sublayer); – the *mac_group_address* attribute is reset (array of 0 elements); – the system automatically releases all AAs which can be released. NOTE 5 The second item is not present in IEC 61334-4-512:2001. The predefined MAC addresses are shown in Table 15.
mac_group_ addresses	Holds the MIB variable *mac-group-address* (variable 4) specified in IEC 61334-4-512:2001 5.3 and in IEC 61334-5-1:2001 4.3.7.6. Contains a set of MAC group addresses used for broadcast purposes. array mac-address mac-address::= long-unsigned The ALL-configured-address, ALL-physical-address and NO-BODY addresses are not included in this list. These ones are internal predefined values. This attribute shall be written by the initiator using DLMS services to declare specific MAC group addresses on a server system. This attribute is locally read by the MAC sublayer when checking the destination address field of a MAC frame not recognized as an individual address or as one of the three predefined values (ALL-configured-address, ALL-physical-address and NO-BODY).

repeater	Holds the MIB variable *repeater* (variable 5) specified in IEC 61334-4-512:2001, 5.3 and in IEC 61334-5-1:2001, 4.3.7.6.
	
	It specifies whether the server system effectively repeats all frames or not.
	
	enum: (0) never repeater,
	             (1) always repeater,
	             (2) dynamic repeater

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repeater cont'd	If the *repeater* variable is equal to 0, the server system should never repeat the frames.
	If it is set to 1, the server system is a repeater: it has to repeat all frames received without error and with a current credit greater than zero.
	If it is set to 2, then the repeater status can be dynamically changed by the server itself.
	NOTE 6 The value 2 value is not specified in IEC 61334-4-512.
	This attribute is internally read by the MAC sub-layer each time a frame is received.
	The default value shall be specified in project specific companion specifications.
repeater_status	Holds the current *repeater status* of the device.
	boolean (0) FALSE = no repeater, : (1) TRUE = repeater
min_delta_credit	Holds the MIB variable *min-delta-credit* (variable 9) specified in IEC 61334-4-512:2001, 5.3 and in IEC 61334-5-1:2001,4.3.7.6.
	NOTE 7 Only the three least significant bits are used.
	The Delta Credit (DC) is the subtraction of the Initial Credit (IC) and Current Credit (CC) fields of a correct received MAC frame. The delta-credit minimum value of a correct received MAC frame, directed to a server system, is held by this variable.
	The default value is set to the maximal initial credit (see IEC 61334-5-1:2001, 4.2.3.1 for further explanations on the credit and the value of MAX_INITIAL_CREDIT). A client system can reinitialise this variable by setting its value to the maximal initial credit.
initiator_mac_ address	Holds the MIB variable *initiator-mac-address* specified in IEC 61334-5-1:2001, 4.3.7.6.
	Its value is either the MAC address of the active-initiator or the NO-BODY address, depending on the value of the *synchronization_locked* attribute (see below). See also IEC 61334-5-1:2001, 3.5.3, 4.1.6.3 and 4.1.7.2.
synchronization_ locked	Holds the MIB variable *synchronization-locked* (variable 10) specified in IEC 61334-4-512:2001, 5.3.
	Controls the synchronization locked / unlocked state. See IEC 61334-5-1:2001 for more details.
	If the value of this attribute is equal to TRUE, the system is in the synchronization-locked state. In this state, the *initiator-mac-address* is always equal to the MAC address field of the active-initiator MIB object. See attribute 2 of the S-FSK Active initiator IC in 5.8.4.
	If the value of this attribute is equal to FALSE, the system is in the synchronization-unlocked state. In this state, the *initiator_mac_address* attribute is always set to the NO-BODY value: a value change in the MAC address field of the active-initiator MIB object does not affect the content of the *initiator_mac_address* attribute which remains at the NO-BODY value. The default value of this variable shall be specified in the implementation specifications.
	NOTE 8 In the synchronization-unlocked state, the server synchronizes on any valid frame. In the synchronization locked state, the server only synchronizes on frames issued or directed to the client system the MAC address of which is equal to the value of the *initiator_mac_address* attribute.

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transmission_ speed	The transmission speed supported by the physical device. See also IEC 61334-5-1:2001, 3.2.2.		
	enum:	50Hz	60 Hz
	(0)	300 baud	360 baud
	(1)	600 baud	720 baud
	(2)	1 200 baud	1 440 baud
	(3) -- default	2 400 baud	2 880 baud
	(4)	4 800 baud	5 760 baud
	(5)	7 200 baud	8 640 baud
	(6)	9 600 baud	11 520 baud

Table 15 – MAC addresses in the S-FSK profile

Address	Value
NO-BODY	000
Local MAC	001…FIMA-1
Initiator	FIMA…LIMA
MAC group address	LIMA + 1…FFB
All configured	FFC
NEW	FFE
All Physical	FFF
NOTE MAC addresses are expressed on 12 bits. These addresses are specified in IEC 61334-5-1:2001 4.2.3.2, 4.3.7.5.1, 4.3.7.5.2 and 4.3.7.5.3.	
FIMA = First Initiator MAC address; C00	
LIMA = Last Initiator MAC address; DFF	

5.8.4   S-FSK Active initiator (class_id = 51, version = 0)

An instance of the "S-FSK Active initiator" IC stores the data of the active initiator. The active initiator is the client system, which has last registered the server system with a CIASE Register request. See IEC 61334-4-511:2000, 7.2.

S-FSK Active initiator		0…n	class_id = 51, version = 0			
Attributes		*Data type*	*Min.*	*Max.*	*Def.*	Short name
1. logical_name	(static)	octet-string				x
2. active_initiator	(dyn.)	initiator_descriptor				x + 0x08
Specific methods		*m/o*				
1. reset_NEW_not_synchronized						x + 0x10

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Attribute description	
logical_name	Identifies the "S-FSK Active initiator" object instance. See 6.2.22.

active_initiator	Holds the MIB variable *active-initiator* (variable 15) specified in IEC 61334-4-512:2001, 5.6.
	
	Contains the identifiers of the active initiator, which has last registered the system with a Register request. See IEC 61334-4-511:2000, 7.2.
	
	The Initiator system is identified with its System Title, MAC address and L-SAP selector:
	
	initiator_descriptor::= structure
	{
	     system_title: octet-string,
	     MAC_address: long-unsigned,
	     L_SAP_selector: unsigned
	}
	
	The size and the structure of the system title may be specified in system specifications. When the system title is used as part of the initialisation vector of cryptographic algorithms, then the size shall meet the requirements applicable for the initialisation vector.
	
	The MAC_address element is used to update the *initiator-mac-address* MAC management variable when the system is configured in the synchronization-locked state. See the specification of the *initiator_mac_address* and the *synchronization_locked* attributes of the S-FSK Phy&MAC setup IC in 5.8.3.
	
	As long as the server is not registered by an active initiator, the L_SAP_selector field is set to 0 and the system_title field is equal to an octet string of 0s.
	
	The default value of the initiator-descriptor is: system_title = octet-string of 0s, MAC_address = NO-BODY and L_SAP_selector = 0.
	
	The value of this attribute can be updated by the invocation of the *reset_NEW_not_synchronized* method or by the CIASE Register service.

Method description

reset_NEW_not_ synchronized (data)	Holds the MIB variable *reset-NEW-not-synchronized* (variable 17) specified in IEC 61334-4-512:2001, 5.8.

Allows a client system to "reset" the server system. The submitted value corresponds to a client MAC address. The writing is refused if:

- the value does not correspond to a valid client MAC address or the predefined NO-BODY address;

- the submitted value is different from the NO-BODY address and the *synchronization_locked* attribute is not equal to TRUE.

For the description of the Intelligent Search Initiator process, see NOTE Harmonized as EN 62056-7-6:2013 (not modified).

IEC 62056-8-3:2013, 10.7.

When this method is invoked, the following actions are performed:

- the system returns to the unconfigured state (UNC: MAC-address equals NEW-address). This transition automatically causes the synchronization lost (function of the MAC sub layer);

- the system changes the value of the *active_initiator* attribute: the MAC_address is set to the submitted value, the L-SAP_selector is set to the value 0 and the system_title is set to an octet-string of 0s;

- all AAs that can be released are released.

5.8.5 S-FSK MAC synchronization timeouts (class_id = 52, version = 0)

An instance of the "S-FSK MAC synchronization timeouts" IC stores the timeouts related to the synchronization process.

S-FSK MAC synchronization timeouts		0…n	class_id = 52, version = 0			
Attributes		*Data type*	*Min.*	*Max.*	*Def.*	*Short name*
1. logical_name	(static)	octet-string				x
2. search_initiator_timeout	(static)	long-unsigned				x + 0x08
3. synchronization_confirmation_ timeout	(static)	long-unsigned				x + 0x10
4. time_out_not_addressed	(static)	long-unsigned				x + 0x18
5. time_out_frame_not_OK	(static)	long-unsigned				x + 0x20
Specific methods		*m/o*				

Attribute description	
logical_name	Identifies the "S-FSK synchronization timeouts" object instance. See 6.2.22.
search_initiator_ timeout	This timeout supports the intelligent search initiator function.
	It defines the value of the time, expressed in seconds, during which the server system is searching for the initiator with the strongest signal.
	During this timeout, all initiators, which may be heard by the servers, are expected to talk.
	After the expiry of this timeout, the server will accept a Register request from the initiator having provided the strongest signal and it will be locked to that initiator.
	If the value of the timeout is equal to 0, this means that the feature is not used.
	The timeout is started at the beginning of the Search Initiator Phase, when the server receives the first frame with a valid initiator MAC address. The timeout is restarted when the Search Initiator Phase is over and the server locks on the initiator. During the Check Initiator Phase, it is restarted on the reception of each valid frame.
	NOTE A Fast synchronization may be performed if the level of signal is good enough (Level of initiator signal >= Search-Initiator-Threshold) and one of the MAC addresses (Source or Destination) is an Initiator MAC address. This means that the module (the meter) is next to a DC or next to a module that is already locked on that DC. The module locks in this case on that initiator.
synchronization_ confirmation_ timeout	Holds the MIB variable *synchronization-confirmation-timeout* (variable 6*)* specified in IEC 61334-4-512:2001, 5.3 and IEC 61334-5-1:2001, 4.3.7.6.
	Defines the value of the time, expressed in seconds, after which a server system which just gets frame synchronized (detection of a data path equal to AAAA54C7 hex) will automatically lose its frame synchronization if the MAC sublayer does not identify a valid MAC frame. The timeout starts after the reception of the first four bytes of a physical frame.
	The value of this variable can be modified by a client system. This time-out ensures a fast desynchronization of a system, which has synchronized on a wrong physical frame. See IEC 61334-5-1:2001, 3.5.3 for more details.
	The default value of this variable should be specified in the implementation specifications.
	A value equal to 0 is equivalent to cancel the use of the related *synchronization_confirmation_timeout* counter.

time_out_not_ addressed	Holds the MIB variable *time-out-not-addressed* (variable 7) specified in IEC 61334-4-512:2001, 5.3 and in IEC 61334-5-1:2001, 4.3.7.6.
	Defines the time, in minutes, after which a server system that has not been individually addressed:
	– returns to the non configured state (UNC: MAC-address equals NEW-address): this transition automatically involves the loss of the synchronization (function of the MAC sub layer) and releasing all AAs that can be released;
	– loses its active initiator: the MAC address of the active-initiator is set to NO-BODY, the LSAP selector is set to the value 00 and the System Title is set to an octet-string of 0s.
	Because broadcast addresses are not individual system addresses, the timer associated with the *time-out-not-addressed* delay ensures that a forgotten system will sooner or later return to the unconfigured state. It will be then discovered again.
	A forgotten system is a system, which has not been individually addressed for more than the "*time-out-not-addressed*" amount of time.
	The default value of this variable should be specified in the implementation specifications.
	A value equal to 0 is equivalent to cancel the use of the related time-out-not-addressed counter.
time_out_frame_ not_OK	Holds the MIB variable *time-out-frame-not-OK* (variable 8), specified in IEC 61334-4-512:2001, 5.3 and in IEC 61334-5-1:2001, 4.3.7.6.
	Defines the time, in seconds, after which a server system that has not received a properly formed MAC frame (incorrect NS field, inconsistent number of received sub frames, false Cyclic Redundancy Code checking) loses its frame synchronization.
	The default value of this variable shall be specified in the implementation specifications.
	A value equal to 0 is equivalent to cancel the use of the related *time-out-frame-not-OK* counter.

5.8.6   S-FSK MAC counters (class_id = 53, version = 0)

An instance of the "S-FSK MAC counters" IC stores counters related to the frame exchange, transmission and repetition phases.