DeviceLab
EXTRACTING VALUE

What are we going to talk about

- Take data from water meter and show how it could look for
  - C mode Wmbus telegram
  - OMS LPWAN splitting mode telegram
  - OMS over mioty with Adaptation layer.

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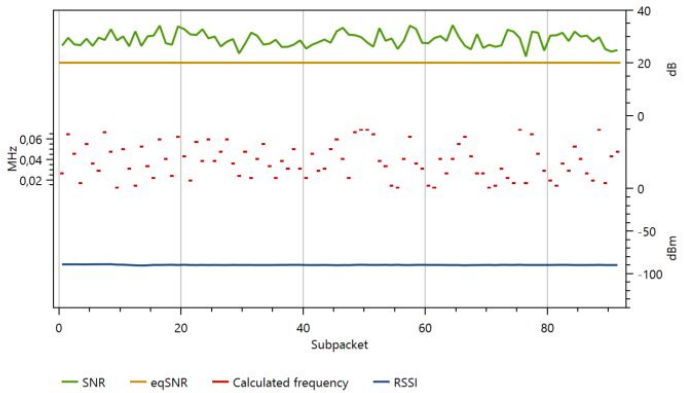
Real world OMS LPWAN example meter frame

Reception time	RSSI	SNR	eqSNR	Long Address	Serial	Manuf	Ver	Dev	Description	Status	Main value	ACC	Encryption	wMbus mode	Frame format
06/04/2026 15.45.30				0000000000000001	87282251	DME	63	07	Hydrus 2.0 -	70	0,200 m3	4268	TsUnbMac	Mioty	MiotyFixedMac
06/04/2026 15.45.30					87282251	DME	63	07	Hydrus 2.0 -	70	0,200 m3	C9	Mode7	ModeC1	FormatA
06/04/2026 15.45.30	-90	30,21	20,13		87282251	DME	63	07	Hydrus 2.0 -	70	0,200 m3	C9	Mode7	SplittingMode	FormatC

Subpackets info



Error flags

Flag: Temporary error
Flag: No plausible ultrasound receiver signal (E-7)
Flag: Air in pipe (E7)

Fields

Description	Value	Unit	SubUnit	Tariff	Storage	Function	T
Volume	0,200	m3	0	0	0	Instantaneous value	
Volume (backward flow only accumulation)	0,000	m3	0	0	0	Instantaneous value	
Volume flow	0,000	m3/h	0	0	0	Instantaneous value	
Error flags	2048		0	0	0	Instantaneous value	
Flow temperature	22,7	°C	0	0	0	Instantaneous value	
External temperature	21,3	°C	0	0	0	Instantaneous value	

Legend: Main | Due date | Error field

Hexadecimal encoded frame

```
00 5B 44 A5 11 51 22 28 87 63 07 B8 90 0F 00 2C
25 62 36 19 00 DC 4A B1 D5 C7 41 9A 33 7A C9 70
32 07 10 C9 9A 41 D0 61 1B 68 CC 9B 23 69 3A CC
79 F8 A6 B1 2E C7 0A ED F3 29 DC 4A 49 FE 1B CC
39 07 66 7E 27 AC 5C F7 08 20 E9 17 B1 16 B1 E9
56 5C F2 55 96 6E A0
```

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Needed parts to create different telegrams

C Mode:

Link layer | CRC | AFL* | TPL* | APL*

OMSLPWAN:

MAC header | AFL | TPL | APL | MAC CRC

OMS over mioty:

Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | CMAC

** Includes Frame Format A CRCs*

*** Encrypted as per mioty fixed MAC*

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C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | CMAC

Full frames

Wm-bus Mode C:

5044A511512228876307AE43900F002C2562361900DC4AB1D5C7419AB82E337A C970320710C99A41D0611B68CC9B0AE923693ACC79F8A6B12EC70AEDF329DC4A3008
49FE1BCC3907667E27AC5CF70820E91718B9B116B1E9565CF29CD3

OMSLPWAN Splitting mode:

005B44A511512228876307B8900F002C2562361900DC4AB1D5C7419A 337A C970320710C99A41D0611B68CC9B 23693ACC79F8A6B12EC70AEDF329DC4A
49FE1BCC3907667E27AC5CF70820E917 B116B1E9565CF255966EA0

OMS over mioty before encryption:

400001004268304900F002C2562361900DC4AB1D5C7419A 337251222887A5116307C970320710C99A41D0611B68CC9B 23693ACC79F8A6B12EC70AEDF329DC4A
49FE1BCC3907667E27AC5CF70820E917 B116B1E9565CF2

OMS over mioty after encryption:

400001004268 40FD91F571296CF4F548F008A39D7AD659B0D9 B62ECCA704C0A450BE121397B41E 9A14D37A3485F0529E7089687A0FDC55D1E2ECF8E66678B17F
5154BC834C5F87474FC918A5753DF8383BF804AB7154A8 0DD96DD5

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C Mode:	**Link layer** | **CRC** | AFL* | TPL* | APL*
OMSLPWAN:	**MAC header | Link layer** | AFL | TPL | APL | MAC CRC
OMS over mioty:	**Mioty fixed MAC** | **MBAL**** | AFL** | TPL** | APL** | CMAC

Telegram beginning: MAC and Link layer overview

```
LEN MHCTL LC C  MFR  ID       VER DEV CRC  ACC
Wm-bus Mode C:
50           44 A511 51222887 63  07  AE43

OMSLPWAN Splitting mode:
    00    5B 44 A511 51222887 63  07      B8


MIOTYMAC     MPF MBAL
OMS over mioty before encryption:
400001004268 83  04

OMS over mioty after encryption:
400001004268 40  FD
```

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C Mode:	**Link layer** | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | CMAC

Standard Wm-bus Mode C link layer

- Specified in EN13757-4.
- Here with frame format A.

Fields:

- **Control:** `0x44` => SND_NR: Send, no response

HEX	Description
50	Length(LEN)
44	Control(C)
	Address:
A511	Manufacturer(MFR)
51222887	Serial (ID)
63	Version (VER)
07	Device (DEV)

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EXTRACTING VALUE

C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	**MAC header | Link layer** | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | CMAC

OMS LPWAN header information

- Specified in OMS 5.01 Volume 2 Annex Q.
- Also called MAC + frame format C.

Fields:

- **MHCTL**(Mac header control): `0x00` => MSNR, Simple dataframe with no extra MAC features
- **LC[0]**(Declare fields): `0x5B` => Message includes Control, Transmitter address, ACC, and Data
  - Synchronous frame
- **Control:** The same as plain wmbus (`0x44`)

HEX	Description
00	MHCTL
5B	LC[0]
44	Control(C)
A511	Manufactuer(MFR)
51222887	Serial(ID)
63	Version(VER)
07	Device(DEV)
B8	Frame counter (ACC)

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EXTRACTING VALUE

C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	**Mioty fixed MAC** | MBAL** | AFL** | TPL** | APL** | CMAC

Mioty fixed MAC (MIOTYMAC) for OMS over mioty

- Wraps MBAL data in mioty frame

Fields:

- Must enable MPF
- Example with Short address `0x0001`
- MPDUCNT is the same as message counter in APL

HEX	Description
40	Short addr, has MPF
0001	ADDR
004268	MPDUCNT

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C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | **MBAL**** | AFL** | TPL** | APL** | CMAC

OMS over mioty® MBus Adaptation Layer (MBAL)

- See EN 13757-8
- Used as payload for mioty fixed MAC frame

HEX	Description
83	MPF
04	MBAL-CL

Fields:

- OMS address needed for CMAC and decryption
- Access 0 - no access, unidirectional device
- Function 4 - SND_NR, same as Control `0x44`
- **MPF** => Use short MBAL without optional MBAL CI

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EXTRACTING VALUE

C Mode:	Link layer | CRC | **AFL*** | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | **AFL** | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | **AFL**** | TPL** | APL** | CMAC

Shared header information (AFL)

AFL	CRC	AFL
Wm-bus Mode C:		
900F002C2562361900DC4AB1D5C7419A	B82E	33
OMSLPWAN Splitting mode:		
900F002C2562361900DC4AB1D5C7419A		33
OMS over mioty before encryption:		
900F002C2562361900DC4AB1D5C7419A		33
OMS over mioty after encryption:		
91F571296CF4F548F008A39D7AD659B0		D9

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EXTRACTING VALUE

C Mode:	Link layer | CRC | **AFL*** | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | **AFL** | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | **AFL**** | TPL** | APL** | CMAC

Shared header information (AFL)

- Authentication and Fragmentation Layer (AFL)
- Explains how data is secured against manipulation and potentially split into fragments
- See also EN 13757-7 Section 6

DeviceLab
EXTRACTING VALUE

C Mode:	Link layer | CRC | **AFL*** | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | **AFL** | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | **AFL**** | TPL** | APL** | CMAC

Shared header information (AFL) - Fields

- Control information (**CI**): Authentication and fragmentation layer = `0x90`
- **AFLL:** Length of the AFL (length 15)
- Fragmentation Control Field (**FCL**):
  - MCLP: Message Control is Present
  - MCRP: Message Counter is Present (MCR)
  - MACP: Message Authentication is Present
- Message control fiel (**MCL**):
  - MCMP: Message Counter Present (**MCR**)
  - AT: AES-CMAC-128 with length 8 bytes (**AES-CMAC**)

HEX	Description
90	Control(CI)
0F	AFLL
002C	FCL
25	MCL
62361900	MCR
DC4AB1D5C7419A33	AES-CMAC

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EXTRACTING VALUE

C Mode:	Link layer | CRC | AFL* | **TPL*** | APL*
OMSLPWAN:	MAC header | Link layer | AFL | **TPL** | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | **TPL**** | APL** | CMAC

Shared header information transport (TPL)

CI ADDRESS	HEADER
Wm-bus Mode C:	
7A	C970320710
OMSLPWAN Splitting mode:	
7A	C970320710
OMS over mioty before encryption:	
72 51222887A5116307	C970320710
OMS over mioty after encryption:	
B6 2ECCA704C0A450BE	121397B41E

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C Mode:	Link layer | CRC | AFL* | **TPL*** | APL*
OMSLPWAN:	MAC header | Link layer | AFL | **TPL** | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | **TPL**** | APL** | CMAC

Shared header information transport (TPL) - Fields

- Explains APL encoding and encryption.
- See also EN 13757-7 Section 7

HEX	Description
7A	CI => TPL
C9	ACC
70	Status
320710	Config + extension

Fields:

- Control information (**CI**): Transport layer, short header `0x7A`
- Access counter (**ACC) :** Counts the number of telegrams sent
- **Status**: `0x70` is temporary error and manufacturer specific 1 and 2
- **Config**:
  - Mode 7 encryption
  - 3 Encrypted blocks
  - Content index 2
  - Key derivation with function A

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C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | **TPL**** | APL** | CMAC

Address mapping

- Mioty fixed MAC does not contain OMS address
- OMS decryption requires address
- OMS TR08 suggests e.g.:
  - Install frame with address
  - Use long TPL header with address
  - Side channel transfer of install information

HEX	Description
72	New CI
	Address:
51222887	Serial
A511	Manufacturer
63	Version
07	Device
C970320710	Data from short header

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EXTRACTING VALUE

C Mode:	Link layer | **CRC** | AFL* | TPL* | **APL***
OMSLPWAN:	MAC header | Link layer | AFL | TPL | **APL** | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | **APL**** | CMAC

Encrypted application data (APL)

DATA	CRC	**DATA**	CRC	**DATA**	CRC	**DATA**
Wm-bus Mode C:						
C99A41D0611B68CC9B	0AE9	23693ACC79F8A6B12EC70AEDF329DC4A	3008	49FE1BCC3907667E27AC5CF70820E917	18B9	B116B1E9565CF2
OMSLPWAN Splitting mode:						
C99A41D0611B68CC9B		23693ACC79F8A6B12EC70AEDF329DC4A		49FE1BCC3907667E27AC5CF70820E917		B116B1E9565CF2
OMS over mioty before encryption:						
C99A41D0611B68CC9B		23693ACC79F8A6B12EC70AEDF329DC4A		49FE1BCC3907667E27AC5CF70820E917		B116B1E9565CF2
OMS over mioty after encryption:						
9A14D37A3485F0529E		7089687A0FDC55D1E2ECF8E66678B17F		5154BC834C5F87474FC918A5753DF838		3BF804AB7154A8

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C Mode:	Link layer | CRC | AFL* | TPL* | **APL***
OMSLPWAN:	MAC header | Link layer | AFL | TPL | **APL** | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | **APL**** | CMAC

Application payload (APL)

HEX	Description	Values
0C 13 00020000	Volume	200 [l]
0C 933C 00000000	Backflow	0 [l]
0B 3B 000000	Volume flow	0 [l/h]
04 FD17 00080000	Error flags	flag #20 active
0A 5A 2702	Flow temperature	22.7 [°C]
0A 66 1302	External temperature	21.3 [°C]

Encrypted data

C99A41D0611B68CC9B23693ACC79F8A6
B12EC70AEDF329DC4A49FE1BCC390766
7E27AC5CF70820E917B116B1E9565CF2

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C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | **MBAL**** **| AFL**** **| TPL**** **| APL**** | CMAC

Encrypted mioty data (**)

- Almost the entire frame
- Except Mioty fixed MAC and CMAC
- Example uses encryption key : `00000000000000000000000000000000`
- Example uses EUI address : `0000000000000001`

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C Mode:	Link layer | **CRC** | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | **MAC CRC**
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | **CMAC**

Trailing

CRC CRC32 CMAC

Wm-bus Mode C:
9CD3

OMSLPWAN Splitting mode:
55966EA0

OMS over mioty before encryption:

OMS over mioty after encryption:
0DD96DD5

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C Mode:	Link layer | CRC | AFL* | TPL* | APL*
OMSLPWAN:	MAC header | Link layer | AFL | TPL | APL | MAC CRC
OMS over mioty:	Mioty fixed MAC | MBAL** | AFL** | TPL** | APL** | CMAC

Full frames

Wm-bus Mode C:

5044A511512228876307AE43900F002C2562361900DC4AB1D5C7419AB82E337A C970320710C99A41D0611B68CC9B0AE923693ACC79F8A6B12EC70AEDF329DC4A3008
49FE1BCC3907667E27AC5CF70820E91718B9B116B1E9565CF29CD3

OMSLPWAN Splitting mode:

005B44A511512228876307B8900F002C2562361900DC4AB1D5C7419A 337A C970320710C99A41D0611B68CC9B 23693ACC79F8A6B12EC70AEDF329DC4A
49FE1BCC3907667E27AC5CF70820E917 B116B1E9565CF255966EA0

OMS over mioty before encryption:

400001004268304900F002C2562361900DC4AB1D5C7419A 337251222887A5116307C970320710C99A41D0611B68CC9B 23693ACC79F8A6B12EC70AEDF329DC4A
49FE1BCC3907667E27AC5CF70820E917 B116B1E9565CF2

OMS over mioty after encryption:

400001004268 40FD91F571296CF4F548F008A39D7AD659B0D9 B62ECCA704C0A450BE121397B41E 9A14D37A3485F0529E7089687A0FDC55D1E2ECF8E66678B17F
5154BC834C5F87474FC918A5753DF8383BF804AB7154A8 0DD96DD5

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Thank you

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