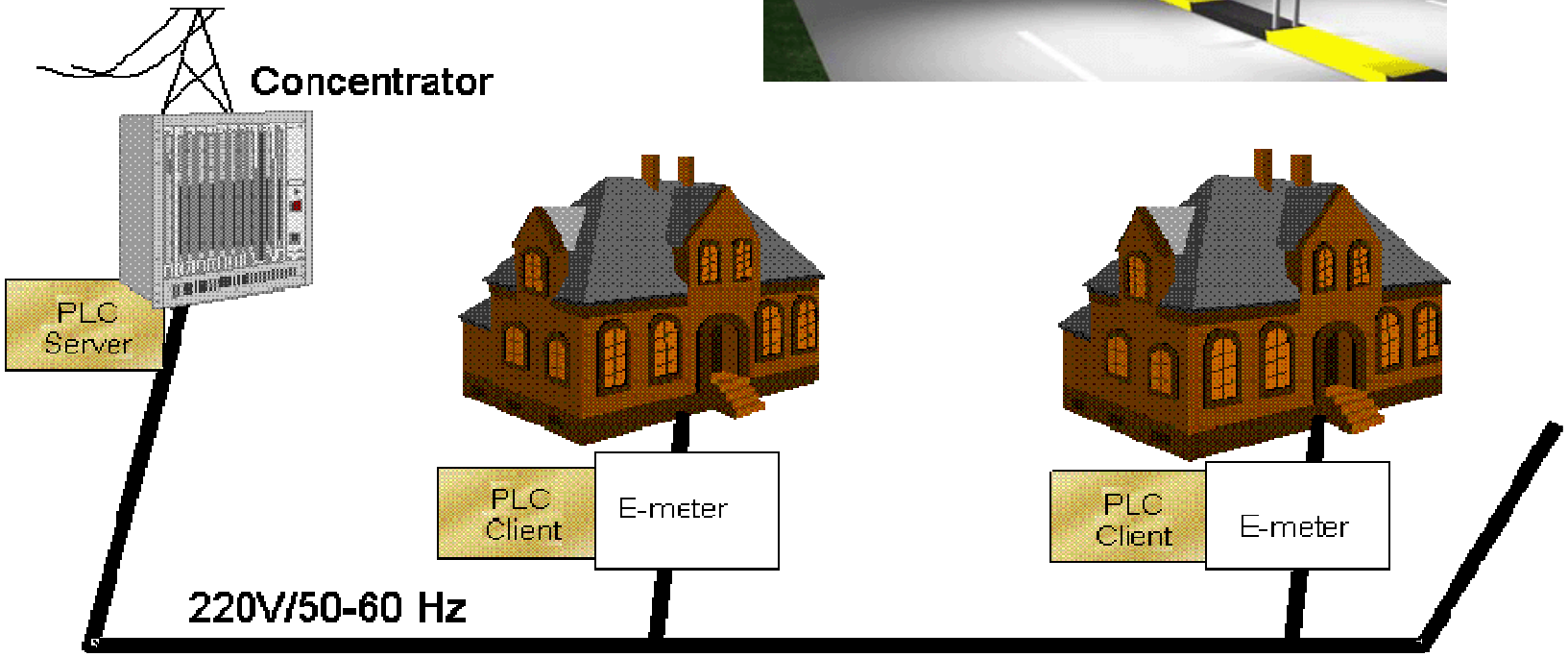
Power Line Carrier Modem

Koen Geirnaert, Product Marketing Mgr

PLC Application

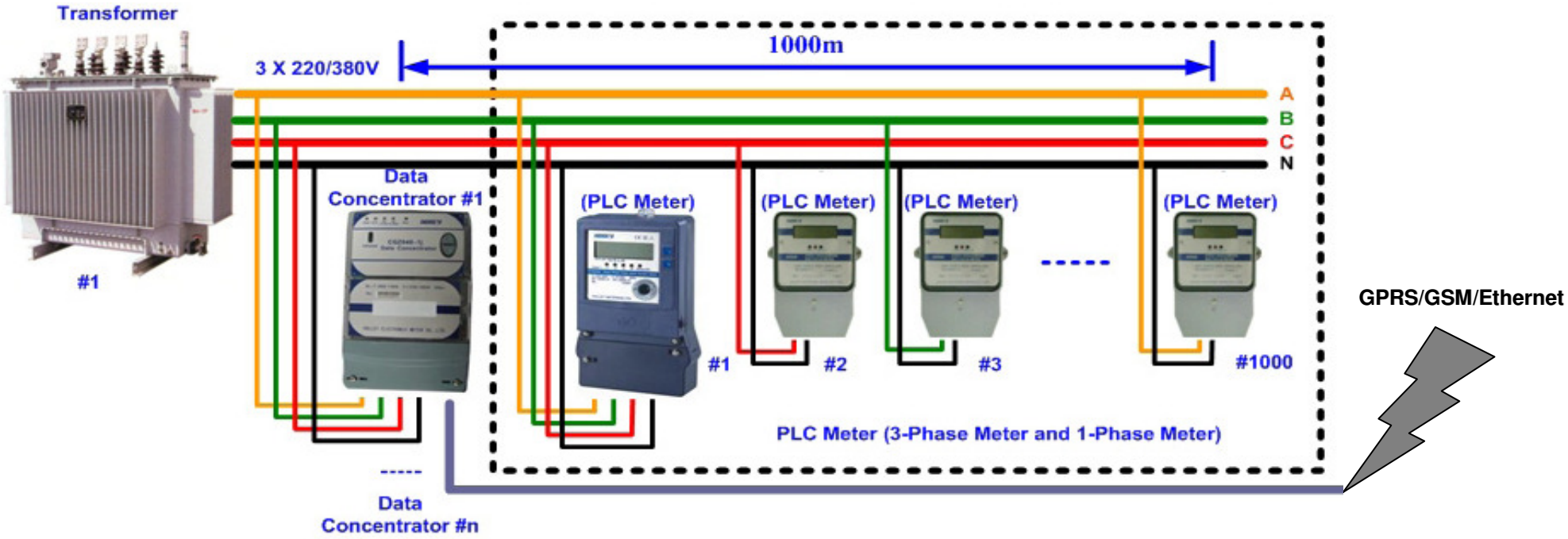
- Smart Metering
- Street lighting
- Smart power plug



PLC Modem-Smart Meter EU market

- European commission impose all EU meters to be replaced by 2022.
- France will be the largest deployment of smart metering ever done at once
- 35 Million units will be replaced from 2012 to 2019. According to our information tender runs in 3 main phases
  - Consortium selection : Done : 3 e-meters manufacturers selected for pilot phase
  - Pilot Phase (300 k e-meters + 10's k concentrator deployed in the field). Start in Q4 09. 49587
  - Deployment Phase: More suppliers will come in the game (5 to 10).

PLC Smart Meter Network



Communication OSI Layers

From Computer Desktop Encyclopedia
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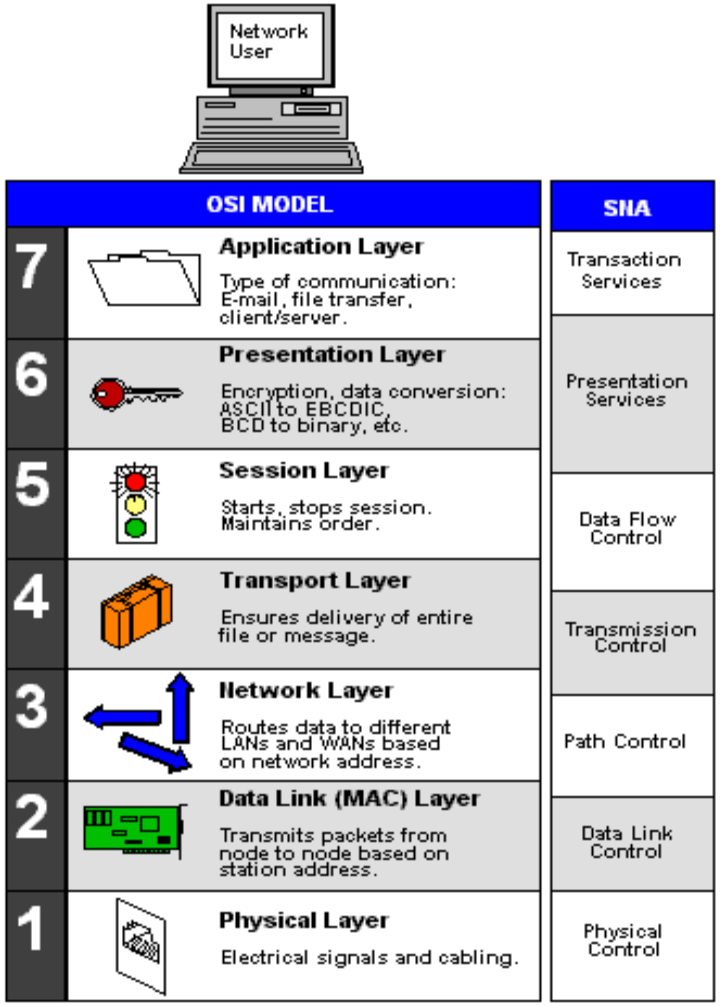
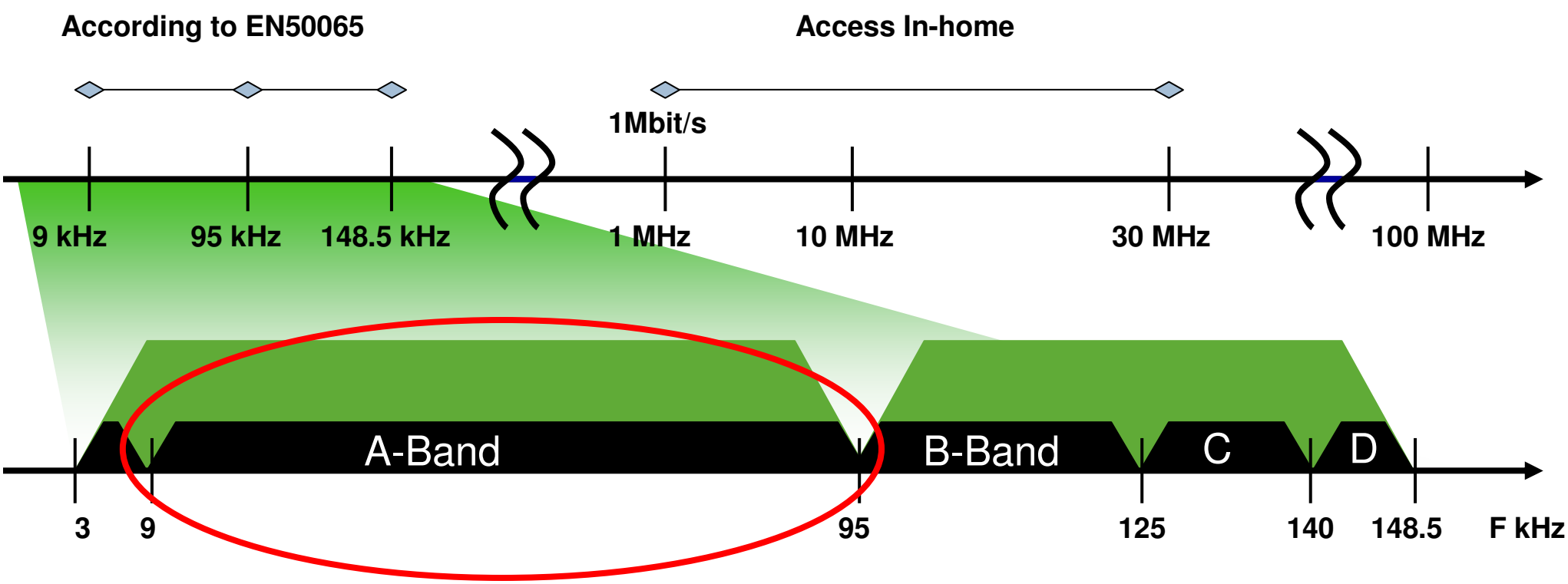


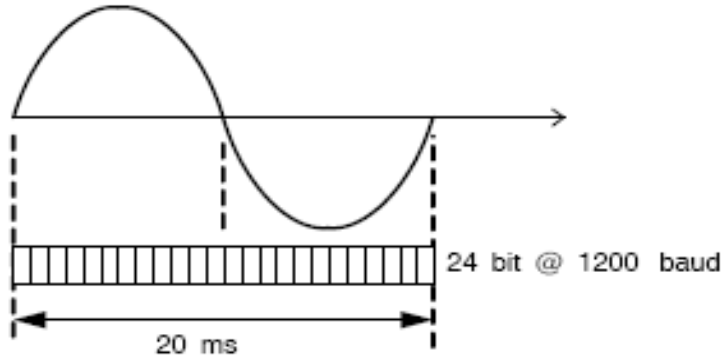
- Physical Layer is the power cable
  - Modulation technique is determining how data is set on the cable (S-FSK, OFDM, FSK, …)
- Data Link Layer (broadcasting, half duplex communication)
  - MAC, medium access controller
  - LLC, logic link controller : Addressing of the different nodes

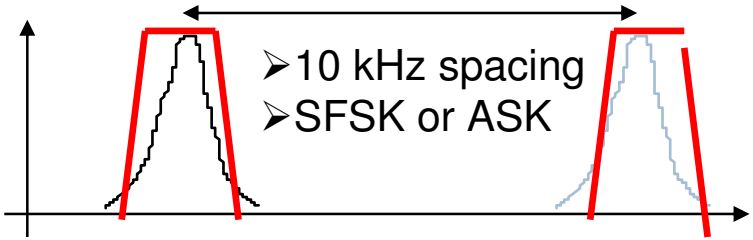
	AMIS30585	AMIS49587
Function	PLC S-FSK Modem 9-95KHz	PLC S-FSK Modem 9-95KHz
Technology	C05A, PLCC20	C05A, PLCC 20 and QFN package
Speed	1200 Baud	2400 Baud
Bit Synchronization	Automatic/Manual (SYNCHRO bit mode value)	Manual
Time_Ou_Search_Initiator	Not available	
Core	ARM7 TDMi, 24MHz	ARM7 TDMi, 24MHz
Installed Base	1Mu	200K (France) 200K (ROW)

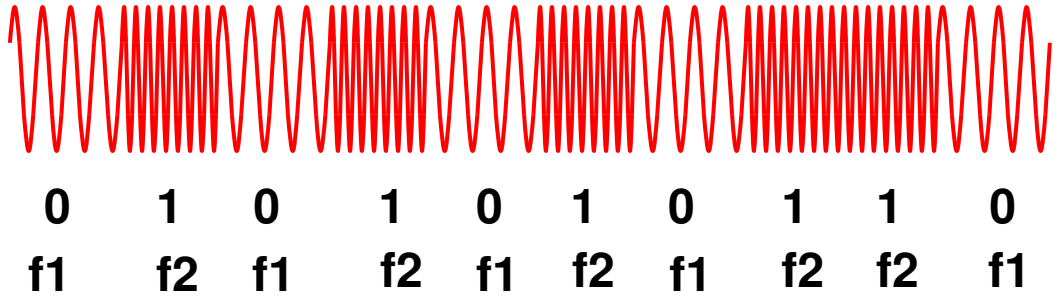
CENELEC BAND

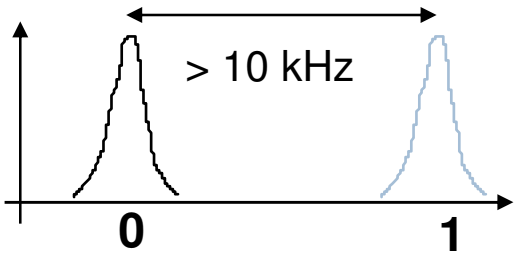


S-FSK


24 bit @ 1200 baud
20 ms

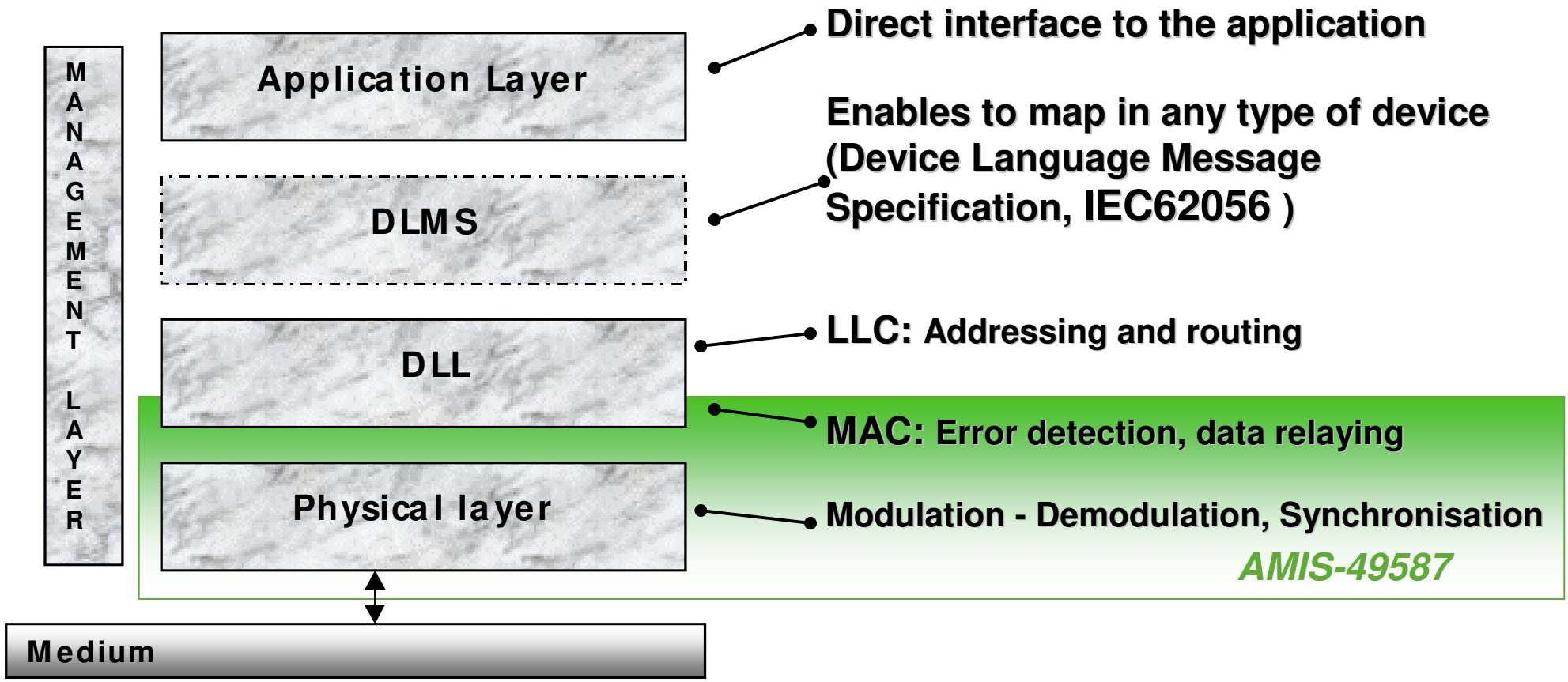

➢10 kHz spacing
➢SFSK or ASK


0 1 0 1 0 1 0 1 1 0
f1 f2 f1 f2 f1 f2 f1 f2 f2 f1

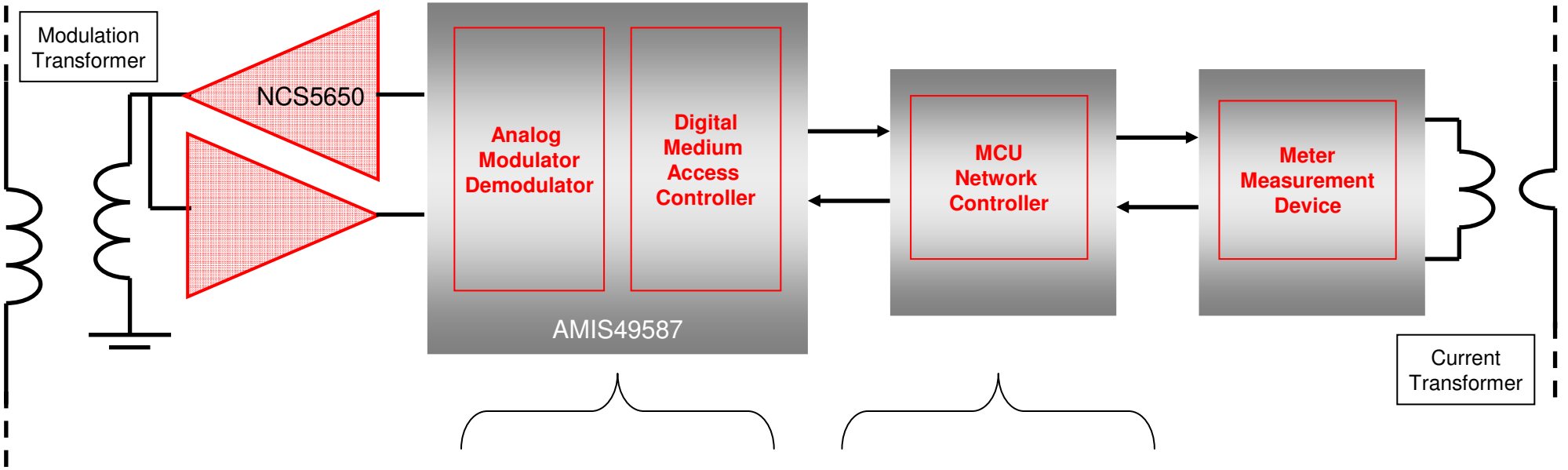

> 10 kHz
0
1

AMIS49587 Protocol handling

The OSI reference model (IEC 61334)

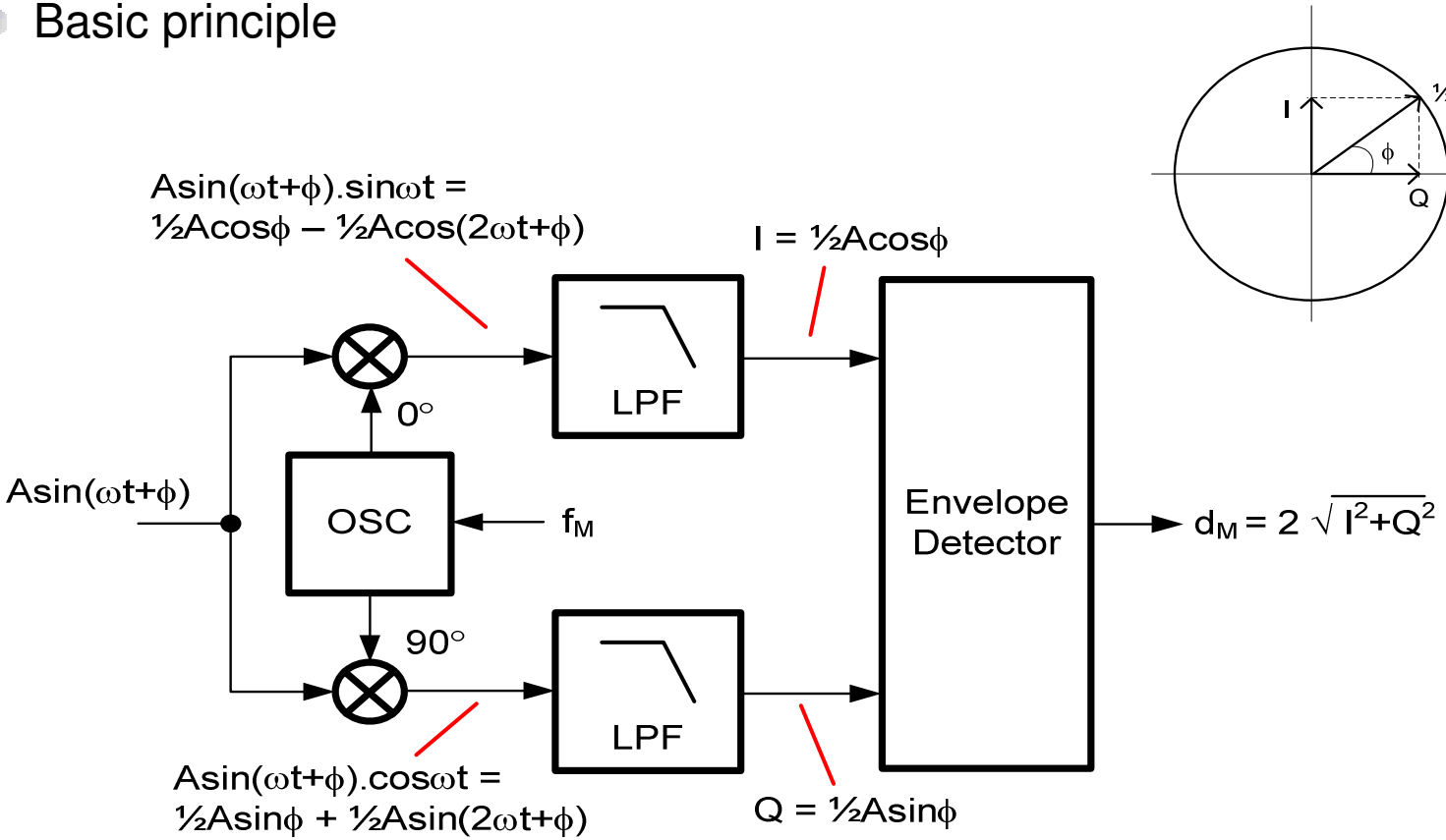


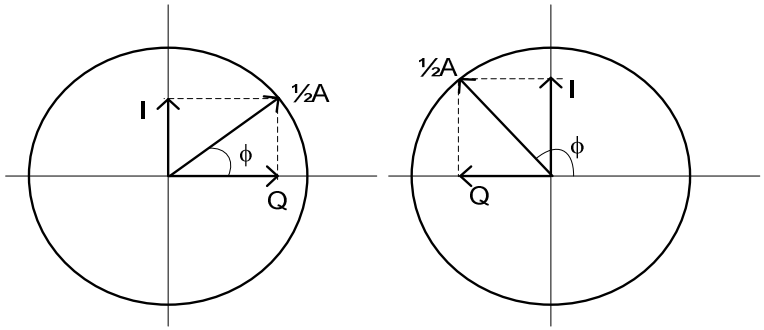
PLC Meter Topology



PHY level : S-FSK Modulation

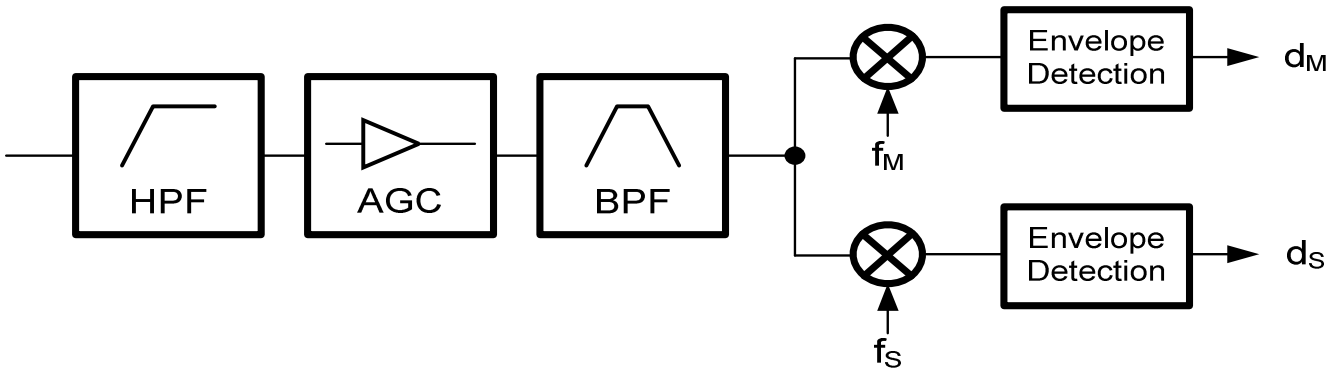
- Basic principle





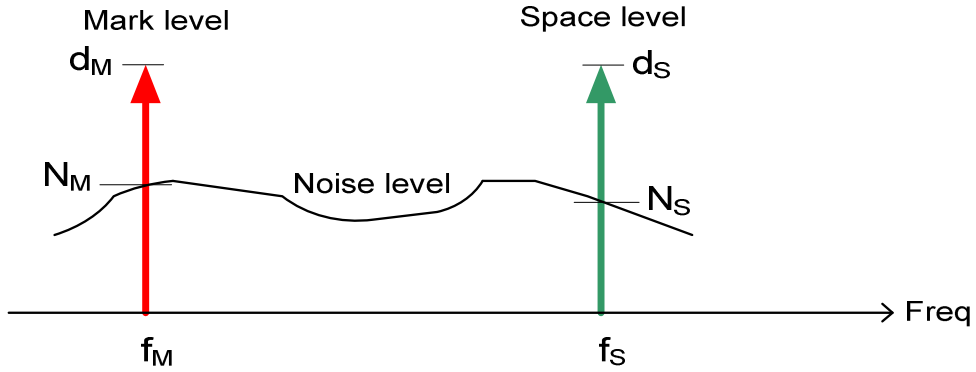
PHY level : S-FSK Modulation

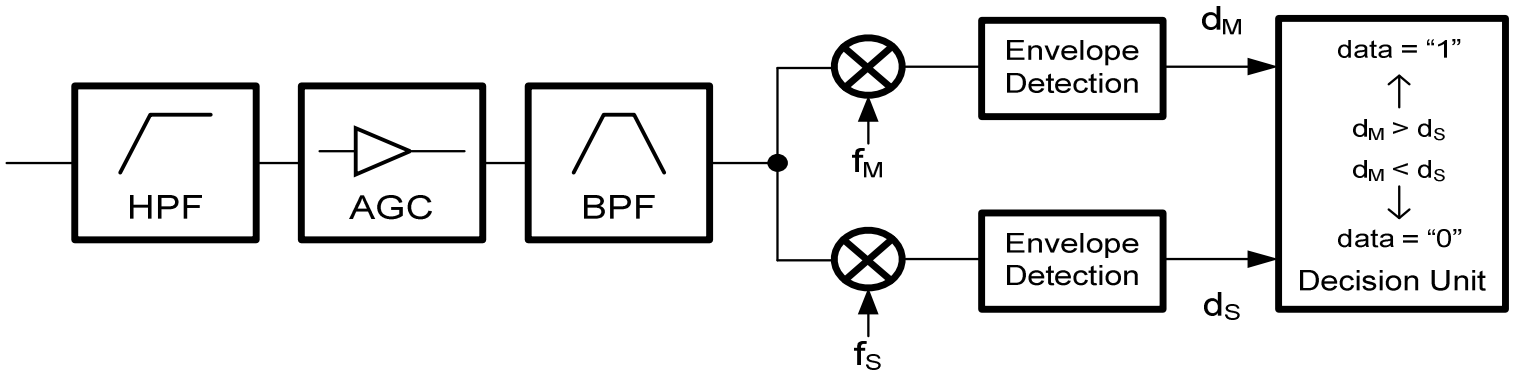
- Simplified implementation



PHY level : S-FSK Modulation

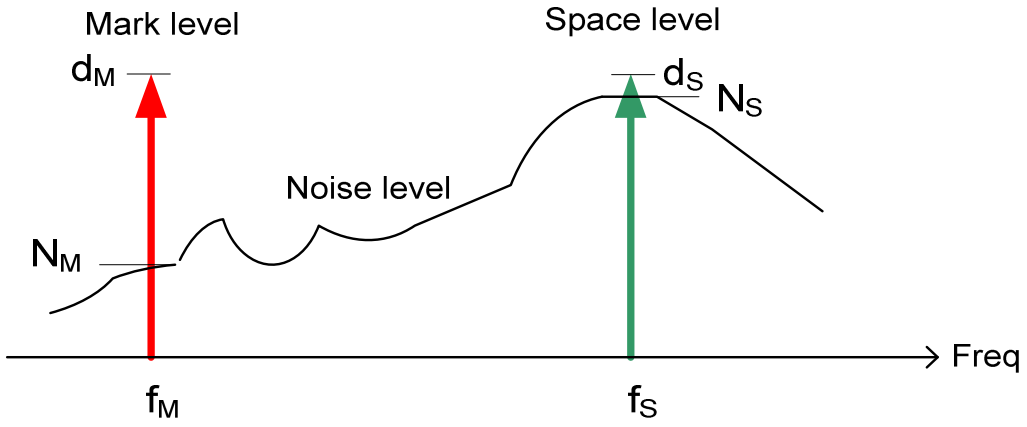
- Demodulation decision

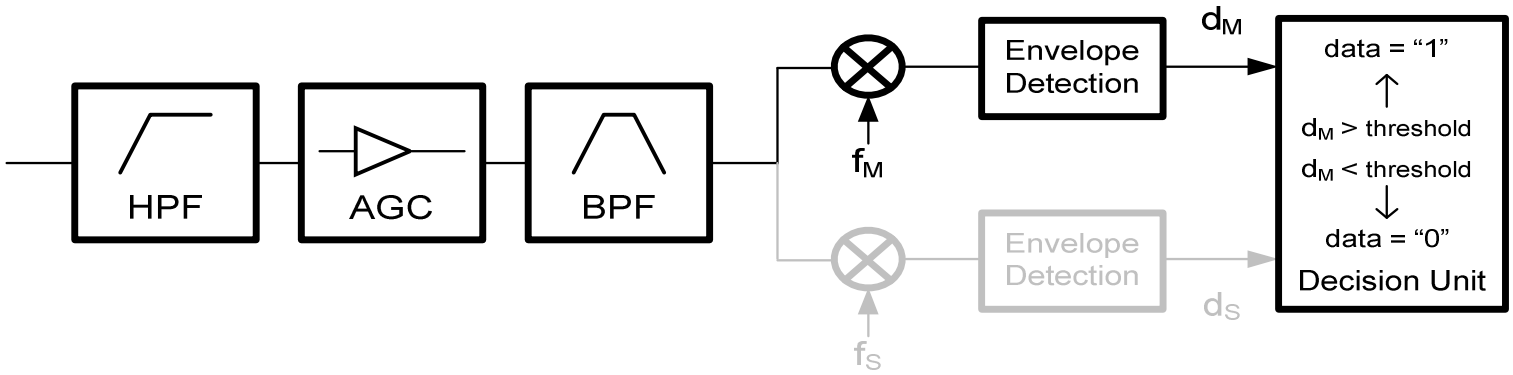




PHY level : S-FSK Modulation

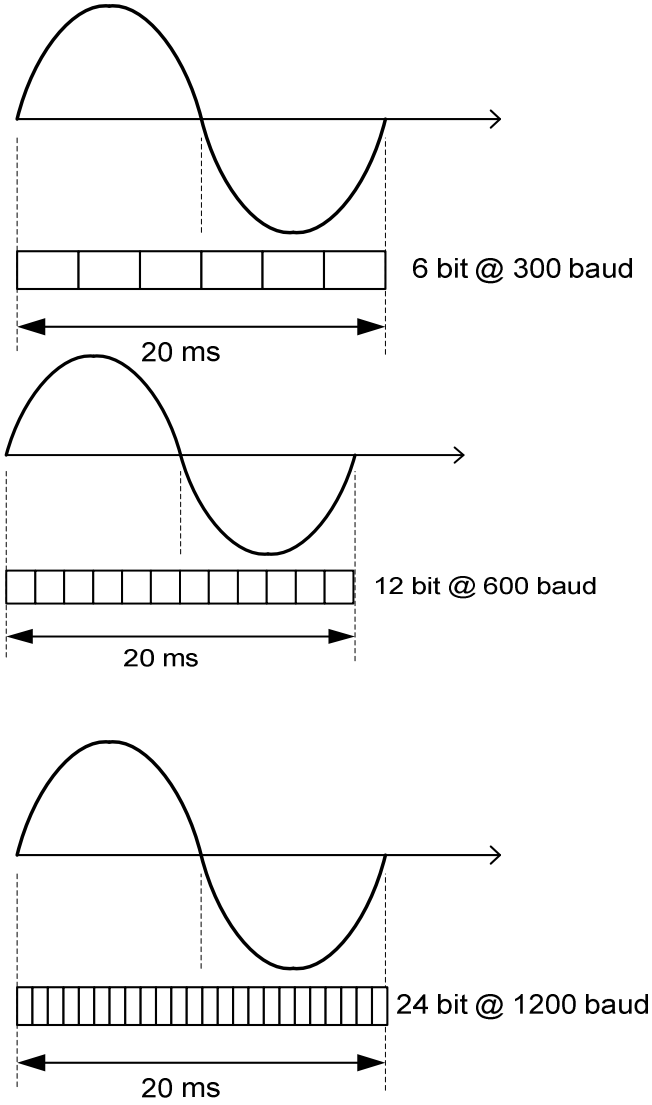
- Demodulation decision



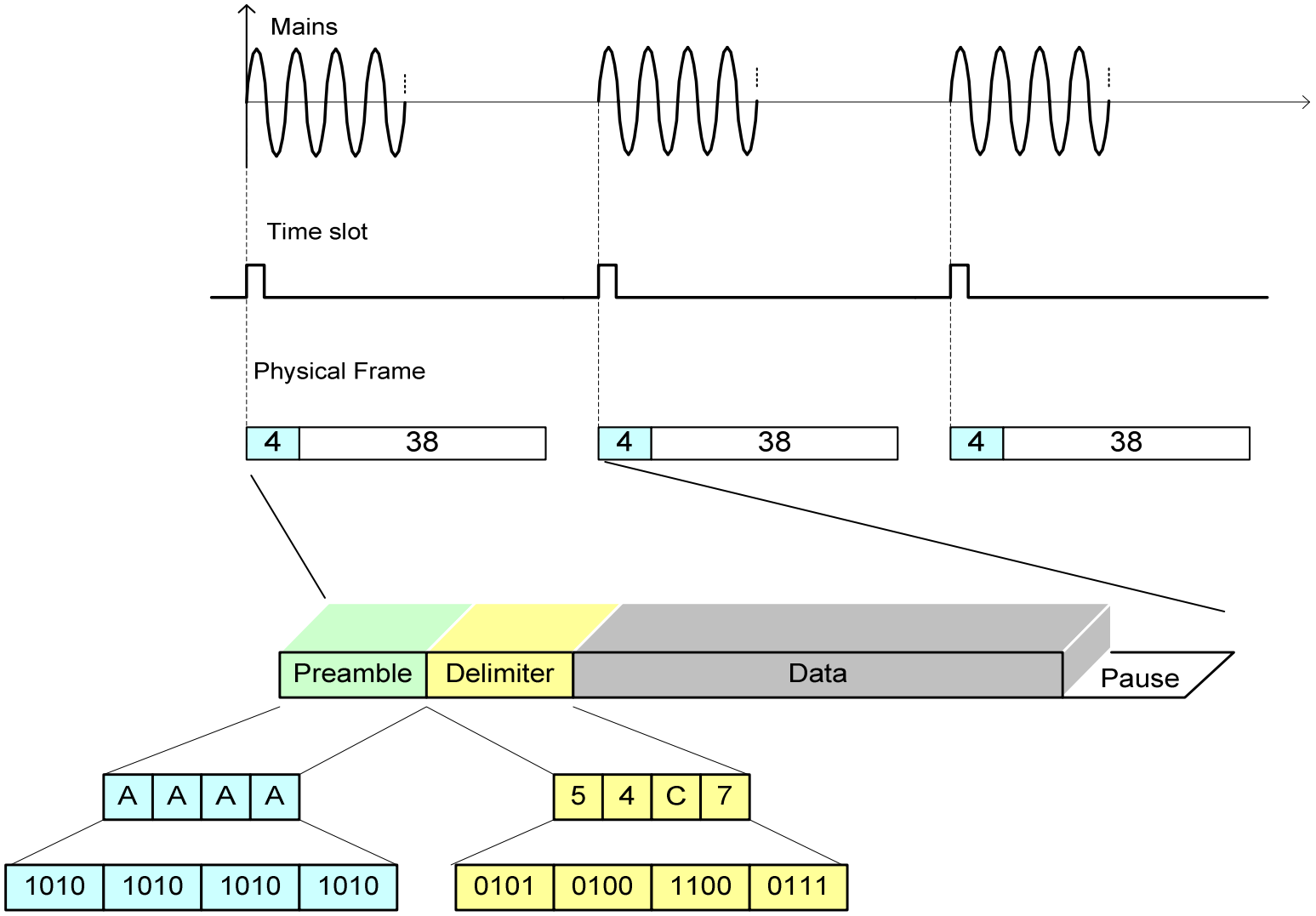


PHY level : Bit timing

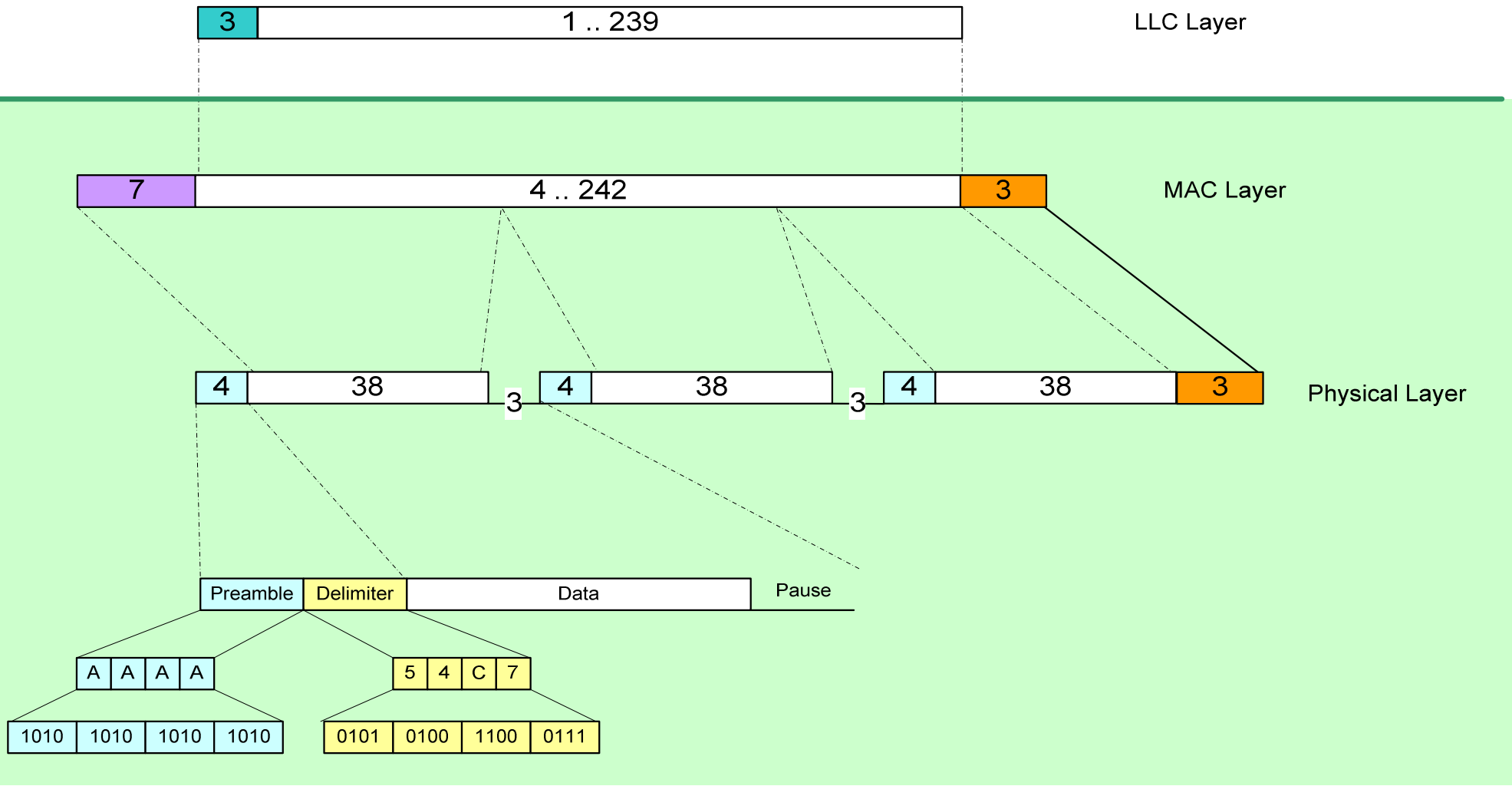
- Bit timing and synchronization are referred to mains frequency and phase
- Requires good zero cross detection:
  - Use of PLL
  - Low jitter
- Bit sync is done by dividing the zero crossing interval by 3, 6 or 12 depending on selected speed



PHY level : Frame Structure

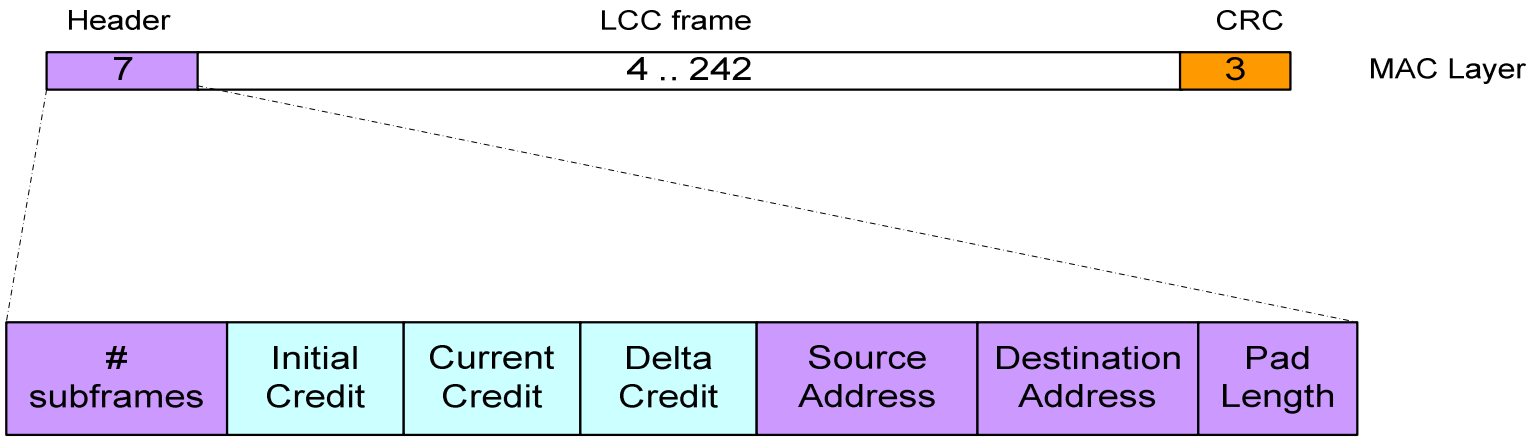


MAC level : Frame Structure



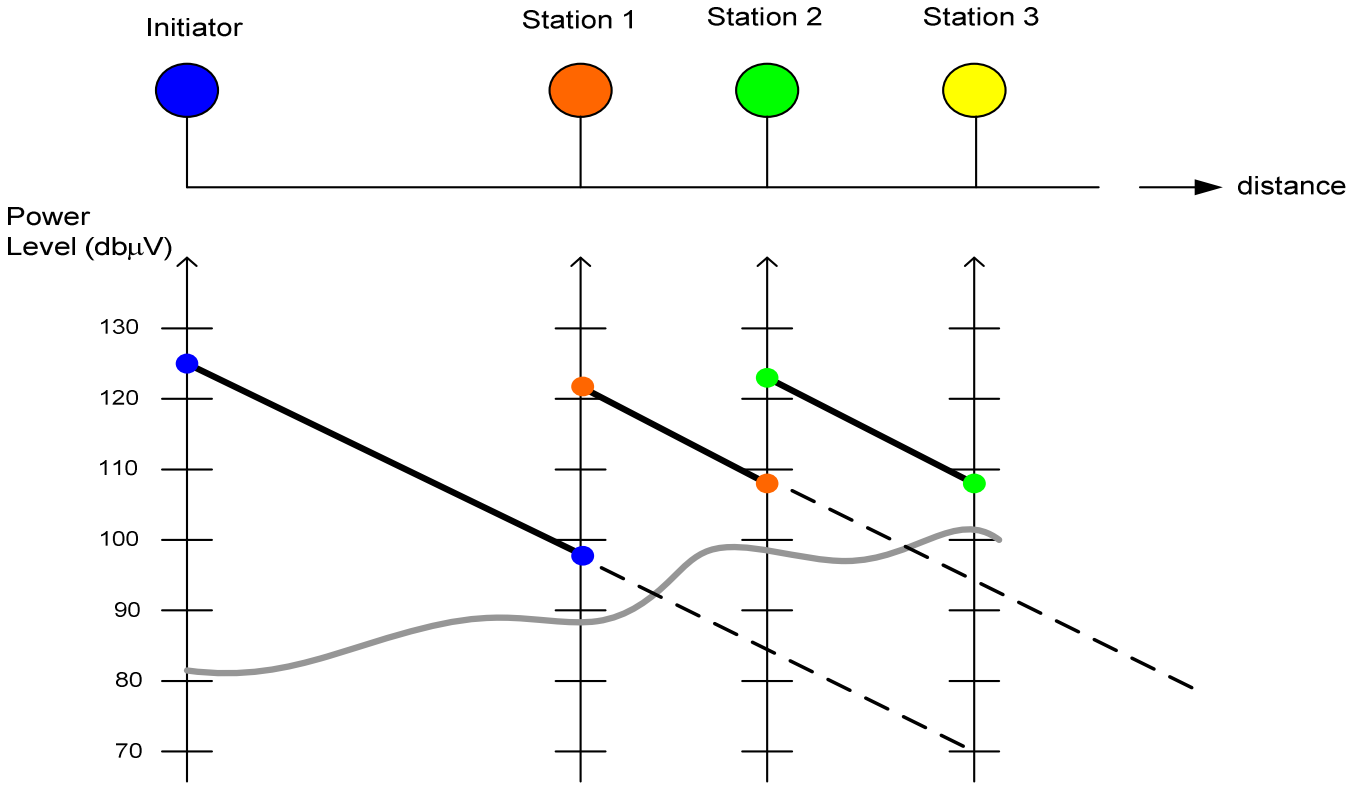
MAC level : Robust through algorithm

- MAC level
  - Repetition with credit
    - To take care about high loss 40dB/ 100m
    - Impedance & losses space & time variability
  - Principle



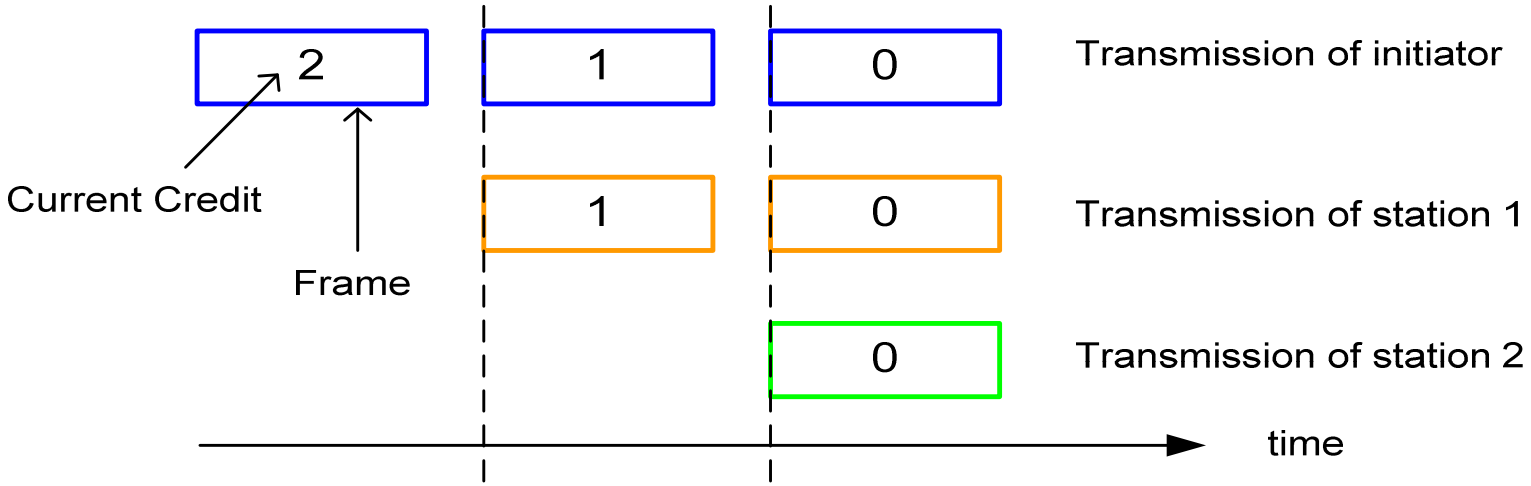
MAC level : Robust through algorithm

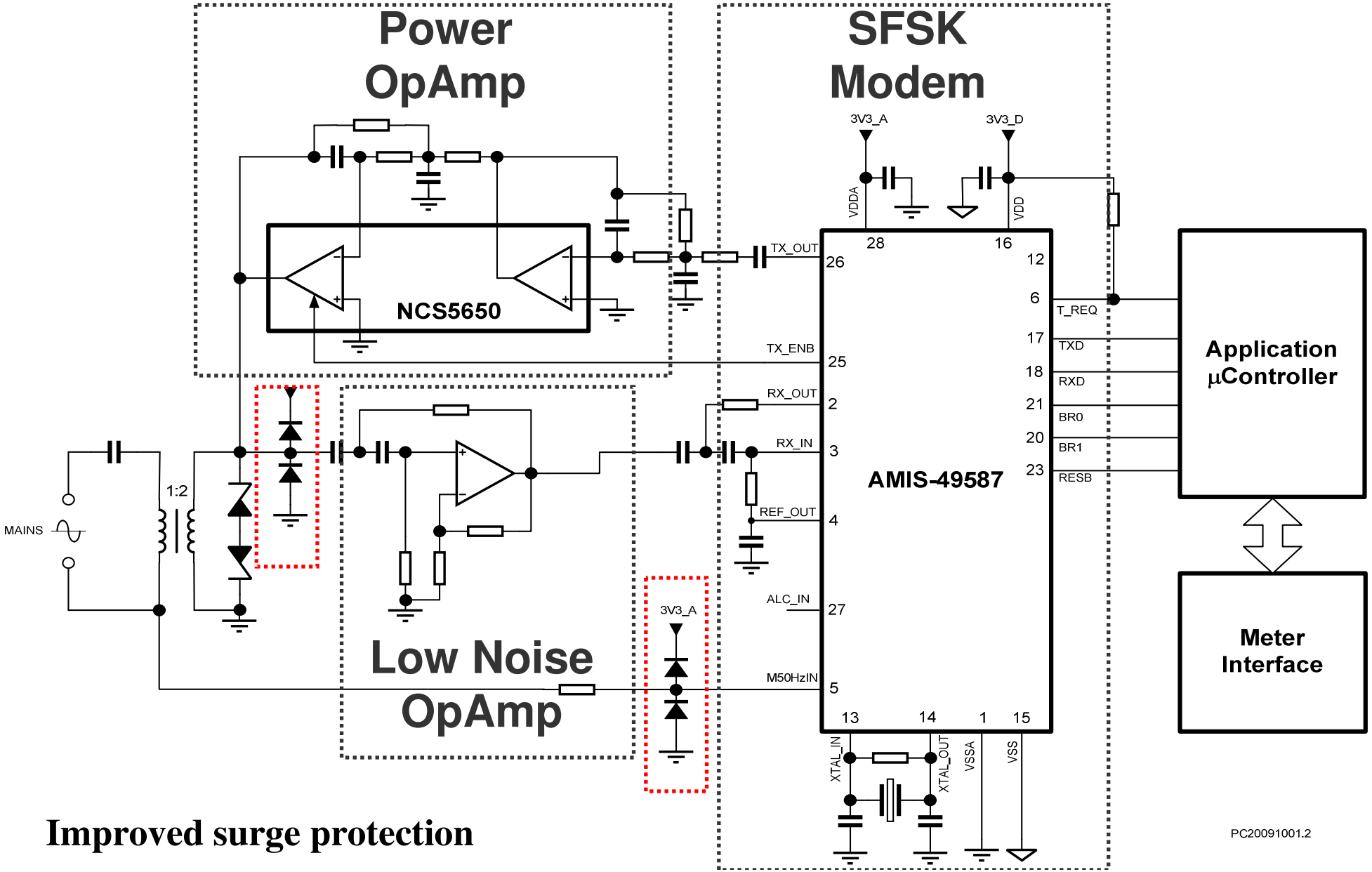
- MAC level
  - Repetition with credit



MAC level : Robust through algorithm

- MAC level
  - Each PLC act as a repeater for the others

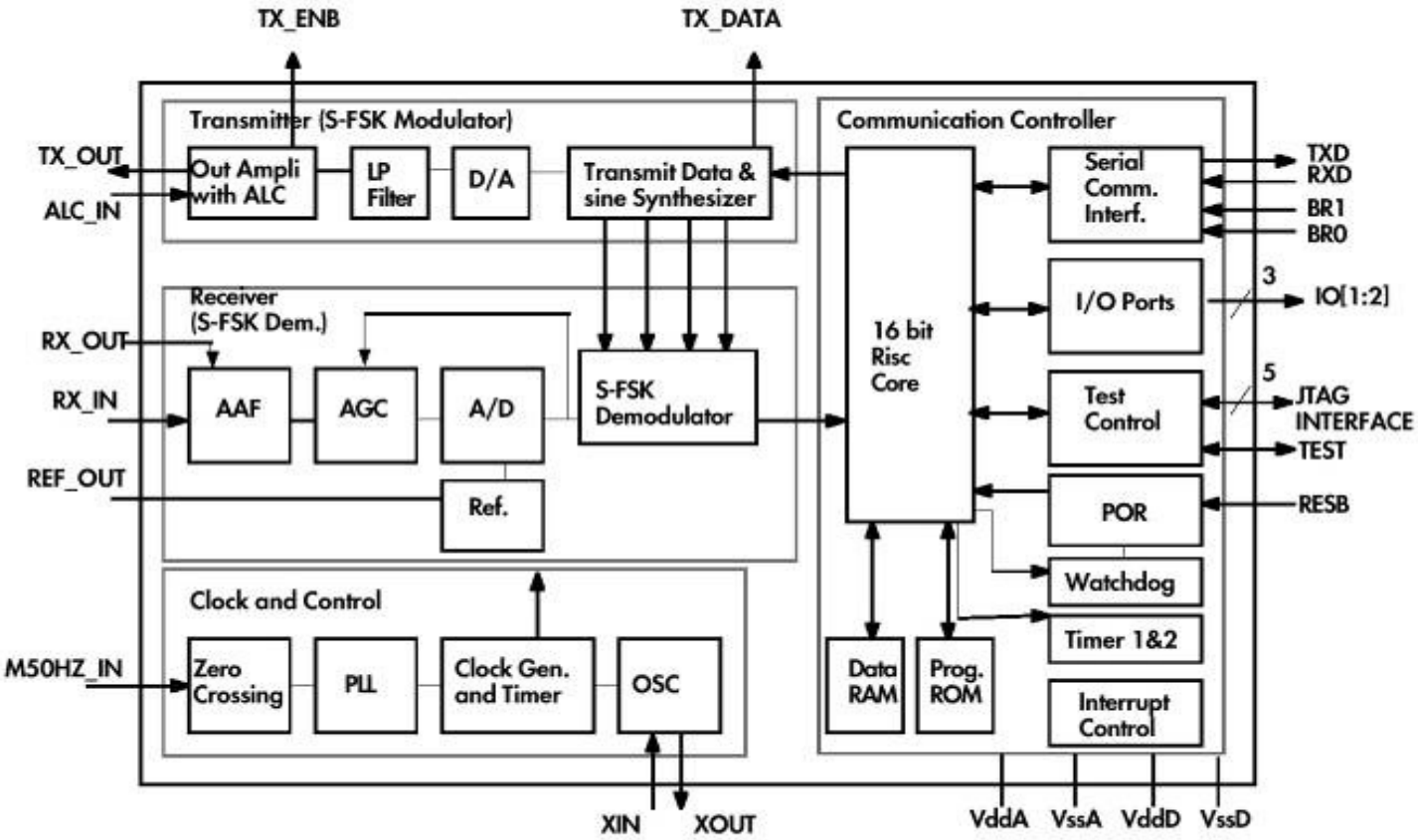




Improved surge protection

PC20091001.2

AMIS49587 Block Diagram



S-FSK Modem Block Diagram

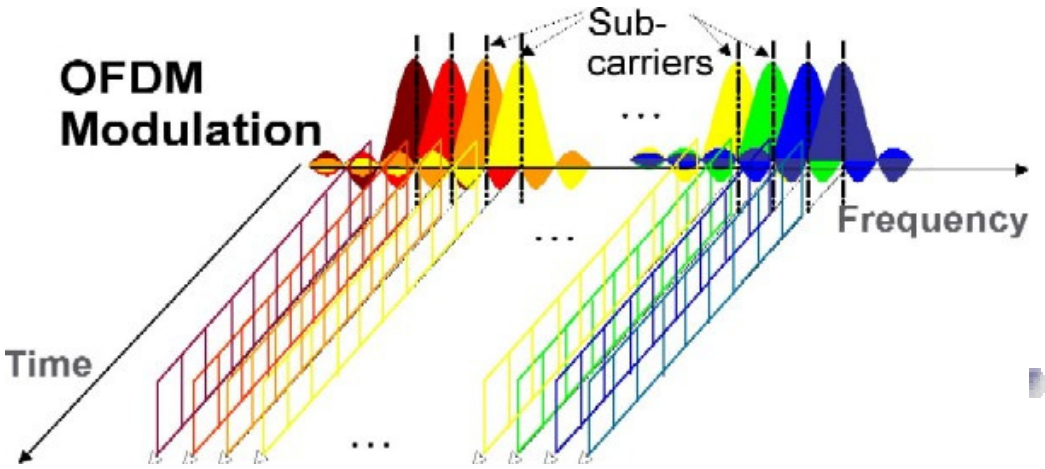
PLC Solution Competition

S-FSK IEC61334	Renesas	Texas Instruments	ST Microelectronics	ON Semiconductor
Device Part Number	M16C/CS + ?	TMS320F28015 + OPA561	ST7570	AMIS49587 + NCS5650
Baud rate	2400	2400	2400	2400
Bands	A,B,C	A,B,C	A,B,C	A,B*,C*
Noise Immunety (white, sinusoidal)	?	?	?	market reference
Demodulation Accuracy	12 bit	12 bit	?	market reference 16bit
Analog Input Sensitivity (mV)	?	?	?	0.4
Digital Core	Single (DSP)	Single (DSP based)	Dual (DSP+ 8 bit)	Single (ARM)
Supplies	2	2	4	2
Power consumption (mW)	?	?	?	470
Hardware Embedded MAC + PHY (ROM)	no	no	yes	yes
repetition with credit	no	no	yes	yes
PLL jitter	?	?	?	market reference
Drive Capability (Apeak)	1.4	1.2	1.4	2
Package	QFN48	QFN48	QFN48	QFN52 + QFN20
Field Proven	no yes	no yes	no	yes no
Total BOM Count	?	?	?	29
LV Passive	?	?	?	25
HV Passives	?	?	?	2
Actives	2	2	1	2

Protocols

CENELEC BAND	IEC61334	3G	PRIME
Carriers	2	36	97
Speed	2.4K baud	36K baud	136K baud
Frequency band (kHz)	A-band	A-band	A-band
Modulation	S-FSK	OFDM	OFDM

OFDM



- Orthogonal Frequency Division Multiplexing
- Prime
  - 97 carriers
- G3
  - 36 carriers

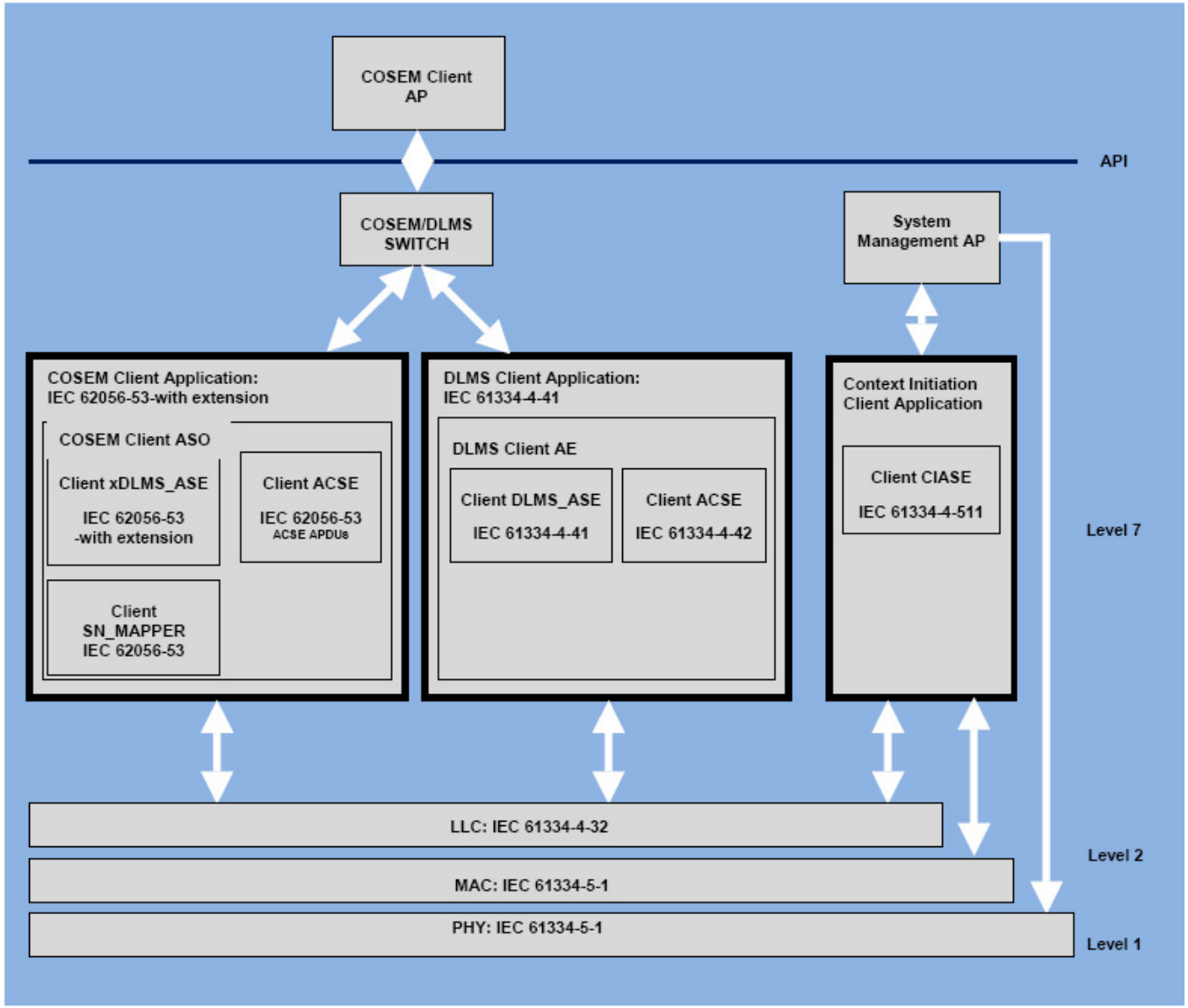
Performance Comparison

S-FSK	OFDM
low power consumption	high power consumption
high robustness	high robustness
low implementation cost	high implementation cost
single standard	multiple standard
bridges long distances	covers medium distance
low data rate	high data rate

AMIS49587 Key Features

- Data communication on power line up to 2400 Bauds
  - Complete handling of protocol layers (PHY to MAC)
  - Compliance to standards IEC61334-5-1 / EN 50065 and specific ERDF requirement
  - Proven with 175Hz TCFM signaling
- Best in Class Analog demodulation chain
  - Extremely robust transmission (noise immunity and input sensitivity)
- PHY dedicated to S-FSK modulation with programmable interval
  - Programmable carriers in range of 9kHz-95kHz, by steps of 10Hz
  - Programmable frequency spread : typical separation of 10kHz
  - Extremely robust PLL, Dynamic range: 104 dB
- Half duplex asynchronous communication
  - for mains frequency 50Hz => programmable data rate 300/600/1200/2400 bauds
  - Embedded Support chorus transmission (repetition with credit)
- ARM MCU for advanced filtering and MAC implementation
- Interfacing to the outside
  - Operates from a single 3,3V power supply
  - Programmable SCI Baud rate to Application µC 4800/9600/19200/38400 baud

Concentrator



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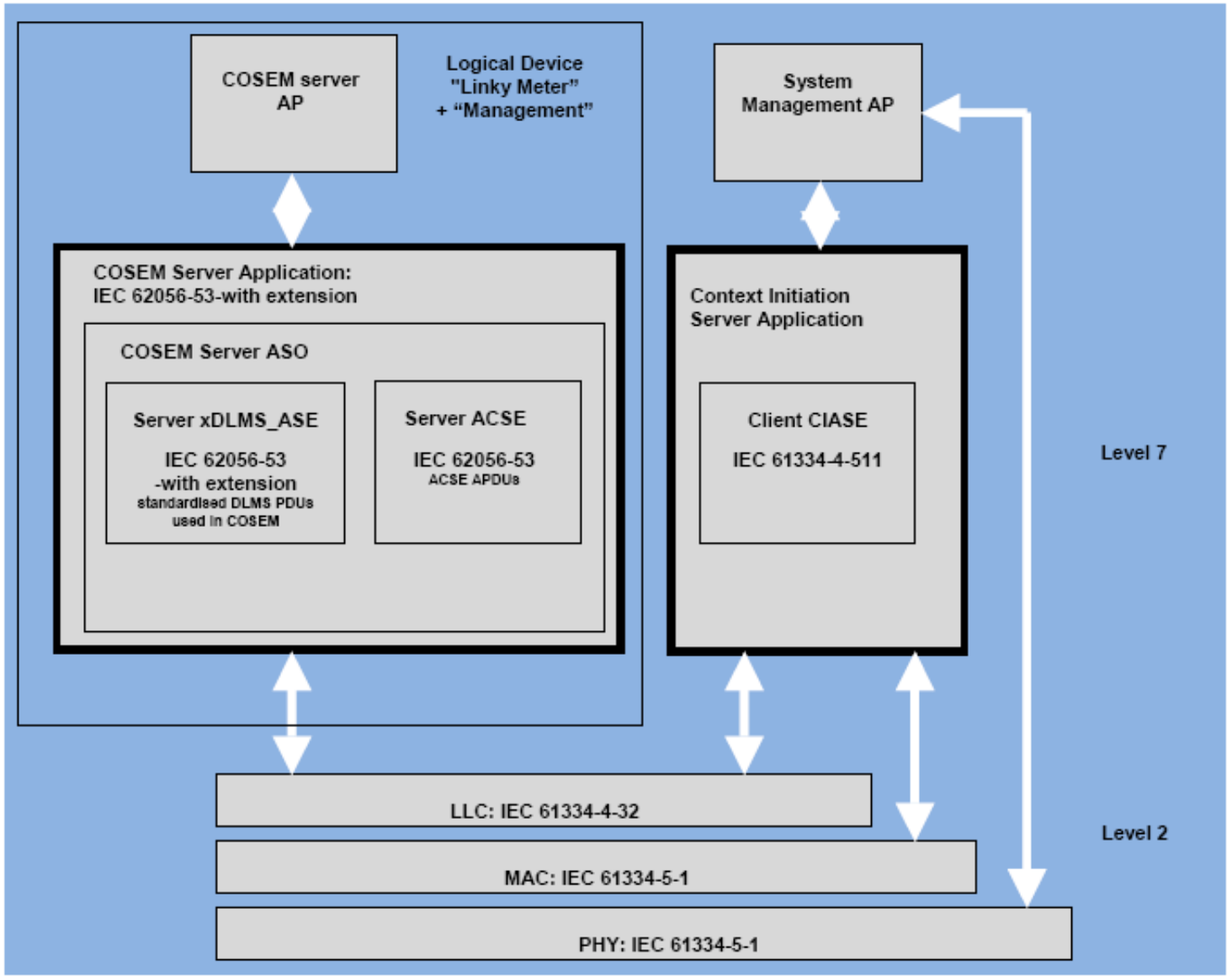
Meter



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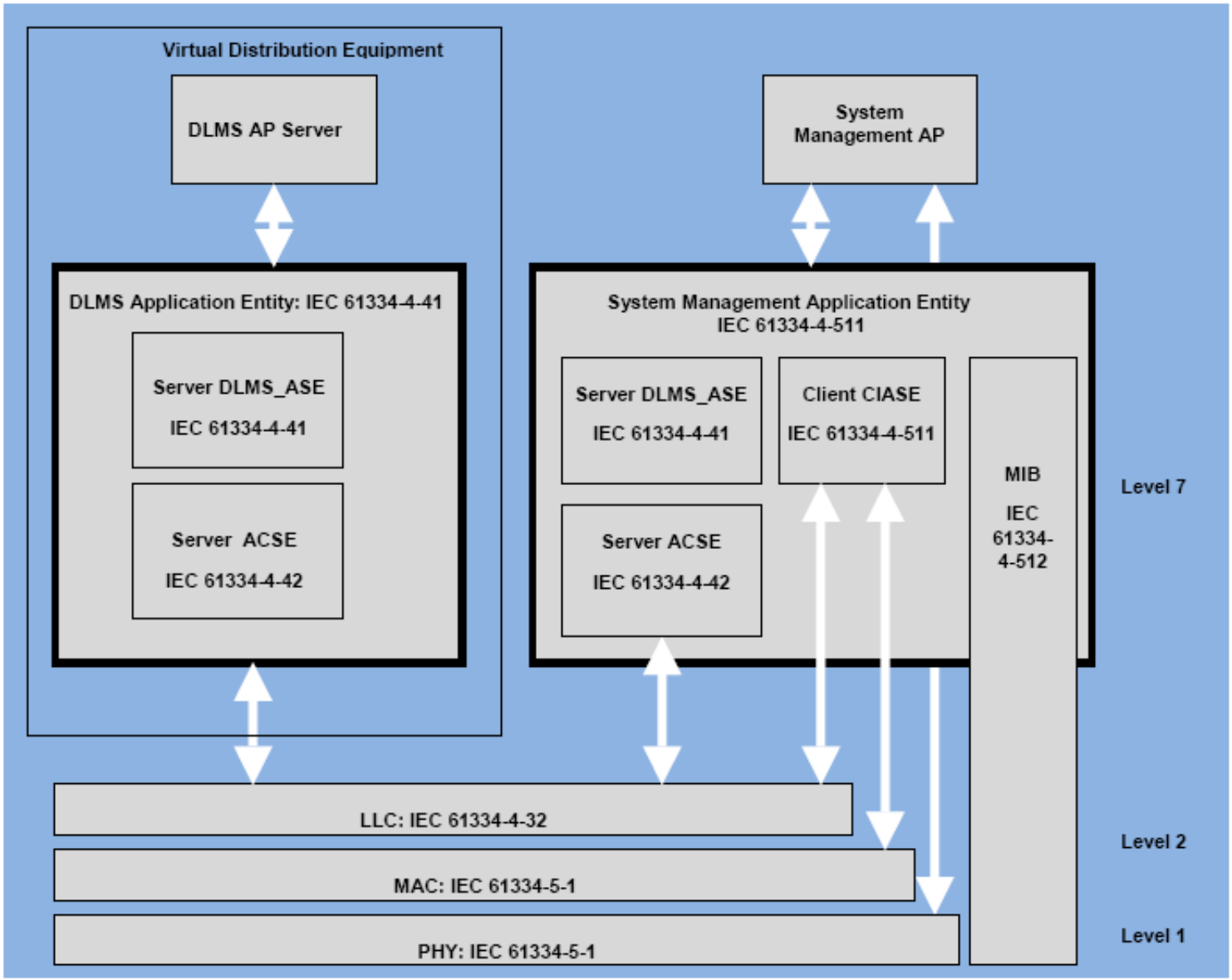
Meter



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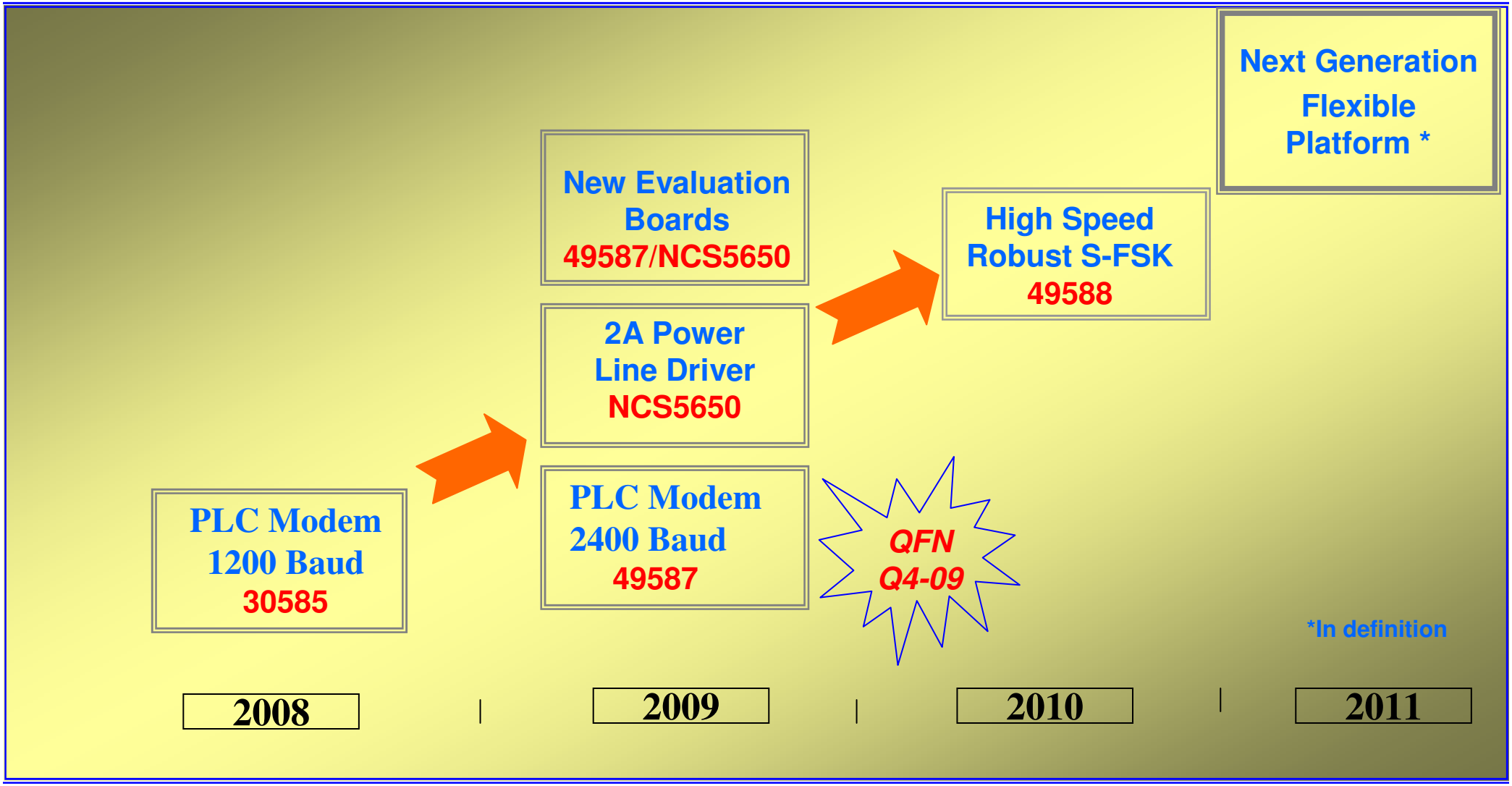
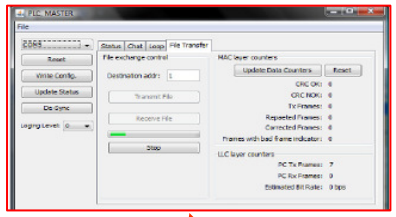
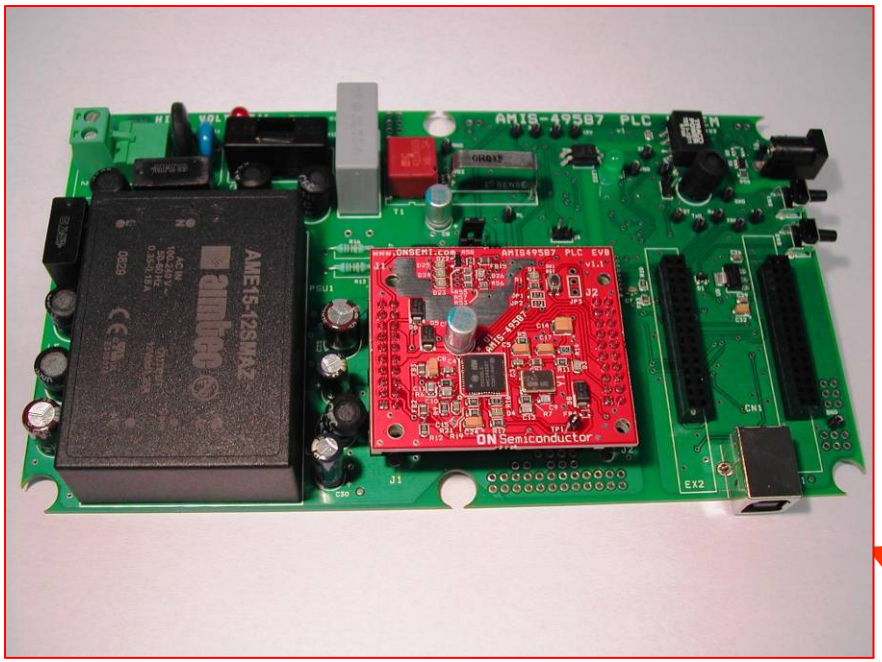
OnSemi PLC Modem Roadmap
New products arriving!

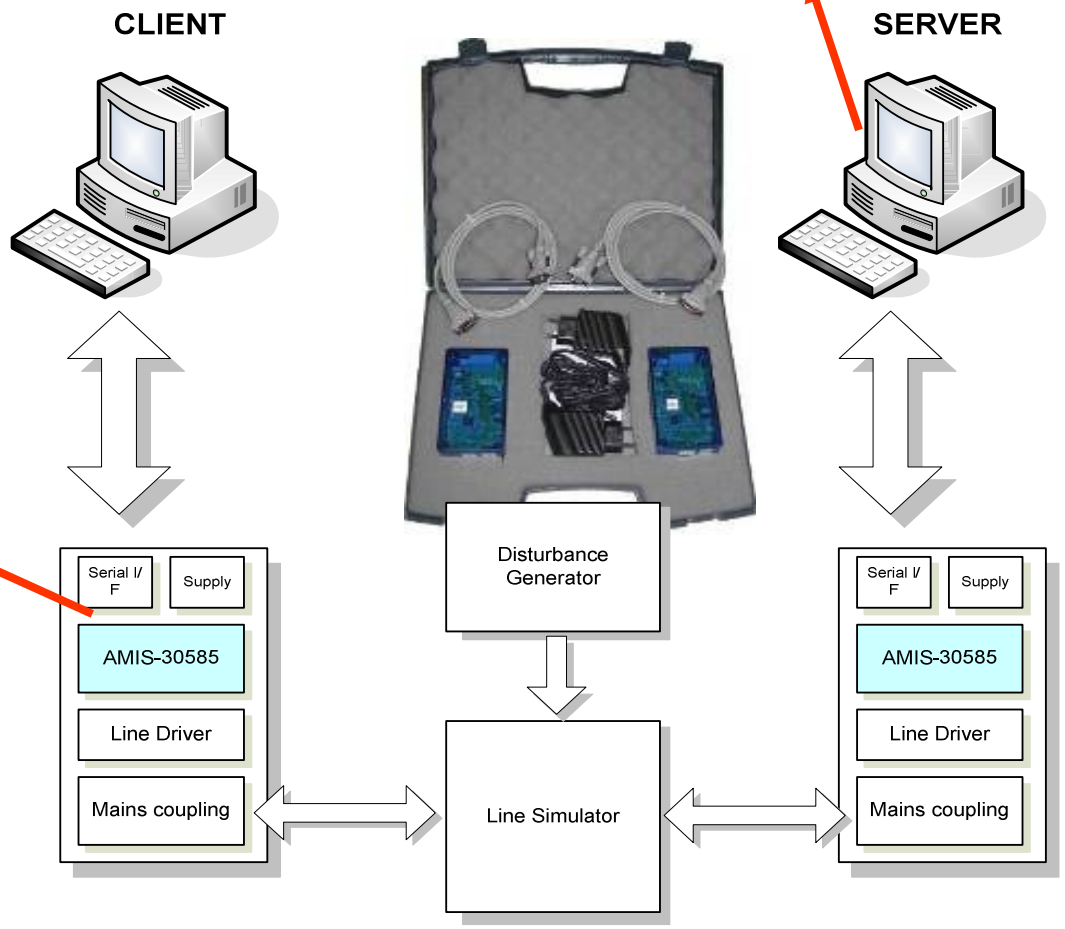


Evaluation kit AMIS49587EVK

- Evaluation Kit AMIS49587EVK
  - Evaluation kit contains 2 PLC modems to set-up communication between client and server
  - Evaluation kit contains open source GUI for setting up end to end communication







Additional Information

- Additional Questions
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