

TRedess

HOW A TRANSMITTER MANUFACTURER CAN CONTRIBUTE TO THE ENERGY SAVING ON A DAB+ NETWORK?

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Brief TRedess company introduction

Portfolio of solutions, project references, etc.

2

Optimizing the Energy Efficiency on a DAB+ (or TV) network

- Key aspects on the design of a high efficient transmitter
- Latest Doherty technologies → Use case
- MER versus Efficiency optimization → Use case
- Adding more functionalities into the transmitter → Use case
- Coverage extension with Gap Fillers → Use case
- Other aspects (multiple architectures, compact solutions, etc)

3

Conclusions

BRIEF INTRODUCTION TO TREDESS

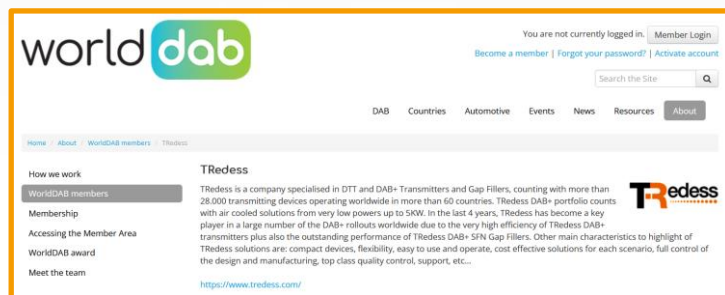
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1.1) TRedess > Company overview

TRedess is a Spanish company **specialized in air cooled TV and DAB+ Transmitters and Gap Fillers**, counting with **more than 28.000 TV transmitting devices** operating worldwide in **65 countries**.

TRedess **TV and DAB+ portfolio** counts with air cooled solutions **from very low powers up to 5KW**.

In the last 3 years, **TRedess has become a key player** in a large number of the **DAB+ rollouts worldwide**, with **more than 500 x DAB+ transmitters deployed in more than 15 countries**.



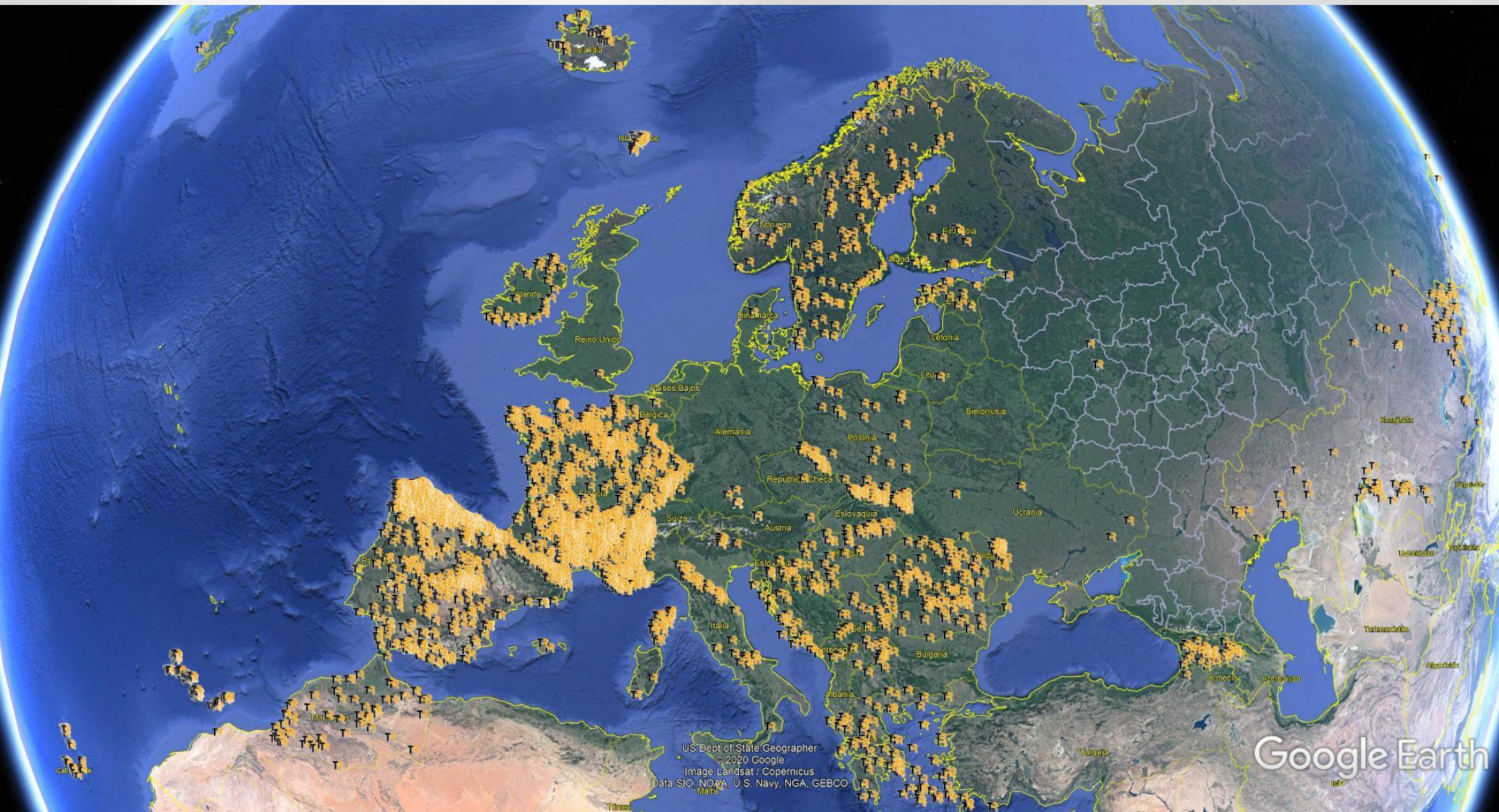
1.2) TRedess > Customer references

- More than **28.000 TV Transmitters** and Gap Filler devices on the field.
- TRedess solutions present in **more than 65 countries** Worldwide.

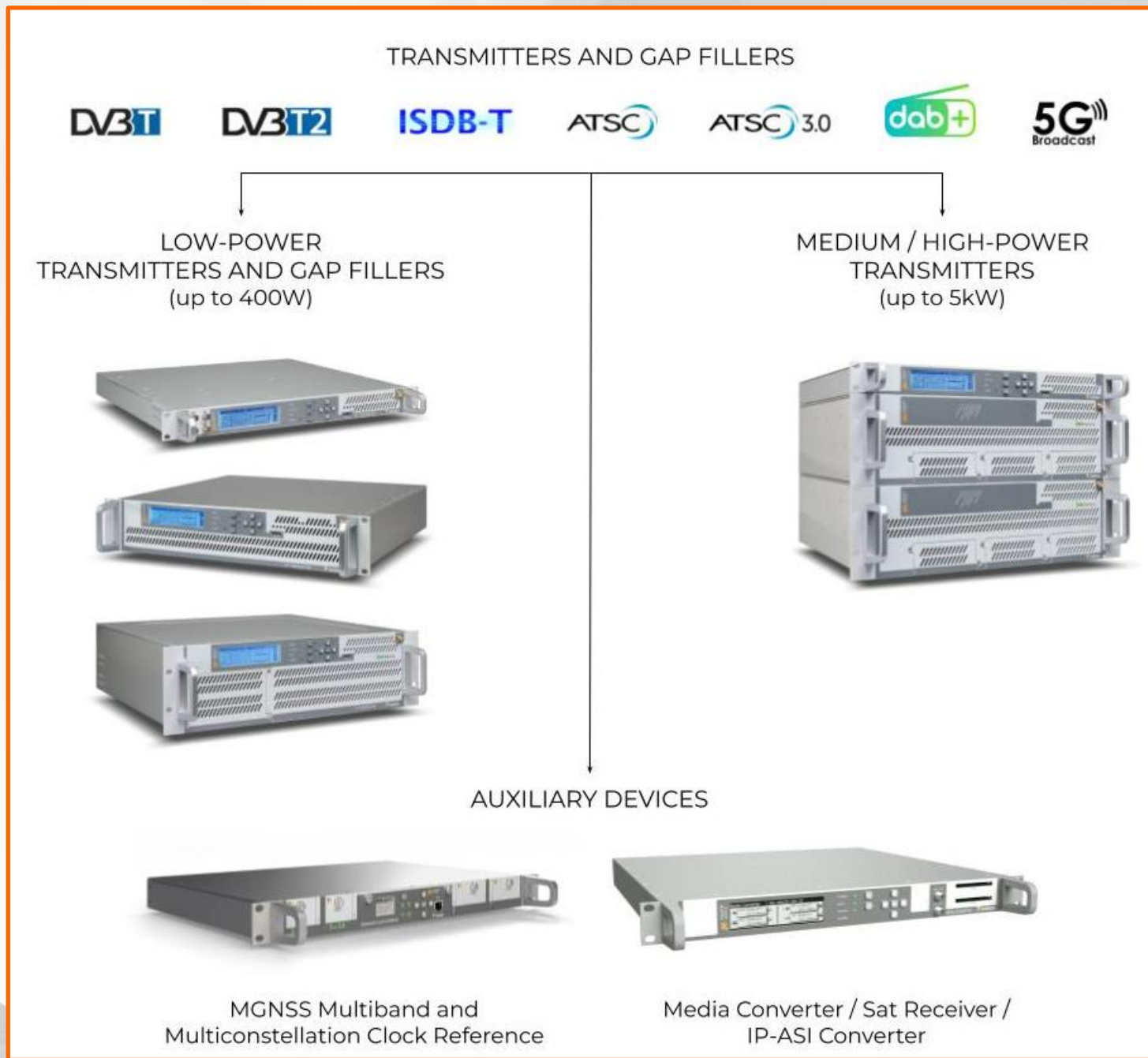
Spain	Kazakhstan
France	Vietnam
Sweden	Thailand
Norway	Hong Kong
Finland	Mongolia
Estonia	Singapore
Hungary	Morocco
Poland	Guinea
Italy	Mali
Romania	Senegal
Greece	Gambia
Croatia	Cape Verde
Ireland	South Africa
Georgia	Brazil
Faroe	Peru
Malta	Chile, Bolivia...



1.2) TRedess > Customer references



1.3) TRedess > Portfolio of solutions



1.2) TRedess > Customer references > Examples



System 3+1 in 10W



System 5+1 in 2.5KW



5KW TRANSMITTER AIR COOLED IN A SINGLE RACK



TRedess > Key technical aspects

Key technical aspects:

- very **high efficiency** of TRedess DAB+ transmitters (up to 53%)
- the **outstanding performance** of TRedess echo canceller for **DAB+ SFN Gap Fillers**.
- Other main characteristics are: compact devices, flexibility, easy to use and operate, cost effective solutions for each scenario, full control of the design and manufacturing, top class quality control, support, etc...





OPTIMIZING THE ENERGY EFFICIENCY ON A DAB+ TX

2

- Key aspects for designing of a high efficient transmitter
 - MER versus Efficiency optimization
 - Adding more functionalities into the transmitter
- Allowing the coverage extension using Gap Fillers
 - Other aspects (multiple architectures, etc)

2.1) How to design of a high efficient transmitter

- ❑ Use of **Doherty Technology** (used almost as a standard nowadays)



Ultra Wideband Doherty technology allows to maintain very high levels of efficiency with the **clear advantage of using the same amplifier or the entire DAB+ band** (easy operation, easy maintenance, optimization in number of spares, etc)

- ❑ Make use of the **most advanced transistors** and **optimization of the design of the Doherty circuitry** around the transistor

Older devices
Mid 20% / Low 30%



Nowadays transmitters can reach Efficiencies up to 53% on DAB+

- ❑ It is also important to count with **Doherty solution** not just for the High Power transmitters but **also for Low Power transmitters**

Example: Fourth Series 400W VHF Wideband Doherty DAB+ Transmitter



2.1) How to design of a high efficient transmitter

- ❑ Effect of making use of the latest and more advanced Doherty technology: Saving energy consumption → hence TCO costs for BNOs



High-efficiency
air-cooled
VHF Band III
DAB+ Transmitters

UWB Doherty

Top class efficiency figures:

- Leading Ultra-Wide-Band Doherty Technology
- Single HW for all the Band III.
- Efficiency optimization algorithm.
- Efficiency up to 53%.

DEVICE	RF Power (W)	Efficiency (%)	Consumption (W)	Saving KWh per day	Saving KWh per year	Price €/ KWh 0,16 €	Saving € per Year	Saving € per 10 years
2400W OLDER TECHNOLOGIES DAB TX	2400	25,00%	9600,00					
2400W TREDESS LATEST DAB+ TRANSMITTERS	2400	50,00%	4800,00	115,20	42048,00		6.727,68 €	67.276,80 €

2.1.1) Use case: Renewal of an existing DAB+ network

❑ Let's imagine a network built with:

❑ 5 x TX 2400W

❑ 10 x TX 1200W

❑ 20 x TX 600W

DEVICE	RF Power (W)	Efficiency (%)	Consumption (W)	Save KWh per day	Save KWh per year	Price € KWh 0,16 €	Savings per unit per Year	Savings per unit per 10 years	Number transmitters	Total savings in 10 years
2400W OLDER DAB TECHNOLOGY	2400	25,00%	9600,00							
2400W TREDESS LATEST DAB+ TRANSMITTER	2400	50,00%	4800,00	115,20	42048,00		6.727,68 €	67.276,80 €	5	336.384,00 €
1200W OLDER DAB TECHNOLOGY	1200	25,00%	4800,00							
600W TREDESS LATEST DAB+ TRANSMITTER	1200	50,00%	2400,00	57,60	21024,00		3.363,84 €	33.638,40 €	10	336.384,00 €
600W OLDER DAB TECHNOLOGY	600	25,00%	2400,00							
600W TREDESS LATEST DAB+ TRANSMITTER	600	50,00%	1200,00	28,80	10512,00		1.681,92 €	16.819,20 €	20	336.384,00 €
									Total=	1.009.152,00 €

2.1.2) Use case: Renewal of an existing DAB+ network

❑ Let's imagine a network built with:

❑ 20 x TX 2400W

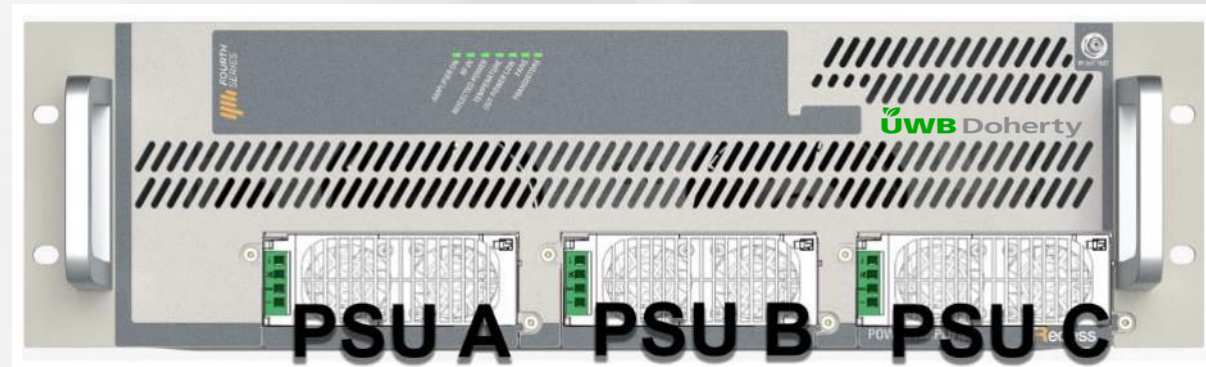
❑ 30 x TX 1200W

❑ 40 x TX 600W

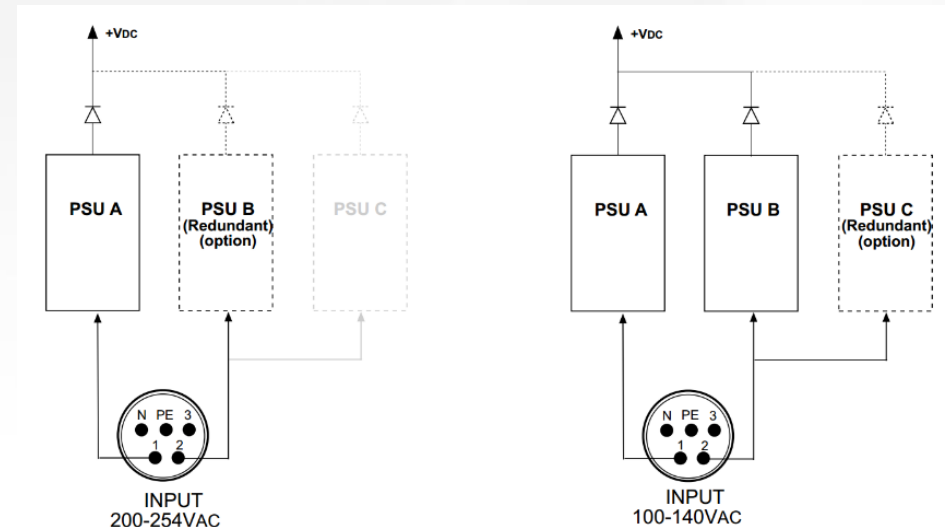
DEVICE	RF Power (W)	Efficiency (%)	Consumption (W)	Save KWh per day	Save KWh per year	Price € KWh	Savings per unit per Year	Savings per unit per 10 years	Number transmitters	Total savings in 10 years
						0,16 €				
2400W OLDER DAB TECHNOLOGY	2400	25,00%	9600,00							
2400W TREDESS LATEST DAB+ TRANSMITTER	2400	50,00%	4800,00	115,20	42048,00		6.727,68 €	67.276,80 €	20	1.345.536,00 €
1200W OLDER DAB TECHNOLOGY	1200	25,00%	4800,00							
600W TREDESS LATEST DAB+ TRANSMITTER	1200	50,00%	2400,00	57,60	21024,00		3.363,84 €	33.638,40 €	30	1.009.152,00 €
600W OLDER DAB TECHNOLOGY	600	25,00%	2400,00							
600W TREDESS LATEST DAB+ TRANSMITTER	600	50,00%	1200,00	28,80	10512,00		1.681,92 €	16.819,20 €	40	672.768,00 €
									Total=	3.027.456,00 €

2.1) How to design of a high efficient transmitter

- ❑ One key element is the **correct selection of a very high-performance Power Supply:**



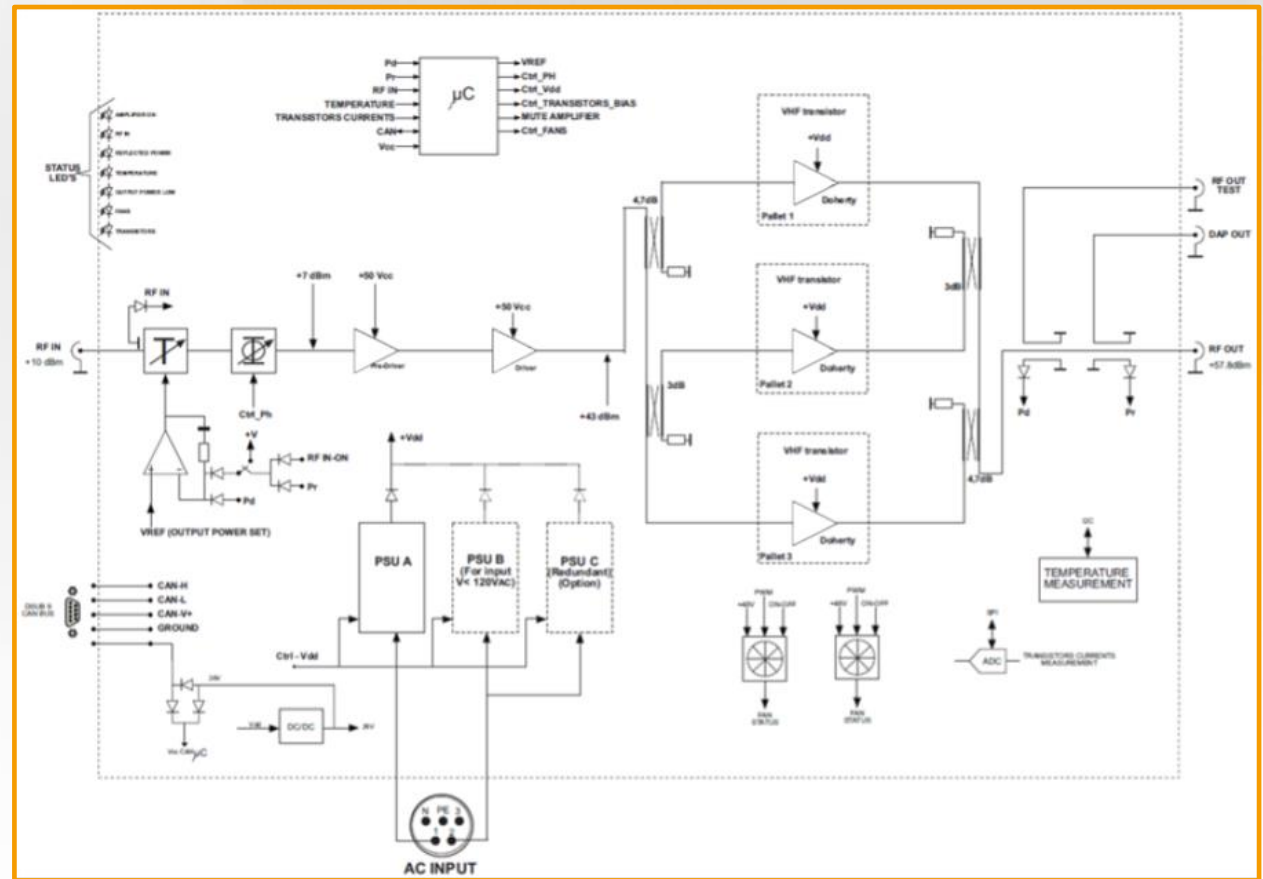
NOTE: It is important to select a PSU element that is able to maintains a high level of efficiency even when it is not operating at its maximum load → This will imply the transmitter to maintaining a high level of efficiency when not operating at maximum power



2.1) How to design of a high efficient transmitter

❑ Optimize the energy consumption in any small detail on the design:

- ❑ Signal processing board
- ❑ Control boards
- ❑ Pre-Driver
- ❑ Driver
- ❑ Pallet design
- ❑ Combining elements
- ❑ Fan speed control



❑ It is key to have the design focused in the minimization of losses at the difference stages of the transmitter and to avoid having any unnecessary over dimensioned element: All aspects need to be addressed in a way that the performance & linearity of the amplifier is optimized but using the minimum consumption.

2.2) MER vs EFFICIENCY

- ❑ The two parameters are directly related:

The higher the MER → the lower the Efficiency, and viceversa

- ❑ In the same way as on the TV projects, the MER requirement is quite similar among them (around 33dB/34dB/35dB)
- ❑ On the contrary, there is a wide variety of MER requirement worldwide in DAB+ networks: Some countries operating DAB+ networks with MER requirements of 30dB, and others are even proposing to move down from current MER of 26dB to 25dB or even lower.
- ❑ So, it is important to count with a transmitter device that can easily optimize the efficiency according to the MER target the BNO defines.

2.2) MER vs EFFICIENCY

- ❑ Important to count with a **very good performance of the Adaptive Precorrection**: MER and Efficiency are two linked parameters, so if MER is already optimized by the Precorrection, the efficiency does not need to be degraded to improve the MER.
- ❑ Very interesting to count with an **Algorithm for the Optimization of MER versus Efficiency**.

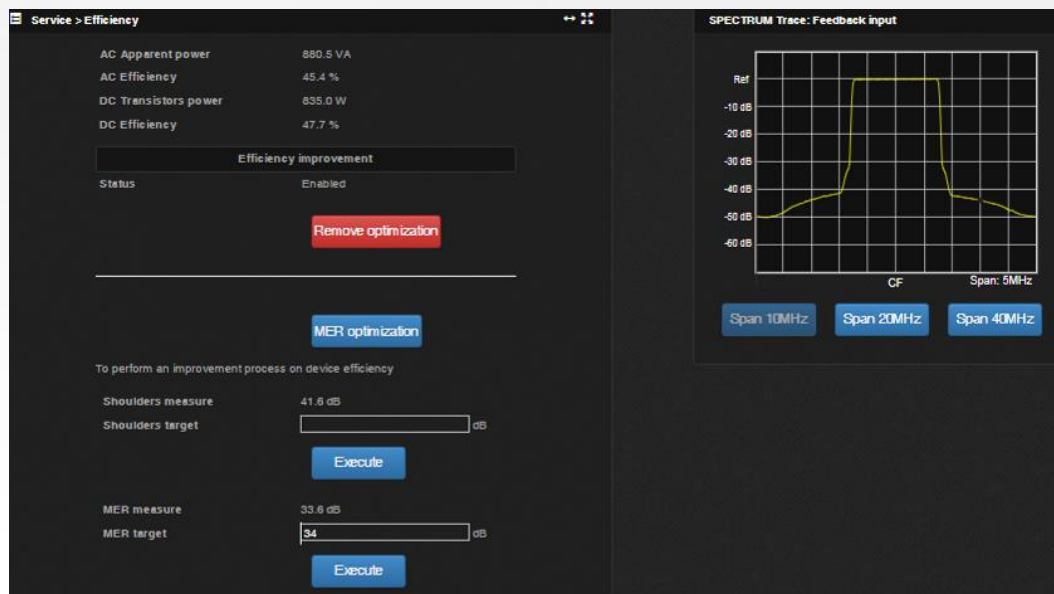




Fig: MER vs EFICIENCY OPTIMIZATION

- **MER vs Efficiency Optimization:** it is possible to set up a target of the minimum MER you need, and then optimize the consumption (efficiency), being of course also possible to revert this back to continue optimizing performance and getting the maximum MER.

2.2) MER vs EFFICIENCY

- Effects of the **Algorithm for the Optimization of MER versus Efficiency.**

TREDESS 2,4kW DAB+ TRANSMITTER WIDEBAND DOHERTY			
			
Channel / Frequency	Output power	Total Transmitter Efficiency for MER = 32dB	Total Transmitter Efficiency for MER = 26dB
7A / 188.928 MHz	2,4 kW	50,00 %	53,00 %

DEVICE	RF Power (W)	Efficiency (%)	Consumption (W)	Saving KWh per day	Saving KWh per year	Price €/ KWh	Saving € per Year	Saving € per 10 years
2400W WITHOUT EFFICIENCY OPTIMIZATION (MER 32dB)	2400	50,00%	4800,00			0,16 €		
2400W WITH EFFICIENCY OPTIMIZATION (MER 26dB)	2400	53,00%	4528,30	6,52	2380,08		380,81 €	3.808,12 €

2.2) MER vs EFFICIENCY: Use case

❑ Let's imagine a network built with:

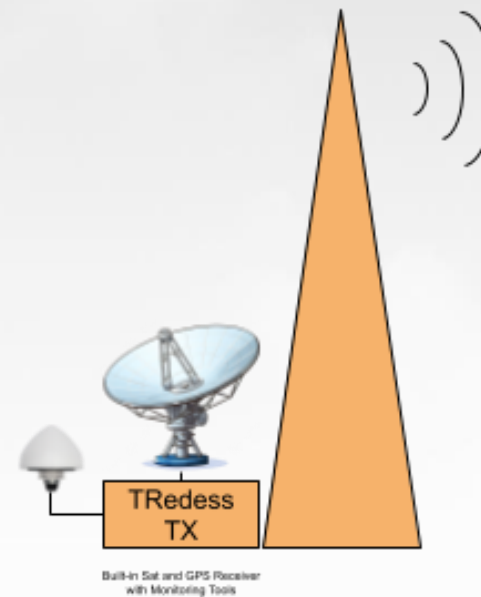
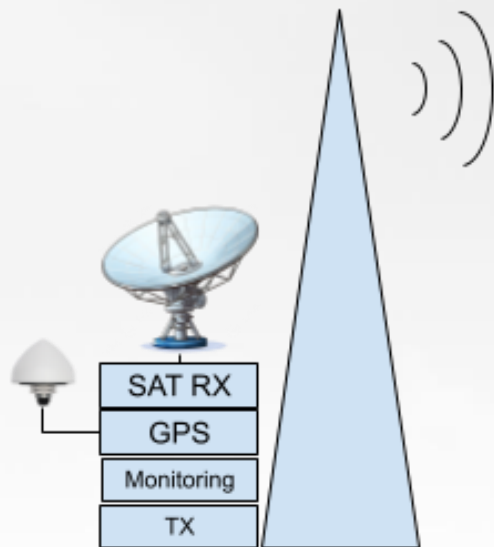
- ❑ 20 x TX 2400W
- ❑ 30 x TX 1200W
- ❑ 40 x TX 600W

❑ The effect of defining a network based on **MER 32dB** OR **MER 26 dB** would be:

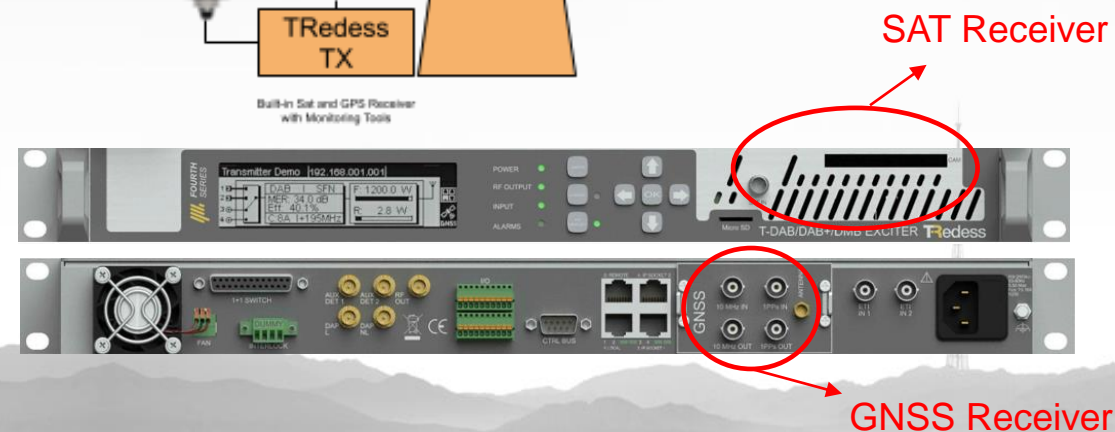
DEVICE	RF Power (W)	Efficiency (%)	Consumption (W)	Save KWh per day	Save KWh per year	Price € KWh 0,16 €	Savings per unit per Year	Savings per unit per 10 years	Number transmitters	Total savings in 10 years
2400W WITHOUT EFFICIENCY OPTIMIZATION (MER = 32dB)	2400	50,00%	4800,00							
2400W WITH EFFICIENCY OPTIMIZATION (MER = 26dB)	2400	53,00%	4528,30	6,52	2380,08		380,81 €	3.808,12 €	20	76.162,42 €
1200W WITHOUT EFFICIENCY OPTIMIZATION (MER = 32dB)	1200	50,00%	2400,00							
1200W WITH EFFICIENCY OPTIMIZATION (MER = 26dB)	1200	53,00%	2264,15	3,26	1190,04		190,41 €	1.904,06 €	30	57.121,81 €
600W WITHOUT EFFICIENCY OPTIMIZATION (MER = 32dB)	600	50,00%	1200,00							
600W WITH EFFICIENCY OPTIMIZATION (MER = 26dB)	600	53,00%	1132,08	1,63	595,02		95,20 €	952,03 €	40	38.081,21 €
									Total=	171.365,43 €

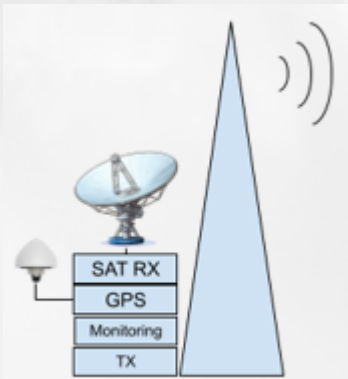
2.3) Adding more functionalities to the transmitter device

- ❑ Some transmitter manufacturers have integrated into the transmitter device some functionalities like the **built-in SAT receiver**, a **built-in GNSS receiver** and also some transmitters provide a very complete embedded monitoring system with a lot of information on QoS parameters (MER, shouldered, efficiencies, etc) that can be received via NMS.

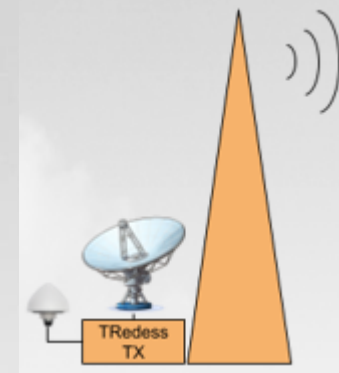


These embedded functionalities into the transmitter directly contribute to the cost optimization and also the saving of energy consumption at the site!!

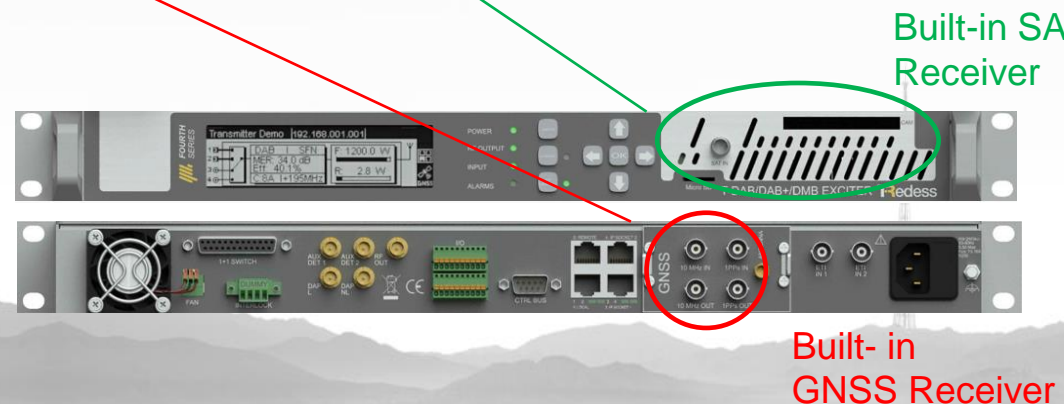




TRedess Standalone SAT Receiver

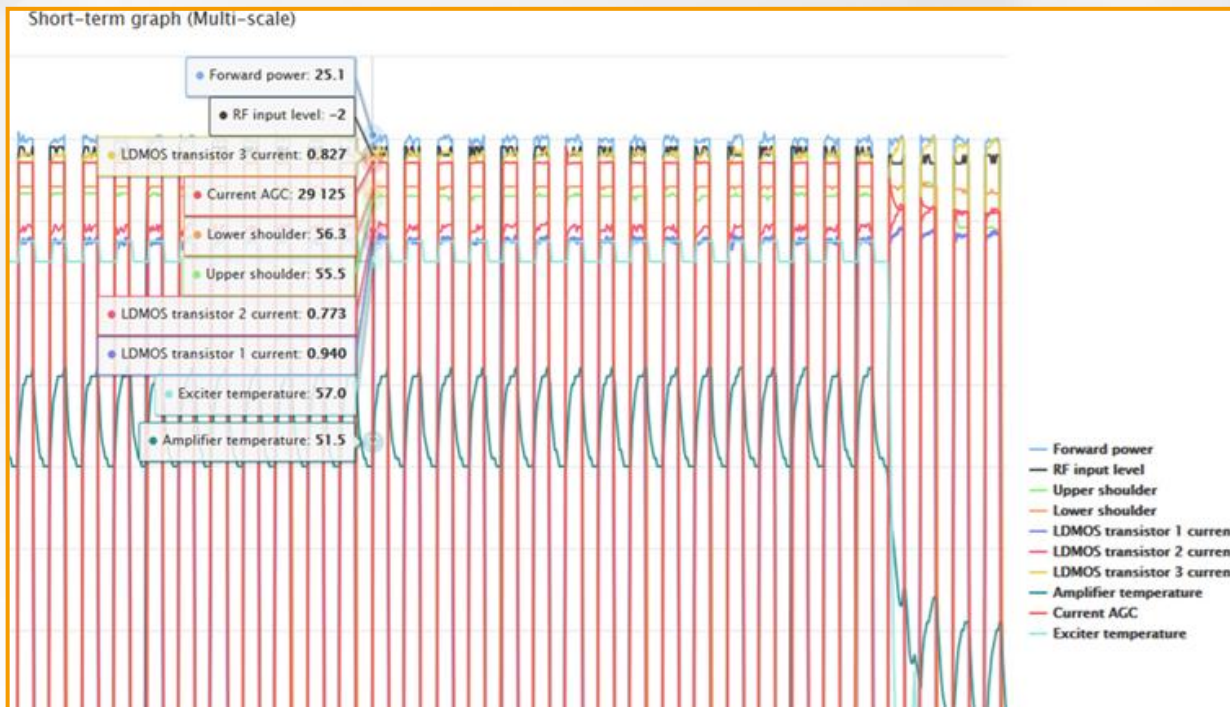


TRedess Standalone MGNSS Receiver



2.3) Adding more functionalities to the transmitter device

- ❑ Modern transmitters also include a **Enhanced Monitoring tool for DAB+ Transmitters**: providing a complete embedded monitoring system with information on QoS parameters (MER, shoulders, efficiencies, etc) but with also information about currents, voltages, temperatures, etc



Short & Long term evolution of performance & internal operating parameters

Parameters are visually displayed in a histogram and that can also be exported to multiple formats.

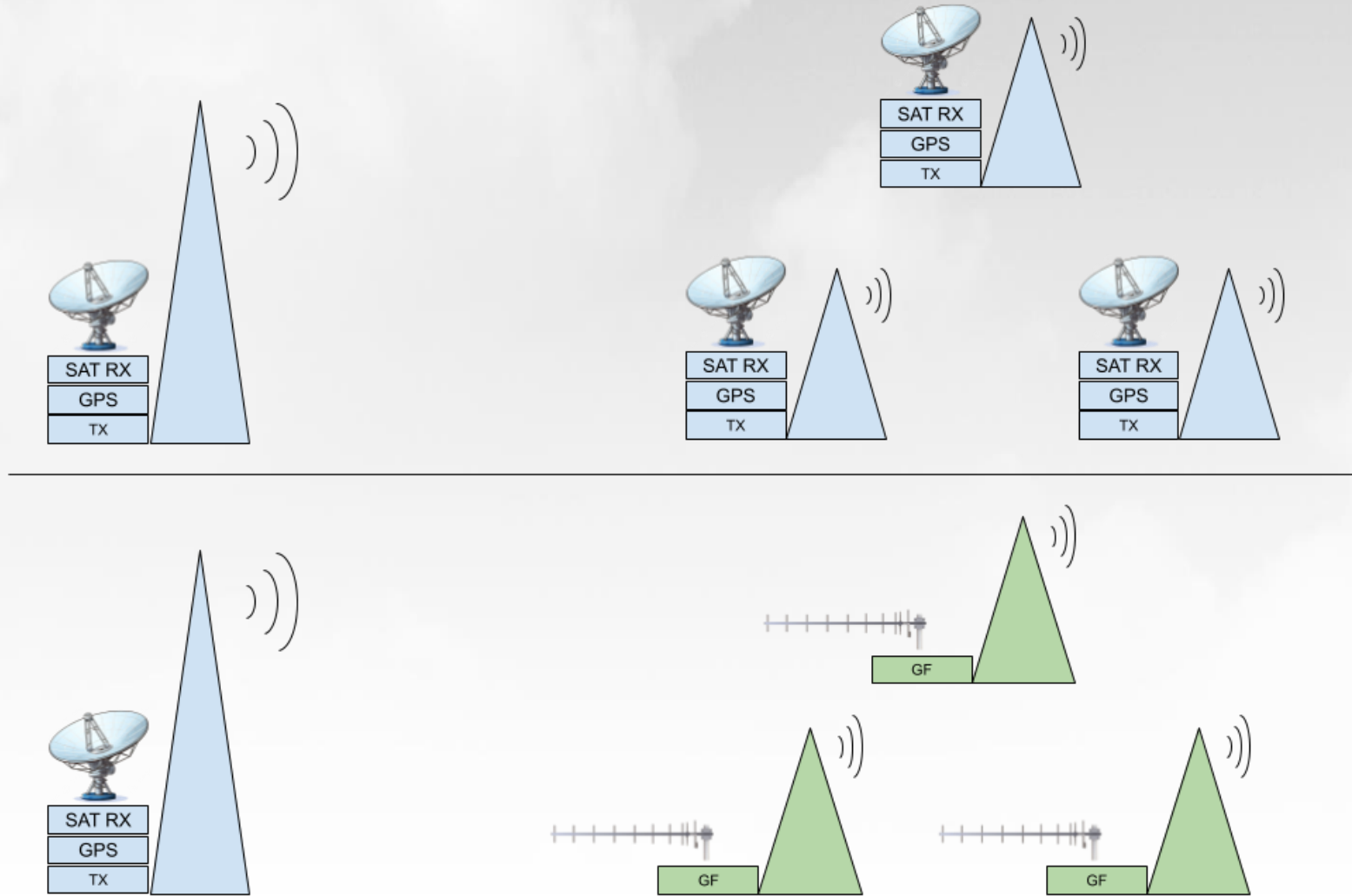
Very useful graphical tool (possibility to export values in to other formats) **for troubleshooting and for proactive health checks, what could be valid enough to avoid the need of an external monitoring unit**

2.3) Adding more functionalities into the transmitter device



Device	Typical Electrical Consumption (W)	Saving KWh per day	Saving KWh per year	Unit price KWh	Saving € per Year	Saving € per 10 years
GNSS receiver	15	0,36	131,40	0,16 €	21,02 €	210,24 €
Satellite receiver	60	1,44	525,60		84,10 €	840,96 €
Monitoring	40	0,96	350,40		56,06 €	560,64 €
					161,18 €	1.611,84 €

2.4) Making use of latest technology allowing the network to use DAB+ Gap Fillers for the coverage extension



- Current Gap Filler technology allows DAB+ Gap Fillers to operate in SFN
- Gap Filler site needs less elements into the site (no RX SAT, no GPS) → Energy Savings

Low Power DAB+ GAP FILLERS (SFN ON-CHANNEL REPEATERS)



New !!!

**Fourth Series
DAB+ Gap Fillers
with Enhanced
Echo Cancellation**

- Gain Margin 30dB (capable of cancelling echos 30db higher than the receiving signal)
- Multiple Cancellation **Windows**
- Doppler Effect cancellation
- Very low MER degradation
- Very Fast processing time



Ideal solution for coverage extension of DAB+ networks without the need of SAT reception at the site, or uWave link, fiber optic, etc...

Simple & reliable

More cost effective solution

**Successful sites installed with DAB+
Gap Fillers with 100W and 400W units**

REAL CASE 150W TV GAPFILLER Majalengka- Indonesia :

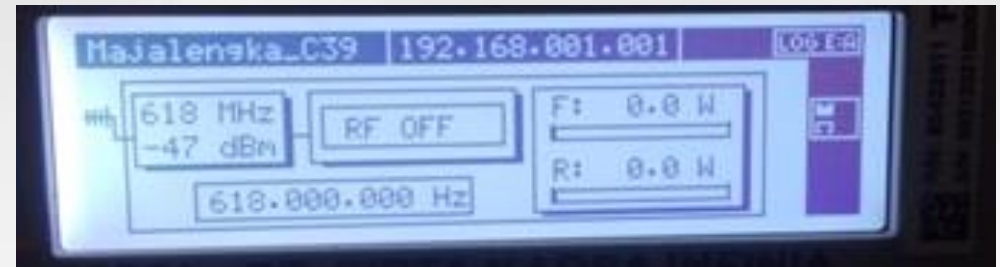
DVB-T2



Tower height: 50m

Reception antenna height: 20 m

Input signal level from main Tx: -47 dBm



Isolation: 90 dB

RF output power: 150 W (51,76 dBm)

Echo level: +9dB (GAIN MARGIN: -9dB)





The site is primary a mobile base station.

The mast is only a short one → Therefore we were limited in the space between the Rx-Tx-Antennas.

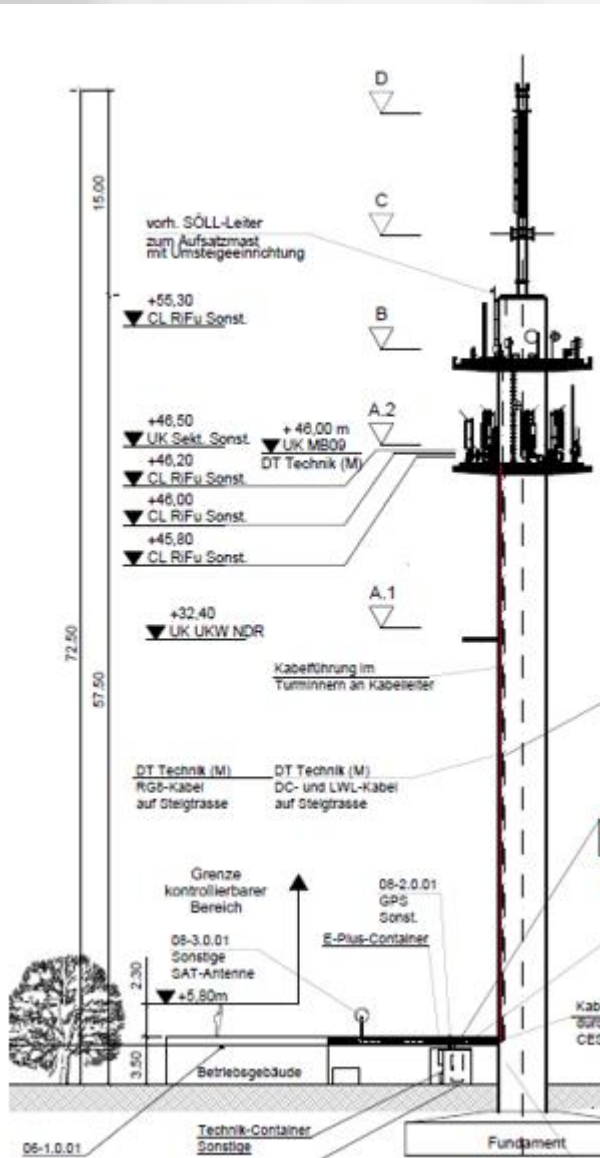
There the isolation between rx and tx antenna is only 75 dB

And the input power at the rx-ant is -54dBm.

Attenuation of output filter and feeder is about 4dB.

The repeater achieved an output power of about 40W.





The transmitting and receiving antenna are offset by 180°.

Spatially 10m apart but decoupled by a platform.

The decoupling at this location is 80db.

The input level is also quite high.

TRedess DAB+ GF is operating very stable with 400W output power.

2.5) Other aspects that can contribute to the Energy Efficiency

- ❑ Counting with **multiple models and architectures**, like Multicarrier / Multichannel solutions for Lower Power sites → So, the cost per channel and the energy consumption per channel is clearly optimized:

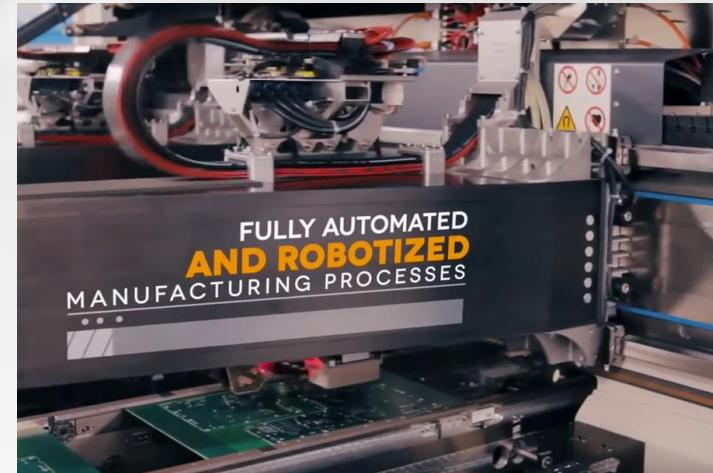


- ❑ **More efficient transmitters (also in lower power units)** → Less necessary air conditioning at the sites → Less energy consumption



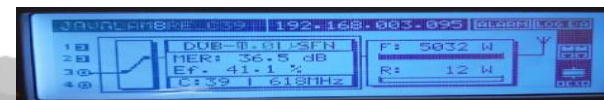
2.5) Other aspects that can contribute to the Energy Efficiency

- ❑ **Automatization on the manufacturing process & making stronger quality controls on the products** → Higher reliability on the devices → Less necessary visits to the sites → Less costs and less energy consumption → Environmental benefit



2.5) Other aspects that can contribute the Energy Efficiency

- ❑ **Redundant Systems based on distributed architectures** (1+1, Dual Drive, Power Supply redundancy (with no need of an additional Automatic Switching Unit for driving the commutation) → Less space usage → Lower costs → Less points of failure → Higher reliability → Energy savings → Environmental benefits
- ❑ **More compact solutions** → Less space usage at the sites → Multiple transmitters per rack → Cost savings in equipment → And also Energy savings in transportation due to lower number of racks & electrical panels.
- ❑ **User friendly interface + Easy local & remote operation + Easy maintenance of the unit** → Less visits to the sites → Less visits to the sites → TCO costs optimization + energy savings → Environmental benefits.



CONCLUSIONS

3

1) First conclusion: ENERGY EFFICIENCY is nowadays a key topic for all customers / BNOs

Due to 3 main reasons:

- **TCO Cost optimization**
- **Company policies**
- **Environmental aspects**

2) **Second conclusion:** transmitter manufacturers are key contributors for helping BNO's to reduce the energy consumption at the sites, based on:

- A good internal design, using the **latest Doherty Technology** and the latest and more **modern transistors** → allows the **transmitter efficiency to reach levels of 50% (even up to 53%)**
- Also, the **integration in the transmitter of additional functionalities** like a **built-in SAT receiver + GNSS receiver + Enhanced monitoring system with QoS measurements** → contributes to minimize the number of external elements at the site → optimizing costs & energy usage.
- Integrating an **easy algorithm / embedded tool** into the transmitter that will allow the BNO **to optimize the MER versus EFFICIENCY** → the network is maximizing the energy efficiency and achieving the MER quality required.
- The **latest technology on the Echo Cancellation** allows the **successful implementation of SFN Gap Fillers for DAB+ networks** → Ideal solution to extend the coverage in a more cost effective way than basing the entire network on transmitters (as the site only needs a RX antenna instead of SAT receiver, GNSS Receiver etc...)
- The **compactness** of the solutions + the **redundancy** on the systems + the **stronger quality control processes** + the full **automatization** on the manufacturing processes + **easy operation** and **maintenance** of the unit → are all leading to **higher reliability** → and indirectly to also **cost savings** + additional **energy savings** & **environmental benefits**.

Thank you

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