

Connecting What's Next

Transmission solutions to manage cost Eng. Oscar Hu



- General Introduction
- Transmitter system
- Total Cost of Ownership
- Gates Air DAB solutions
- Multi Carrier Transmitter
- PMT Transmitter
- Summary





Connecting for the Future

A LONG HISTORY OF INNOVATION



- GatesAir has been a pioneer in over-the-air broadcasting for more then 100 years
- We developed groundbreaking over-the-air radio and television transmitter designs that continue to this day
- GatesAir actively and proudly participates in projects that set new standards in broadcasting, content delivery, and more









Gates Air Transmission chain









TOTAL COST OF OWNERSHIP

TOTAL COST OF OWNERSHIP (TCO)

Торіс

- High-efficiency transmitters are the cornerstone of low TCO, though many other factors are equally important.
- Today we will look at all the major drivers of total cost of ownership, including repairability, modularity, footprint, and several other factors that can help you select a reliable transmitter that will provide you costeffective operation throughout the life of the product.





Connecting for the Future



TOTAL COST OF OWNERSHIP DEFINITION

There are many definitions for TCO, these fit best:

- "Total Cost of Ownership is the total cost of acquisition and operating costs over the asset life cycle". A TCO analysis can be used to gauge the viability of any capital investment.
- 2. "Total cost of ownership (TCO) is an analysis that places a single value on the complete life cycle of a capital purchase". This value includes every phase of ownership: acquisition, operation, and the softer costs of change management that flows down from acquisition such as documentation and training.



Courtesy: http://www.wilsonmar.com/1tco.htm







This example uses 200 meters transmission line. Frequency 560MHz.

	Ch 29 (5	560MHz)								
Line size / type	Loss/ 100ft (dB)	Line Loss (dB) 200 meters (656ft)	Mask Filter Loss (dB)	Total Loss (dB)	Tx Power (kW)	Antenna Input Power (kW)	Tx AC Input Power (kW)	AVR Efficiency	AC Input Power	System Efficiency
3" Flex HCA-300-50J	0.325	-2.132	-0.270	-2.402	9.6	5.52	24	97%	24.74	22.3%
3-1/8" 50 Ohm Rigid	0.220	-1.443	-0.270	-1.713	9.6	6.47	24	97%	24.74	26.2%
4-1/16" 50 Ohm Rigid	0.174	-1.141	-0.270	-1.411	9.6	6.94	24	97%	24.74	28.0%

- The transmitter is only one part
- Adding losses for:
 - AVR
 - Mask Filter (typ. 0.27dB)
 - 200 meters transmission line (See table for losses)
- Assume Tx is 40% Efficient
 - AC input = 9.6/0.40 = 24kW



ANTENNA

Of the 24.74kW power going into the transmitter, only 5.52kW feeds the ante

97%



• Efficiency of a transmitter:

• Definition: (RF Power Out / AC Power In) x 100%





Older Technology TV Transmitter

- 10kW Class AB UHF DTV Transmitter
- Efficiency 10/50 x 100% = 20%





Very Efficient TV Transmitter

- 10kW High-Efficiency UHF DTV Transmitter (New Generation)
- Efficiency 10/24 x 100% = 41.7%





TRANSMITTER EFFICIENCY

- Transmitter System Efficiency
- Some Items may have fixed losses:
 - Control System
 - Exciters
- Some Items may have varying losses:
 - PA Module (varies with modulation, saturation)
 - Drivers (varies with modulation, saturation)
 - Cooling System (speed-controlled pumps and fans)
 - Power Supplies (can vary depending on load)
- Why are low power transmitters less efficient than high power?
 - As power is reduced, fixed losses become a larger part of the equation





GATESAIR PRIMARY EFFICIENCY DRIVERS IN A TX

- Power Amplifiers
 - Most older designs used Class AB PA's
 - PA Efficiency in range 23% to 33% (Overall Tx efficiency in range of 16% to 27%)
 - Most new designs uses High-Efficiency (Doherty) PA's
 - PA Efficiency over 50% VHF and UHF (Overall Tx efficiency often > 40%)
- Power Supplies
 - 12 years ago 86% was "state-of-the-art" efficiency
 - Today power supplies can be up to 96% efficient
- Cooling System
 - Older less efficient transmitters used large high volume and pressure blowers
 - Large pumps and heat exchangers in liquid-cooled transmitters
 - New systems use variable speed fans and pumps and have less heat to remove



EFFECT OF POWER SUPPLY EFFICIENCY

Item	Old Technology PS 86% Effy.	Recent Power Supply 90% Effy	New High Eff. PS 96% Effy.
RF Power Output (W)	10,000	10,000	10,000
Power Amplifier Efficiency	51%	51%	51%
Combining losses (dB)	0.30	0.30	0.30
RF power before losses (W)	10,715	10,715	10,715
DC Power to PA's (W)	21,010	21,010	21,010
Power Supply Efficiency	86%	90%	96%
AC Power to Power Supplies (W)	24,430	23,345	21,886
Power Supply Loss (W)	3420	2334	875
Drivers	600	600	600
Exciters	150	150	150
Control	120	120	120
Cooling	600	600	600
Total AC Input (kW)	29,321	27,149	24,231
Overall Tx Efficiency	34%	37%	41%

- Clearly, the design of the power supply has a significant impact on total efficiency
- Example of a high-efficiency power supply:
 - Efficiency 96% at 50% FL
 - Power factor typ. 0.995
- Input voltage range typ. 185 300 VAC













ASIA (EX. NEAR EAST) Electricity Pricing - C/kW-Hr 2021







DAB PRODUCTS

MAXIVA LOW POWER ULTRA-COMPACT SERIES

- Available output power: 15W 30W 80W 150W average DTV
- High-efficiency, Doherty broadband VHF BIII
- Adaptive pre-correction
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Configurable as: Transmitter, Transposer, Regenerative Gap Filler
- Hot Swappable Power Supply & RF amplifier
- DAB+/DMB Standard
- HTML5 Interface





MAXIVA ULTRA-COMPACT SERIES

- Available power levels: 300W (2RU) 450W (2RU) – 550W – 750W (3RU)
- High-efficiency broadband VHF BIII
- Adaptive pre-correction circuits with MER >33 dB typical
- EDI + ETI + DVB-S/S2 + RF input interfaces available
- Transmitter, Repeater, Transposer, Regenerative Gap Filler
- Hot-swappable Power Supply from front panel
- DAB+/DMB





MEDIUM POWER AIR-COOLED

- Available output power: 300W, 450W, 550W, 750W, 1200W, 1500W, 1900W. Single or Dual redundant Exciters
- High-efficiency broadband VHF
- Adaptive pre-correction circuits with MER > 33 dB typical
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Embedded ETI/EDI & RF Switch Over matrix for Dual Redundant Exciters
- Hot Swappable Power Supplies
- DAB+/DMB





HIGH POWER AIR & LIQUID -COOLED

- Available output power: from 3000W to 13,600W Air cooled and 45,600W Liquid Cooled
- High-efficiency broadband VHF BIII
- Adaptive pre-correction with MER >up to 33 dB typical
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Hot-swappable Power Supplies with 2 of 3 redundancy
- Low consumption Pump and Heat Exchanger (pump + heat exchanger + external fans = 535W)
- Dual Redundant Pumps standard
- 2 x coolant reserve tanks (8 litres) for automatic liquid refilling, reduces on-site maintenance
- Very small external heat exchanger with 24V power



GATES ENERGY CONSUMPTION – ANALOG & DIGITAL

Transmitter	FM	DAB+
Power	10 kW	2.5 kW rms
Efficiency	72%	50%
Consumption per Transmitter	13.9 kW	5 kW
Transmitters	18	1
Energy all Transmitters	250 kW	5 kW
Annual cost of energy	328,500	6,570

- DAB+ energy savings
 50x lower compared to FM
- Power consumption in kW
- Assumes 0.15 USD per kWh

- Energy costs over 10 years of operation
- DAB+ energy savings over 10 years
 3,219,300 USD compared to FM



Example: 18 Radio Programs same coverage

POWER SUPPLIES

2 of 3 High Redudancy Power supply system



Liquid-cooled PA module with front panel removed

- Same Power supply as FAX/FLX:
 - GE Power CP2725
 - 450,000 hrs. MTBF
 - 96.3% efficient
- Hot-swap, front access





PS1

PS2

PS3

100%

OUTPU

T POWER



HIGH EFFICIENCY TECHNOLOGY - VHF BAND III

TECHNOLOGIES ON THE MARKET

Narrow Band Doherty

- Up to 1-2 Channels
- Problem with spare parts
- Problem with N+1 systems



Broadband Doherty

- Complete VHF BIII from 170 to 240 MHz
- Convenient for N+1 and Spares
- Optimized Efficiency up to 41%









CASE MULTICARRIER TRANMITTER

DAB Multicarrier







MULTICARRIER DAB Spectrum – Up to 4 CH



GATES MULTI CARRIER DAB SOLUTIONS REDUCE COSTS, AND INCREASE ROI





MULTICARRIER DAB 1RU Up to 150 Wrms Total

FRONT VIEW





MULTICARRIER DAB 1RU Up to 150 Wrms Total

BACK VIEW





MULTICARRIER DAB – 240 Wrms Total





MULTICARRIER DAB – 3 RU Up to 750 Wrms Total





Accessories: Automatic changeover

2+1 or 1+1 Configuration (N Connectors)

Front View



Rear View





Accessories: Automatic changeover

Options



Option: ETI Input Splitter / Matrix



Option: Power supply



EXAMPLE: 1+1 (4+4ch) Configuration





EXAMPLE: 1+1 (4+4ch) Configuration

Output filter: STANDARD VHF BIII Band Pass (NO DAB Filter required)





Systems comparison

Main Features

	Multicarrier D	AB Stan	dard solution
Number of Transmitters	1		4
Dimensions TX	1U		4 X 1U/2U/3U or bigger
Independent management of single	emux YES		YES
RF DAB Combiner	NO		YES
Special Filter Combiner: DAB + Service (for special applications only - ex: tuni	es nel coverage)		YES
Power output W/CH *	175W rms	•	175W rms
Efficiency Always be	tter than standard solution	•	Always worst than Multicarrier

*higher powers available







GETTING AWAY FROM THE 19" PARADIGM

- Why an outdoor transmitter?
 - Breaking the normal Broadcast tradition
 - A complete "Transmitter in a box" concept
 - Well-proven in other industries (cellular)
 - No building, no indoor lease space
 - Save \$\$, lower TCO
 - Fast & easy to deploy
 - Can make a great alternative solution for the lowest power level transmitters, repeaters







Courtesy Vanu Inc.

Low Power Cell Tx (Vanu)

Efficient transmitter: This 50-watt (power consumption) unit is the lowest-power outdoor cell-phone base station in the world, according to an analysis by its maker.

Examples of outdoor transmitters



Cellular Base Station Tx (Samsung)

Power Pole-mounted 5G Tx & Antenna (Unknown Brand)



INSTALLATION FLEXIBILITY!



- Mount on any suitable structure
- Waste heat dissipated via heatsink fins
- Simple bracket designs for pole, mast, wall mount, etc.
- Versatility in terms of mounting location vs. pole-mount only
- Available to order now





Mount





Wall / Side of Building

Tower/Pole Mount Top of Building

44





GPS





Interface for Sat RcvrModulator

Amplifier DC Supply

4



- Basic Configurations
 - Transmitter / Transposer / On-Channel Gap Filler
 - Integrated Mask Filter
 - Up to 50W TPO average DTV after filter
 - ⁻ or 100W Analogue
 - Modulations: DAB/+, T-DMB, ATSC-1, DVB-T/T2, ISDB-T, Analogue
 - GPS Option
- Inputs & Options
 - 1 x TS (ETI / EDI / BTS / ASI / SMPTE-310M) + 1 x GbE (TSoIP) -Included
 - Off-Air Receiver (Regenerative or Direct Conversion) Option
 - Satellite Receiver DVB-S2/S2X Option
- Power source
 - External DC: 36V to 72V
 - External AC to DC Power Supply Option





GatesAir's new Maxiva[™] PMTX-1, is a complete self-contained, outdoor transmitter system. Housed in a completely environmentally sealed enclosure, the PMTX-1 includes many options, allowing configuration flexibility for many applications.

The unit is capable of being configured as a Transmitter or Transposer (Translator). Waste heat is efficiently dissipated via the metal housing and heatsink, there is no active cooling and no fans. This allows the unit to be mounted on a variety of structures, including tower, legs, poles, or building walls. For regions with extreme climate conditions, options for ambient air temperatures up to +50°C (122°F) and down to -80°C (-40°F) are available.

The compact dimensions (429W x 280D x 503H mm) of the Maxiva PMTX-1 chassis are key to this unique design, allowing installation on a wide variety of outdoor poles, or mast structures. Access

is via a lockable and sealed door. The sealed metal housing of the PM-TX-thas been engineered to remove heat efficiently from the internal circuitry. The unique design of the PMTX-1 provides a high level of installation versatility, allowing it to be installed on virtuality any suitable outdoor structure.

This versatile unit does not require a building, shelter or any additional outdoor enclosure. The totally sealed metal case has been designed specifically for outdoor environmental conditions, providing protection from all humidity levels, precipitation and wide temperature extremes.

The unit can be configured and operated as a 50W digital / 100W analogue transmitter or transposer, with various input options. A satellite receiver card with CAM slot is also available. The unit includes an internal mask filter. The external power source requirement is 36-72 VDC.

Product Features

- Compact chassis: 429W x 280D x 503H mm
- Outdoor, pole-mounted, using adapter plate
- Output Power (Post-Filter): 50W rms Digital or 100W analogue
- Input interface options:
- ASI, BTS, T2MI, SMPTE-310M, ETI
- Gbe port (TS over IP)
- DVB-5/52 Satellite Receiver input available (including CAM interface)
- RF receiver input for Transposer/Gap-Filler configuration (Direct Conversion – zero IF)

- Regenerative receiver input option for Transposer
- Supports DVB-T/H, ISDB-T/Tb, DVB-T2, ATSC & Analogue modulations
- Embedded Re-Multiplexer/Layer Combiner/TS to BTS (188 to 204 byte) converter for ISDB-Tb
- Adaptive pre-correction circuits
- Optional High stability GPS / GLONASS receiver with battery
- SNMP, Web User Interface



- Environmental
 - Ambient air temperature range:
 - -20°C to +45°C (standard)
 - -40°C to +50°C (optional)
 - Weatherproof, sealed enclosure
- Performance (Adaptive correction is included):
 - MER ≥ 34dB
 - Shoulders \leq -37dB
- Remote Control
 - GPIO (parallel remote)
 - Full-featured HTML-5 Web Remote GUI
 - LTE Module (option)

		Specifications and designs are subject to cl	hange without notice
		General	
		RF Output Frequency Range	PMTX-1-U: UHF Band, 470-700MHz
		Transmission Standards	ATSC, DVB-T, DVB-T2, ISDB-Tb, Analogue
		RF Channel Bandwidth	6, 7 or 8MHz
		Number of Transmitters per Unit	1
		RF Power Output per Transmitter	At output of integrated filter: 50W average DTV, 100W analogue p.s.
		VSWR Protection	Included
		Mechanical Dimensions	429W x 280D x 503H mm
		Power Supply Configuration	External DC power source, connected to bottom of unit.
		Power Supply Voltage	DC: 36 to 72V
		Remote Control	Web Remote and SNMP
		Pre-correction	Real Time Adaptive
		Input Options (per tx module)	
		RF Input	Type N (f) connector, 50 ohms
		ASI/BTS/T2-MI//SMPTE-310M	BNC (f), 75 ohms
		GbE Port (TSoIP)	RI-45
		DVB-S/S2 Satellite Receiver	Type F. CAM slot included, with Multi-Stream capabilities
		Environmental	
		Operational Temperature Range	Standard range: 2010 to +5010 ontions to 4010 available
		Polatias Humidity	Dis 90% per condensing
		Preserve richtarty	Use to 2500m MMCL Decision may temperature 210 per 200m of elevation
		Altitude	> 2.500m on request
		DVB-T/T2 Transmitter Performance	de Marcale W
		Standard	EN300744 EN307304 EN302755 T5101191 T5102773 (T2,MD T5102034
		Deces Created Cashiller	27.0 7.40 emiles
		Power Output Statisty	To Olivera
		RF Load impedance	50 Onms
		Operating Load VSWR	Up to 1.4:1
		MER	≥ 38 dB
		Shoulder Level	s-39 dB
	()	Spurious and Harmonics	-60dBc (After mask filter)
Technical Engineering [Data (TED)	Channel Bandwidth	6-7-8 MHz
reennieur Engineening E		FFT	1K (DVB-T2), 2K, 4K, 8K, 8K ext. (DVB-T2), 16K & 16K ext. (DVB-T2), 32K & 32K ext. (DVB-T2)
Charat			All modes available according to the standard
2 HECO			Block Short or Normal (DVB-T2)
TV Transmitter Technic	al Engineering Data Sheet	t	DV8-T2 BCH LDPC
			1/32 1/16 1/8 1/4 19/256 (DVR.T2) 19/128 (DVR.T2) 1/128 (DVR.T2)
Transmitter Type: PMTX-1U	UHF, Air Cooled, Solid State Transmitter		OPSK 160AM 640AM 2560AM (DVR-T2) Rotated and non-instated (DVR-T2)
Transmitter Type: PMTX-1U Destrical Date: OFDM & SVSB Modulation	UHF, Air Cooled, Solid State Transmitter Pole Mount Transmitter sylens		QPSK, 16QAM, 64QAM, 256QAM (DVB-T2). Rotated and non-rotated (DVB-T2) Complex to FTS F1011 101
Treasmilter Type: PMTX-1U Electrical Data: OFDM & WVSB Modulation 10° Out Put Lise State: TYPE N	UHF, Air Cooled, Solid State Transmitter Pole Mount Transmitter systems		QPSK, 16QAM, 64QAM, 256QAM (DVB-T2): Rotated and non-rotated (DVB-T2) Complies to ETSI EN 101 191
Transmitter Type: PMTX-U Descrived Bate: FF On Put Line Bate: FF ON Put	UHF, Air Cooled, Solid State Transmitter Pole Mozat Transmitter systems		OPSIL TO COMPARE AND ADDRESS OF
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Transmitter Tape: PMTX-IU Description OFD AL SVIDS Modulation DF Out Put Lines Take TYPE N Power Angellice Type: Brandhand Trappenty Page: 475-585 Mdr Nominal Put Mak Filter RF Power Output 590 *	1387: Air Cooled, Bold Rate Transmitter Pole Mount Transmitter sylems		[0%5, 1502M, 6402M, 25602M (2V872), Rosend and non-neutral (2V872) [Complex to ET2 EH 10:19 [0%6, 10%75, 10\%75, 10\%
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Connecting What's Next

Summary



- Worldwide Electricity Price increase
 - We need go green, high efficiency with multiple service
- Multi carrier DAB
 - Save TCO for repeater and gapfiller sites
- PMT
 - NO cost of rental for building or dedicated room
 - NO additional OPEX cost for Air conditioning
 - Less maintenance cost



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