



# ADBS Workshop: Review of Transmitter Total Cost of Ownership

March 4, 2015

ABU Digital Broadcasting Symposium 2015

Featuring  
GatesAir's



Martyn Horspool  
Product Manager,  
TV Transmission



Connecting What's Next

# ADBS Workshop: Review of Transmitter Total Cost of Ownership

Wednesday March 4<sup>th</sup> 14:00 – 15:30

Martyn Horspool  
Product Manager, TV Transmission  
GatesAir, USA

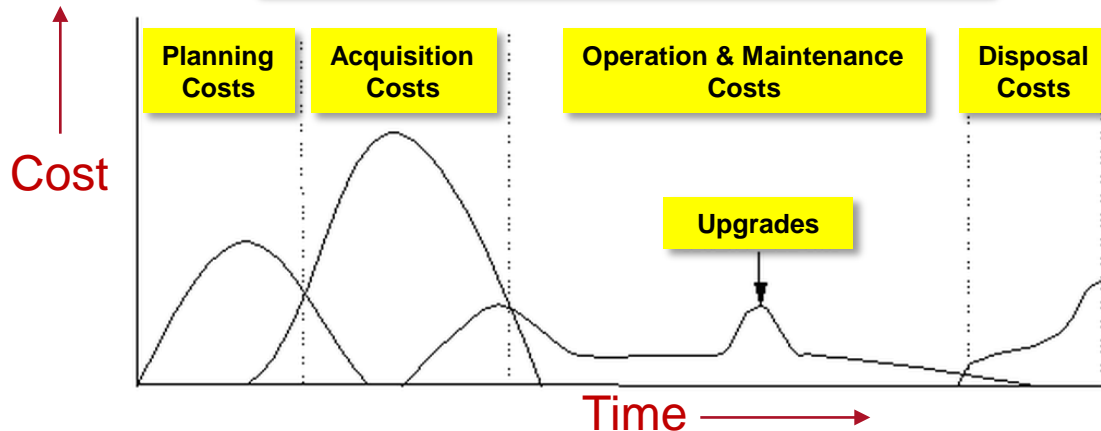
- Review/definition of TCO
  - Factors and costs to consider in a TCO analysis
- Transmitter efficiency basics
- GatesAir TCO calculator for Broadcast Transmitters
- Use cases and TCO estimates:
  - New technology DTV tx vs. recent technology DTV tx
  - New technology DTV tx vs. early technology DTV tx
- Other potential cost savings areas
- Review of a transmitter optimized for low TCO:
  - GatesAir liquid-cooled Maxiva ULXT series
- Wrap Up and Q&A








## ■ Total Cost of Ownership - General Definition

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

### Typical Asset Life Cycle Costs



# Factors Affecting TCO

- When purchasing, or replacing a transmitter, Total Cost of Ownership is more important than just the price
- Some of the items that must be considered:
  -  Equipment acquisition cost (and taxes/duties, etc.)
  -  Financing/Loan Terms (if applicable)
  -  Building space requirements (own, lease, purchase)
  -  Shipping to site, Installation and commissioning costs
  -  Operational cost of the equipment, including:
    - § AC power costs
    - § Personnel training
    - § Routine maintenance costs / site visits
    - § Repair costs
    - § Upgrades
    - § Warranty and other factors

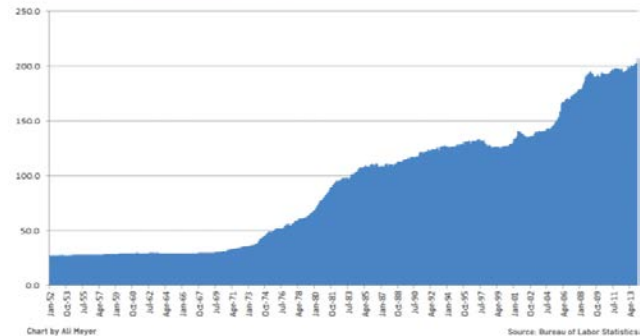


# Issues Broadcasters are Facing

## Rising Cost of Energy

- Electricity prices have increased an average of 6.6% per year for the past 5 years
- Projected to continue to rise throughout the world - 60% increase by 2030

## Electricity Prices Hit all Time High



## Carbon Taxes

- Some countries are imposing taxes based on energy usage, example Australia from 2012-14:

Financial Year	Price* (USD \$)
2012-13	23.00
2014	24.15
1 July 2014 onwards	Revoked

Source: Clean Energy Regulator - per tonne of emitted CO<sub>2</sub>



# TCO versus Efficiency

## ■ TCO is what is really important to a transmission operator:

- It's the total cost to own and operate the transmitter system over time
- Includes initial equipment cost and delivery
- Includes the installation/commissioning cost
- Routine and unscheduled maintenance costs
- Repair/replacement and other operational costs



## ■ AC power consumed by the transmitter is important

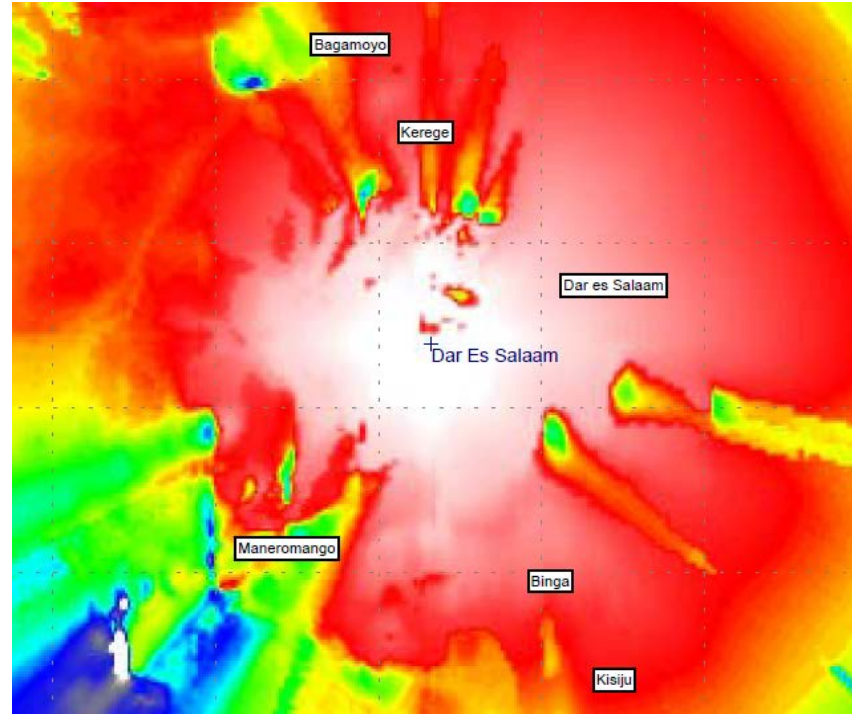
- However, other factors also affect the system efficiency:
  - AC transformers and voltage regulators
  - Heat load to the room (HVAC costs)
  - RF system losses (often significant)
  - RF feeder losses
  - Non-optimal antenna pattern (next slide)

Energy converted to heat



# Wasted energy from antenna

- Coverage and antenna patterns not optimal
- Energy is wasted in large area with no viewers





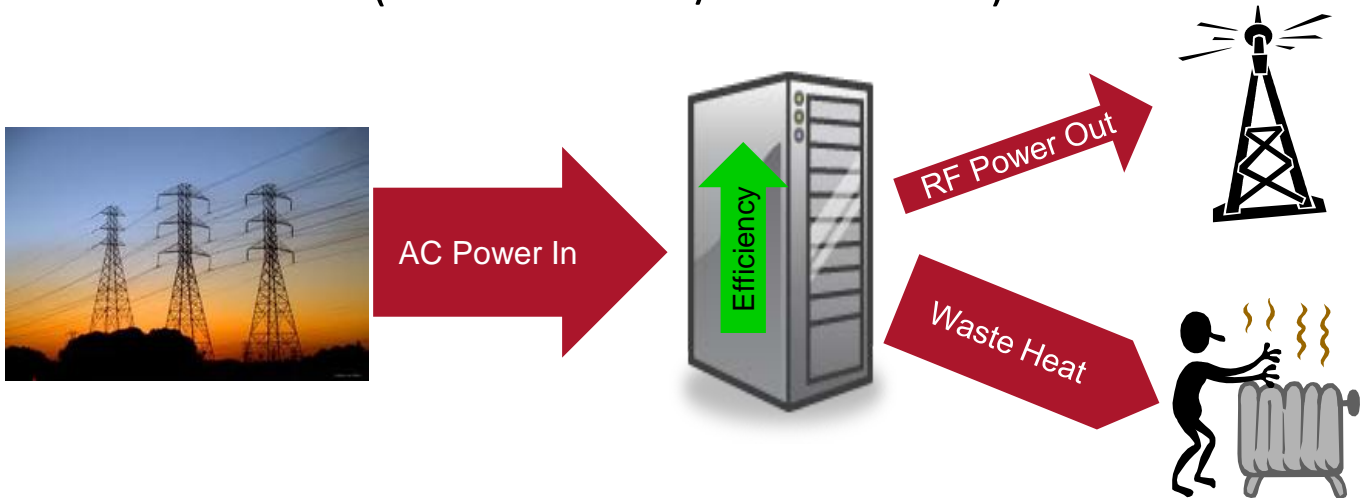
# Transmitter Efficiency



# Transmitter Efficiency Basics

- **Efficiency of a transmitter:**

- Definition:  $(\text{RF Power Out} / \text{AC Power In}) \times 100\%$

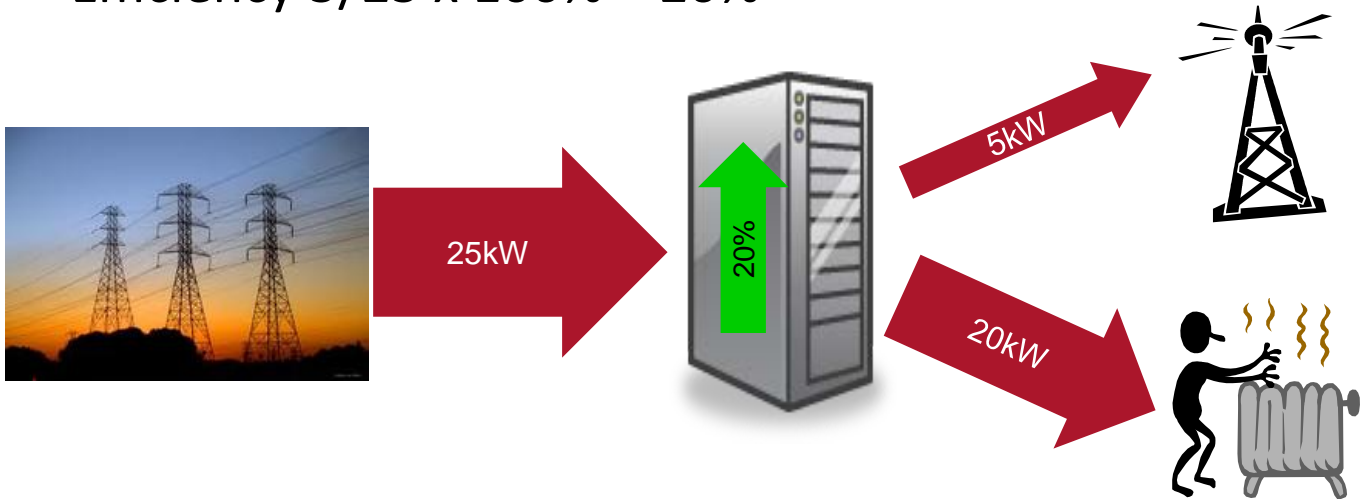


**Increased efficiency: reduces power consumed and reduces energy wasted**



# Typical Class AB Tx Efficiency

- Example: 5kW Standard Class AB DVB-T2 transmitter
- Efficiency  $5/25 \times 100\% = 20\%$



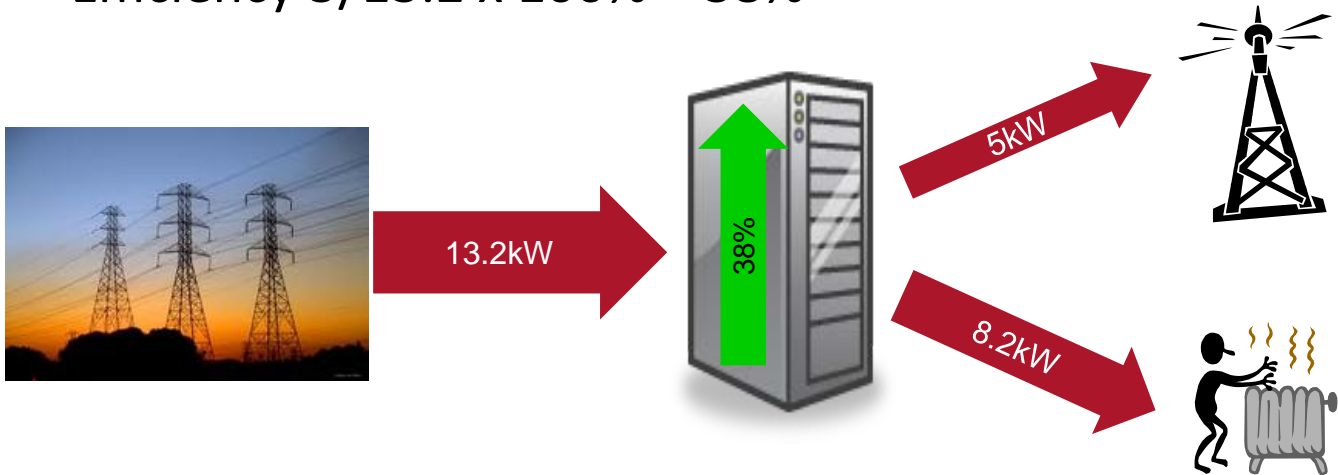
Input power 25kW

Waste heat 20kW



# Typical High Efficiency Tx

- Example: 5kW Doherty DVB-T2 transmitter
- Efficiency  $5/13.2 \times 100\% = 38\%$

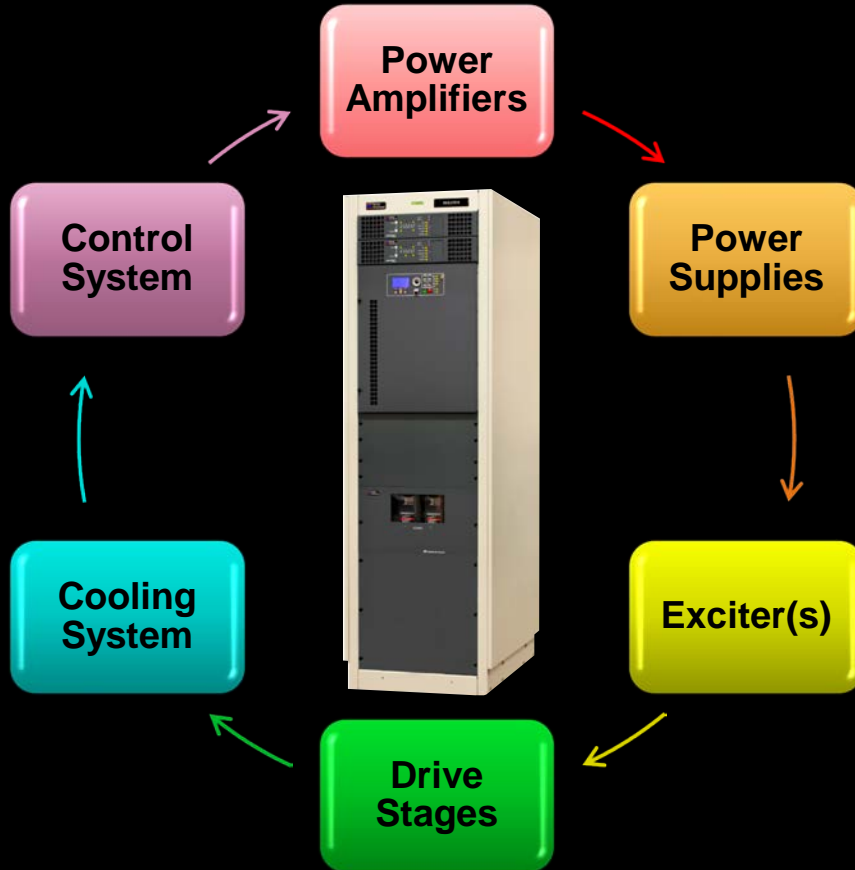


Input power reduced:  $(25-13.2)/25 = 47.2\%$

Waste heat reduced:  $(20-8.2)/20 = 59\%$



# Transmitter Efficiency Includes...

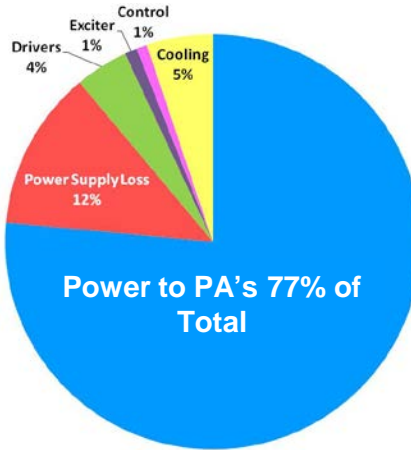


# Every Component Affects Efficiency

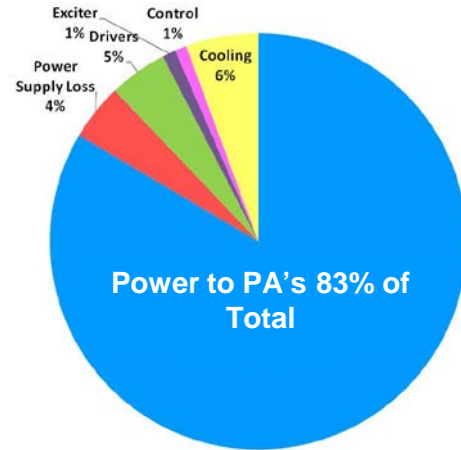


## Effect of power supply efficiency on overall system efficiency

	Tx with older PS	Tx with new High Eff. PS
RF Power Output (kW)	5.0	5.0
Power Amplifier Efficiency	45%	45%
DC Power to PA's	11.11	11.11
Power Supply Efficiency	86%	96%
AC Power to PA's	12.92	11.57
Power Supply Loss	1.81	0.46
Drivers	0.6	0.6
Exciter	0.14	0.14
Control	0.12	0.12
Cooling	0.75	0.75
Total AC Input (kW)	14.53	13.18
Overall Tx Efficiency	34%	38%



**Distribution of Power Usage with Low Efficiency Power Supplies**

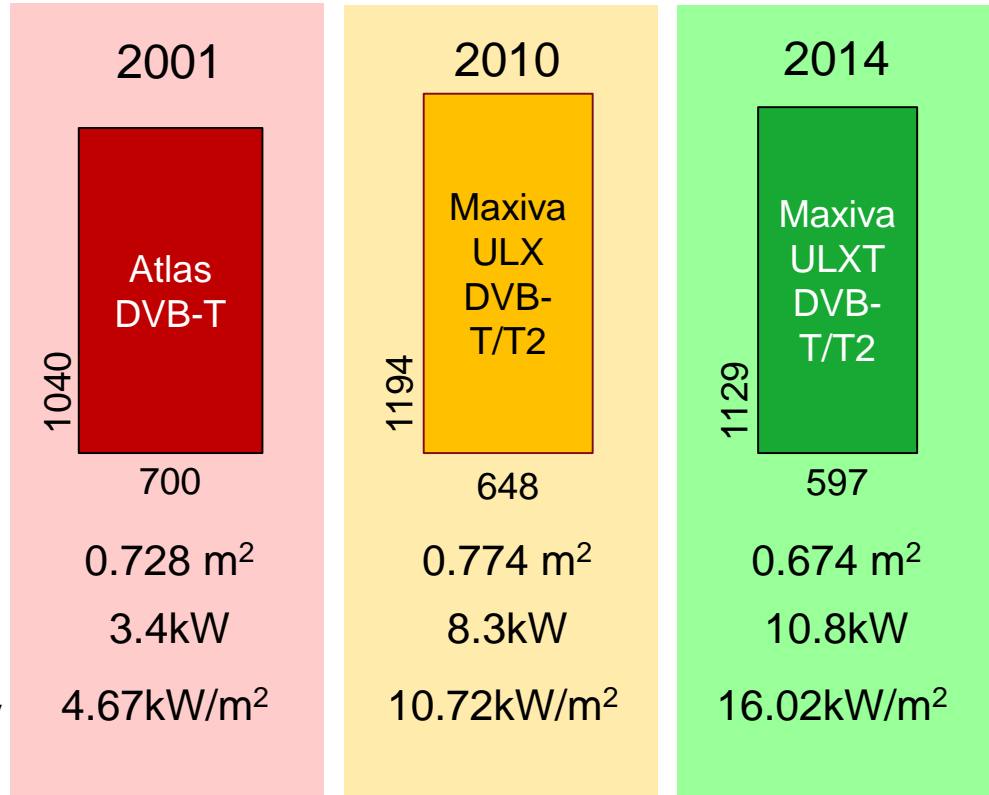


**Distribution of Power Usage with High Efficiency Power Supplies**

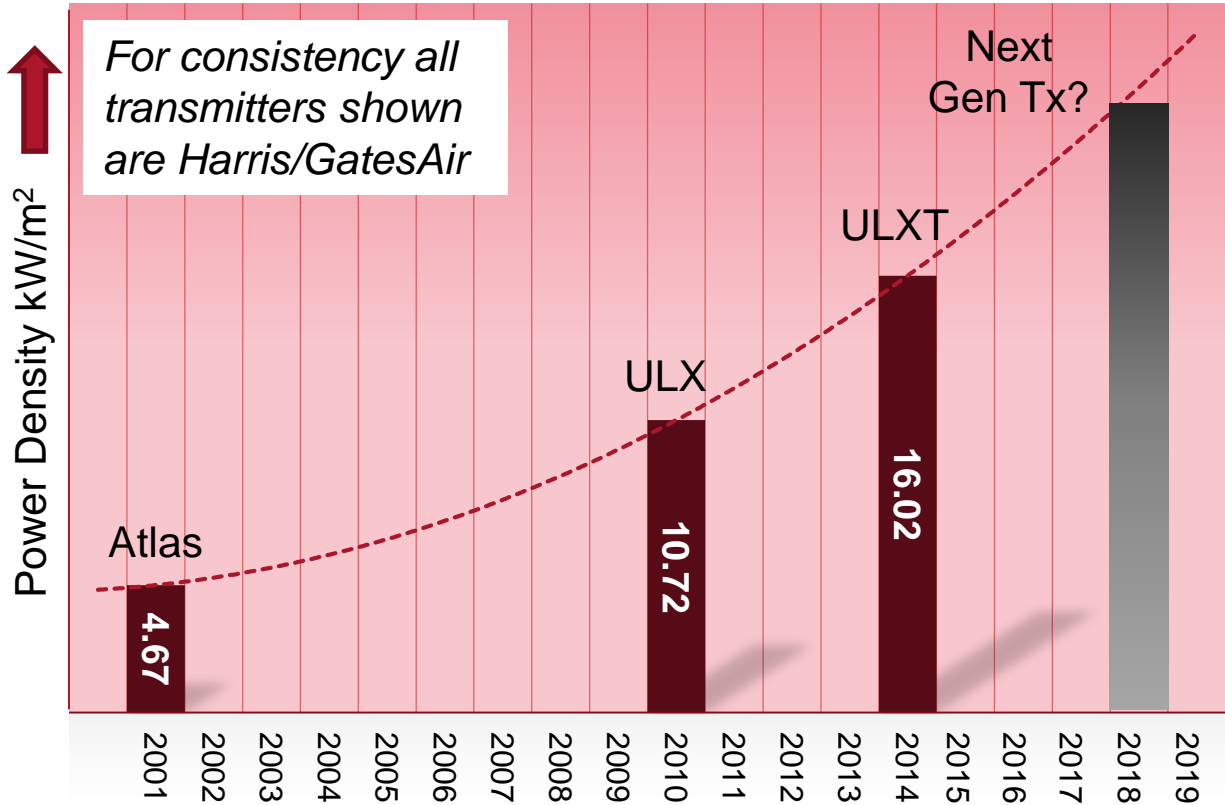
Power Supplies make 4% difference



# Space Efficiency Improvements



# Power Density Trend

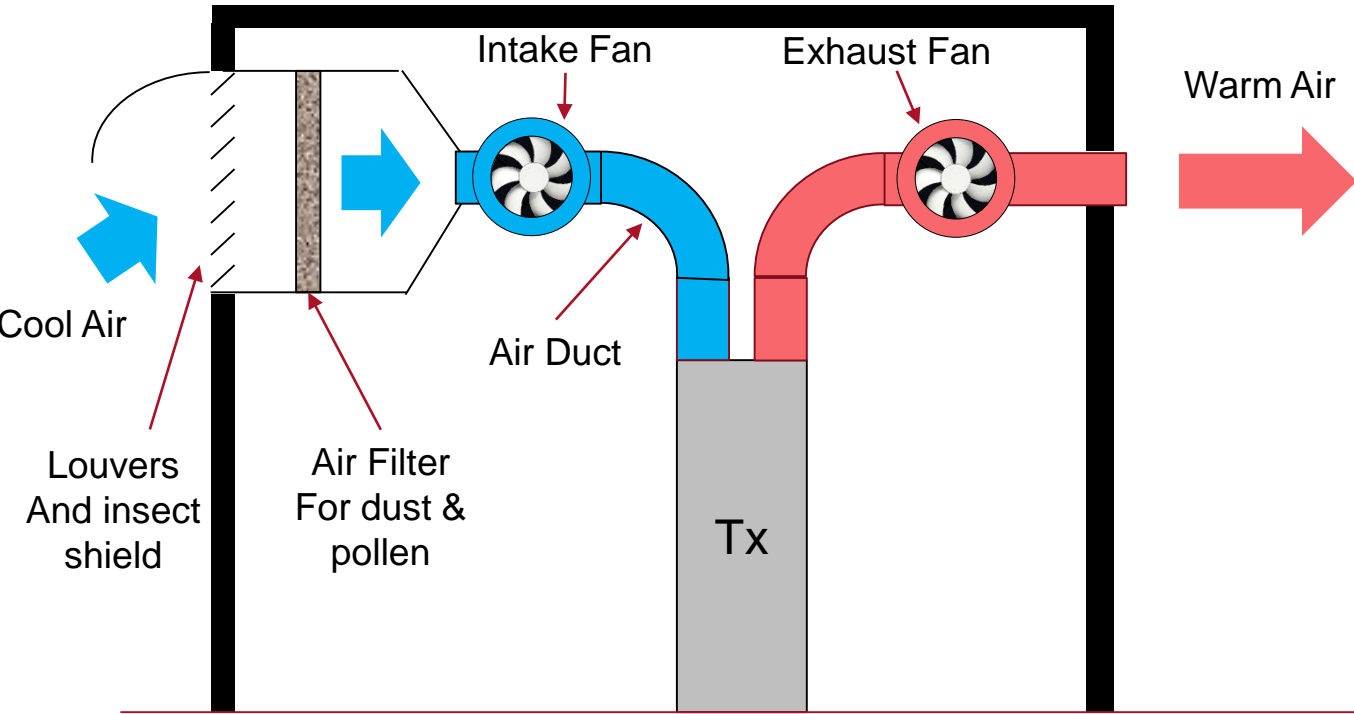




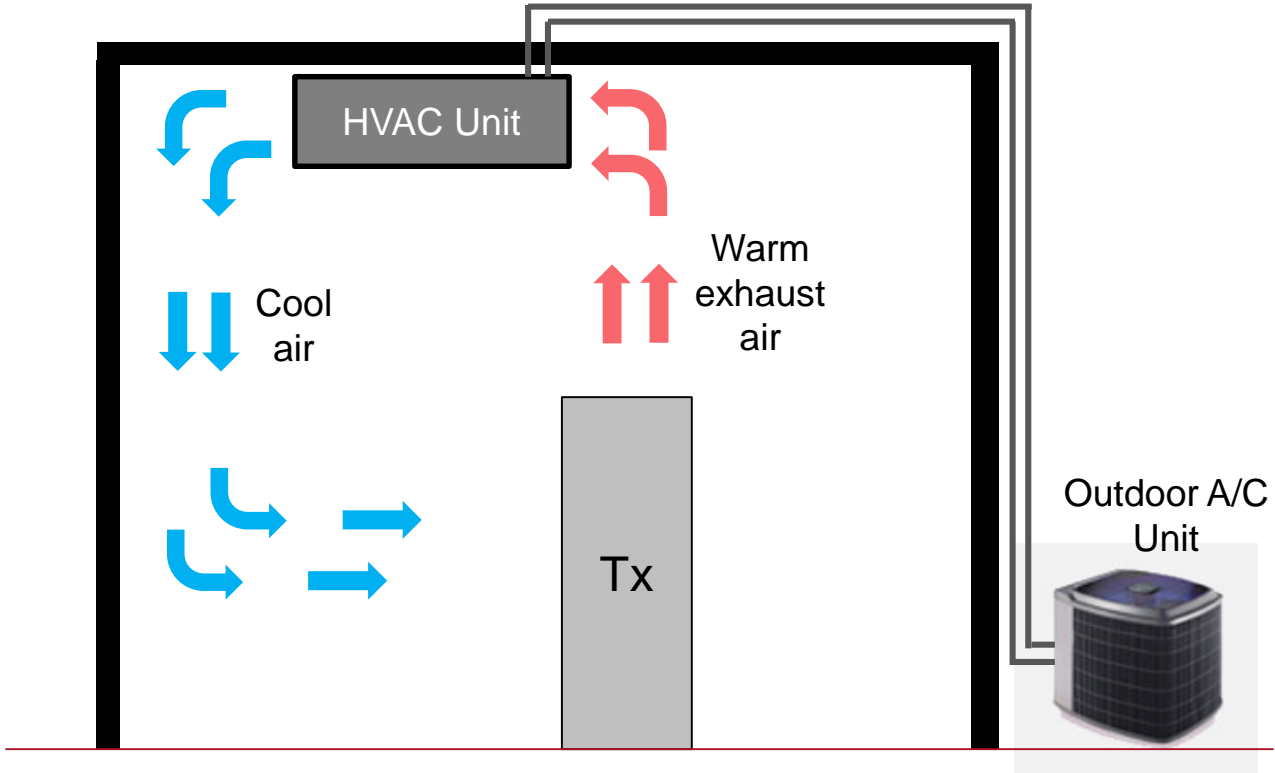
- Three common cooling methods for broadcast transmitters
  - Air-cooled using outside air
  - Air-cooled using inside air and Air-Conditioning
  - Liquid cooling
- Each of these has some advantages and disadvantages



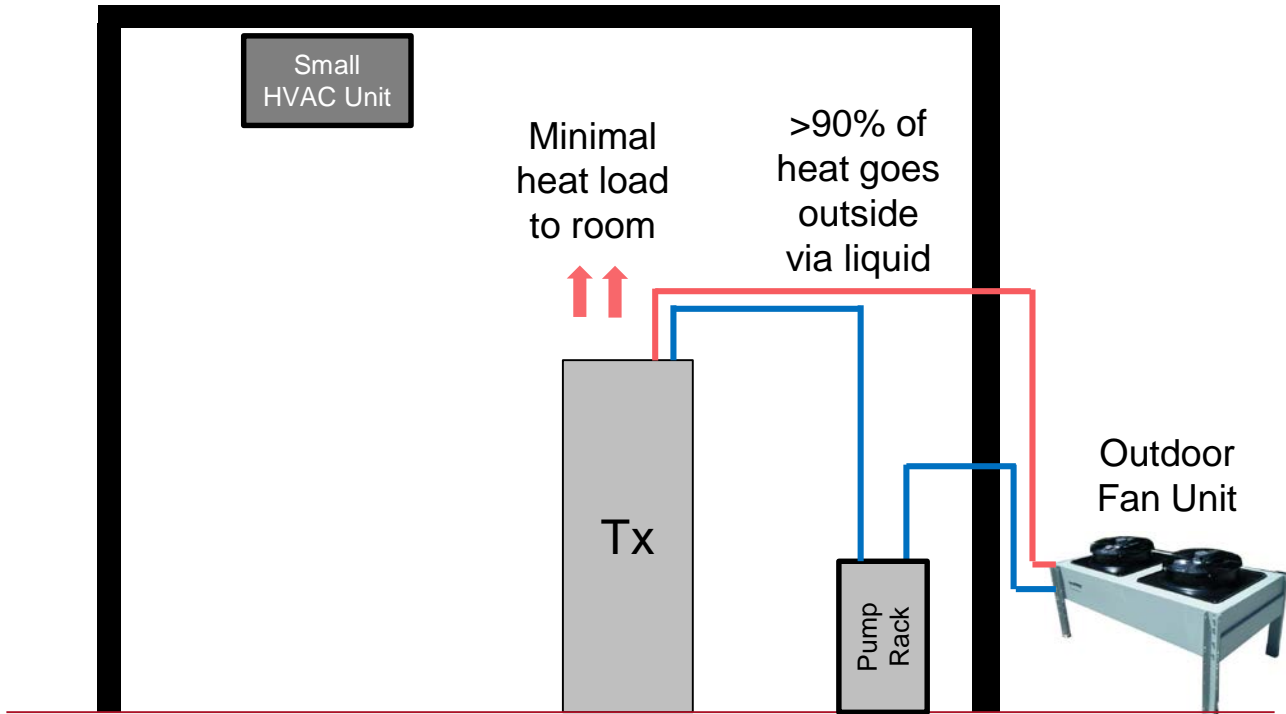
# Air Cooling – Outside Air



# Air Cooling – Sealed Room HVAC



# Liquid Cooling



# Cooling Comparison



Item	Air-Cooled (outside air)	Air-Cooled (HVAC)	Liquid Cooled
Energy cost	Low	High	Low
Maintenance	Very High	Medium	Low
Installation cost	High	Medium	Medium/Low
Site visits	Frequent	Infrequent	Infrequent
Humidity control	None	Excellent	Excellent
Dust & dirt	Filter dependent	Excellent	Excellent
Reliability	Medium	Medium	Good/Excellent *
<b>TCO Rank</b>	<b>3</b>	<b>2</b>	<b>1</b>

\* Redundant pumps and fans provide excellent reliability, on-air service capability



# GatesAir TCO Calculator for Broadcast Transmitters

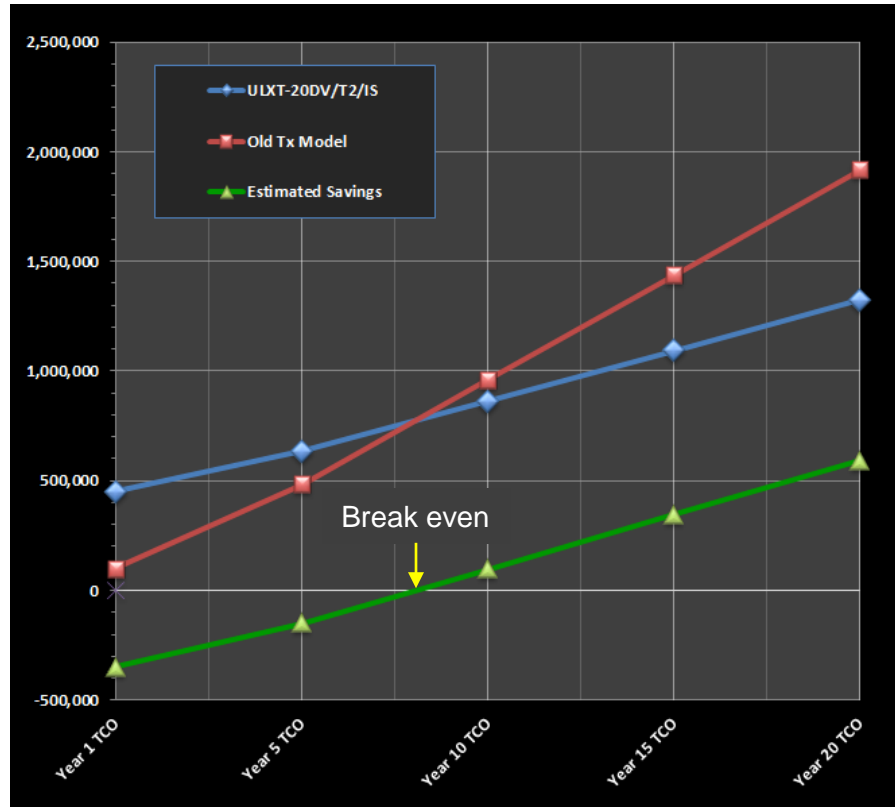


# The GatesAir TCO Calculator



## ■ TCO Calculator:

- Calculates the total cost of ownership of a transmitter system
- Compares TCO of a new GatesAir transmitter with your existing transmitter (GatesAir or another brand)
- Adjust cost of AC power and other factors to match your scenario
- Calculate total savings over time
- Estimate break-even period



# TCO – New vs. Previous Gen Tx



- Input New Tx Data (Maxiva ULXT)
  - Tx Model
  - Tx Max power level
  - Required power level
  - New Tx cost
  - Installation cost
  - Commissioning cost
  - Training cost
  - Electrical cost (look up table, or manual entry)
  - Currency/ex rate (manual entry)
- Based on some preset criteria, TCO is calculated

SYSTEM VARIABLES	<i>User entry cells in pink</i>	OPEX & TCO	
<b>Transmitter Model &amp; Costs:</b>		Currency	US Dollar
Product Series	Maxiva ULXT COFDM	Exchange Rate	1.000 (Man)
Model	ULXT-10DV/T2/IS	Annual OPEX	28,539
Tx Maximum Output Power	6,010 W	First Year TCO	214,439
Required Output Power	5,800 W	Five Year TCO	328,596
Tx Purchase Price	170,000	Ten Year TCO	471,293
Installation	6,000	Fifteen Year TCO	613,989
Commissioning	1,400	Twenty Year TCO	756,685
Training	2,000		
<b>Total Cost</b>	<b>179,400</b>		
<b>Energy Costs:</b>			
Region	Asia		
Country/State	Malaysia		
Electricity Price/kW-hr <sup>1</sup>	0.1240		
Price/kW-hr (override)	0.1650		
Tx System Efficiency	37.8%		

Year	TCO
1	214,439
5	328,596
10	471,293
15	613,989
20	756,685

<sup>1</sup> Multiple sources used - 2010 data, GatesAir not responsible for any errors





# TCO – New vs. Previous Gen Tx



- Input Existing Tx Data (Maxiva ULX)
  - Tx Model
  - Tx Max power level
  - Required power level
  - Costs can be left as zero for existing tx
  - Electrical cost copied from new tx data
  - Currency/ex rate (manual entry)
- Based on some preset criteria, TCO is calculated

## Existing GatesAir Transmitter TCO Analysis

**SYSTEM VARIABLES** *User entry cells in pink*

**Transmitter Model & Costs:**

Product Series	Maxiva ULX COFDM
Model	ULX-5500
Tx Maximum Output Power	5,850 W
Required Output Power	5,800 W
Purchase Price	0
Installation	0
Commissioning	0
Training	0
<b>Total Cost</b>	<b>0</b>

**Energy Costs:**

Region	Asia
Country/State	Malaysia
Electricity Price/kW-hr <sup>1</sup>	0.1240
Price/kW-hr	0.1650
<b>Tx System Efficiency</b>	<b>20.6%</b>

**OPEX & TCO**

Currency	US Dollar
Exchange Rate	1.000
Annual OPEX	49,798
First Year TCO	56,298
Five Year TCO	255,489
Ten Year TCO	504,477
Fifteen Year TCO	753,466
Twenty Year TCO	1,002,455

Year	TCO
1	56,298
5	255,489
10	504,477
15	753,466
20	1,002,455

<sup>1</sup> Multiple sources used - 2010 data, GatesAir not responsible for any errors



# TCO – New vs. Previous Gen Tx



- GatesAir ULXT and ULX transmitters
- Side-by-side comparison
- New vs. previous generation solid DTV state tx
- Breakeven period ~ 8.4 years

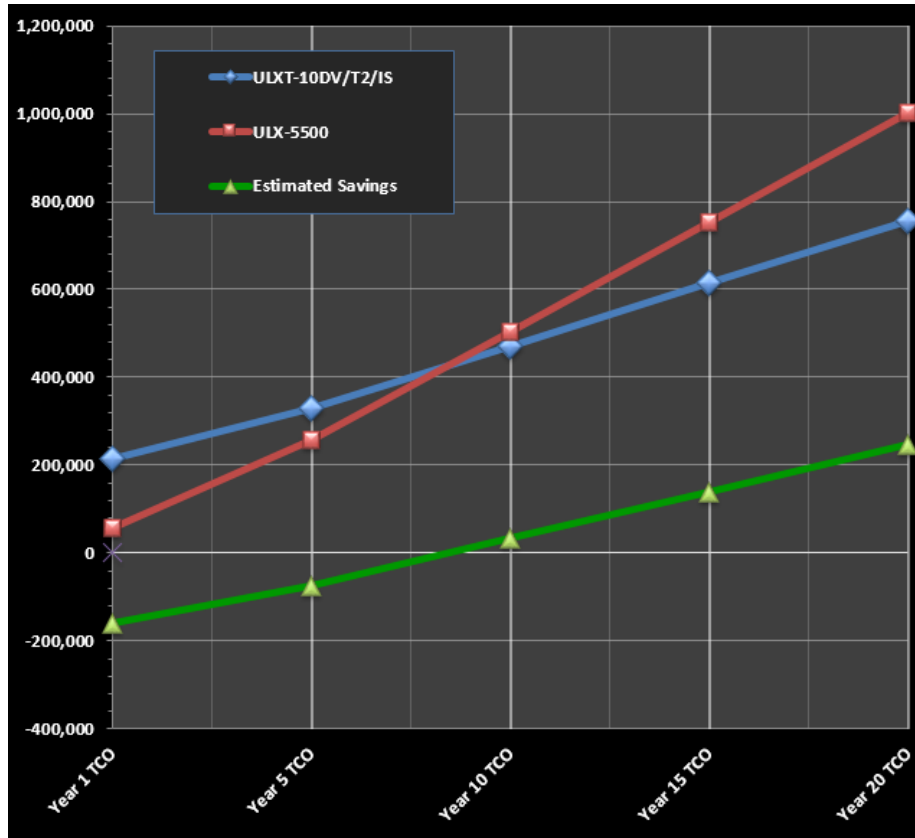
Transmitter Models:	ULXT-10DV/T2/IS	ULX-5500	Estimated Savings
<b>Product Series</b>	Maxiva ULXT COFDM	Maxiva ULX COFDM	
<b>Model</b>	ULXT-10DV/T2/IS	ULX-5500	
<b>Tx Maximum Output Power</b>	6,010 W	5,850 W	
<b>Required Output Power</b>	5,800 W	5,800 W	
<b>Purchase Price</b>	170,000	0	-170,000
<b>Installation</b>	6,000	0	-6,000
<b>Commissioning</b>	1,400	0	-1,400
<b>Training</b>	2,000	0	-2,000
<b>Total Cost</b>	179,400	0	-179,400
<b>Energy Costs:</b>			
<b>Region</b>	Asia	Asia	
<b>Country/State</b>	Malaysia	Malaysia	
<b>Price/kWh</b>	\$0.165	\$0.165	
<b>Tx System Efficiency</b>	37.8%	20.6%	
<b>OPEX:</b>	ULXT-10DV/T2/IS	ULX-5500	Estimated Savings
<b>Annual OPEX</b>	28,539	49,798	21,258
<b>Year 1 TCO</b>	214,439	56,298	-158,142
<b>Year 5 TCO</b>	328,596	255,489	-73,108
<b>Year 10 TCO</b>	471,293	504,477	33,185
<b>Year 15 TCO</b>	613,989	753,466	139,477
<b>Year 20 TCO</b>	756,685	1,002,455	245,770
<b>Breakeven Period</b>			8.4 Years



# TCO – New vs. Previous Gen Tx



- Graphical representation
- GatesAir ULXT and ULX transmitters
- New TX **Blue**
- Old Tx **Red**
- Loss/savings **Green**
- Breakeven period ~ 8.4 years



# TCO – New vs. Older Gen Brand x Tx



- Input older generation Tx data
  - Tx Model
  - Tx Max power level
  - Required power level
  - Costs can be left as zero for existing tx
  - Electrical cost copied from new tx data
  - Currency/ex rate (manual entry)
- Based on some preset criteria, TCO is calculated

## Other Brand Transmitter TCO Analysis

*User entry cells in pink*

SYSTEM VARIABLES		OPEX & TCO	
Transmitter Manufacturer	Other	Currency	US Dollar
Product Series	Standard Series	Exchange Rate	1.000 (Man)
Model	T2-5000	Annual OPEX	66,753
Tx Maximum Output Power	5,800 W	First Year TCO	74,753
Required Output Power	5,800 W	Five Year TCO	341,765
Total Purchase Price	0	Ten Year TCO	675,530
Tx System Efficiency	17.5%	Fifteen Year TCO	1,009,295
Tx Cooling	Liquid	Twenty Year TCO	1,343,060
Tx Room Cooling	HVAC		
Total Cost	0		
<b>Energy Costs:</b>			
Region	Asia		
Country/State	Malaysia		
Electricity Price/kW-hr <sup>1</sup>	0.1240		
Price/kW-hr (override)	0.1650		
Tx System Efficiency	17.5%		

Year	TCO (Man)
1	74,753
5	341,765
10	675,530
15	1,009,295
20	1,343,060

<sup>1</sup> Multiple sources used - 2010 data, HBC not responsible for any errors



# TCO – New vs. Older Gen Tx



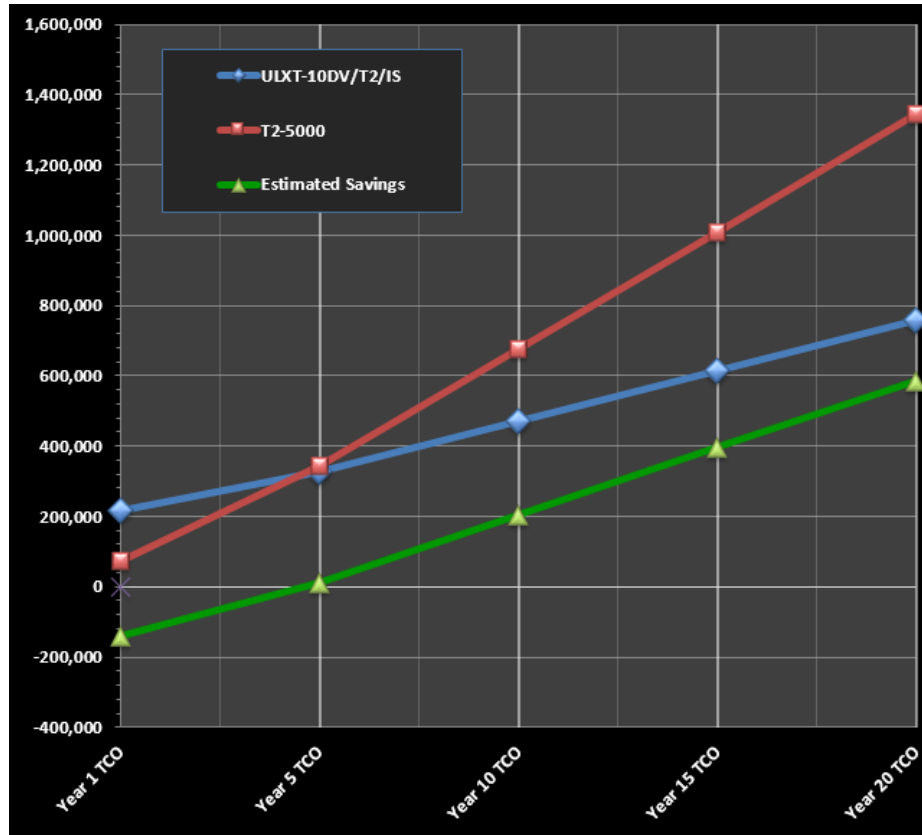
- GatesAir ULXT and other brand transmitter
- Side-by-side comparison
- New vs. early generation solid state DTV tx
- Breakeven period ~ 4.6 years

Transmitter Models:	ULXT-10DV/T2/IS	Other	Estimated Savings
<b>Product Series</b>	Maxiva ULXT COFDM	Standard Series	
<b>Model</b>	ULXT-10DV/T2/IS	T2-5000	
<b>Tx Maximum Output Power</b>	6,010 W	5,800 W	
<b>Required Output Power</b>	5,800 W	5,800 W	
<b>Purchase Price</b>	170,000	0	-170,000
<b>Installation</b>	6,000	0	-6,000
<b>Commissioning</b>	1,400	0	-1,400
<b>Training</b>	2,000	0	-2,000
<b>Total Cost</b>	179,400	0	-179,400
<b>Energy Costs:</b>			
<b>Region</b>	Asia	Asia	
<b>Country/State</b>	Malaysia	Malaysia	
<b>Price/kWh</b>	\$0.165	\$0.165	
<b>Tx System Efficiency</b>	37.8%	17.5%	
<b>OPEX:</b>	ULXT-10DV/T2/IS	T2-5000	Estimated Savings
<b>Annual OPEX</b>	28,539	66,753	38,214
<b>Year 1 TCO</b>	214,439	74,753	-139,686
<b>Year 5 TCO</b>	328,596	341,765	13,169
<b>Year 10 TCO</b>	471,293	675,530	204,237
<b>Year 15 TCO</b>	613,989	1,009,295	395,306
<b>Year 20 TCO</b>	756,685	1,343,060	586,375
<b>Breakeven Period</b>			4.6 Years



# TCO – New vs. Older Gen Tx

- Graphical representation
- GatesAir ULXT and other brand early gen transmitters
- New TX **Blue**
- Old Tx **Red**
- Loss/savings **Green**
- Breakeven period ~ 4.6 years



# Manual Data Input on TCO Calc



- The TCO Calculator allows user define inputs

## Additional User Inputs:

System Variables	Manual Entry Value	Default Value	Notes
Tx Cooling Headroom (0 to 100%)	40%	60%	0% is exactly sized for the typical tx heat load. Typically headroom should be used, 20% to 80%
HVAC SEER Number	11	12	Varies by make/model - Typically 10 to 16 SEER value
HVAC Installation Cost (USD)	\$5,000	\$2,500	May be zero if the existing HVAC can be re-used in an existing plant
HVAC Replacement Cycle (Years)	10	8	Unit replacement cycle, typically 7 to 10 years
Tx room cooling (HVAC or ducted air)	HVAC	HVAC	HVAC more expensive, especially for air cooled, non-ducted tx
Annual Prev Maintenance Visits	2	2	Number of planned maintenance visits to site (assumes unmanned site)
Average cost per site visit (USD)	\$2,400	\$1,200	Average cost to visit the site, varies depending on employee versus contract, etc.

- There are several pages of additional information on the excel sheet that provide the data for the calculations:

➤ Link to Excel Workbook

**TCO Calculator**



- In addition to the savings and payback analysis, there are additional potential savings with a new tx:
  - Room Space savings due to higher power density
  - Higher MTBF (less down time, less unexpected site visits)
  - Lower maintenance -longer time between routine site visits
  - Intuitive design – easier set up – less training required
  - Availability of spare parts in the future versus discontinued model(s)
  - Commonality of spares across platforms





# New Products for Lowest TCO



## Low Pwr Air Cooled

5W → 2kW

UHF Band IV/V



Maxiva™ UAXT

## High Pwr Liquid Cooled

→ 10kW



Maxiva™ ULXT

## Super High Power

→ 30kW+



Maxiva™ ULXT  
(Multi-rack)

VHF Band III



Maxiva™ VAX-3D



Maxiva™ VLX

**All TV transmitters  
support all DTV  
standards**



# Maxiva ULXT

Liquid-Cooled High Efficiency  
Broadband UHF Transmitter



# Maxiva ULXT Introduction



**The Maxiva ULXT is a liquid-cooled UHF high power TV transmitter using latest technology LDMOS RF devices**

**The design has been carefully optimized for lowest Total Cost of Ownership (TCO).**



ULXT Transmitters in Final Test  
GatesAir Factory, Quincy, IL USA



# Maxiva ULXT – *Designed for Low TCO*



- **Broadband, high-efficiency design**
  - High AC to RF efficiency
  - Broadband design
  - Only one spare power amplifier module is needed to service any ULXT series transmitter in the network. No adjustment, or retuning of any type, is required. = Low TCO
  
- **Future-proof architecture**
  - Spectrum re-packing... potential channel changes in the future... The broadband ULXT transmitter is ready for such changes, without any need to swap PA modules, combiners, or other components. = Low TCO



ULXT-20  
10.8kW OFDM



# Maxiva ULXT – *Designed for Low TCO*



## ■ Modular design with small, lightweight, PA modules

- PA module weighs 11kg, far lighter than PA modules from others
- Safer, no 2 person lift per safety regulations
- Much easier to replace, while on the air
- Reduced transportation cost = Low TCO



## ■ Small, lightweight, individual PA power supplies

- Each PA module has a dedicated power supply.
- Separate assembly from the PA module, making it much easier to service and replace, if needed.
- Weigh is less than 2kg (4.4lb) and can be exchanged on-air in less than 1 minute = Low TCO



Proprietary and confidential. | 36



# Maxiva ULXT - *Designed for Low TCO*



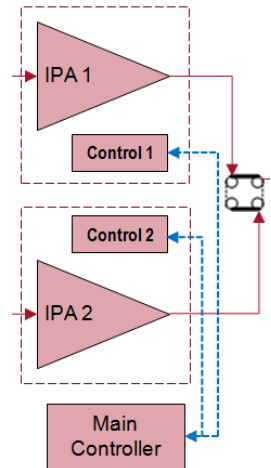
## ■ Cost-effective PA Module and Power Supply

- Our modular design approach with smaller/lighter replaceable PA's and associated DC Power Supplies are less costly to replace than combined PA/Power supply assemblies that others may use. = Low TCO



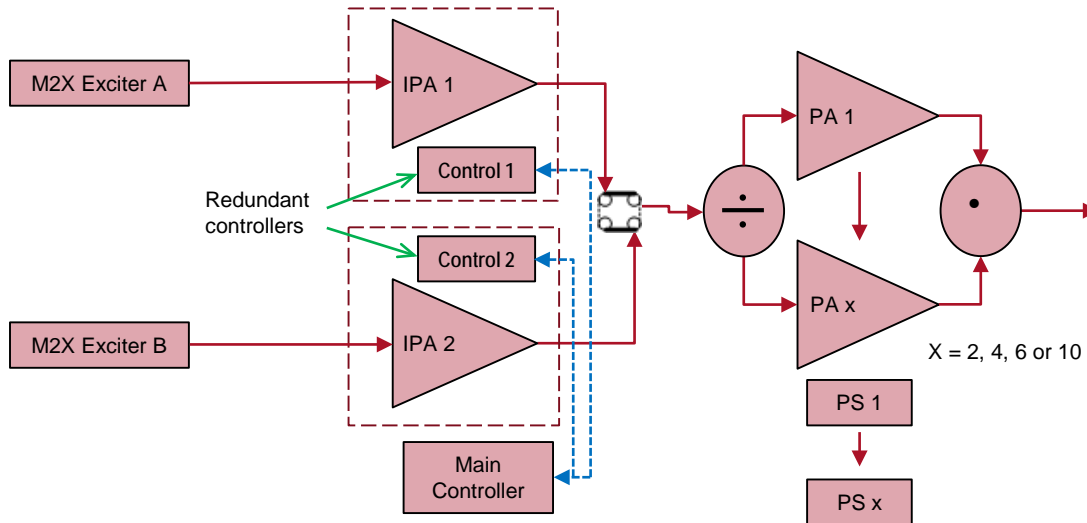
## ■ Robust Control System with Redundant Controllers = Low TCO

- Safe operation even if the main control board is defective or needs to be removed for service. An HTML web browser interface and SNMP is included with every transmitter



# Block Diagram ULXT

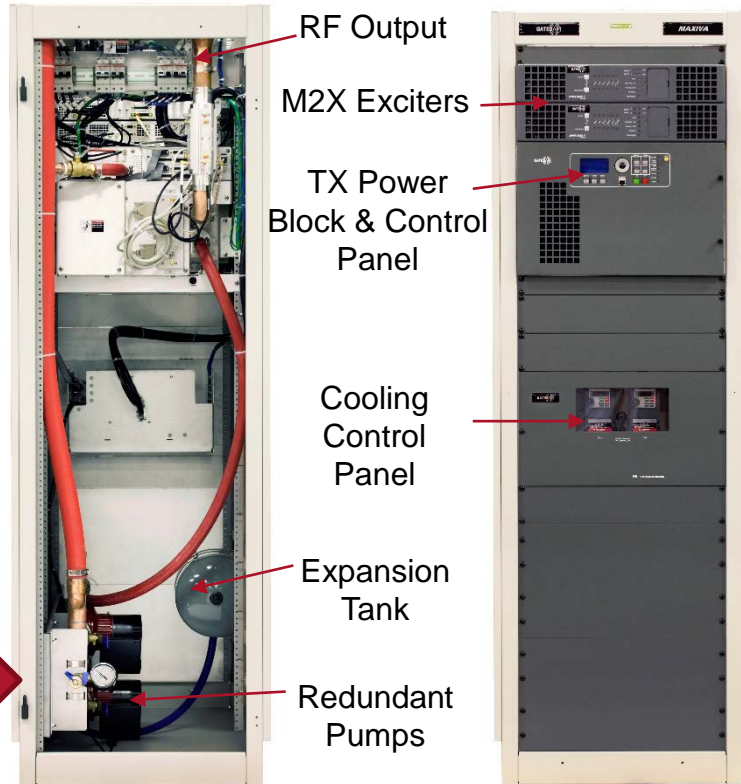
## 10 PA System shown with Dual Drive (option)



# ULXT Integrated Pump System



- With single rack, single power block systems, an integral pump system is available
- Save floor space, save plumbing
- Smaller pumps – low power consumption – more efficient!
- External pump Module also available





# High Efficiency Ext. Pump Module



- GatesAir design and manufacture
- Optimized for High Efficiency
  - Pumps are speed controlled = Low TCO
- 2 Pumps, with auto/manual changeover
  - Replace a pump during on-air operation!
- Small physical size = Low TCO



# High Efficiency (HE) Heat Exchanger



- GatesAir design and manufacture
- Dual fans with on-air servicing/replacement capability
- Low noise, with high-efficiency fan blades
- Vertical or horizontal airflow (mounting can be adapted on site for either configuration)
- Speed controlled = Low TCO



Vertical Air Flow



Horizontal Air Flow



# Maxiva M2X Exciter



- Field-proven - 1,000's shipped
- Software Defined Modulator (Easy to change)
- RTAC – Real Time Adaptive linear and non-linear Correction – standard
- Internal GPS/GLONASS option
- Internal UPS option
  - 1 minute - Full exciter power
  - 20 minutes - Frequency processing board
  - Eliminates re-boot of exciter after a brief AC power loss (glitch)
- Simple web browser interface
- Can be interfaced to competitive transmitters.
- No manual adjustments
- All Worldwide DVT standards supported



# ULXT-2xx (with dual drive option)



- Up to 1.2kW OFDM / 1.8kW ATSC



- Exc A
- Exc B (option)
- IPA A
- IPA B (option)
- PA 1
- PA 2



# ULXT-10xx (with dual drive option)



- Up to 5.5kW OFDM / 9kW ATSC



- Exc A
- Exc B (option)
- IPA A
- IPA B (option)
- PA 1
- PA 2
- PA 3
- PA 4
- PA 5
- PA 6
- PA 7
- PA 8
- PA 9
- PA 10

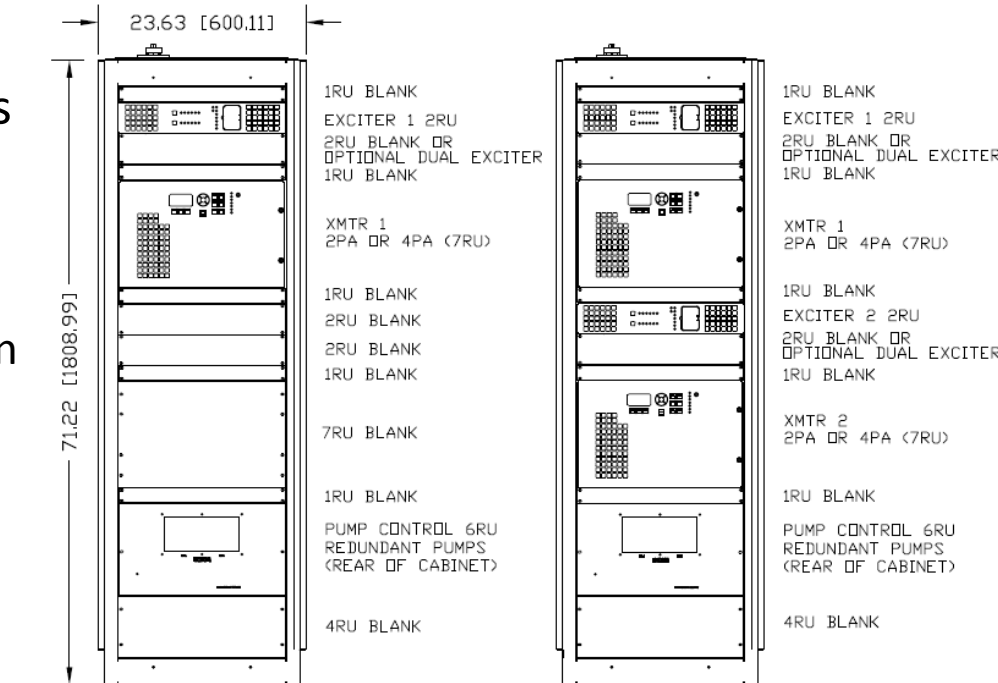
Proprietary and confidential. | 44



# ULXT – Standard Configurations



- 1.2kW and 2.4kW Systems
  - Single or dual drive
  - 1 or 2 transmitters in 37 RU rack
  - Internal Redundant Pumps



Single 2.4kW Tx in 37RU rack  
Integrated dual pumps

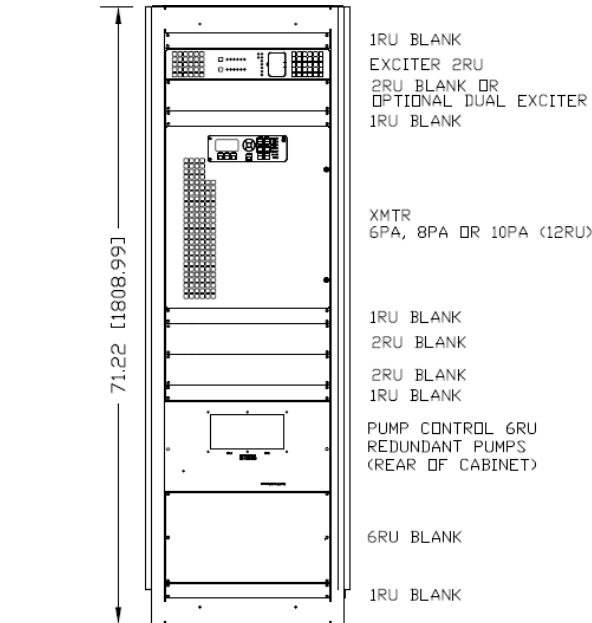
Dual 2.4kW Tx in 37RU rack  
Integrated dual pumps



# ULXT – Standard Configurations



- 5.5kW System
  - Single or dual drive
  - 1 transmitter in 37 RU rack
  - Internal Redundant Pumps



5.5kW Tx in 37RU rack  
Integrated dual pumps



# ULXT – Standard Configurations



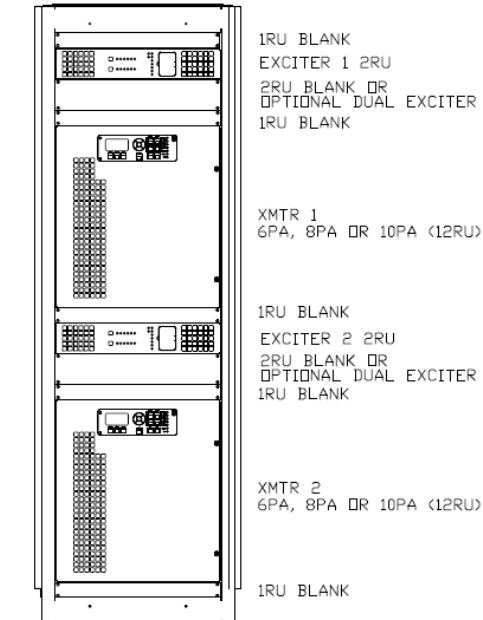
## ■ 10.8kW System

- Single or dual drive
- 1 transmitters in 37 RU rack
- External Pump Module

Or:

## ■ 2 x 5.5kW Systems

- Each Single or dual drive
- 2 transmitters in 37RU rack
- External Pump Module



10.8kW Tx in 37RU rack  
Integrated dual pumps

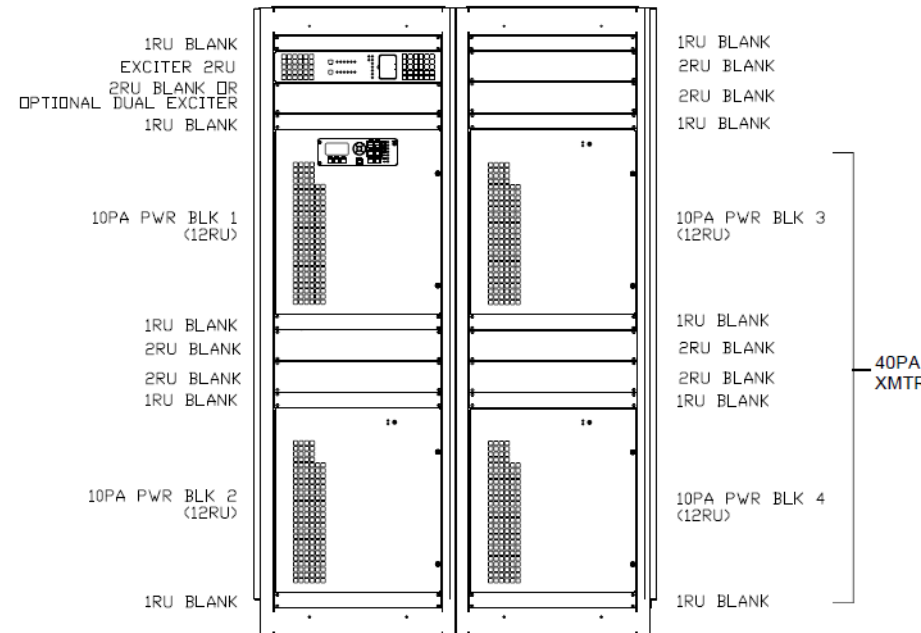




# ULXT – Standard Configurations



- 21.4kW tx
  - Single or dual drive
  - 1 transmitter in 2 x 37 RU racks
  - External Pump Module



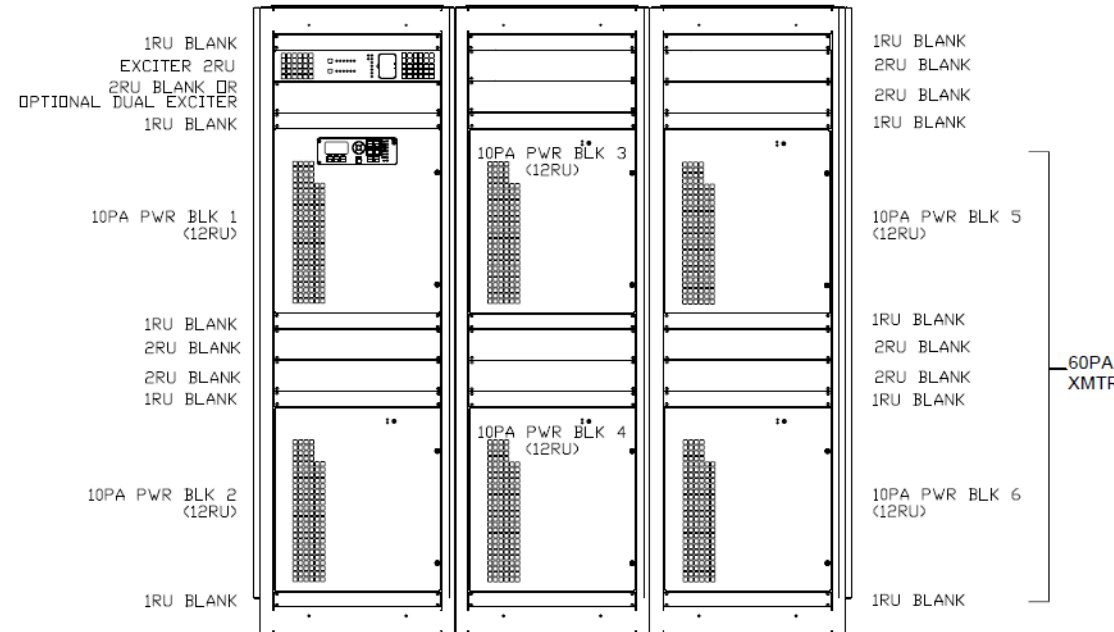
21kW Tx in 37RU rack  
Integrated dual pumps



# ULXT – Standard Configurations



- 31.8kW tx
  - Single or dual drive
  - 1 tx in 3 x 37 RU racks
  - External Pump Module ONLY



SINGLE DRIVE & OR DUAL DRIVE  
37RU CABINET



# Maxiva™ ULXT Model Summary



## Maxiva ULXT Series - Weights, Dimensions & Power Levels

Transmitter Model	# Racks	Transmitter Width		Transmitter Height		Transmitter Depth		Transmitter Weight		OFDM	ATSC
	(Rack Size)									Pre-Filter Power	Pre-Filter Power
		RU	mm	in	mm	in	mm	in	kg	lb	Watts
ULXT-2xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	238	524	1,200	1,800
ULXT-4xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	276	608	2,400	3,600
ULXT-6xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	314	693	3,600	5,400
ULXT-8xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	404	890	4,600	7,200
ULXT-10xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	433	955	5,500	9,000
ULXT-12xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	472	1,040	7,000	10,600
ULXT-16xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	591	1,302	9,000	14,200
ULXT-20xx	1 (37)	600	23.6	1,809	71.2	1,161	45.7	709	1,564	10,800	17,700
ULXT-24xx	2 (37)	1,162	45.8	1,809	71.2	1,161	45.7	840	1,852	13,400	21,100
ULXT-30xx	2 (37)	1,162	45.8	1,809	71.2	1,161	45.7	999	2,202	16,100	26,300
ULXT-40xx	2 (37)	1,162	45.8	1,809	71.2	1,161	45.7	1,445	3,186	21,400	35,100
ULXT-50xx	3 (37)	1,727	68	1,809	71.2	1,161	45.7	1,721	3,795	26,500	43,400
ULXT-60xx	3 (37)	1,727	68	1,809	71.2	1,161	45.7	1,998	4,404	31,800	52,100
ULXT-80xx	4 (37)	2,324	91.6	1,809	71.2	1,161	45.7	2,890	6,372	42,300	69,700

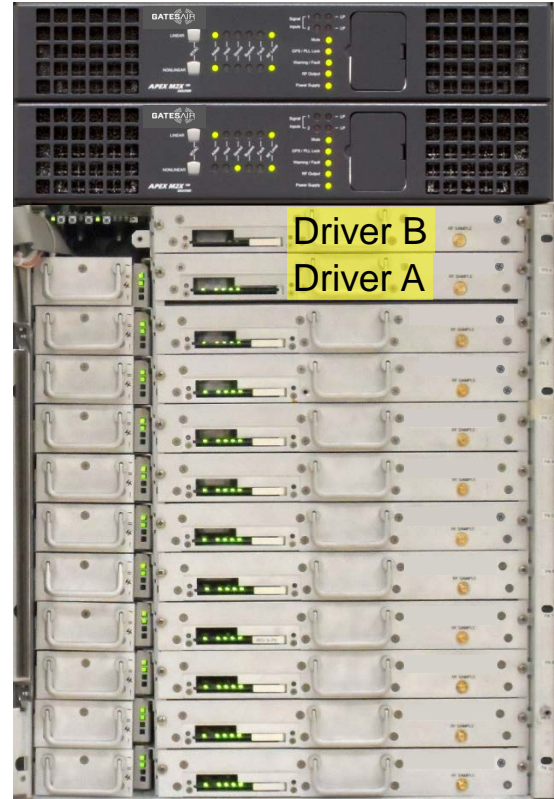
Note: xx = Modulation code



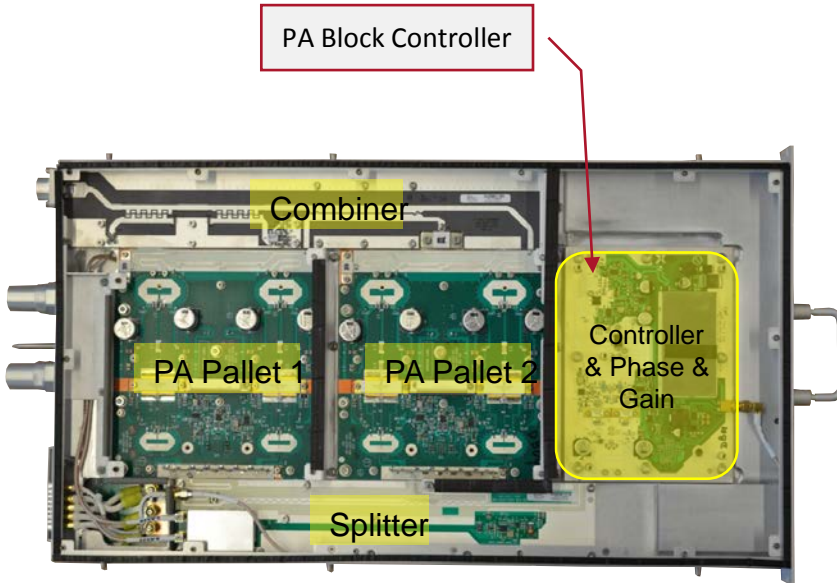
# IPA / Drive Chain



- Dual drive includes dual redundant driver modules
- This system provides fully redundant drive for on-air maintenance
- DC power is provided by multiple power supplies for redundancy



# PA Block Control Redundancy



- Each IPA module includes the Power Amplifier Block control circuitry.
- PA Block controller is incorporated on the Phase & Gain board.
- Fully redundant PA block control is provided due to redundant drive chain / IPA module architecture



# High Efficiency PA Module



- Power ~ 600W OFDM / 900W ATSC
- High Efficiency
- Liquid cooled
- Light weight: 11kg
  - Easy to remove and service
  - Lower shipping cost
  - DC power supply is separate assembly
- Hot-swap front plug-in design using push-on / pull-off connectors
- Up to 10 PA Modules per Power Block



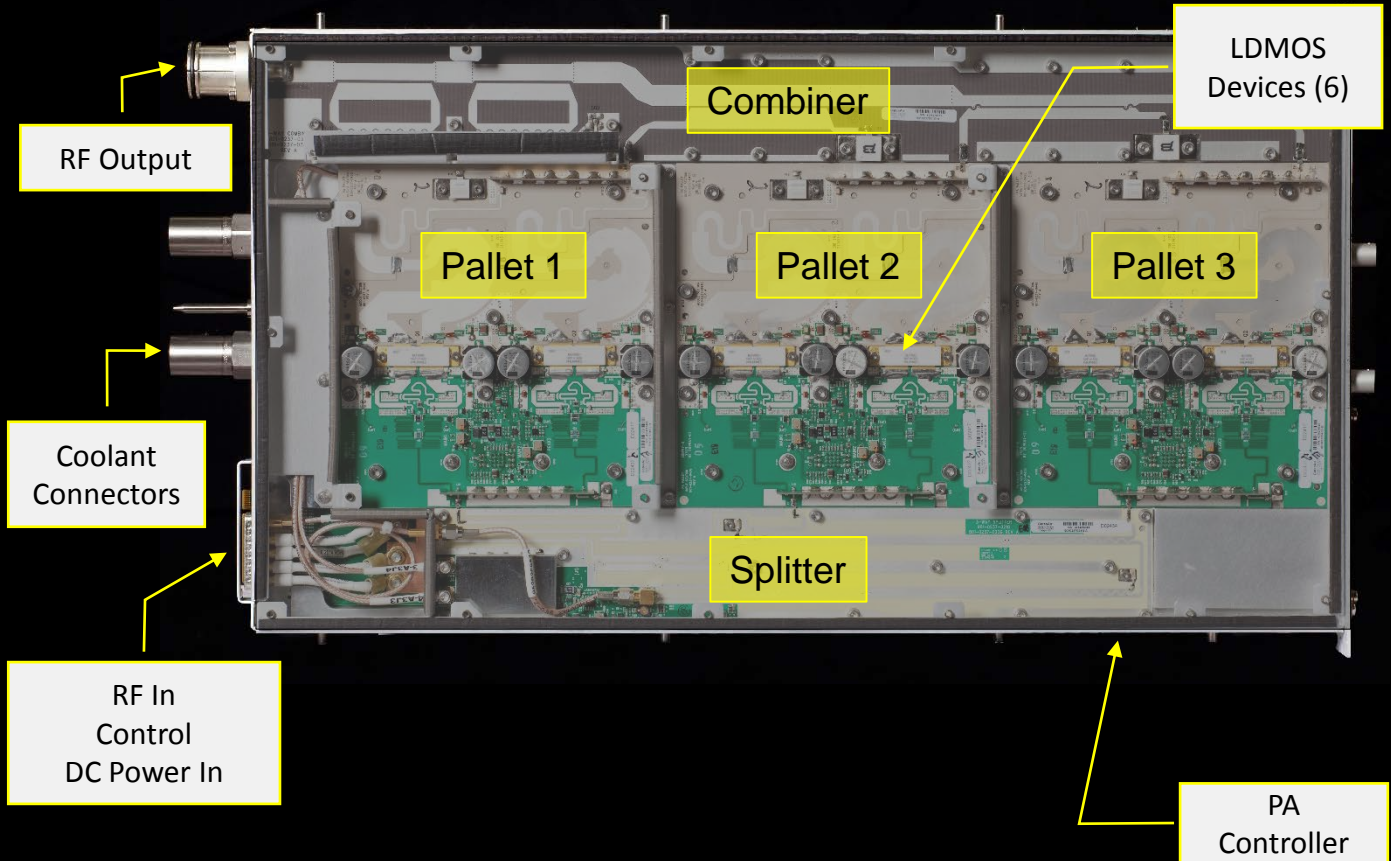
PA Module (Front)



PA Module (Rear)

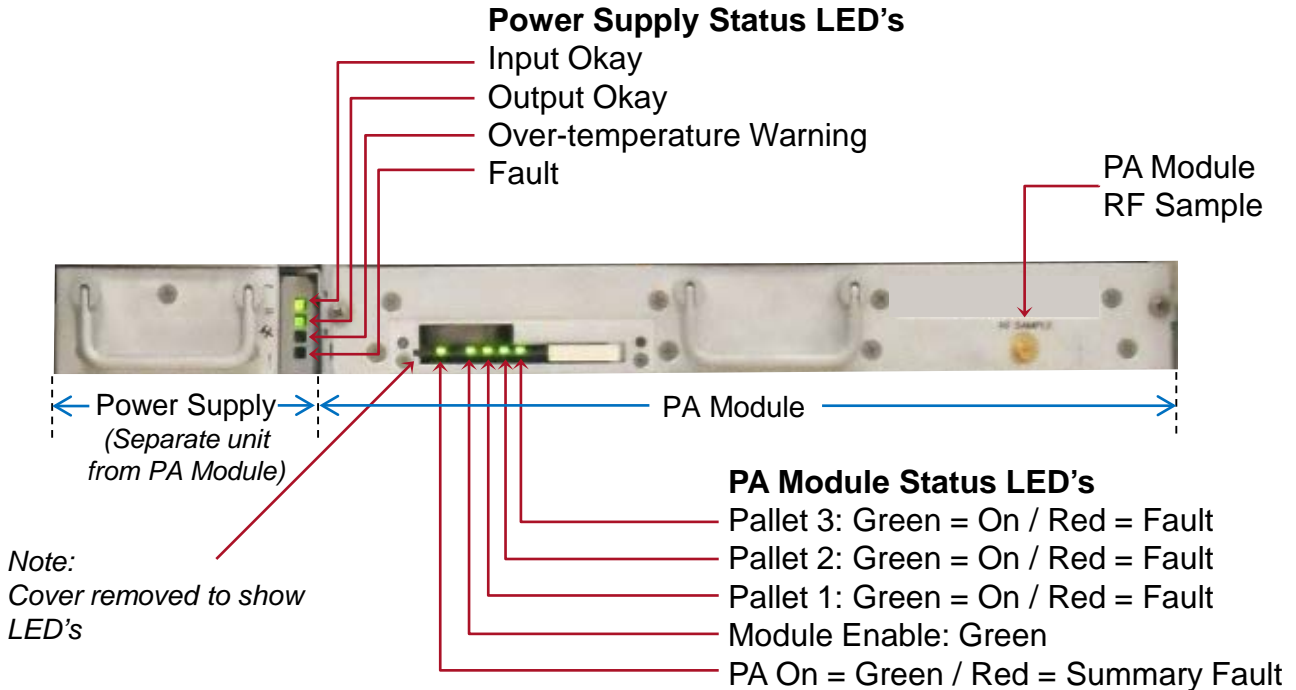


# High Efficiency PA Module



Connecting What's Next

# PA Module & PS Status LED's





# High Efficiency DC Power Supply



- Separate assembly from the PA module
  - Small and light (< 2kg / 4.4lb)
  - Lower replacement cost = Low TCO
- Hot swap, easy replacement in seconds
- One Power Supply per PA module
- IPA's powered by all PA power Supplies (paralleled)
- Wide AC input regulation
- Same power supply as used in other GatesAir
  - Consolidate network spares = Low TCO



# Options & Accessories

- Internal GPS/GLONASS receiver
- GPS/GLONASS antenna and RF cable
- Exciter UPS – Provides 1 minute full exciter back-up and 20 minutes for frequency processing circuits
- Dual drive, 1+1 (main/alternate), or N+1 configurations
- SFN
- Internal pump system for single power block (up to 10 PA) systems
  - Customer can always opt for external pump system



# TCO Benefits Summary



Feature	TCO Benefits
High Efficiency	Reduces electrical energy cost
Broadband	Reduce total spares for a network. Simpler channel change in future
Smaller Footprint	Less floor space = lower building or rental cost
Lighter PA Modules	Easy handling by 1 person (versus 2)
Separate light weight Power Supplies	Replace power supplies separately from PA, Save \$\$ on replacement
Simpler PA Modules	Less parts = longer MTBF, reduces long term maintenance costs and less down time
Variable speed pumps and HE fans	Reduces energy used in cool weather. Optimizes electrical energy usage and cost.

Proprietary and Confidential | 30





Connecting What's Next

# Thank You!

Martyn Horspool

Product Manager, TV Transmission

GatesAir

