



Total Cost of Ownership – Technologies for Optimized Transmitter Systems

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IBC 2015

Featuring
GatesAir's



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Chief Product Officer

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IBC 2015



Create



Transport



Transmit Television

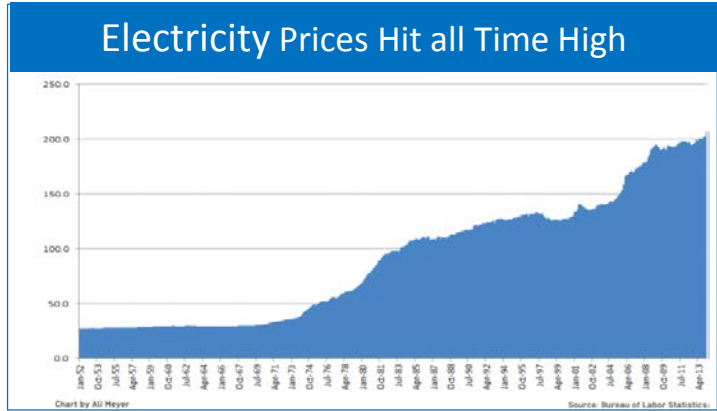


Transmit Radio



Rising Cost of Energy

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



Carbon Taxes

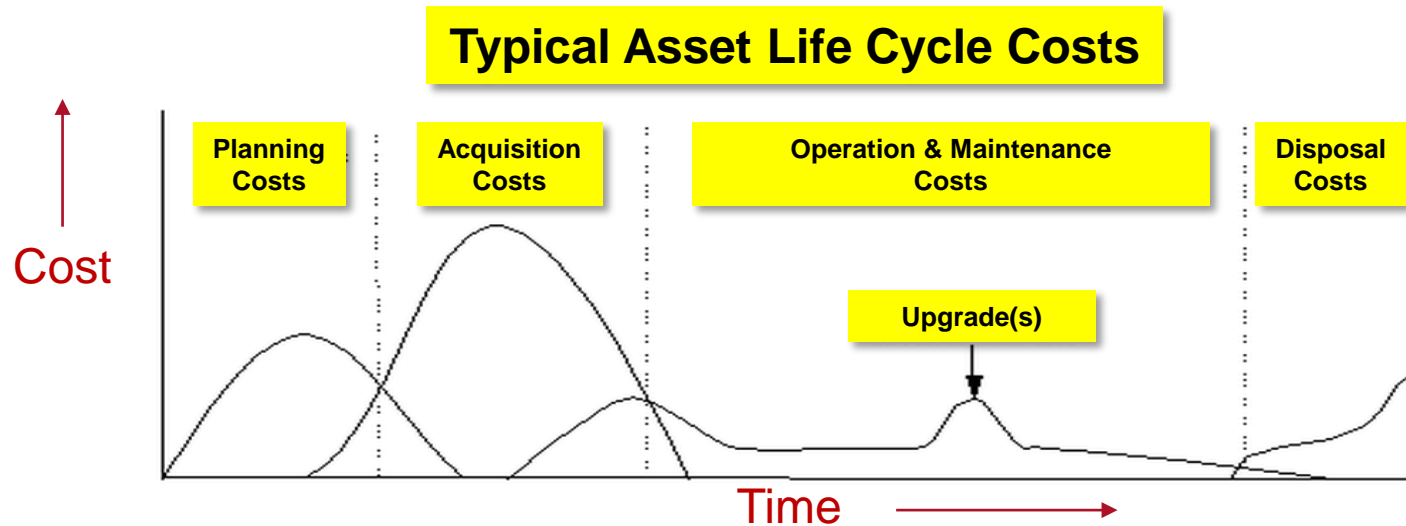
- Some countries are imposing taxes based on energy usage, example Australia from 2012-14:

Financial Year	Price* (USD \$)
2012–13	23.00
2014	24.15

Source: Clean Energy Regulator - per tonne of emitted CO₂

■ 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



Factors Affecting TCO

- When purchasing, or replacing a transmitter, Total Cost of Ownership is more important than just the purchase price alone
- Some of the items that must be considered:



Equipment acquisition cost (inc. taxes/duties/shipping, etc.)



Financing/Loan/Payment 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

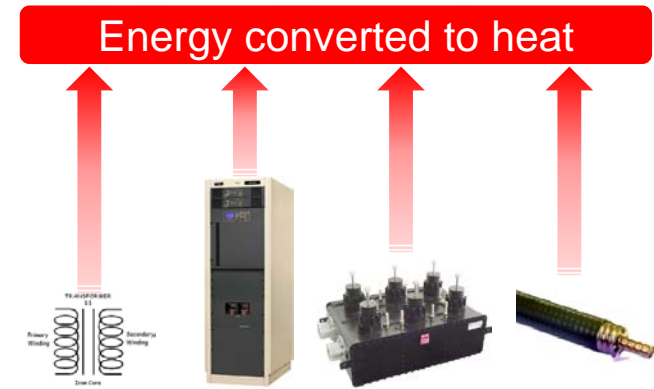


Warranty and other factors



TCO versus Efficiency

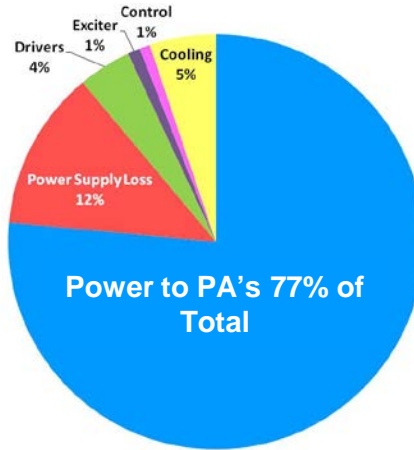
- **TCO is what is really important to a transmission operator:**
 - It's the total cost to own and operate the transmitter system over time
 - Includes initial equipment cost and delivery
 - Includes the installation/commissioning cost
 - Includes routine and unscheduled maintenance costs
 - Repair/replacement 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
 - ex: Ch30, 2,000ft, 6-1/8" rigid line, energy loss = 38%
 - Non-optimal antenna pattern (throwing RF energy away)



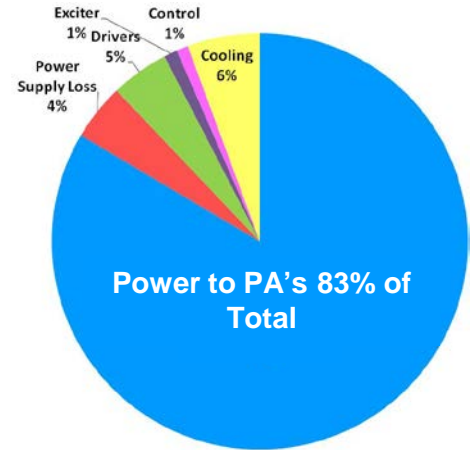
Every Part of The Transmitter Matters

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 Older Technology Power Supplies



Distribution of Power Usage with High Efficiency Power Supplies

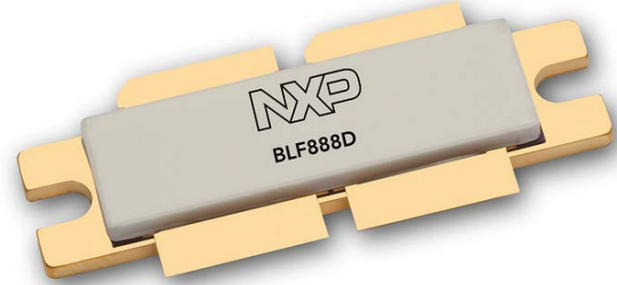


Power Supplies make 4% difference

- At GatesAir we are constantly updating designs to improve efficiency and lower TCO:
 - Higher Efficiency RF Devices & PA Module design
 - Higher Efficiency Power Supplies
 - Optimized Energy Efficient Cooling Systems
 - Broadband, future-proof designs
 - Improved up-time and reduced maintenance costs
 - Modular designs with Faster MTTR (Mean Time To Repair)
 - Higher Power Density for reduced floor space
 - User-friendly designs, easier to understand and operate



- New 50V LDMOS devices introduced that dramatically increase power density and efficiency
- Broadband high efficiency TV devices for VHF Band III and for UHF
- High Gain (> 15dB)
- Power 600W (CW) / 130 W TV average power
- Rugged
- Very High MTBF

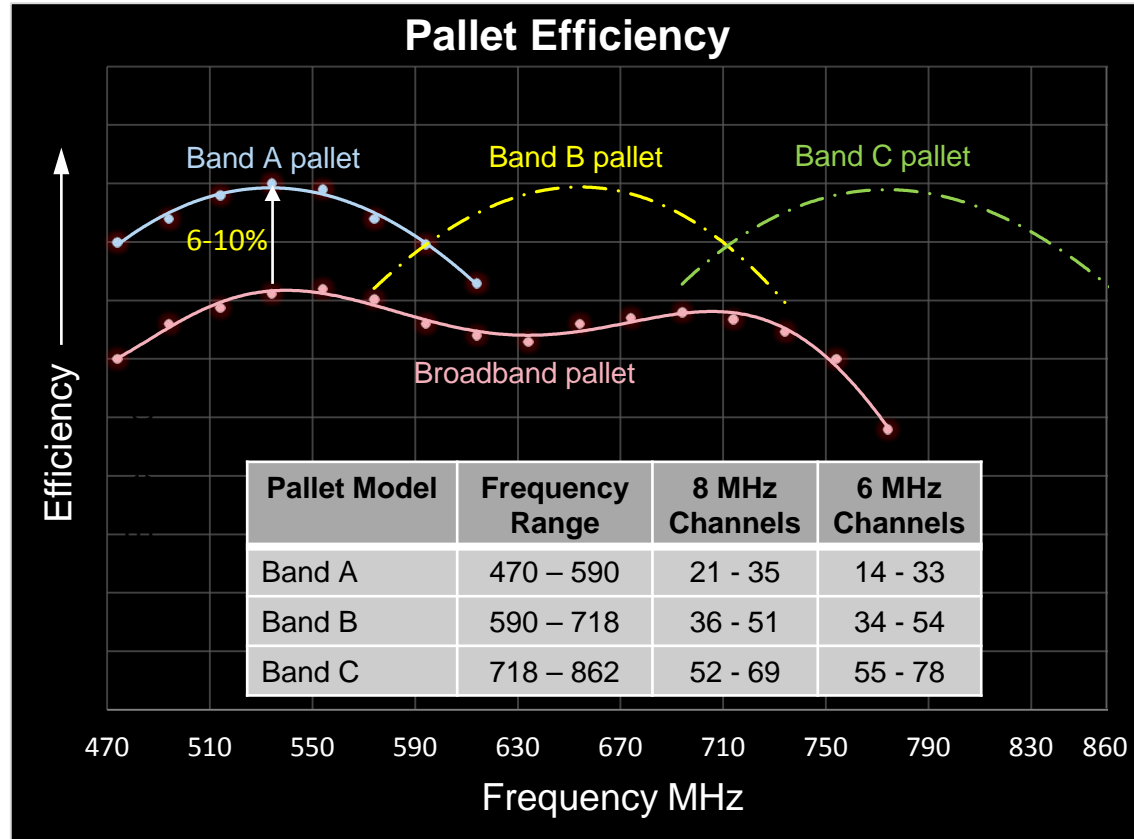


BLF888D Features and benefits (from data sheet):

- High efficiency
- High power gain
- Excellent ruggedness (VSWR > 40 : 1 through all phases)
- Excellent thermal stability
- Integrated ESD protection
- One Doherty design covers the full bandwidth from 470 MHz to 860 MHz
- Internal input matching for ease of use

Wideband Efficiency Optimized UHF Pallets

- Higher Efficiency Pallets:
 - Objective - Meet or exceed **any** competitive system level efficiency
 - 6% to 10% System level Efficiency improvement
 - Up to 44% AC to RF system efficiency for COFDM
 - Broadband version will still be available*

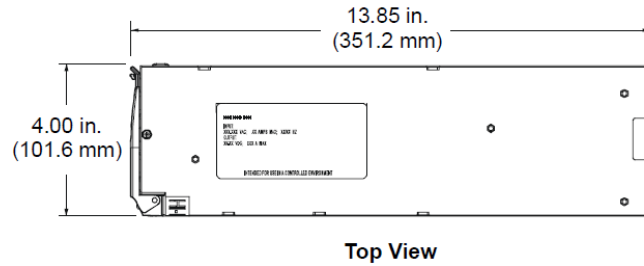


Power Supply Technology

- Improvements in Power density/weight
- Very high conversion efficiency
 - 96.3% versus 84% only 6 years ago
- With 48-50V DC requirement, can leverage the Telecomm industry:
 - Very high MTBF (900,000hrs)
 - High volume part
 - Widely available Worldwide
- Versatile
 - Use same part in FM and TV products



2,725 Watt high-efficiency power supply (weight 2kg)



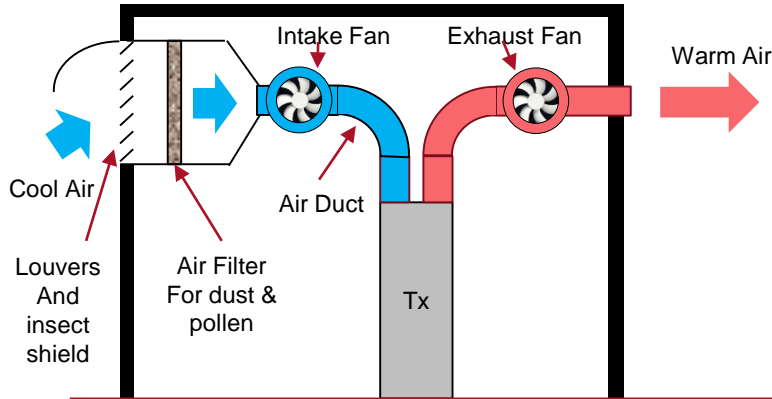
Rear View



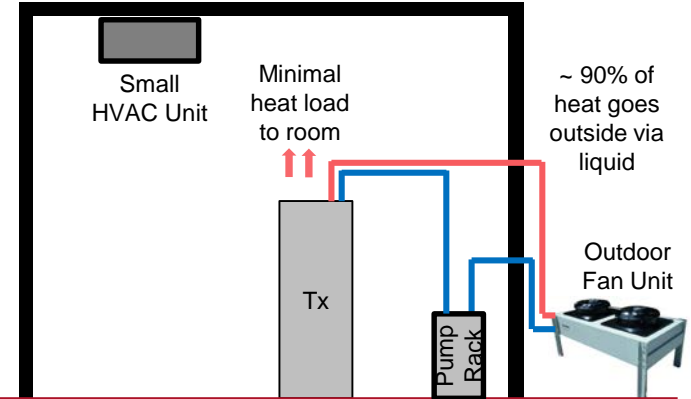
Front View

Reliability (calculated)	900,000	Hours	At ambient of 25°C at full load per Telcordia SR-332, issue 2, Reliability Prediction for Electronic Equipment, Method I Case III.
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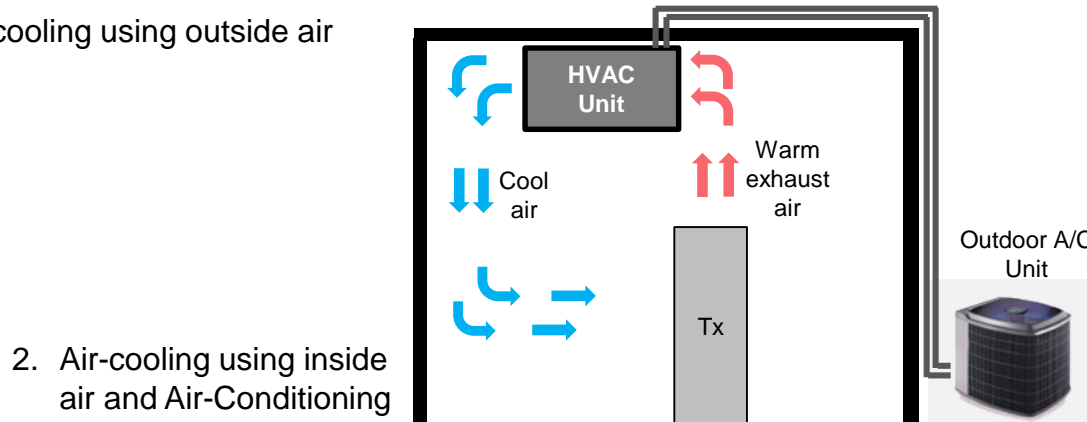
Three Ways to Cool the Transmitter



1. Air-cooling using outside air



3. Liquid-cooling



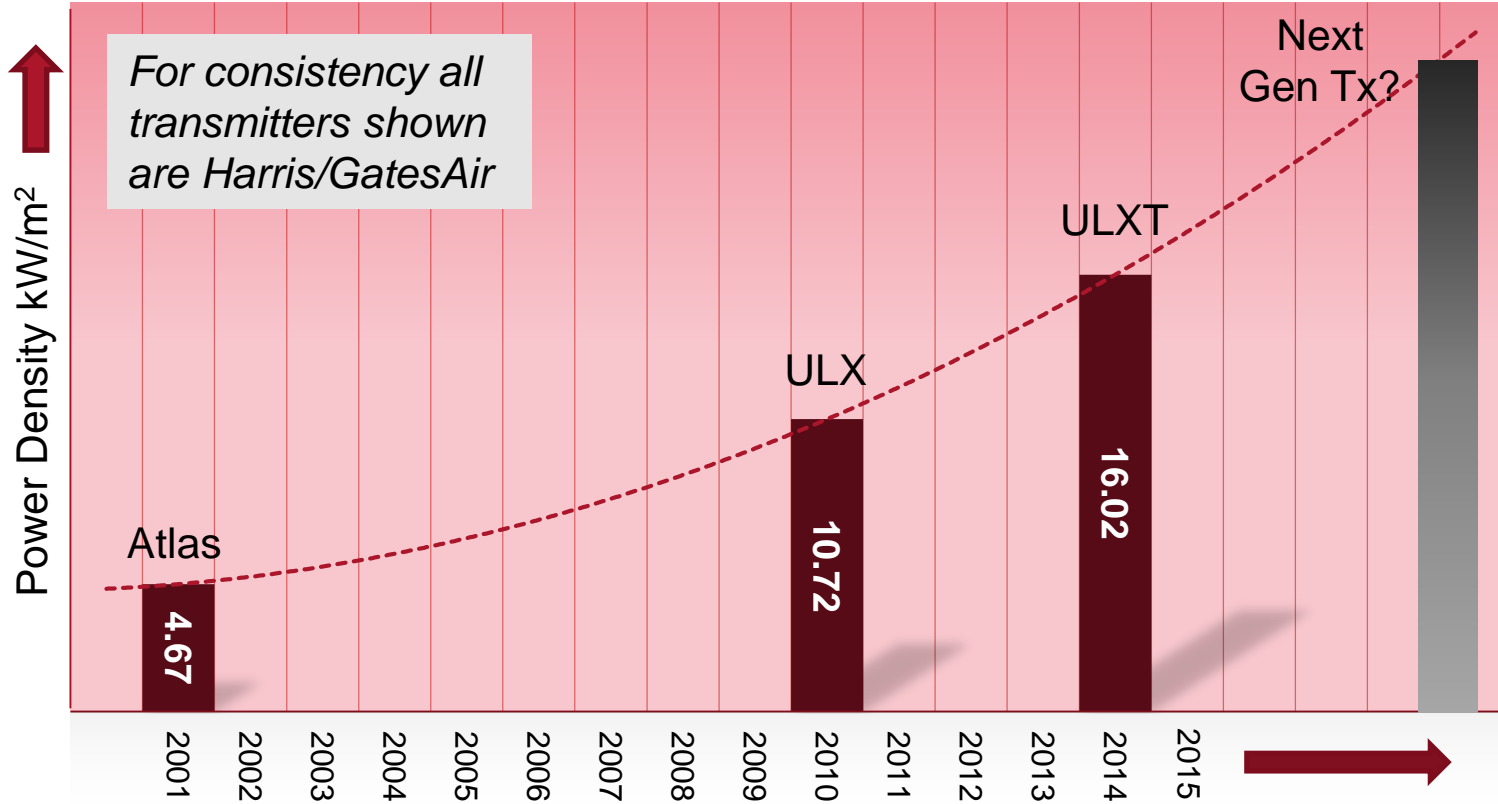
2. Air-cooling using inside air and Air-Conditioning

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	Medium/Excellent
TCO Rank	3	2	1

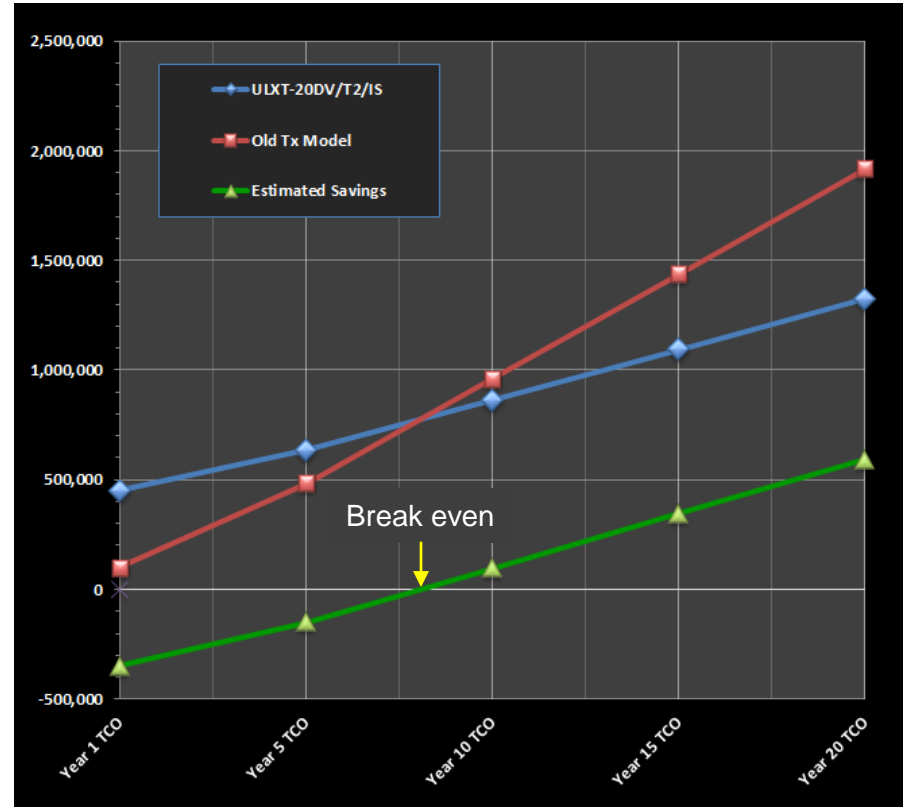


Space Savings Trend (TV liquid-cooled Tx)



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



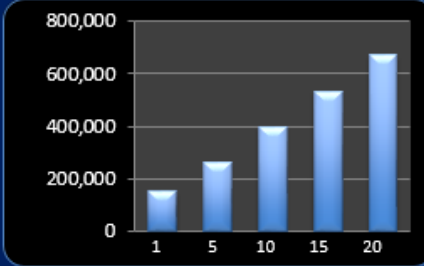
TCO – New vs. Previous Gen Tx

- 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

New GatesAir Transmitter TCO Analysis



SYSTEM VARIABLES	<i>enter cells in pink</i>	OPEX & TCO	
Transmitter Model & Costs:		Currency	US Dollar
Product Series	Maxiva ULXT COFDM	Exchange Rate	1.000 (Man.)
Model	ULXT-10DV/T2/IS	Annual OPEX	27,186
Tx Maximum Output Power	5,500 W	First Year TCO	153,686
Required Output Power	5,000 W	Five Year TCO	262,432
Tx Purchase Price	120,000	Ten Year TCO	398,364
Installation	0	Fifteen Year TCO	534,296
Commissioning	0	Twenty Year TCO	670,228
Training	0		
Total Cost	120,000		
Energy Costs:			
Region	Eastern_Europe		
Country/State	Czech Republic		
Electricity Price/kW-hr ¹	0.1650		
Price/kW-hr (override)	0.1800		
Tx System Efficiency	37.0%		




¹ Multiple sources used - 2010 data, GatesAir not responsible for any errors



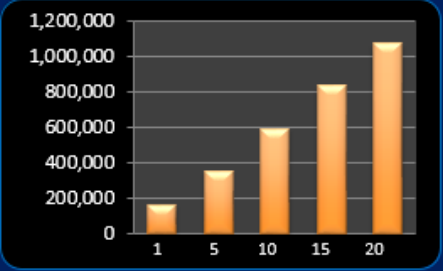
TCO – New vs. Previous Gen Tx

- Input Existing 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



Older Technology Transmitter TCO Analysis

SYSTEM VARIABLES	<i>enter cells in pink</i>	OPEX & TCO
Transmitter Model & Costs:		
Product Series	Maxiva ULX COFDM	
Model	ULX-5500	
Tx Maximum Output Power	5,850 W	
Required Output Power	5,000 W	
Purchase Price	110,000	
Installation	0	
Commissioning	0	
Training	0	
Total Cost	110,000	
Energy Costs:		
Region	Eastern_Europe	
Country/State	Czech Republic	
Electricity Price/kW-hr ¹	0.1650	
Price/kW-hr	0.1800	
Tx System Efficiency	19.6%	
Financials (Man.)		
Currency	US Dollar	
Exchange Rate	1.000	
Annual OPEX	47,882	
First Year TCO	164,382	
Five Year TCO	355,909	
Ten Year TCO	595,318	
Fifteen Year TCO	834,726	
Twenty Year TCO	1,074,135	



Year	TCO (Man.)
1	164,382
5	355,909
10	595,318
15	834,726
20	1,074,135

¹ Multiple sources used - 2010 data, GatesAir not responsible for any errors

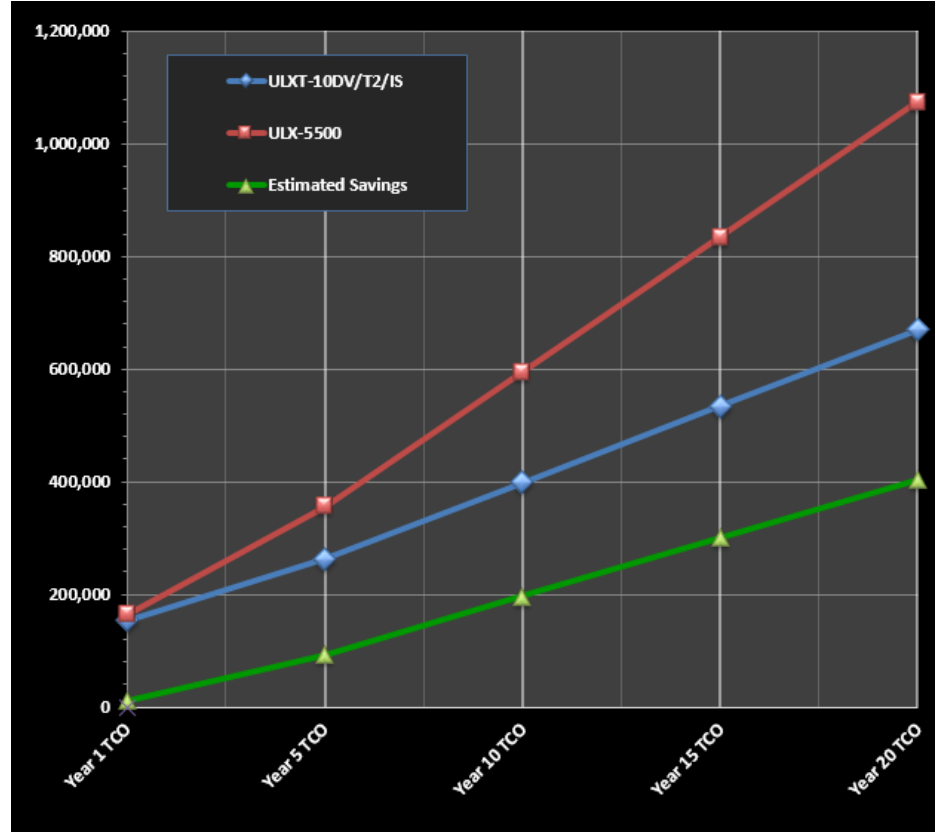
TCO – New vs. Previous Gen Tx

- GatesAir ULXT and ULX transmitters
- Side-by-side comparison
- New vs. previous generation solid DTV state tx
- \$93k savings in first 5 years
- Over \$300k savings over the life of the transmitter

Transmitter Models:	ULXT-10DV/T2/IS	ULX-5500	Estimated Savings
Product Series	Maxiva ULXT COFDM	Maxiva ULX COFDM	
Model	ULXT-10DV/T2/IS	ULX-5500	
Tx Maximum Output Power	5,500 W	5,850 W	
Required Output Power	5,000 W	5,000 W	
Purchase Price	120,000	110,000	
Installation	0	0	-10,000
Commissioning	0	0	0
Training	0	0	0
Total Cost	120,000	110,000	-10,000
Energy Costs:			
Region	Eastern_Europe	Eastern_Europe	
Country/State	Czech Republic	Czech Republic	
Price/kWh	\$0.180	\$0.180	
Tx System Efficiency	37.0%	19.6%	
OPEX:	ULXT-10DV/T2/IS	ULX-5500	Estimated Savings
Annual OPEX	27,186	47,882	20,695
Year 1 TCO	153,686	164,382	10,695
Year 5 TCO	262,432	355,909	93,477
Year 10 TCO	398,364	595,318	196,954
Year 15 TCO	534,296	834,726	300,430
Year 20 TCO	670,228	1,074,135	403,907
Breakeven Period			1.0 Years

TCO – New vs. Previous Gen Tx

- Graphical representation
- GatesAir ULXT and ULX transmitters
- New TX **Blue**
- Old Tx **Red**
- Savings over time **Green**
 - Typically, transmitter pays for itself in 5 to 10 years
 - Less heat load to building due to higher efficiency





NEW FLX Liquid Cooled FM Transmitter

- FLX10K
 - 12 kW Analog at 72% AC -RF Efficiency
 - 9.7 kW Analog, FM+HD @ -14dBc – 60% AC-RF Efficiency
 - 7.7 kW Analog, FM+HD @ -10dBc – 55% AC-RF Efficiency
- **Power Block Scalable 5kW – 80kW**

**Available in Digital-Ready Analog
Or Fully Digital**



FLX10K 16RU Cabinet

- 12 kW average power
- 17kW peak power
- 7 - 50 Volt, 2.75 kW power supplies
 - 96% AC-DC Efficiency
- 14 - **New** 970 Watt PA pallets
- 7 - 1940 Watt PA modules
 - 82% DC-RF PA efficiency
- Dual Exciter and IPA – failover switching





- 88% overall heat dissipation to liquid transfer efficiency
- Internal or external redundant pump modules
- Two 10kW transmitters with dual exciters, in a single rack
- 20kW with dual exciters in a single rack
- 40kW in four racks

= Lowest Total Cost of Ownership!

PowerSmart®



Transmitter TCO Comparison (GatesAir / GatesAir)



Transmitter Models:

Product Series

Model

Tx Maximum Output Power

Required Output Power

Purchase Price

Installation

Commissioning

Training

Total Cost

FLX T 10K @ -10

FLXT
FLX T 10K @ -10
7,700 W
7,600 W
105,299
23,093
0
0
128,392

FAX 10K @ -10

Flexiva FM HD Transmitter
FAX 10K @ -10
7,700 W
7,600 W
\$85,000.000
23,093
0
0
108,093

Estimated Savings

20,299
0
0
0
20,299

Energy Costs:

Region

Country/State

Price/kWh

Tx System Efficiency

USA
Florida
\$0.120
53.7%

USA
Florida
\$0.120
51.3%

OPEX:

Annual OPEX

Year 1 TCO

Year 5 TCO

Year 10 TCO

Year 15 TCO

Year 20 TCO

FLX T 10K @ -10
18,679
148,571
223,289
316,687
410,084
503,482

FAX 10K @ -10
24,630
137,223
235,745
358,897
482,048
605,200

Estimated Savings
5,951
-11,348
12,455
42,210
71,964
101,718

Breakeven Period

3.0 Years

Notes & assumptions:

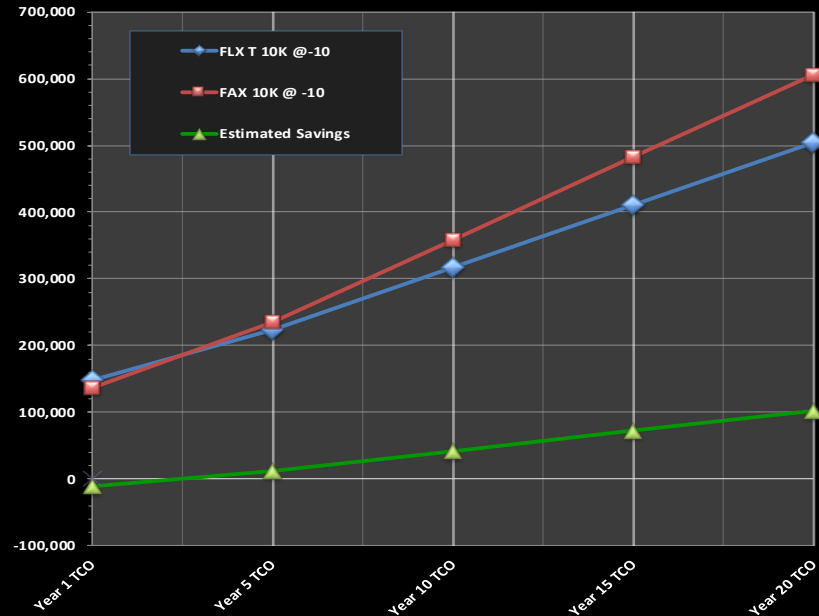
Operating output power must be less than or equal to the max. Tx power is pre-filter

No real estate purchase or rental costs are included

Annual tx maintenance of \$2,400 (unless edited in cells V10, V11)

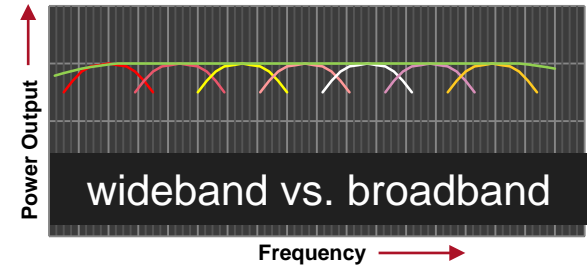
HVAC acquisition cost of \$1,150/ton, installation cost of \$2,500 (unless edited in cell V7)

Tx heat load to room is cooled by HVAC system. Default SEER = 12 (unless edited in cells V6, V10)



Summary – Things to Consider

- Broadband versus Wideband TV Transmitter
- Potential utility company rebates?
- Obsolescence and spare parts availability?
- High-voltage vs. Low-voltage (safety)
- Tx complexity and serviceability
- Modularity and On-air reliability
- Size, weight and ease of replacing modules
- Service & support from manufacturer



VS.



VS.

