



DVB-T2 Technology and New Products

July 2014

Featuring
GatesAir's



Martyn Horspool
Product Manager,
TV Transmission



Connecting What's Next

DVB-T2 Technology and New Products

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Transmission
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- 09:00 – 09:05am Welcome and Opening speech – by Emico
- 09:05 – 09:20am Introduction & History of GatesAir
- 09:20 – 10:00am DVB-T2 Technology - The main advantages/benefits
- 10:00 – 10:30am Tea Break
- 10:30 – 10:40am Overview of GatesAir TV Product Portfolio
- 10:40 – 11:45am New High Efficiency UHF Transmitters (Maxiva ULXT / UAXT)
 - Energy savings and Total Cost of Ownership (TCO)
 - New technology RF devices
 - High efficiency broadband techniques compared
 - Power density and footprint
 - Cooling System
 - Multi Transmitters in 1 rack
 - N+1 Systems
- 11:45 – 12:15pm Advantages of GatesAir Transmitters compared to other brands
- 12:15 – 12:30pm Questions & Answers
- 12:30pm Lunch



Part 1 – Introduction & History of GatesAir



- **1922** - Henry C. and Cora B. Gates founded the Gates Radio & Supply Company in Quincy, Ill., to create a job for their son, Parker S. Gates, who was only 15 years old at the time.
- **1950** - Gates Radio had become a major Radio equipment supplier in USA
- **1957** – Harris Corporation acquires Gates Radio
- **2013** – Gores group acquires Harris Broadcast Division
- **2014** – Harris Broadcast splits into two companies – Imagine Communications and GatesAir



Quincy, Illinois, USA





1922



First Commercial
Radio Station

1929



First TV
Broadcast

1996



First Commercial
DTV Broadcast in USA

2008



Mobile
TV

What's
Next?

Ultra-HD (4K/8k),
LTE Broadcast





Connecting Our Customers to What's Next in Over-The-Air Television, Radio and Distribution



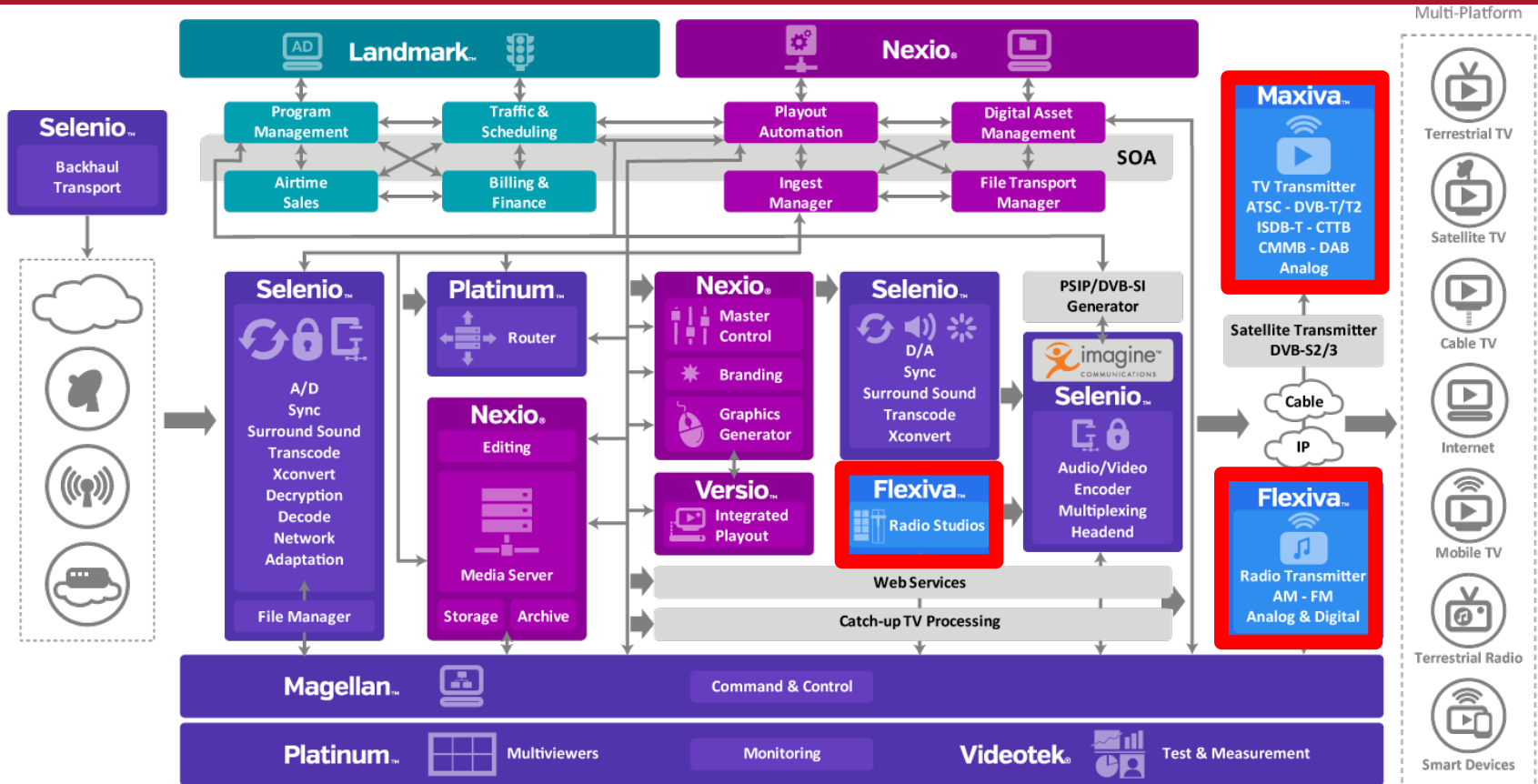
At GatesAir there are no limitations. We seek to find a new way, a better way, in everything we do to serve our customers and each other: We are passionate, innovative, collaborative, accountable and service-oriented.



To Continuously Exceed the Expectations of our Customers



End-to-End Terrestrial Transmission Solutions



Proprietary and confidential. | 6



■ Best in Class Transmission Solutions

- Lowest transmission TCO for broadcasters worldwide
- Innovative, world class products that solve evolving customer needs
- Exceptional Pre and Post Sales Services
- Unique capability to deliver transmission solutions that enable new revenue

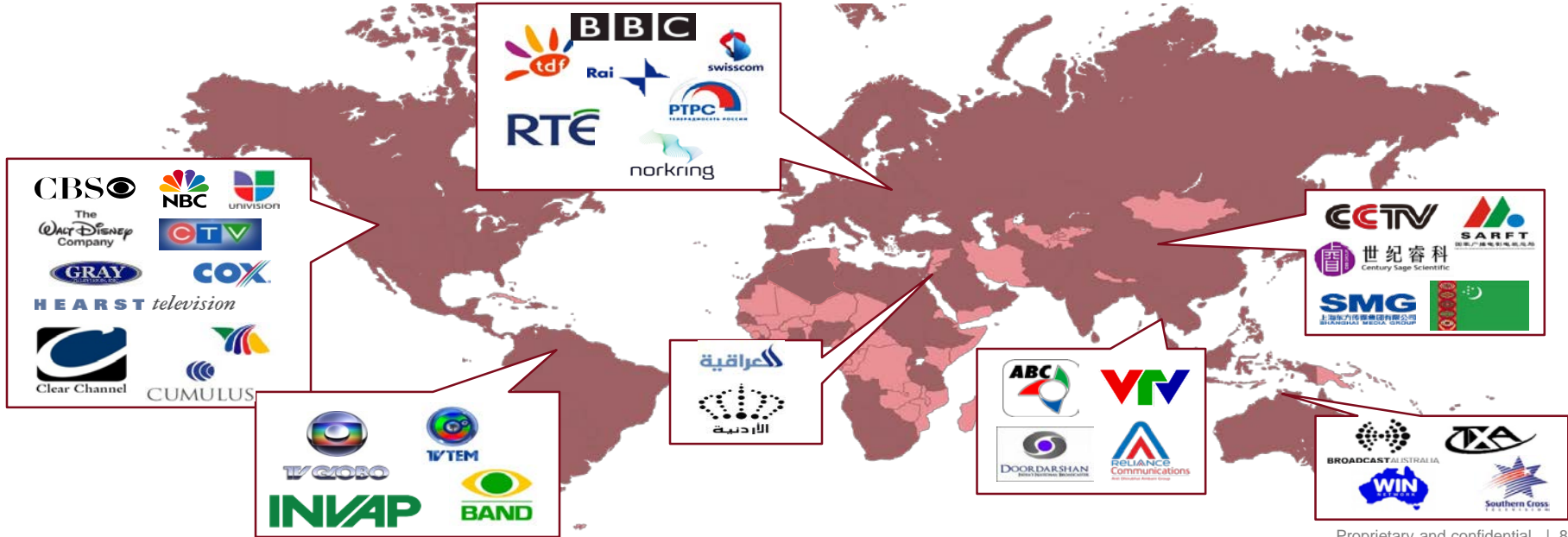
■ Market Leader in Transmission solutions for Core Broadcasters, Network Operators and Government Sponsored Broadcast networks:



Global Footprint

- Customers include top media companies around the world
- Systems are mission-critical to customer's business
- Tenure of relationships with key customers range from 10 to 70+ years

Presence in Over 140 Countries Globally



- Consistent market leader in both in TV and Radio Transmission
- Thousands of products deployed globally
- Extensive history of successive OTA innovations

Customer Ratings and Industry Recognition

Customer Statistics & Ratings*

Transmitters

- Top 2 in product advantage, innovation, reliability, value for money, and reliability

Audio Products

- 7 of top 10 revenue producing radio stations in North America trust their audio to GatesAir

*Source: Devoncroft Big Brand Survey 2013, BIA

Notable Awards



EMMY® Award Winner 2007, 2008



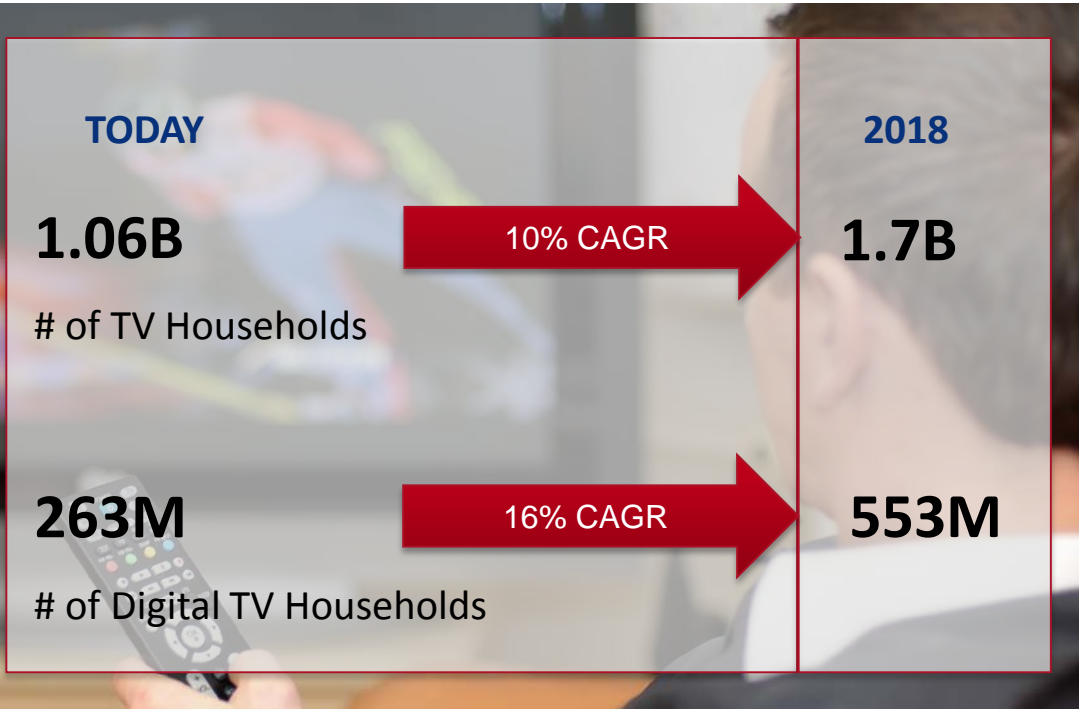
2008 - Pioneering RF Combiners
for Adjacent Channels



2007 - RF Combiners
for ATSC
Transmission System



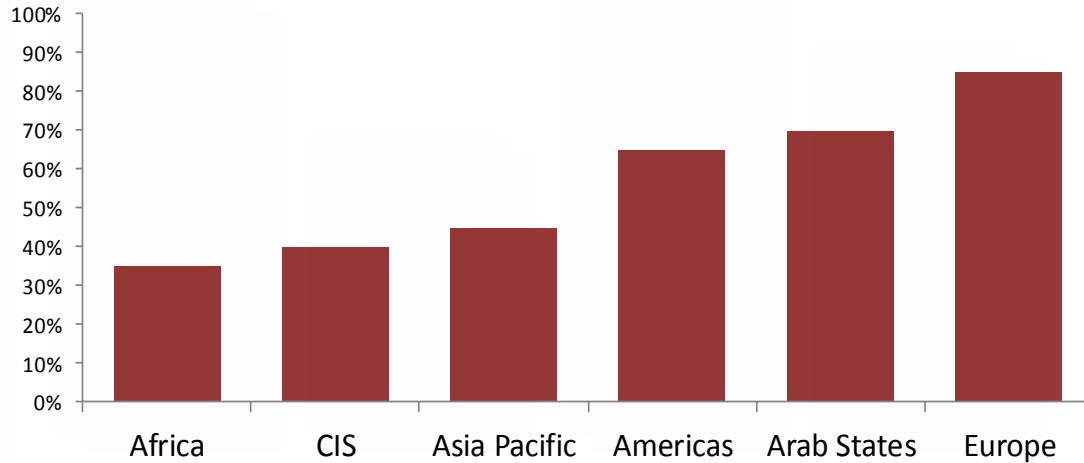
Market Growth Trends



- Strong growth in TV households
- Faster growth in Digital TV
- Over-the-Air (OTA) business benefits from this growth
- GatesAir is among the largest in OTA technology



Digital TV Penetration as % of Total Households



Source: Digital TV Research, ITU 2013

- Many countries just starting the transition to digital
- Often fast growing, but lack wired infrastructure (e.g., cable)
- Significant opportunity exists to enable OTA transitions
- Economics and distances favor OTA as the primary distribution means



Create



Networked Digital
Radio Studios

Transport



Contribution &
Distribution – IP-
TDM - RF

Transmit Radio



AM - FM - DAB
Analog & Digital

Transmit TV



VHF - UHF
Analog & Digital





- VHF and UHF Broadband High Efficiency technology for digital TV and radio delivers lowest total cost of ownership
- Software defined modulation capability addresses today's needs and tomorrows opportunities



**Maxiva
ULXT**

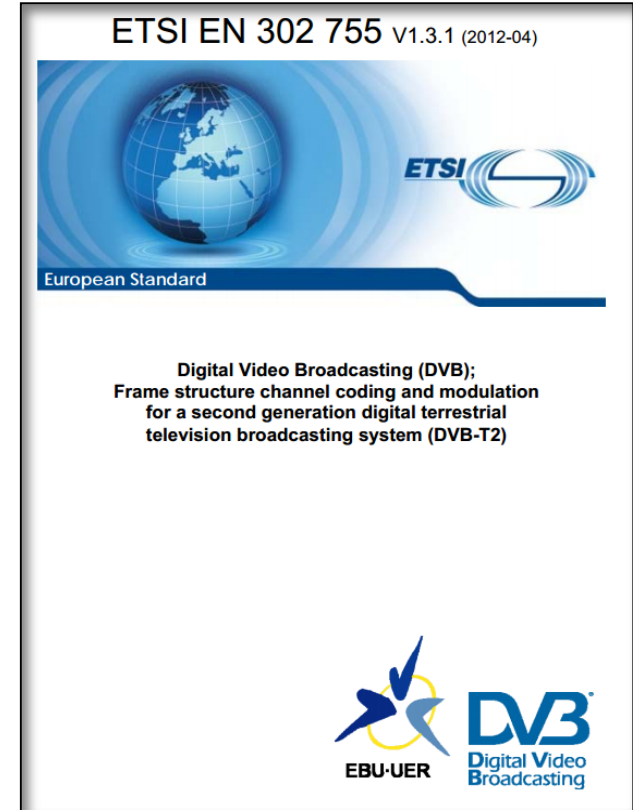
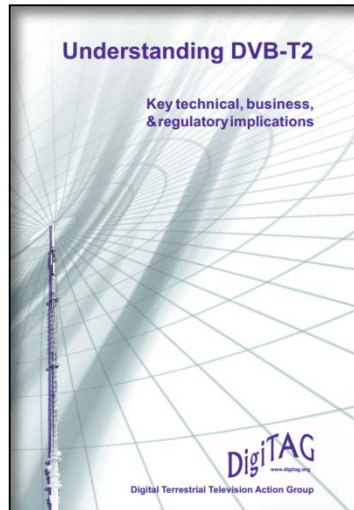
- ↓ 40% less weight
- ↓ 50% less volume
- ↑ 55% more efficient



DVB-T2 Technology Overview



- What is DVB-T2?
- How does DVB-T2 compare with DVB-T?
- Summary of Technical Highlights of DVB-T
- Resources for further information
- Questions?



DVB-T2 – What is it?

- DVB-T2 is currently the most advanced digital terrestrial television (DTT) system
- It offers more robustness and flexibility
- At least 50% more efficient than any other DTT system available today
- It supports SD, HD, UHD, mobile TV, or any combination of these
- But.... DVB-T2 is **NOT** compatible with DVB-T receivers (STB required, or new TV)



- DVB-T2 is able existing antenna installations and re-use existing transmitter infrastructures
- It works with both fixed and portable receivers
- Large capacity increase over DVB-T, with similar planning constraints and conditions as DVB-T
- Improved Single Frequency Network (SFN) performance compared to DVB-T
- Includes a mechanism for service-specific robustness (i.e. provide different levels of robustness to some services compared to others. Also possible to target some services for roof-top reception and other services for portable reception
- Provides bandwidth and frequency flexibility
- Provides the ability to reduce the peak-to-average ratio (PAPR), in order to reduce transmission costs

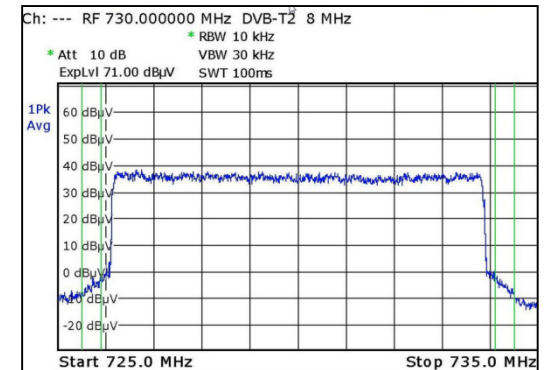
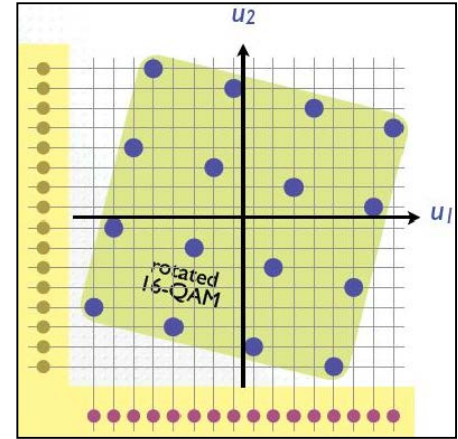


- Like its predecessor, DVB-T2 uses **OFDM** (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal, and offers a range of different modes, making it a very flexible standard.
- DVB-T2 uses the same error correction coding as used in DVB-S2 and DVB-C2:
 - **LDPC** (Low Density Parity Check) coding
 - **BCH** (Bose-Chaudhuri-Hocquengham) coding, offering a very robust signal. The number of carriers, guard interval sizes and pilot signals can be adjusted, so that the overheads can be optimized for any target transmission channel.



Main Advantages of DVB-T2

- New generation Forward Error Correction and 256 QAM
 - Capacity gain of > 30%
- OFDM carrier increase up to 32k and additional guard Interval selections
 - In SFN can provide up to 18% overhead gain
- Rotated Constellations
 - Robust transmission in difficult conditions
- Bandwidth extension
 - 2% payload gain
- Extended Interleaving
 - Including bit, cell, time and frequency interleaving
- Multiple PLP's (Physical Layer Pipes)
 - See next slide
- DVB-T2 Lite
 - Optimized for Mobile applications



“The commercial requirement for service-specific robustness together with the need for different stream types is met by the concept of fully transparent physical-layer pipes, which enable the transport of data independently of its structure, with freely selectable, PLP-specific physical parameters.”

“Both the allocated capacity and the robustness can be adjusted to the content/service providers' particular needs, depending on the type of receiver and the usage environment to be addressed.”

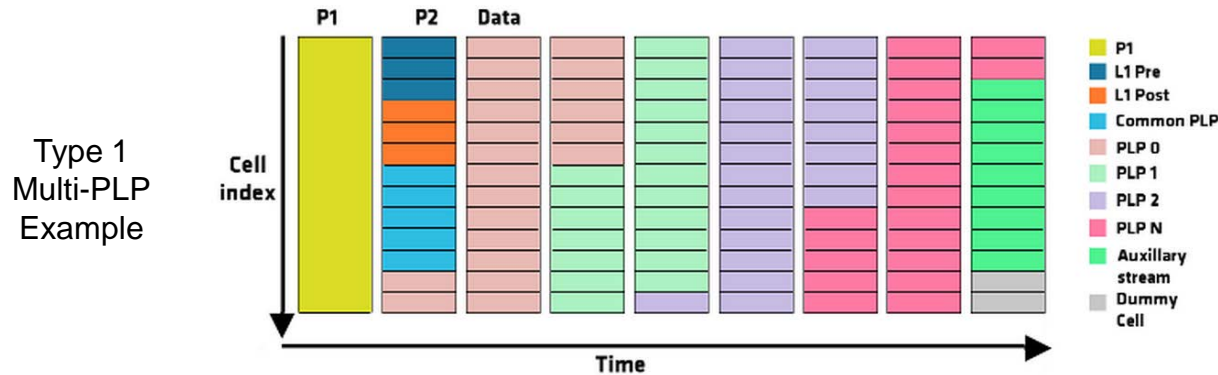
(Excerpt from: A133 DVB Implementation Guidelines)

- PLP's allow a broadcaster to achieve the best optimization of services for their viewers



Physical Layer Pipes

DVB-T2 uses single and multiple physical layer pipes (PLP). A PLP contains a single transport stream and all services in a single transport stream are in a single PLP. Multiple PLPs still have one transport stream per PLP, the advantage is each PLP can have different modulations and coding modes. The Guard Interval will be the same for all PLPs.



Each service is given a slice of data cells within a 'T2 frame'

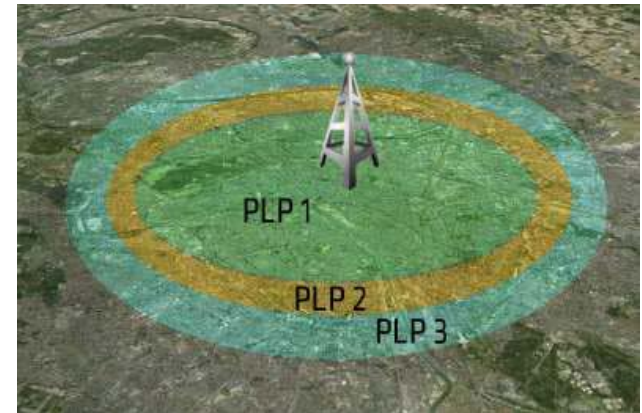
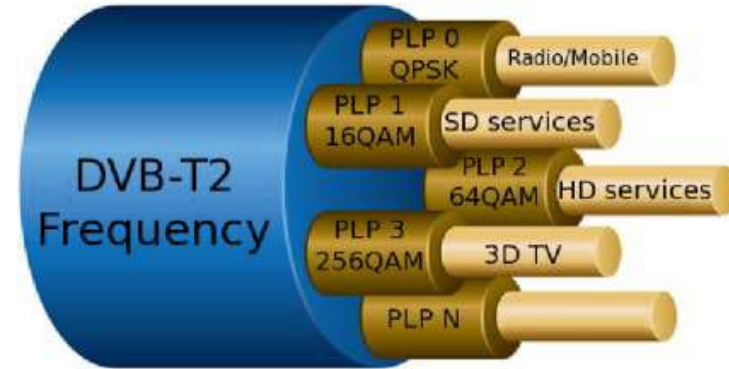
- Each slice is part of a **Physical Layer Pipe** for that service
- Also enables power saving in the receiver
- Slices can be sub-divided into sub-slices within frame in order to give more time diversity (Type 2 PLP)



Multiple Physical Layer Pipes

Simplified Explanation of Concept:

- All PLPs are broadcast over the same frequency (TV channel)
- Every PLP carries an MPEG-TS
- Every PLP has its own modulation, FEC code rate and interleaving
- PLP-based robustness configurations allow adjustment bandwidth and coverage area per PLP



DVB-T and DVB-T2 Comparison



	DVB-T	DVB-T2
Forward error correction (FEC) & Code Rates	Convolutional Coding + Reed Solomon 1/2, 2/3, 3/4, 5/6, & 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, & 5/6
Modulation	QPSK, 16QAM, & 64QAM	QPSK, 16QAM, 64QAM & 256QAM
Rotated constellation Mode	N/A	Rotated or None rotated modes
Guard intervals	1/4, 1/8, 1/16, & 1/32	1/4, 19/256, 1/8, 19/128, 1/16, 1/32, & 1/128
Discrete Fourier Transform (DFT size)	2k & 8k	1k, 2k, 4k, 8k, 16k, & 32k
Scattered Pilots	8% of total	1%, 2%, 4%, or 8%
Pilot Patterns	N/A	8 Patterns Available
Continual Pilots	2.6% of total	0.35% of total
		Single or Multiple PLP



DVB-T2: Bitrate vs. Robustness vs. Coverage

DVB T2 BITRATE VS. ROBUSTNESS VS. COVERAGE: THE ETERNAL DILEMA

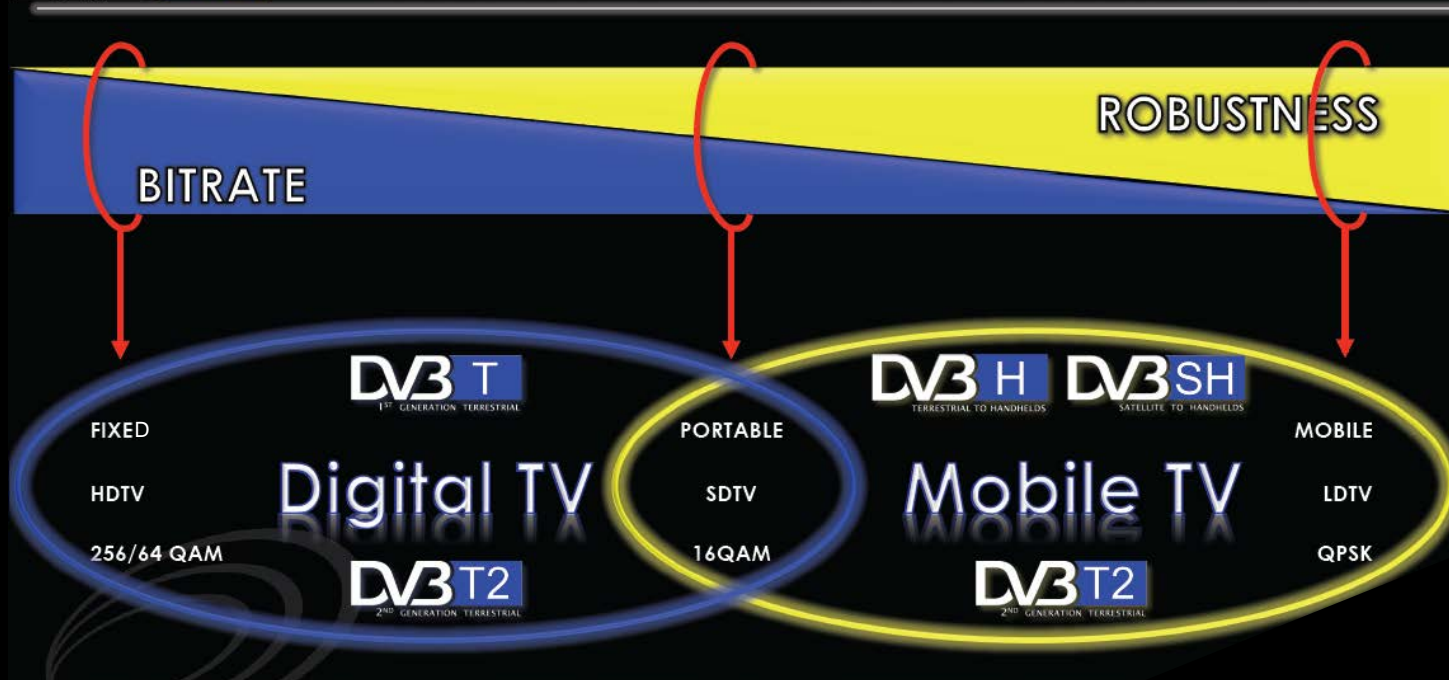


Illustration courtesy of Teamcast

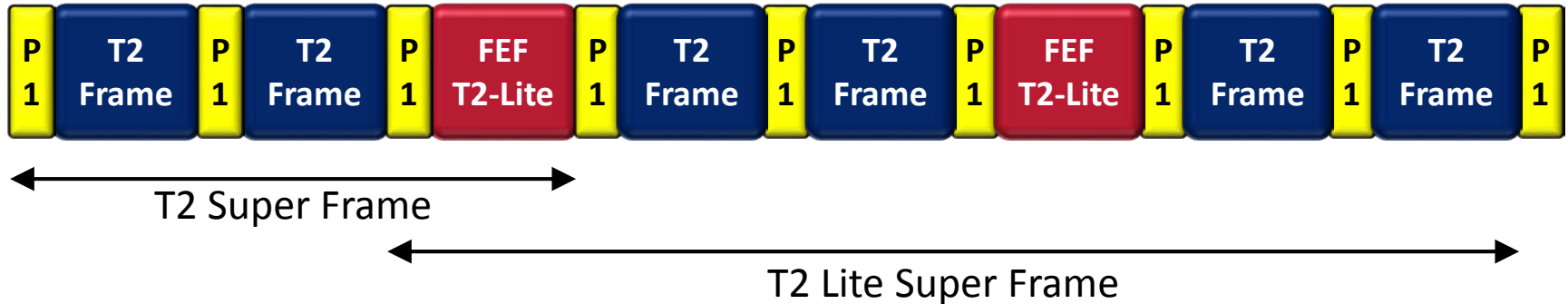


- The DVB T2-lite profile was added in June 2011 to the DVB-T2 standard v1.3.1 as Annex I.
- The T2-Lite profile is mostly a subset of the DVB-T2 standard which is now called the "DVB T2-base" profile.
- Two additional code rates were added for improvement of mobile performance.

DVB-T2 Lite	
FEC block size	LDPC 16k only
Code Rate	1/2, 3/5, 2/3, 3/4, 2/5*, 1/3* (* New code rates)
Constellation Size	QPSK, 16QAM, 64QAM, 256QAM (up to code rate 3/5)
Rotated Constellation	Only for QPSK, 16QAM and 64QAM
Guard Interval	Reduced set of combinations of FFT size, guard interval and pilot pattern.
FFT size	2K, 4K, 8K, 16K, 16K ext.
Scattered pilots	PP8 not allowed
Max. Bandwidth	4 Mb/s
P1 Signalling	New signalling for T2-mobile SISO/MISO
L1 Scrambling	Optional scrambling of L1-post only or entire L1

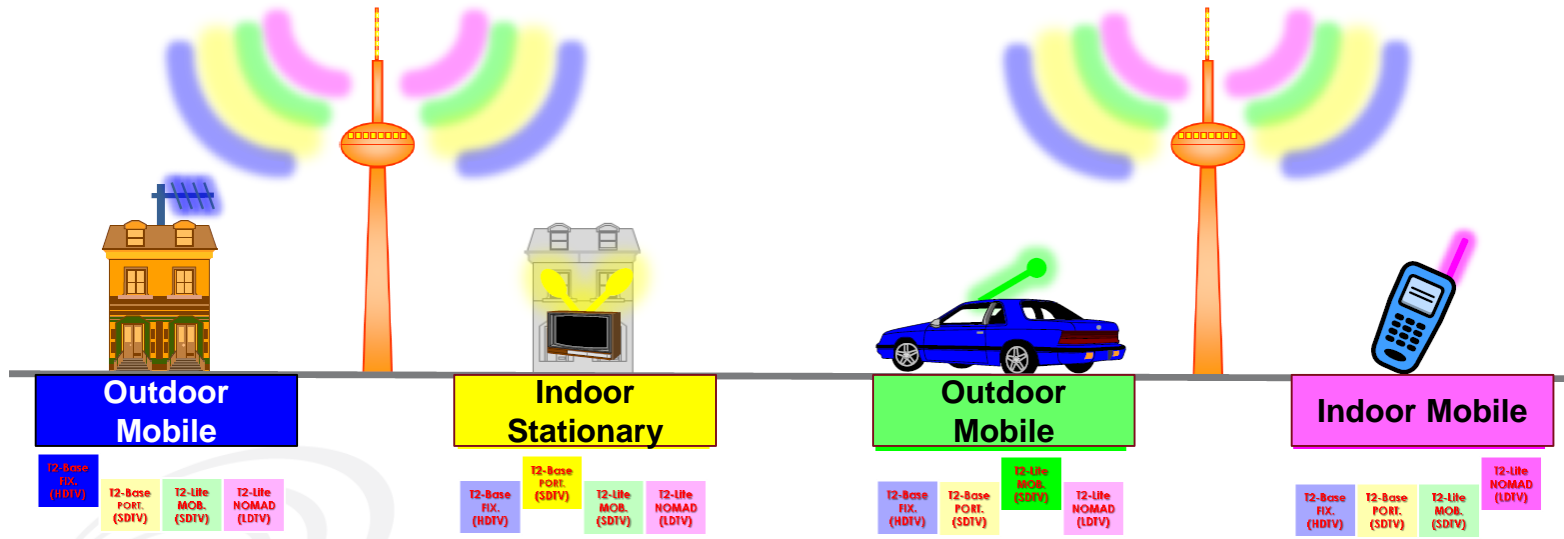


- The T2-Lite signal may either be transmitted as a stand-alone signal ie. in a regular PLP, or as a T2-Lite signal with FEF parts.
- The Future Extension Frame (FEF) carries a T2 Frame dedicated for mobile services and may have different modulation parameters (FFT size, Guard Interval, SFN/MISO, Pilot pattern) than the other T2 Frame to improve mobile reception. The FEF interval and size of the T2-Lite super frame can be defined in the T2 Gateway. The maximum duration of a FEF part is 1 second.



DVB-T2 Lite Summary

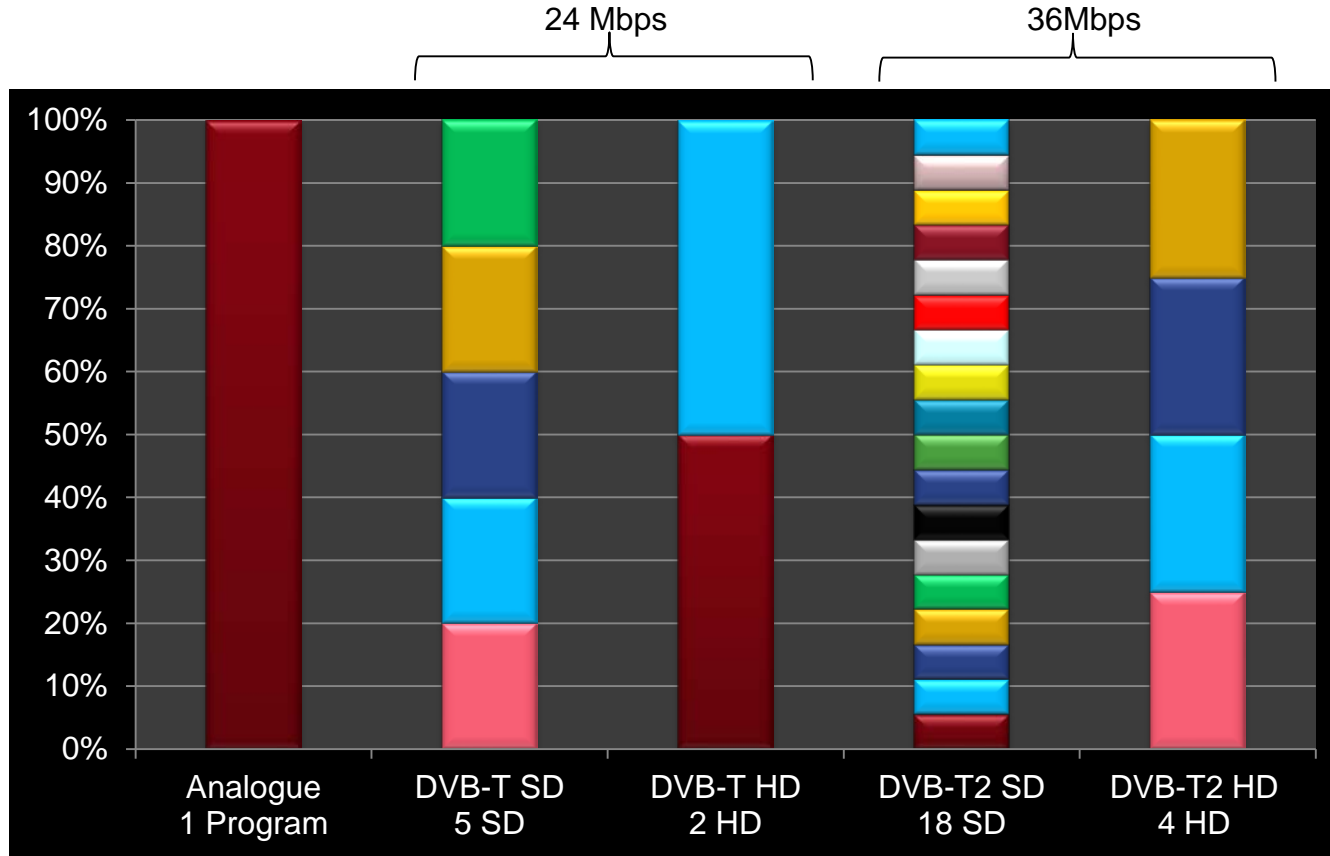
- The T2 Lite profile allows simpler receiver implementations for very low capacity applications such as mobile broadcasting (50% smaller chip size)
- This new profile can be mixed with conventional T2 signals in a single multiplex, to allow separate optimization of the individual components.



DVB-T2 1.3.1 Provides both optimum waveform (Fixed vs. Mobile) & Multiple PLP Robustness (Outdoor vs. Indoor)



Programs Per RF Channel – Analog / T / T2



Summary of Main DVB-T2 Benefits



- Flexibility for network design
 - Frame rates, bit rates, modulation rates, Guard Intervals, etc. to fit what any particular operator desires to achieve.
- Pilots (fixed and scattered) to enable receiver lock in tough conditions (channel estimation)
- PAPR reduction techniques
 - TR and ACE
- Performance limits very near theoretical Shannon limit
- Multiple PLP's
- T2-MI for multiplex management
- FEF's for other data formats (LTE-A+), T2-Lite



- Useful documents are available to assist in better understanding DVB-T2 and network planning aspects:

1. DVB-T2 Fact sheet (Copy on Thumb Drive)

DVB.org web site: <http://www.dvb.org/technology/dvbt2/>

2. Frequency and Network Planning Aspects of DVB-T2 (Copy on Thumb Drive)

EBU Technical Document 3348: <http://tech.ebu.ch/publications>

3. DVB-T2 Standards (ETSI EN 302 755 V1.3.1 and others) (Copy on Thumb drive)

DVB.org web site: https://www.dvb.org/standards?__noframe=8031



Overview of GatesAir TV Product Line



A History of Technology Leadership



- **1981:** Introduced the “Mod Anode Pulser” — a simple technique that reduced the power consumption of klystron analog UHF transmitters by 19%
- **1990’s:** DiamondCD® and Ranger™ series transmitters leverage just debuted high-power UHF LDMOS solid-state devices, providing significant efficiency benefits compared to earlier transistor designs
- **2005:** Our PowerCD® UHF transmitters introduce an advanced IOT design that sets a new benchmark for performance
- **2008:** GatesAir throws out the old playbook with the debut of PowerSmart® — a pioneering architecture for VHF and UHF transmitters that “broke the mold” in power output, compact size and modularity
- **2013:** GatesAir once again leads the way with the introduction of a new line of next-generation, high efficiency VHF and UHF transmitters: Maxiva VAX and ULXT featuring PowerSmart® 3D high-efficiency technology - groundbreaking designs that set an all-new standard for transmitter efficiency



**Maxiva™ ULXT
with
PowerSmart® 3D**



Maxiva Product Family



Low Power Air Cooled

High Power Liquid Cooled

Super High Power

UHF



Maxiva™ UAX & UAXT

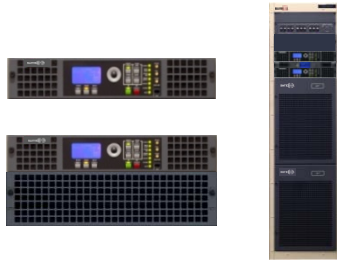


Maxiva™ ULX & ULXT



Maxiva™ ULXT & Power CD (IOT)

VHF



Maxiva™ VAX / VAX-3D



Maxiva™ VLX

(Band III TV and DAB Digital radio)



UHF Solutions

UHF
Liquid-Cooled



Maxima ULX
Up to 25% efficiency
(2009-2014)

PowerSmart[®] 3D

UHF
Liquid-Cooled



Maxima ULXT
Up to 38% efficiency
Available Now



GatesAir High Efficiency Transmitters



- The GatesAir new line of VHF and UHF transmitters: Maxiva™ VAX, UAXT & ULXT, all featuring PowerSmart® 3D high-efficiency technology.



VAX-3D - DAB & DTV
Air Cooled
Band III



ULXT - DTV
Liquid Cooled
Band IV/V



UAXT - DTV
Air Cooled
Band IV/V

- Maxiva™ VAX, UAXT and ULXT transmitters offer full broadband coverage across UHF, VHF Band III for DAB and DTV with a simple, highly reliable design. No adjustments of any kind are required.

Low Total Cost of Ownership Without Compromise



What is PowerSmart® ?

PowerSmart® is the on-going GatesAir design initiative to create the most efficient transmitter designs and products. GatesAir leverages the most sophisticated tools to develop cost, energy, and space efficient solutions.



The Maxiva™ family of UHF transmitters led this initiative with the first 50V LDMOS device-driven transmitter in the industry setting a new benchmark for power density and efficiency.

◀ TV

The Flexiva™ family of FM transmitters set new benchmarks with operating efficiencies of up to 72%, the first FM design to use 50V LDMOS devices, and the smallest footprint at 10kW and higher power levels



Radio ▶



Transmitter Efficiency: What Does It Include?

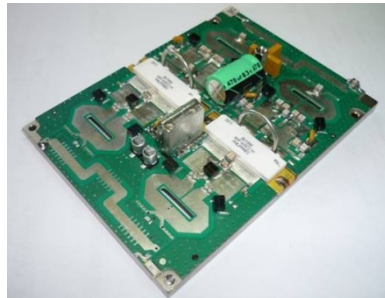
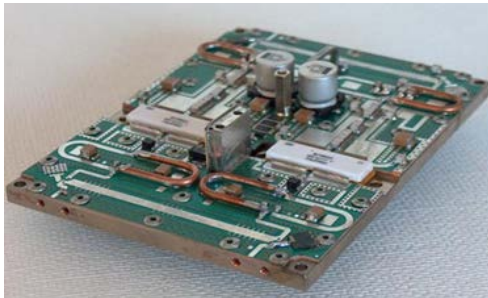


High Efficiency Amplifier Techniques

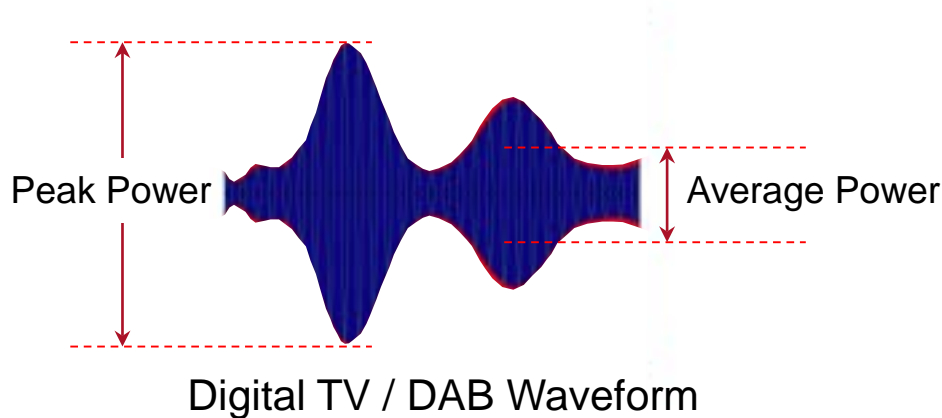


High Efficiency Power Amplifier Technology

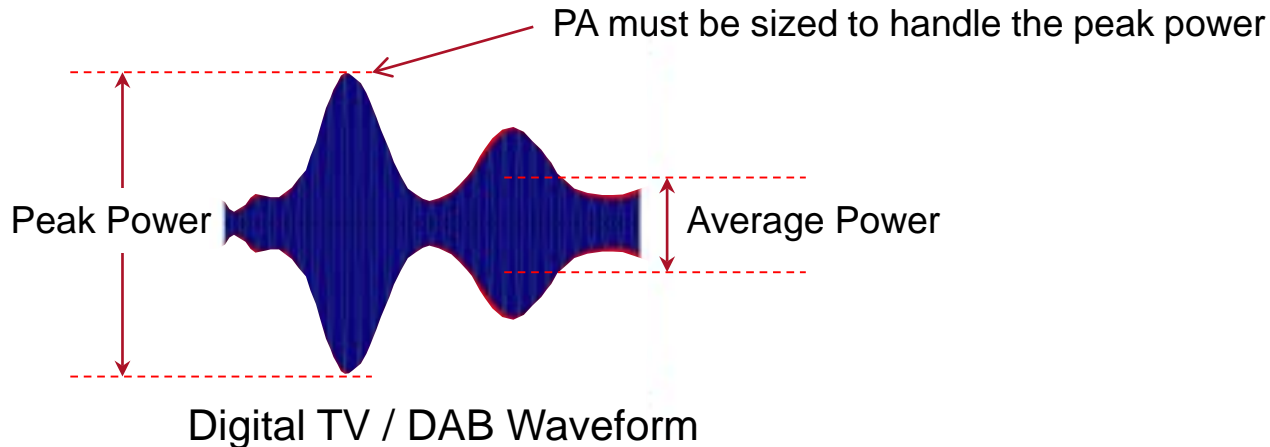
- High interest among broadcasters and RF network operators in new power amplifier technology that offers improved efficiency
- Benefits of higher power amplifier efficiency include:
 - AC power consumption savings
 - Reduction in physical size
 - Reduction in cooling requirements
 - Reduction of carbon footprint in support of green technology



- Digital TV & DAB signals have high Crest Factor / Peak to Average power Ratio (PAR) compared to a constant envelope signal
- Digital modulation waveforms (OFDM / 8VSB) contain complex, simultaneous, AM & PM modulation requiring linear amplification
- Linear amplification needed to meet RF emission mask and minimize in-band RF IMD that degrades the digital signal to noise ratio (EVM / MER)

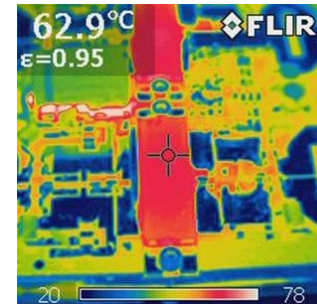
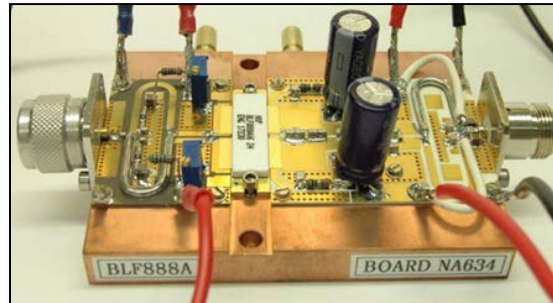
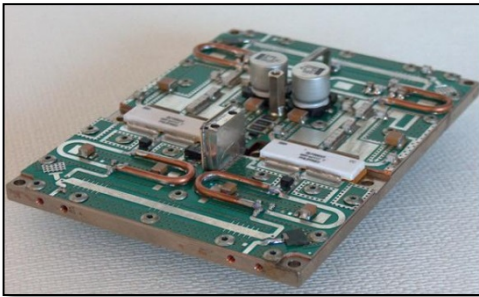


- Efficiency lost when PA operates between saturation and cutoff
- Loading on PA not optimum for RF waveform at point where static bias current through amplifying device is significant portion of total current
- RF Power amplifiers operate at highest efficiency when saturated for maximum power output



Linear Amplification Efficiency Penalty

- To accommodate a digital signal with 8dB peak to average ratio, the amplifier needs to be biased into linear, Class-AB, mode
- Average power reduced by $\sim 8\text{dB}$ to achieve good linearity
- Current VHF & UHF solid state devices can achieve saturated DC to RF efficiencies of up to 70%
- Backed off by 8dB into Class-AB operation, DC to RF efficiency can drop to $\sim 30\%$



High Efficiency Amplifiers – Drain Modulation

■ Drain Modulation

- Varies the RF amplifier device drain voltage exactly in time with the waveform
- Also called “Envelope Tracking”
- Evaluated in depth by Harris Broadcast in 2011 – but not implemented into products due to cost/complexity
- Provides 37% to 38% TV OFDM tx efficiency

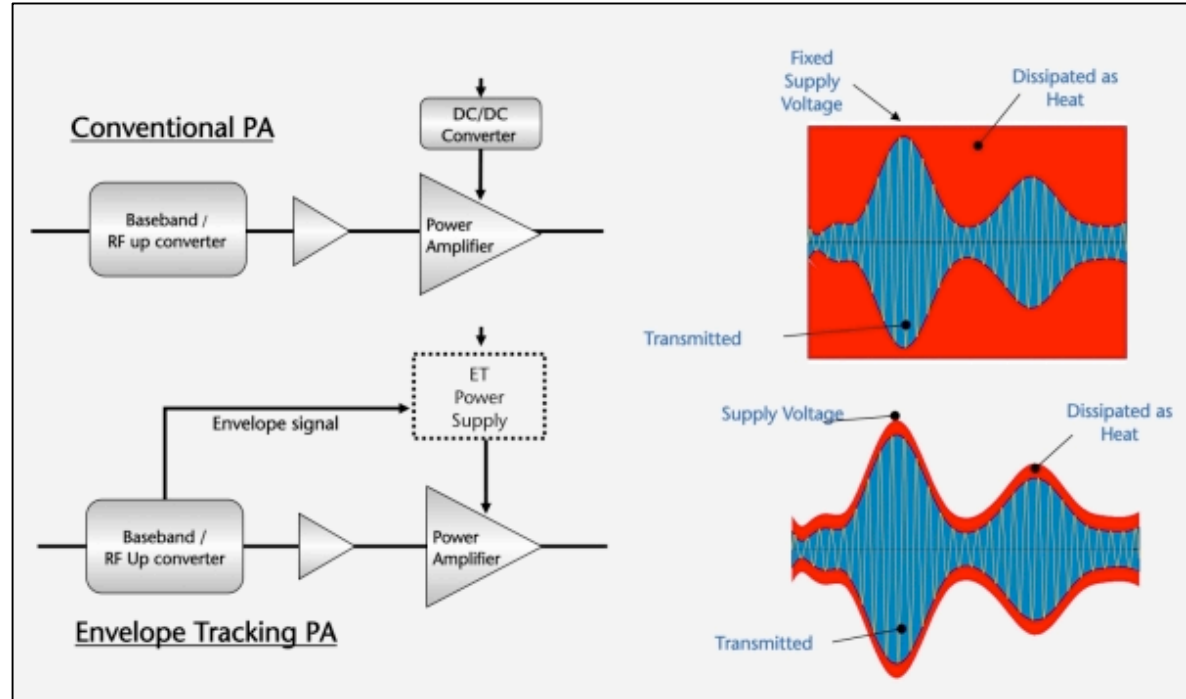


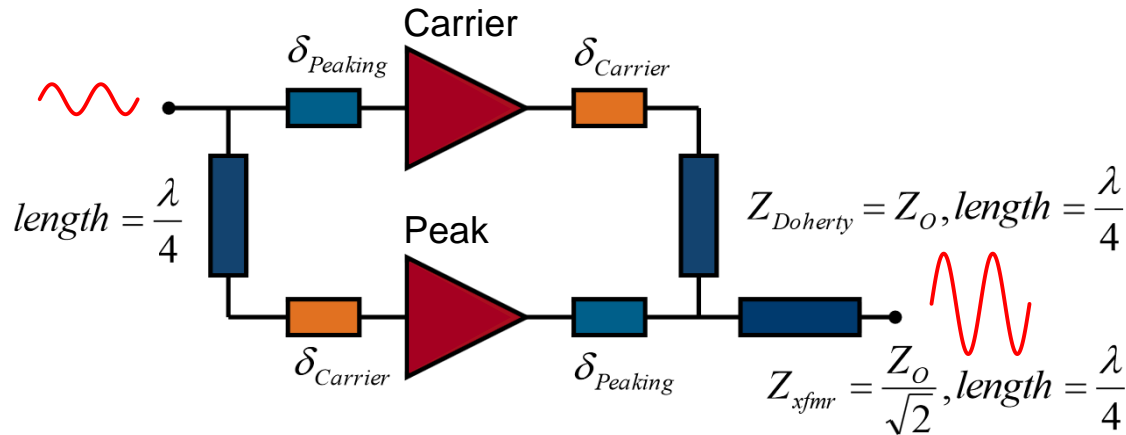
Diagram courtesy of Nujira



High Efficiency Amplifiers – Classic Doherty

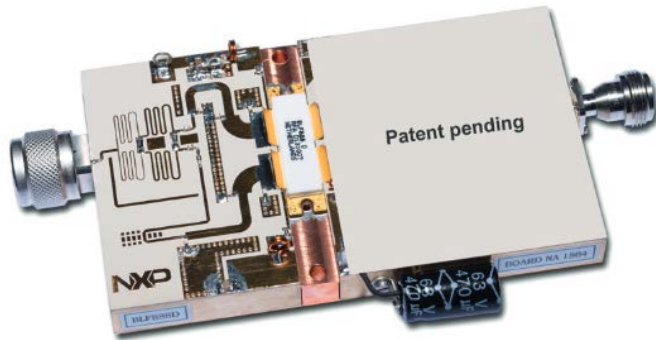
■ Doherty Amplifier (Classic - Narrowband)

- Invented in 1936 by W.H. Doherty of Bell Telephone Laboratories
- The classic Doherty amplifier consists of two amplifiers: a carrier amplifier biased to operate in Class AB mode, and a peaking amplifier biased to operate in Class C mode
- Typically 36% to 39% TV OFDM efficiency
- Tested by Harris Broadcast in early 2000's – Bandwidth limitations at that time (6% to 10% BW) reduced it's usefulness – and not suitable for our fully broadband design initiative

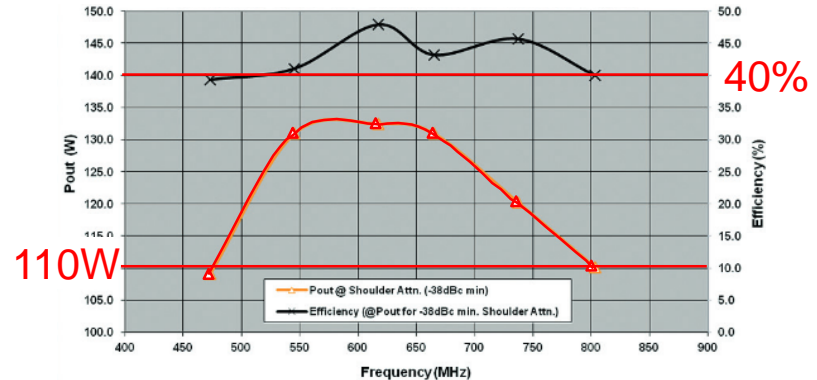


■ Broadband Doherty (Ultra Wideband)

- Recent development work by device manufacturers has resulted in optimized LDMOS devices and innovative amplifier circuitry that allows broadband operation of Doherty
- One example by NXP is the new BLF-888D (110W @ 40% PA Efficiency)
- Patent pending NXP technique



NXP's BLF-888D Ultra-Wideband Doherty Amplifier



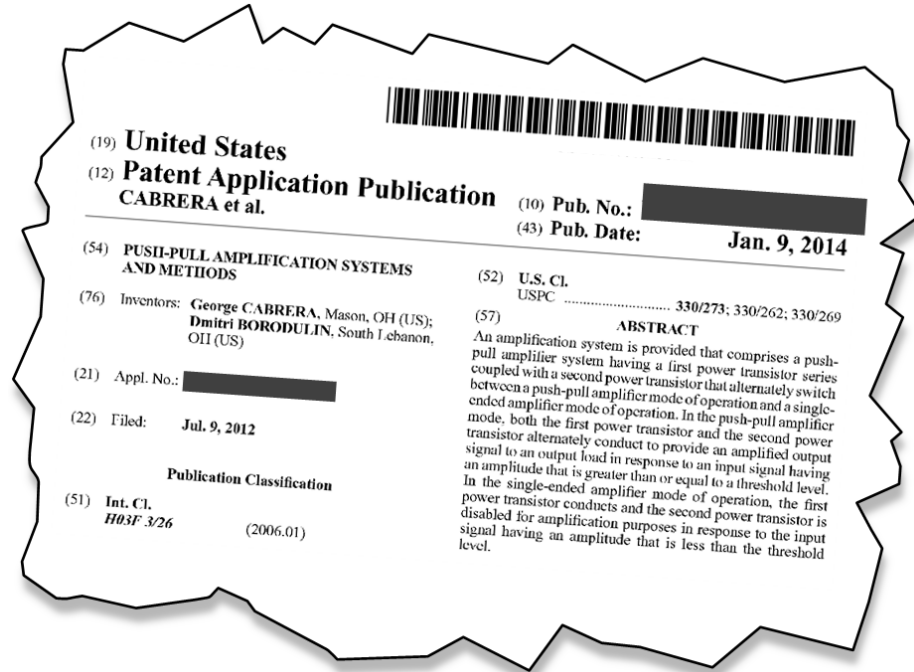
Average DVB-T/T2 Power & Efficiency versus Frequency at Pallet Level



High Efficiency Push-Pull Amplifier (patent pending)



- Harris Broadcast patent application on file
- Provides excellent efficiency
- Broadband technique
- Deployed in new series of VHF Band III DAB/TV transmitters
- DAB Amplifier efficiency up to 52-54% across band III
- Overall transmitter efficiency:
 - 40% in DAB
 - 42% in ATSC
 - 36% in OFDM TV (DVB-T/T2, ISDB-T, etc.)



New High Efficiency UHF Transmitters Liquid-Cooled ULXT Series



Maxiva ULXT - Key Benefits (1)



- **Broadband, high-efficiency design**
 - Maxiva ULXT provides the highest available AC to RF efficiency along with fully broadband operation across the UHF band. This means 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.
- **Future-proof architecture**
 - Re-pack (Restack) of the UHF TV spectrum could mean 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.



Maxiva ULXT - Key Benefits (2)

- **Modular design with small, lightweight, PA modules**
 - A complete ULXT PA module weighs only 11kg (24lb), far lighter than comparable PA modules from others, often weighing in excess of 24kg (53lbs). This makes it much easier to replace while on the air and its small size and weight reduces shipping costs between either our service department, or your spares depot and each transmitter site.
- **Small, lightweight, individual PA power supplies**
 - Each PA module has its own dedicated power supply. Each power supply is a separate assembly from the PA module, making it much easier to service and replace, if needed. PA power supplies weigh less than 2kg (4.4lb) and can be swapped on-air in less than 1 minute.



Maxiva ULXT - Key Benefits (3)



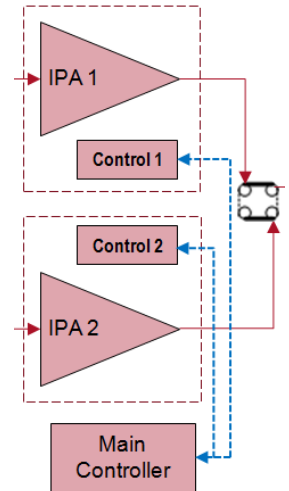
■ Less expensive PA Module and Power Supply

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



■ Robust Control System with redundant controllers

- Our layered control system allows 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.



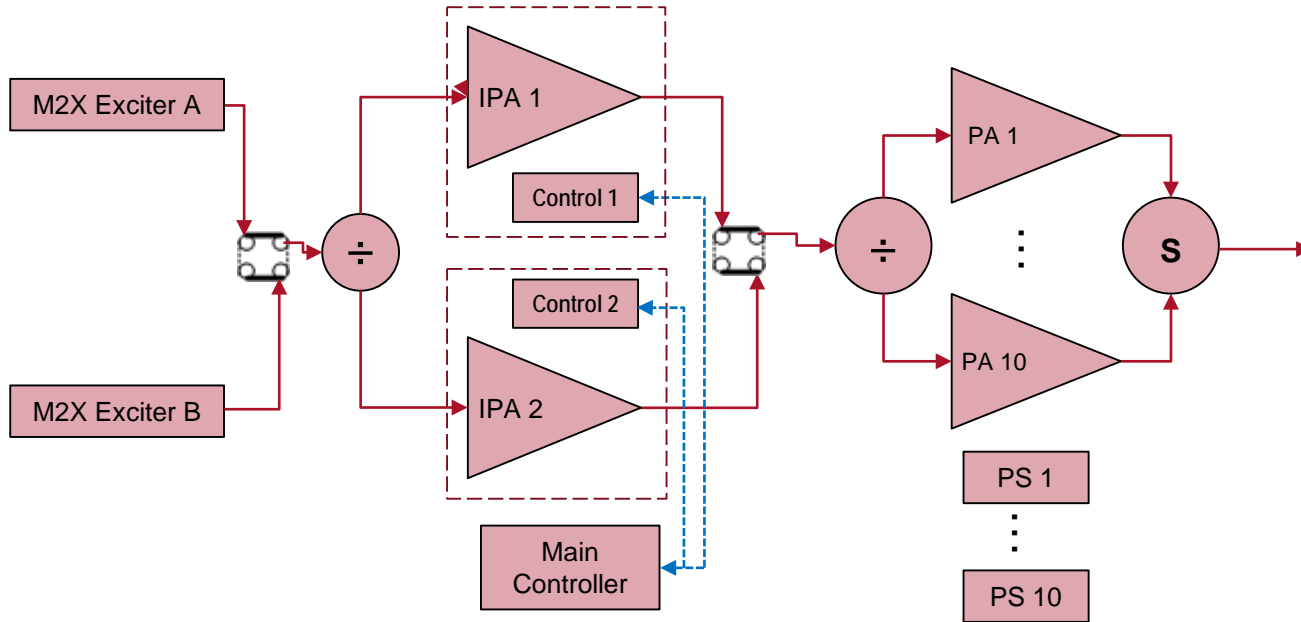
■ General Product Overview:

- Hot swappable front load PA Modules and Power Supplies
- Incorporates field-proven Maxiva™ M2X exciter technology for best in class performance
- All-digital linear and nonlinear pre-correction: Real-Time Adaptive Correction (RTAC™)
- All Worldwide digital modulation standards supported
- Modular & upgradeable architecture
- Rugged, reliable design and construction
- CE Marked / RoHS Compliant

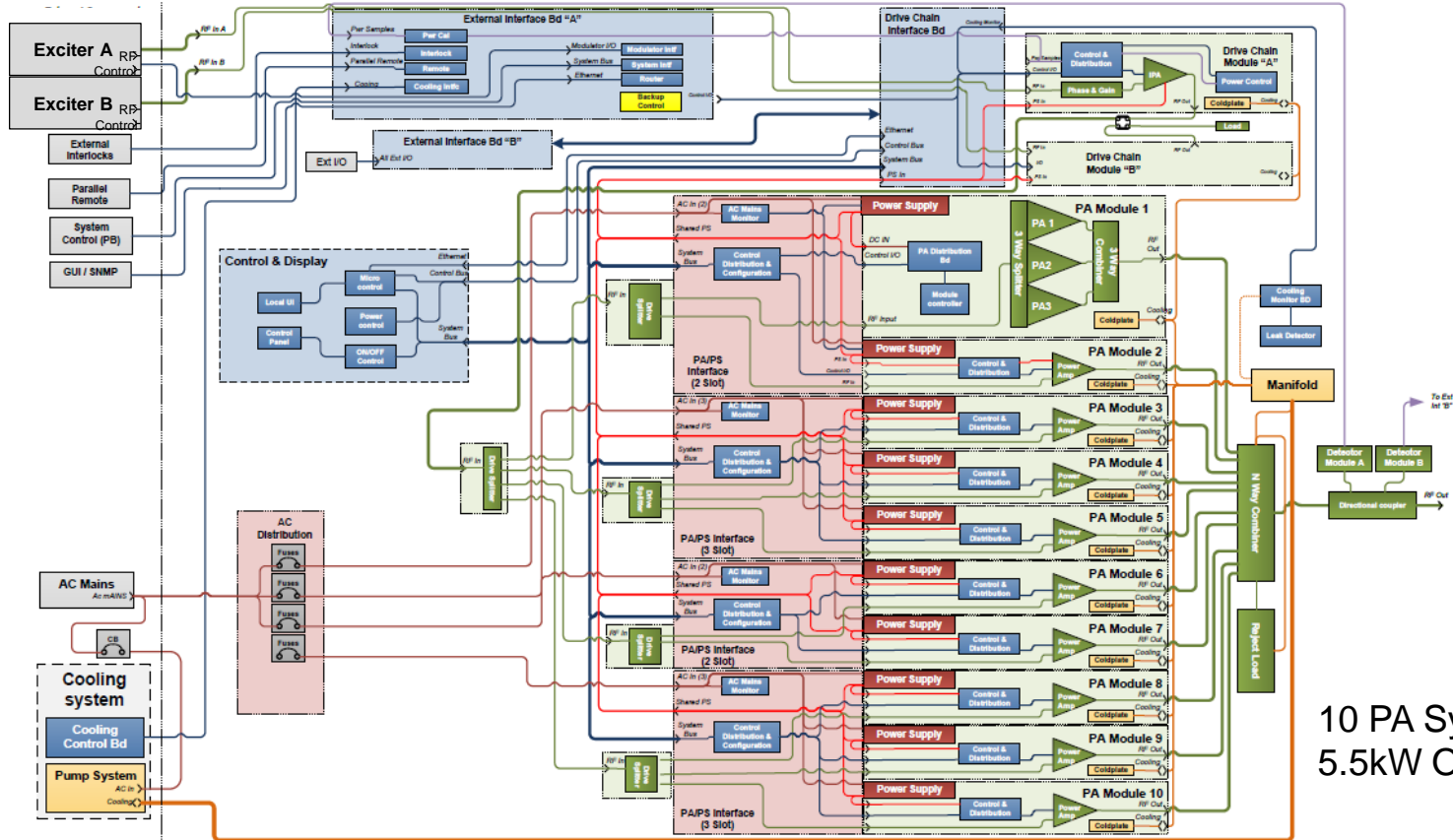


Block Diagram ULXT-10_{xx}

10 PA System - Dual Drive Option Shown



System Block Diagram - Detailed



10 PA System
5.5kW OFDM



Internal/Integral Pump System

- With up to 5.5kW DVB-T2 systems, an integral pump system is available
- Save floor space
- Save plumbing
- Smaller pumps – lower power consumption – more efficient!
- External pump module also available



High Efficiency External Pump Module

- Leveraged from ULX system – Reliable, proven
- 3rd generation – Optimized for High Efficiency
- Small physical size
- 2 Pumps, with auto/manual changeover
- Low maintenance, closed-loop pressurized system
- Quiet – Designed for indoor installation
- Pump speed inverter controlled



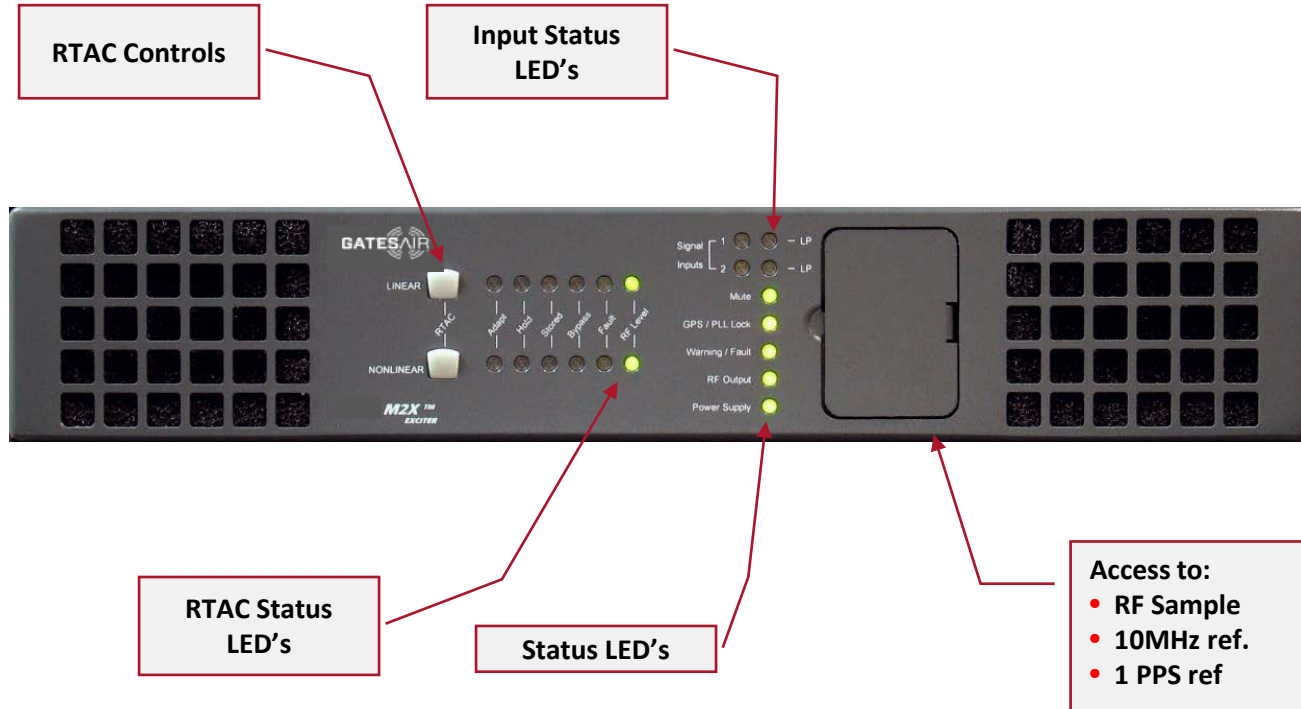
High Efficiency Heat Exchanger



- GatesAir manufactured
- Dual fans with on-air servicing/replacement capability
- Low noise, high-efficiency fan blades)
- Speed controlled for maximum efficiency
- Vertical or horizontal airflow (mounting can be adapted on site for either configuration)
- Two sizes available 20kW & 50kW heat dissipation
- Redundant heat exchangers available



Maxiva M2X TV Exciter



Maxiva M2X - Features

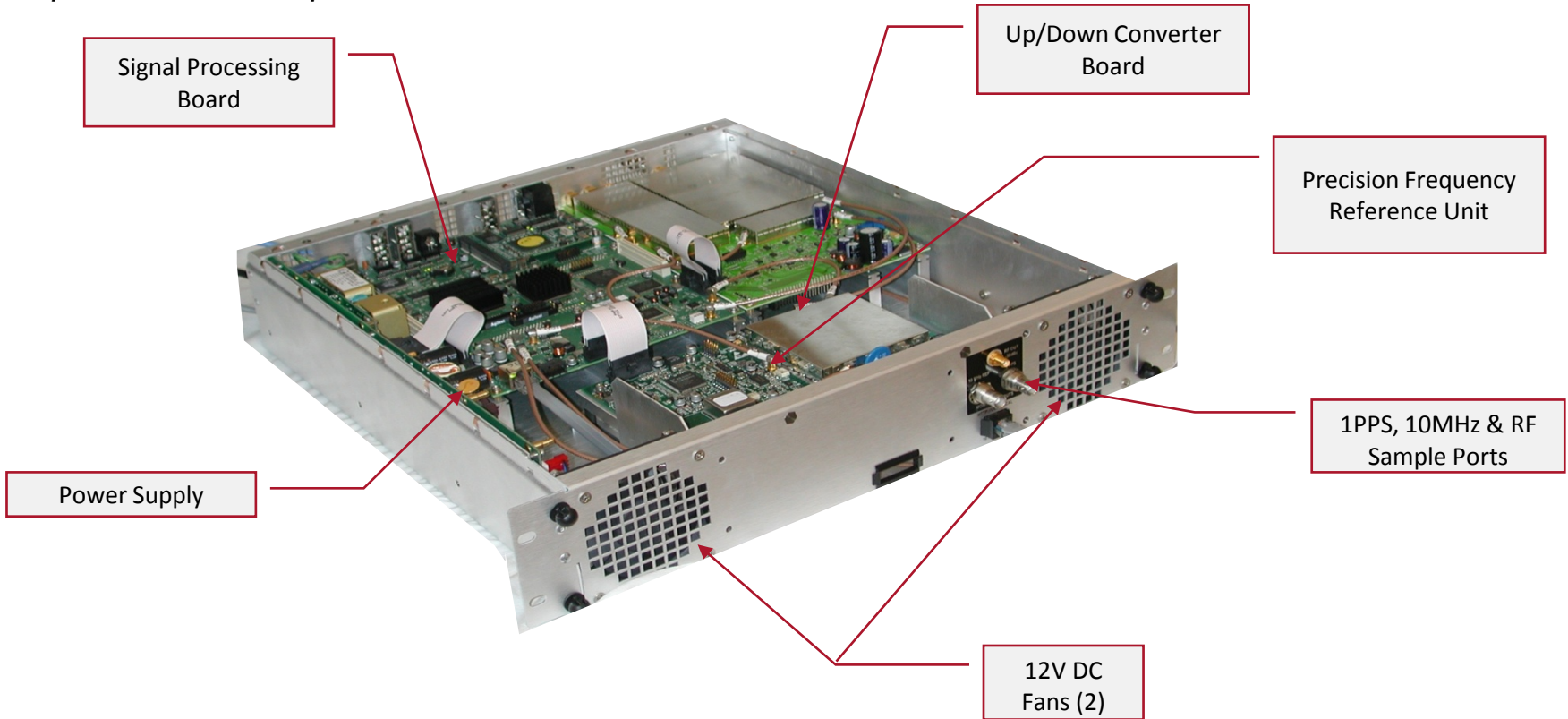


- RoHS Compliant / CE Compliant
- Software Defined Modulator
- Backwards compatible with many GatesAir transmitters.
- RTAC – Real Time Adaptive linear and non-linear Correction – standard
- Internal GPS option (now with GLONASS)
- Internal UPS option – Full exciter power for 1 minute and frequency processing for 20 minutes
- Simple browser interface
- No manual adjustments
- Software key defines modulation:
 - Analog / DVB-T / DVB-T2, etc.
 - Easy change between standards

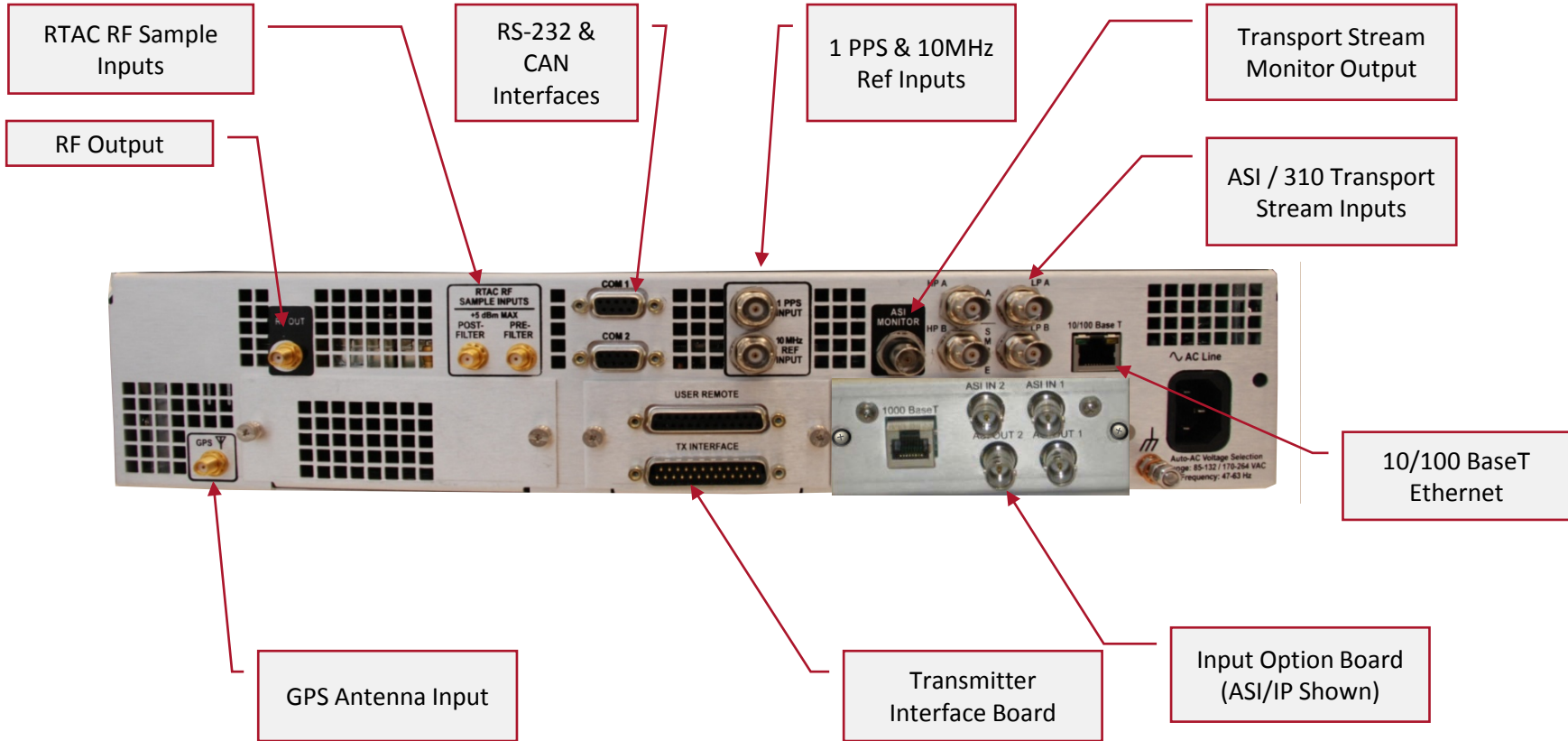


M2X Mechanical – Inside View

Top cover and front panel removed

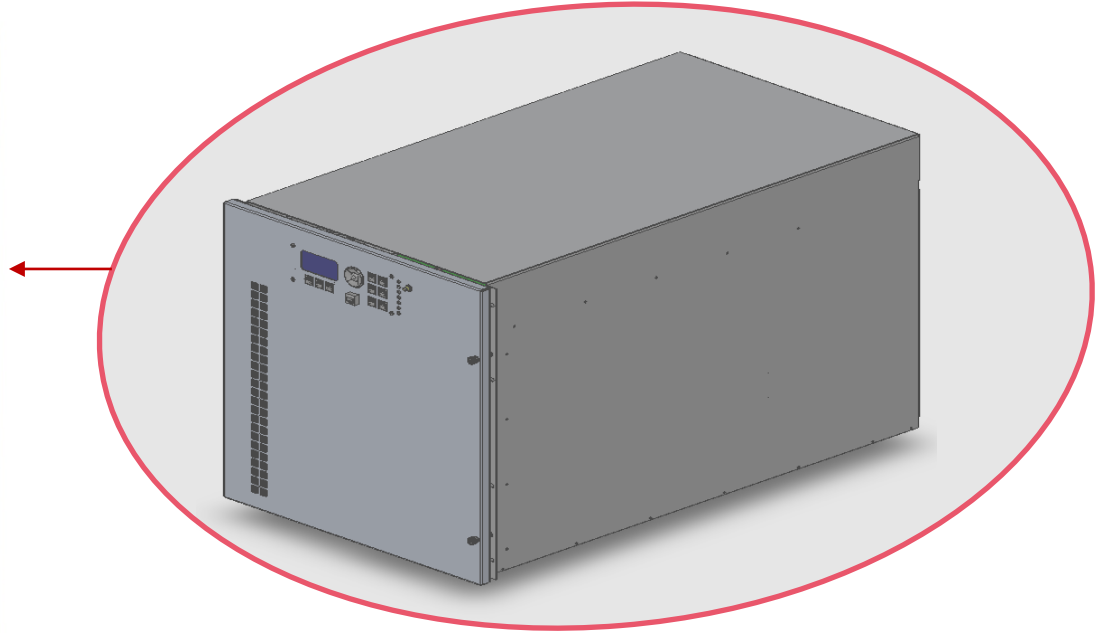


Exciter – Rear Panel



Power Amplifier Block

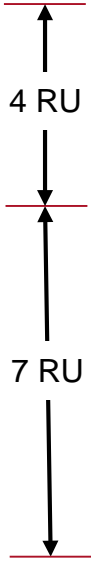
- Modular architecture on a larger scale



ULXT-2T2



- Up to 1.25kW – 2 PA Modules



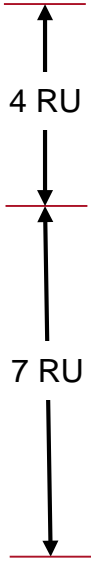
- Exc A
- Exc B (option)
- IPA A
- IPA B
- PA 1
- PA 2



ULXT-4T2



- Up to 2.5 kW – 4 PA Modules



- Exc A
- Exc B (option)
- IPA A
- IPA B
- PA 1
- PA 2
- PA 3
- PA 4



ULXT-6T2



- Up to 3.6 kW



4 RU

12 RU



Exc A

Exc B (option)

IPA A

IPA B

PA 1

PA 2

PA 3

PA 4

PA 5

PA 6



ULXT-6T2 / ULXT-10T2



- Up to 3.6 kW and 5.5kW



4 RU

12 RU



Exc A

Exc B (option)

IPA A

IPA B

PA 1

PA 2

PA 3

PA 4

PA 5

PA 6

PA 7

PA 8

PA 9

PA 10



High Power ULXT Solutions



37RU rack



ULXT-12 / 20xx (12 or 20 PA's)

44RU rack



ULXT-30xx (30 PA's)

44RU racks



ULXT-40 / 50 / 60xx (up to 60 PA's)



Maxiva™ ULXT Models: Size, Weight & Power Levels



Transmitter Model	# Racks (Rack Size)	Transmitter Width		Transmitter Height		Transmitter Depth		Transmitter Weight		DVB-T2 Pre-Filter Power		
		Units	RU	mm	in	mm	in	mm	in	kg	lb.	Watts
ULXT-2xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	238	524	1,250
ULXT-4xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	276	608	2,500
ULXT-6xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	314	693	3,600
ULXT-8xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	404	890	4,750
ULXT-10xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	433	955	5,500
ULXT-12xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	472	1,040	7,000
ULXT-16xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	591	1,302	9,250
ULXT-20xx	1 (37)			593	23	1,803.3	71.0	1,128.6	44.4	709	1,564	11,000
ULXT-24xx	1 (44)			593	23	2,114.3	83.2	1,128.6	44.4	840	1,852	13,750
ULXT-30xx	1 (44)			593	23	2,114.3	83.2	1,128.6	44.4	999	2,202	16,500
ULXT-40xx	2 (44)			1,186	47	2,114.3	83.2	1,128.6	44.4	1,445	3,186	22,000
ULXT-50xx	2 (44)			1,186	47	2,114.3	83.2	1,128.6	44.4	1,721	3,795	27,500
ULXT-60xx	2 (44)			1,186	47	2,114.3	83.2	1,128.6	44.4	1,998	4,404	32,500

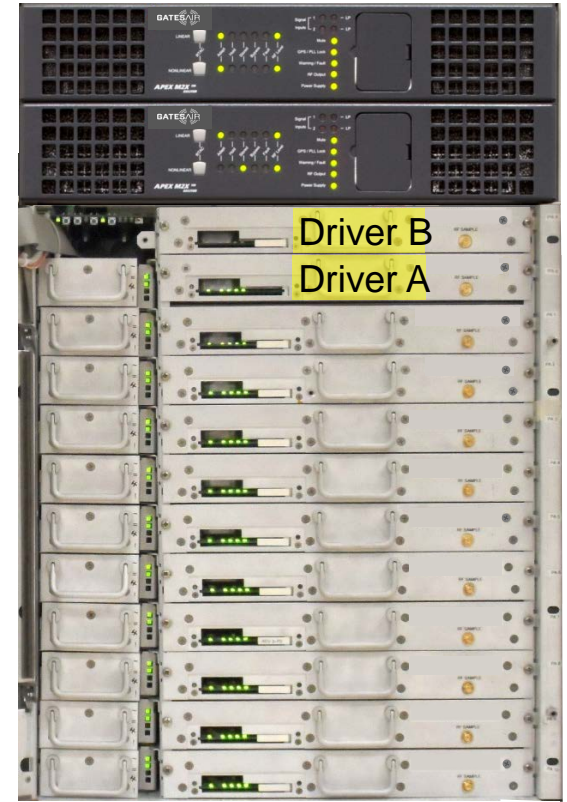
Note: xx = Modulation code



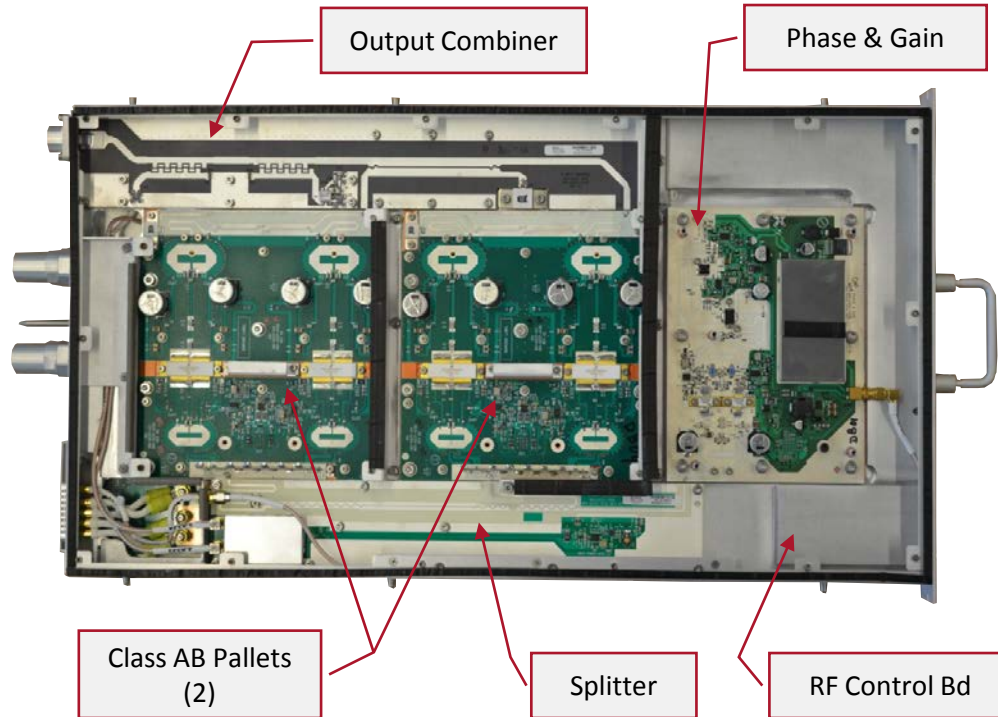
IPA / Drive Chain



- Two redundant 1RU amplifier trays provide a very robust solution to drive the PA Modules in a power block (2, 4, 6 or 10)
- This system provides fully redundant drive capability in case of failure
- Redundant, optimized.. Linear RF drive for the PA's
- Power supplies are shared among drivers for further redundancy (power supply failure will not affect drive stage)



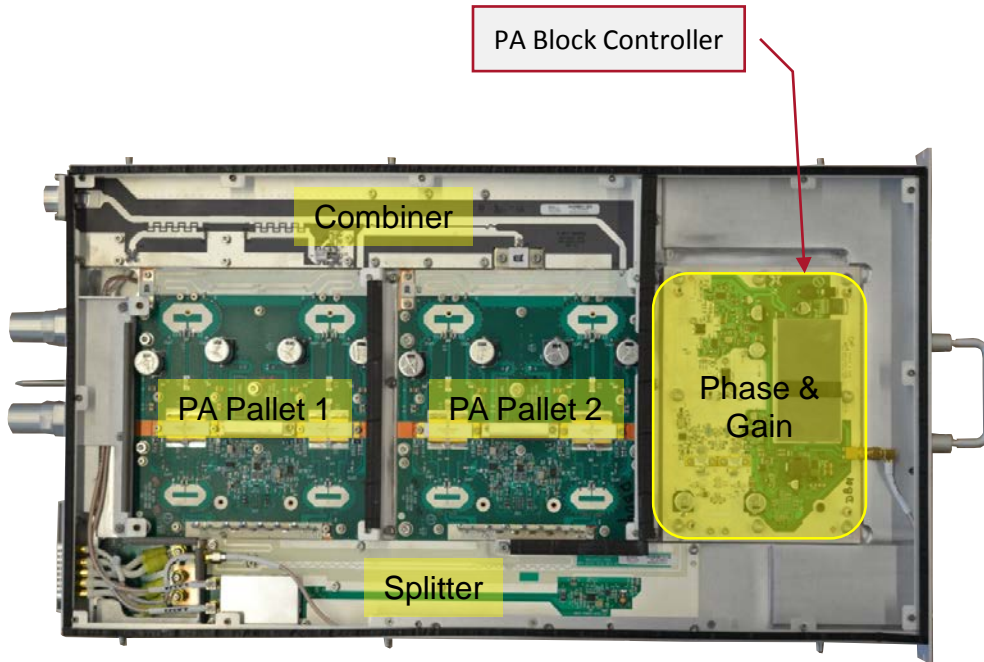
IPA (Driver) Module



- Provides gain stage before PA section
- Front hot pluggable, redundant modules
- Uses same cold plate as the PA for cooling of FETs
- Operated in linear, class AB
- Module interface is a passive assembly which provides electrical and cooling. Hot plug interconnect



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



New High Efficiency PA Module



- Power ~ 640W OFDM / 1kW ATSC
- Efficiency ~ 44% OFDM / 49% ATSC
- Configuration: 3 Pallets in parallel/6 LDMOS devices total
- Liquid cooled
- Light weight ~ 11kg / 24lb
 - 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



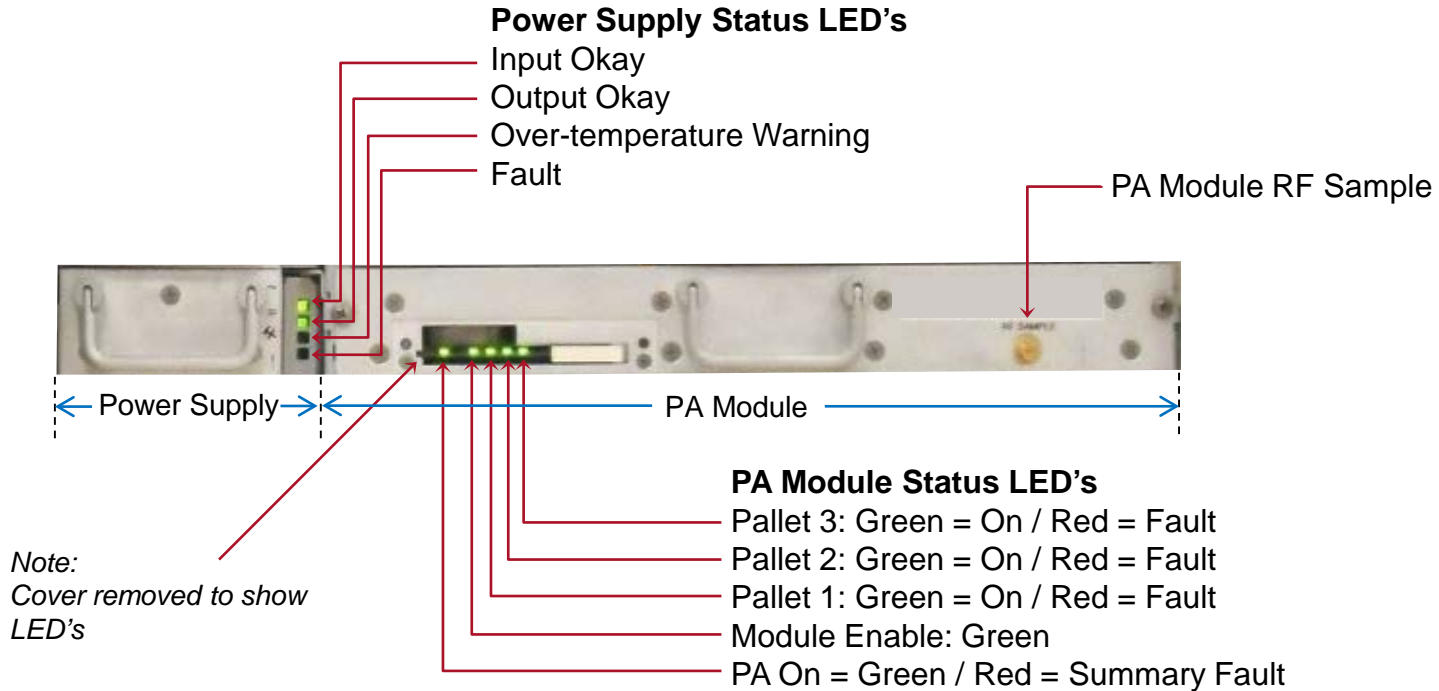
PA Module (Front)



PA Module (Rear)



PA Module & Power Supply Status LED's



High Efficiency DC Power Supply

- Separate assembly from the PA module
 - Small and light (< 2kg / 5lb)
 - Lower replacement cost
- Hot swap, easy replacement in seconds
- One Power Supply per PA module
- IPA's powered by all PA power Supplies (paralleled)
- Rating: 50 VDC / 2,725W / 0.98PF
- Wide AC input regulation ($\pm 15\%$)
- Same power supply as used in Maxiva UAXT and FAX FM transmitters
 - Consolidate network spares



50 Volt DC 2.725kW Power Supply



Options & Accessories

- 37 RU rack is standard for 1 and 2 Power Block systems
- 44 RU rack is used for other systems, or as appropriate
- Internal GPS receiver, now with GLONASS
- GPS 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 systems
 - Customer can always opt for external pump system



Use Case 1: ULXT vs. ULX (or older tx) in DVB-T/T2



■ Major benefits include:

- Dramatic reduction in system electrical power consumption
 - Low TCO
 - More than 35% power savings versus older technology equipment
 - Green design, less waste energy
- Latest technology RF devices provide rugged, reliable operation
- Broadband design – minimizes network spares holdings
- High efficiency and broadband PA modules
- Highest power density on the market



Use Case 1: ULXT vs. ULX in DVB-T/T2

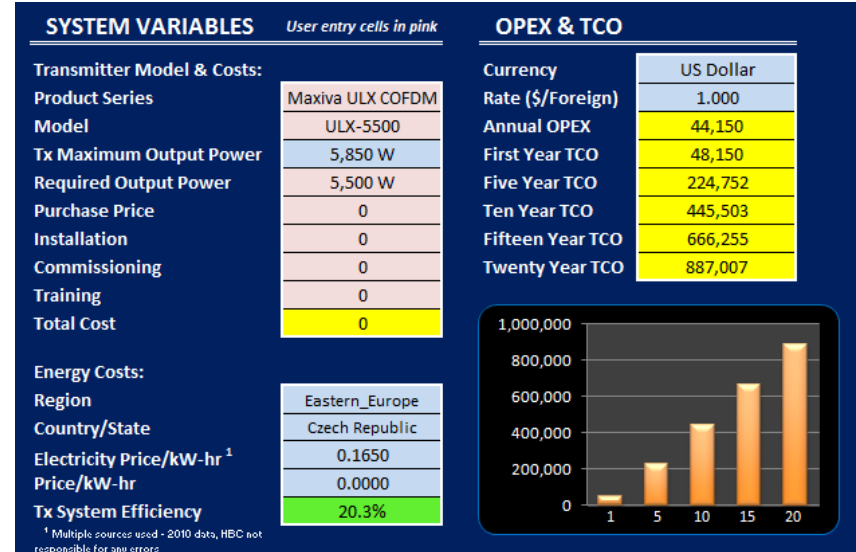
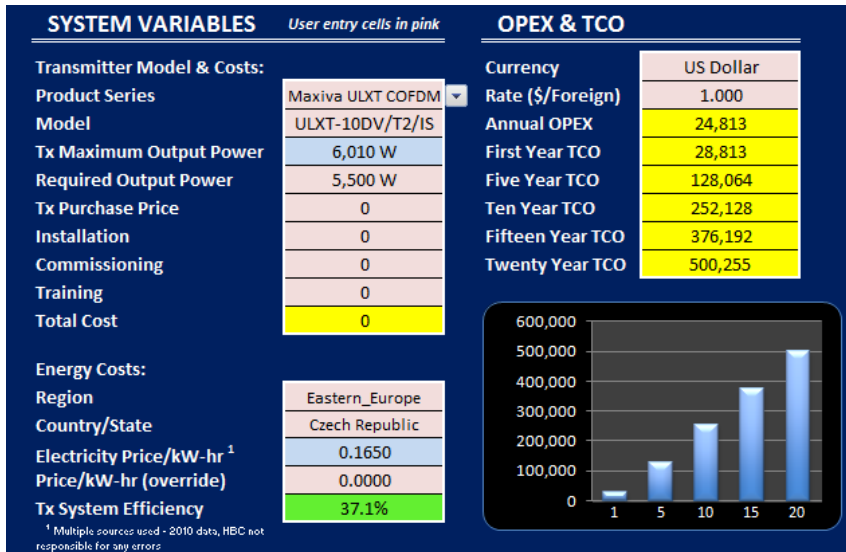


■ ULXT-10T2

- At 5.5kW
- Efficiency 37.1%
- Czech Republic – 16.5 c/kW-hr
- 10 year cost to operate = \$252.12k

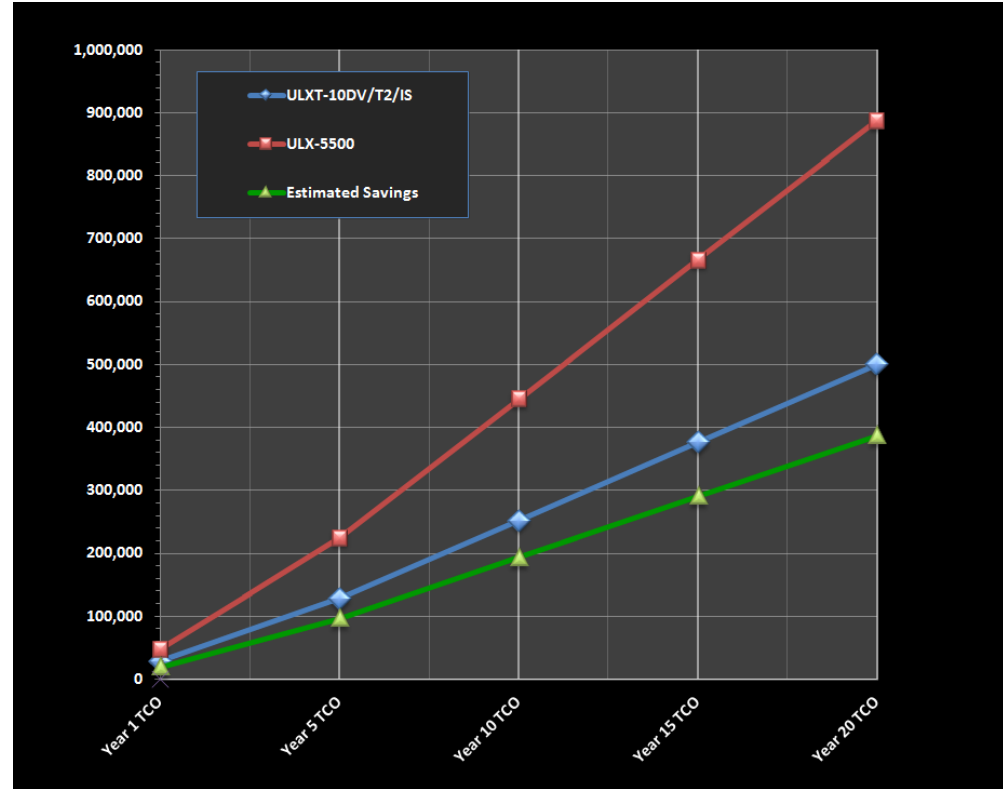
■ ULX-5500T2

- At 5.5kW
- Efficiency 20.3%
- Czech Republic – 16.5 c/kW-hr
- 10 year cost to operate = \$445.5k



Use Case 1: ULXT vs. ULX side-by-side

Transmitter Models:		ULXT-10DV/T2/IS	ULX-5500
Product Series		Maxiva ULXT COFDM	Maxiva ULX COFDM
Model		ULXT-10DV/T2/IS	ULX-5500
Tx Maximum Output Power		6,010 W	5,850 W
Required Output Power		5,500 W	5,500 W
Purchase Price		0	0
Installation		0	0
Commissioning		0	0
Training		0	0
Total Cost		0	0
Energy Costs:			
Region		Eastern_Europe	Eastern_Europe
Country/State		Czech Republic	Czech Republic
Price/kWh		\$0.165	\$0.165
Tx System Efficiency		37.1%	20.3%
OPEX:		ULXT-10DV/T2/IS	ULX-5500
Annual OPEX		24,813	44,150
Year 1 TCO		28,813	48,150
Year 5 TCO		128,064	224,752
Year 10 TCO		252,128	445,503
Year 15 TCO		376,192	666,255
Year 20 TCO		500,255	887,007




SUMMARY:

- **Broadband, high-efficiency design**
- **Future-proof architecture**
- **Modular design with small, lightweight, hot-pluggable PA modules**
- **Small, lightweight, hot pluggable PA power supplies**
- **Less expensive PA Module and Power Supply**
- **Robust Control System with redundant controllers**
- **Best Trained Service Dept. Available 24/7**

= Lowest Total Cost of Ownership!



An aerial photograph of a lush valley. The foreground and middle ground are filled with terraced rice fields in various shades of green and yellow. A winding river flows through the fields. In the background, there are several layers of jagged, forested mountains under a clear sky. The overall scene is vibrant and scenic.

New High Efficiency UHF Transmitters Air-Cooled UAXT Series

Maxiva UAXT - Key Benefits (1)



- **Broadband, high-efficiency design**
 - Maxiva UAXT provides the highest available AC to RF efficiency along with fully broadband operation across the UHF band. This means 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.
- **Future-proof architecture**
 - Re-pack (Restack) of the UHF TV spectrum could mean potential channel changes in the future. The broadband UAXT transmitter is ready for such changes, without any need to swap PA modules, combiners, or other components.



Maxiva UAXT - Key Benefits (2)



■ Power Supplies

- New high efficiency hot-swappable redundant power supplies
- 96% AC to DC conversion efficiency

■ Cooling System

- Air-cooled systems use fans/blowers to extract heat and move it outside of cabinet
- Variable speed cooling fans, based on RF amplifier temperature - optimizes cooling efficiency, and power consumed by the fans



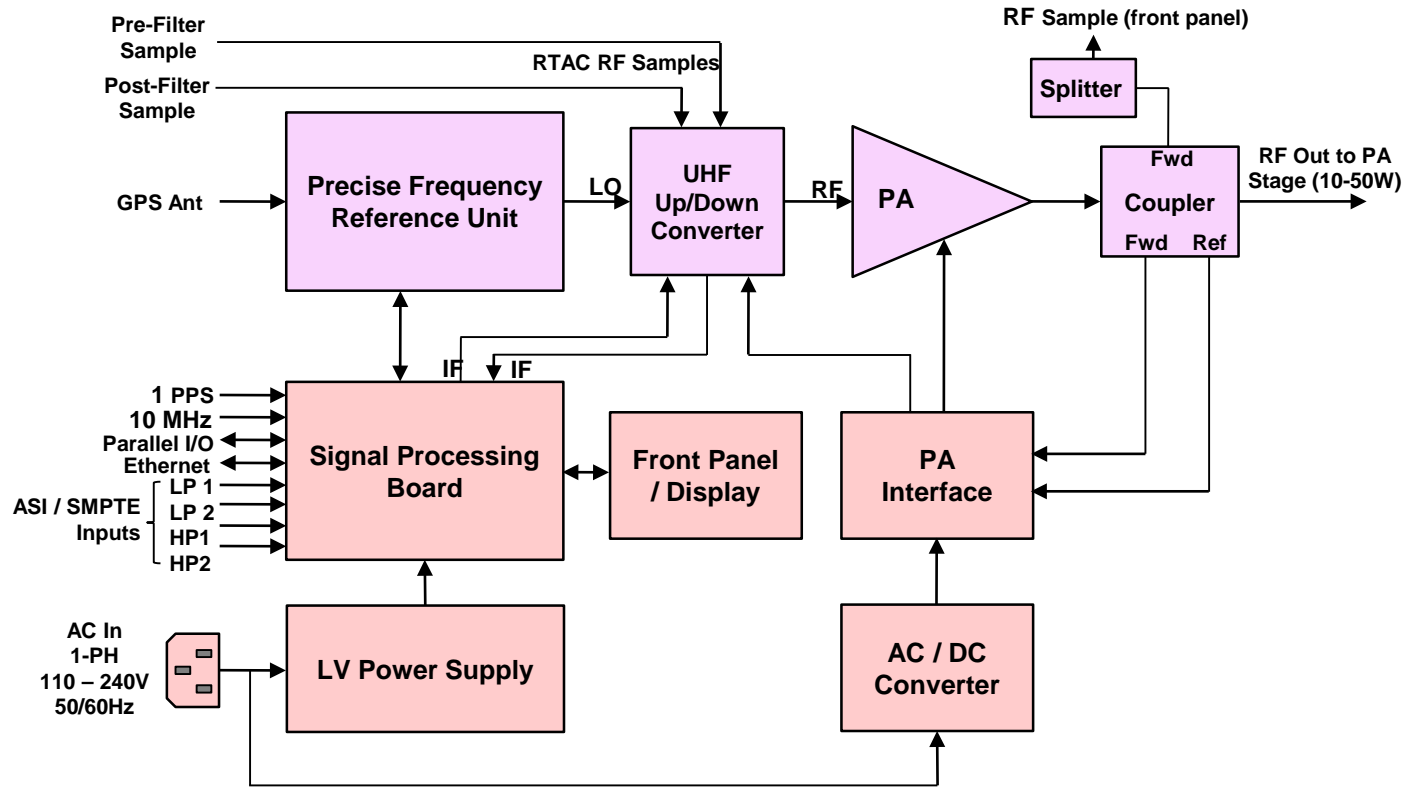
Maxiva UAXT - Key Benefits (3)



- **Identical RF pallets and PA components as the ULXT transmitter:**
 - Common spares stock for both UAXT and ULXT
 - Common design reduces need for additional personnel training
- **Uses identical 50 Volt DC power Supplies as the ULXT transmitter:**
 - Common spares stock for both UAXT and ULXT
- **Very modular design with smaller lightweight components**
 - Compact PA and Power supply assemblies make removal and replacement extremely simple and easy
 - Front load hot swappable power supplies
 - Power amplifier blocks can be replaced while on air (2 to 4 PA block systems)
 - Lower cost replacement parts than the larger integrated PA/Power supply configurations from other tx manufacturers



Exciter/Driver Block Diagram



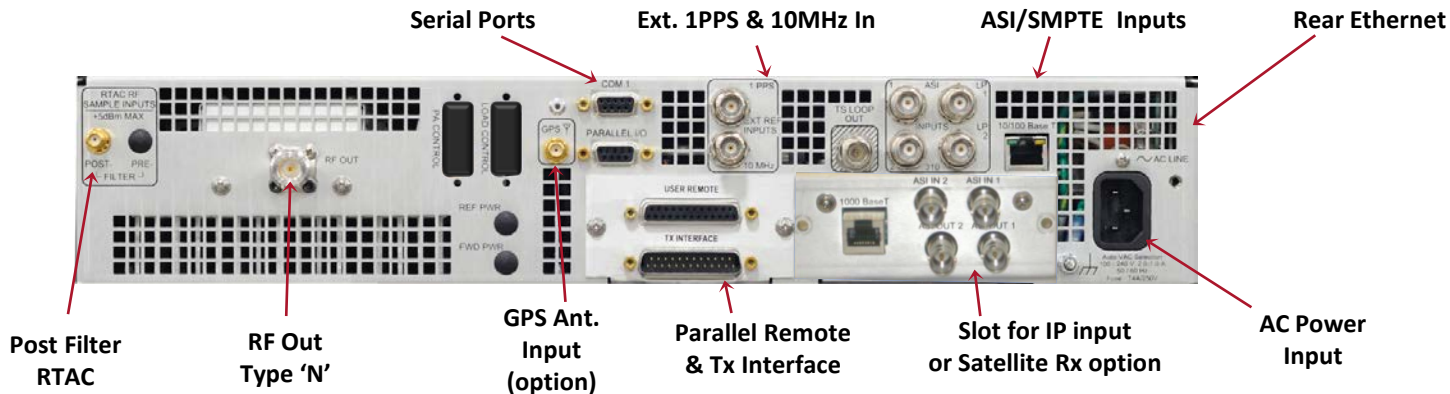
UAX Compact Exciter/Driver



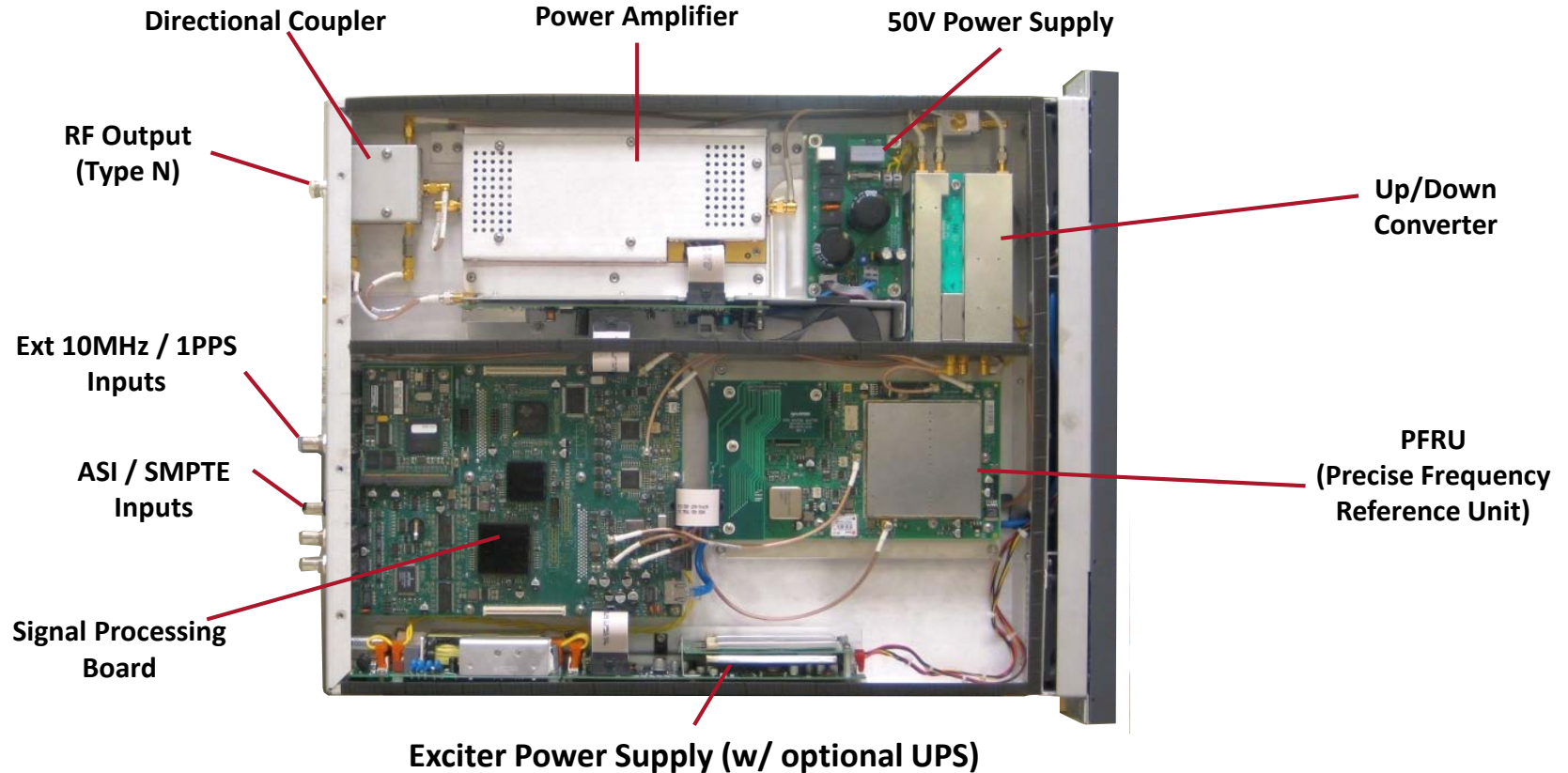
Front Panel



Rear View



UAX Compact Driver – Top View



Product Details Maxiva UAXT TV Transmitter



- High-Efficiency design, using Harris Broadcast PowerSmart 3D™
- Extremely compact (640W/1kW = 5RU)
- OFDM efficiency up to 36% for complete system
- Models:

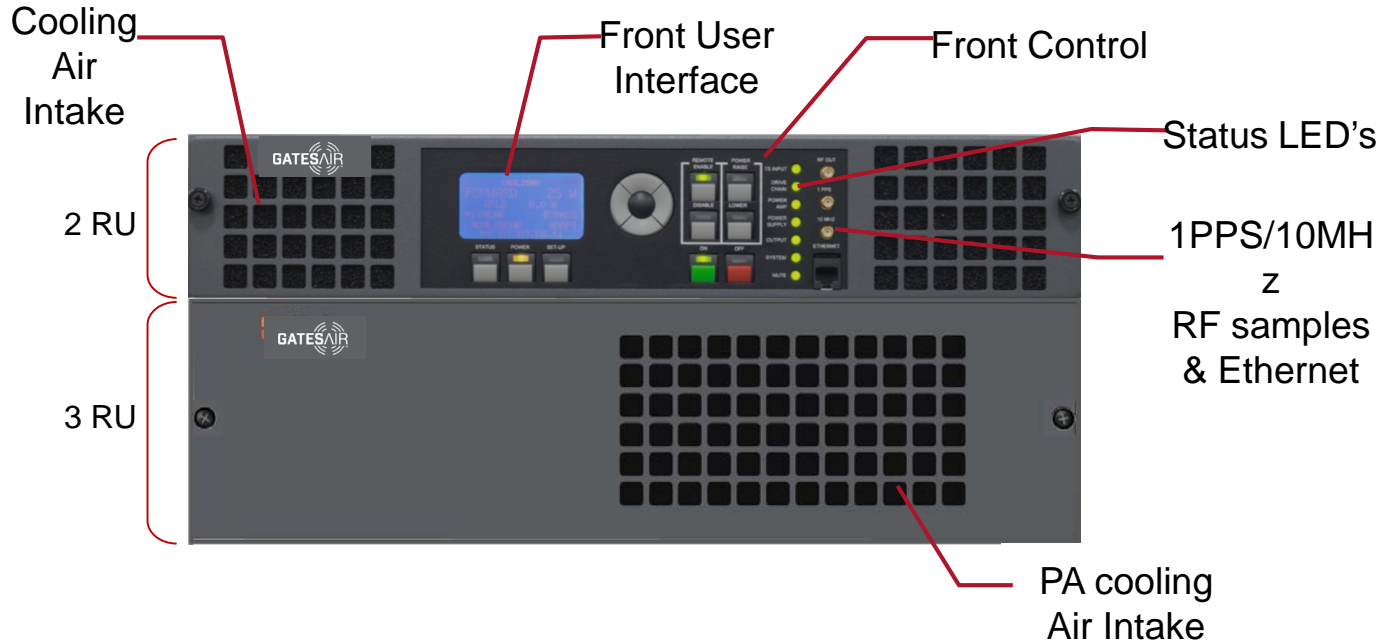


640W OFDM / 1kW ATSC Single Drive Maxiva UAXT transmitter

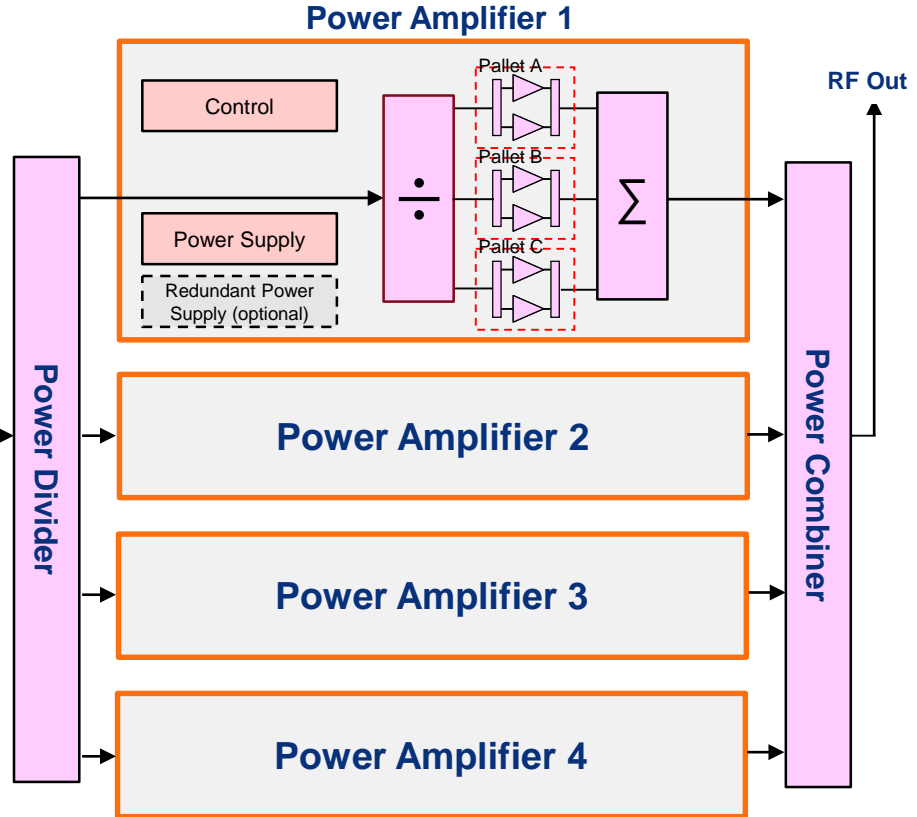
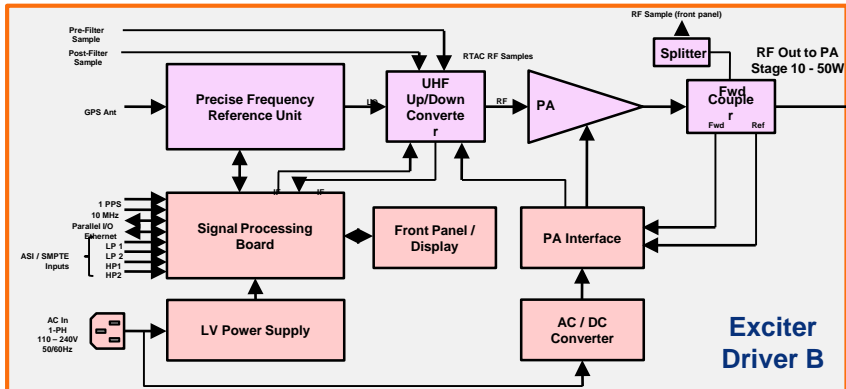
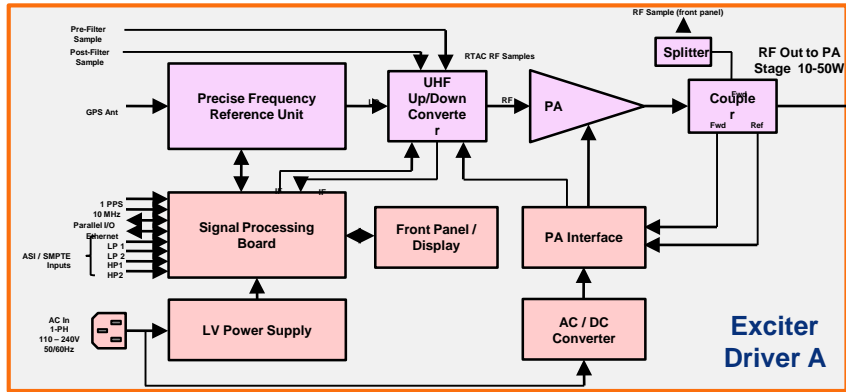
Model Number (xx = modulation)	OFDM Power Before Filter (Watts)*	RF Output Connector	Total Rack Space (1 exciter)	Total Rack Space (2 exciters)
UAXT-1xx	640	DIN 7-16	5RU	8RU
UAXT-2xx	1,200	DIN 7-16	8RU	11RU
UAXT-3xx	1,800	1-5/8" EIA	11RU	14RU
UAXT-4xx	2,300	1-5/8" EIA	14RU	17RU



Maxiva UAXT - Product Details 640W / 1kW



Block Diagram – UAXT Series (1 to 4 PA modules)

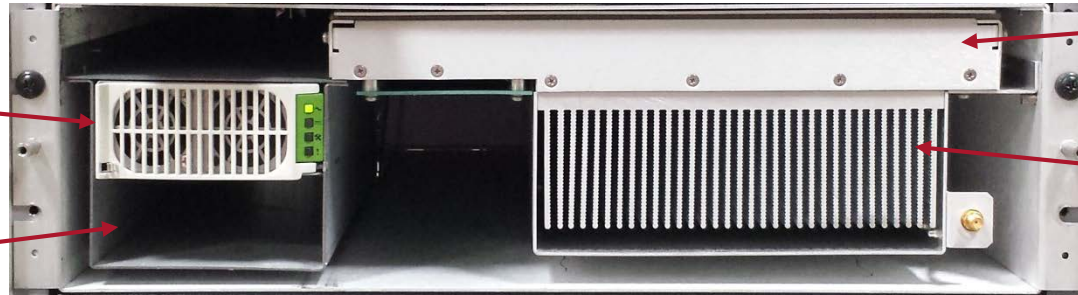


PA Block – Front and Rear

Front View (Cover Removed)

Front access Hot-swappable Power Supply

Space for optional Redundant power supply



PA Module

PA Heat Sink

Rear View

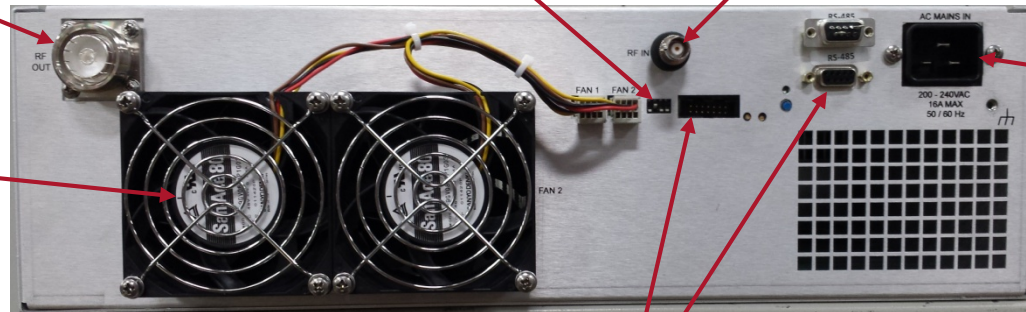
Cooling fans (2)
(Rear access)

RF Output

DIP Switches

RF Input

AC Power



Control / Remote



High Efficiency Power Supply

- Conversion Efficiency typically 96%
- Rated for 2.725kW DC Power at 50V
- Power factor corrected (>0.98)
- Hot Swappable, plug in design
- Same power supply as used in other products (Maxiva ULXT, Flexiva FM)
- Compact and lightweight
- Separate from Power Amplifier for reduced spares cost and modularity



UAXT Configurations (available in 37RU & 44RU Racks)



UAXT-1xx
Single Drive Tx



UAXT-1xx
Dual Drive Tx



UAXT-2xx
Dual Drive Tx



UAXT-3xx
Dual Drive Tx



UAXT-4xx
Dual Drive Tx

Proprietary and
confidential

| 91



Options & Accessories – Maxiva UAXT



- 37 RU rack is standard for most systems
- 44 RU rack is used for larger and multi-tx in a rack systems
- Internal GPS receiver, now with GLONASS
- GPS antenna and RF cable
- Exciter section 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



Additional Options (included in Deluxe Rack)

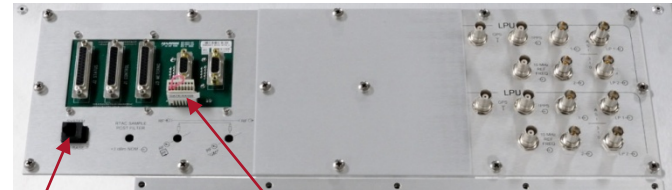
AC Distribution Panel:

- Provided with “Deluxe Rack” option
- Provides convenient AC power distribution to each sub-assembly



Customer I/O Panel:

- Included with “Deluxe Rack”
- Provides a convenient location to connect data inputs, GPS antenna, remote control, etc.



Ethernet /
SNMP

Interlock and GPI
Remote



- Harris Broadcast's Maxiva UAXT High Efficiency Transmitter provides:
 - The most efficient broadband UHF transmitter available
 - Efficiency improvement from 22% up to 36% OFDM /40% ATSC
 - Provides significant AC power savings and lowest total cost of ownership
 - Dramatic rack space savings
 - Examples:
 - 640W OFDM / 1kW ATSC single drive tx is 5 Rack Units high (previously 12RU – 58% savings)
 - 1.28kW OFDM / 2kW ATSC dual drive tx is 11 Rack Units high (previously 32RU – 66% savings)
 - Higher power, or multiple transmitters in one rack for N+1 or 1+1 systems
 - Reliable / Redundant
 - 3 RF pallets per PA block
 - Redundant power supply option



- Most Modern Architecture – Lowest Risk of Obsolescence
- Modular Common Design – Minimizes Spares Requirements
- Broadband – Reduces Network Spares Inventory
- Smallest Facility Space Required – Reduces Costs
- Financial Strength of Harris Broadcast
- Best Trained Service Dept. Available 24/7

Lowest Total Cost of Ownership!

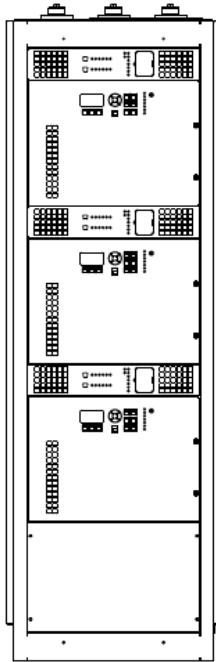


Multiple Transmitters in 1 Rack



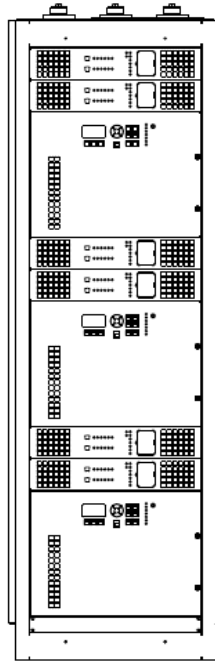
Multiple Transmitters in Single Rack

- Separate Power Blocks allow easy way to configure multiple transmitters in a single rack



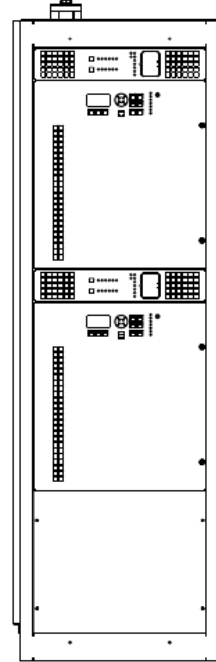
37RU
(1.8m)

3 x 1.25kW or 2.5kW
Single Exciter



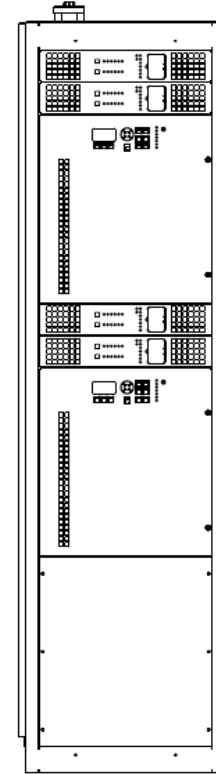
37RU
(1.8m)

3 x 1.25kW or 2.5kW
Dual Exciter



37RU
(1.8m)

2 x 3.6kW or 5.5kW
Single Exciter



44RU
(2.1m)

2 x 3.6kW or 5.5kW
Dual Exciter



Multi-System Controller (MSC-2)



N+1 Controller Solution



- GatesAir MSC-2 (Multi-System Controller)
 - Provides control & switching
 - 1+1 (passive reserve) swicthing
 - N+1 Systems up to 8+1
 - Manual or Automatic switching – Priority selectable
 - Local control
 - Remote web GUI interface (Ethernet RJ-45)
 - Controls program source switching
 - Provides contacts to control RF switches from multiple vendors



Multi-System Controller

Multi-System Controller (MSC) for Redundant Television and Radio Transmission Systems

The GatesAir's Multi-System Controller (MSC) is engineered to ensure your television or radio broadcast is seamless—even in the event of transmitter failure. This next-generation multi-system control platform extends the redundancy capabilities of our transmitters to both new and legacy transmitter platforms—the first system on the market that integrates legacy transmitters into N+1 systems.*

The MSC incorporates the latest advances in technology, reflecting the GatesAir's commitment to innovation and history as the industry-leading provider of redundancy solutions for television and radio transmitters.

* Requires an optional MSC I/O module

Product Features

- Factory scalable and configurable for N = 1 to 8
- Front-panel control and readout of system status
- Operation in automatic or manual mode, and by local or remote control
- Local and remote selection on the front panel to lock out remote inputs during servicing
- One of N logic output to control an external video or audio router
- Ethernet interface to each transmitter and RF switch control board for easy-to-manage connections
- External program router control — routes the correct service to the redundant transmitter
- Fast, reliable operation
- Fail-safe — current system configuration is retained in the eve



- n1 of MSC fault/power failure
- Compatible with 4-port coaxial switches from multiple vendors
- Remote software upgrades available via network connection. Latest software is available on the GatesAir Service Portal (requires a Windows®-based PC, not provided)
- Sleek, elegant GUI — easy navigation of system level or individual transmitter control and monitoring with a single IP connection
- Screensaver with wakeup function to extend life of backlight and prevent accidental front-panel button operation
- SNMP (Simple Network Management Protocol) network agent for broadcast manager operations
- External interlock monitoring — can be removed for servicing without interruption of the interlock chain
- Programmable N+1 priority — for backup of the most important programming during multiple main transmitter outages

*Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Product Details

Cost-effective, Reliable, File



An aerial photograph of a mountain town. In the foreground, there are several buildings with dark, corrugated metal roofs. A prominent yellow building with a brown roof is visible. In the background, a large, multi-story building with a sign that reads "BANDOO CAFE Hotel" is situated on a hillside. The town is surrounded by lush green hills and mountains, with some clouds visible in the distance.

Maxiva Advantages versus Competition

Comparison between GatesAir and Main Competitor



Item	GatesAir	Competitor
Modularity	3 pallets per PA Module	6 pallets per PA module
PA Module weight	11kg. Easy for 1 person to remove	> 25kg. 2-person lift to meet safety code
Power Supply separate from PA	Yes	No – Power supply inside PA module
Power Supply weight	2kg	Part of 25kg PA module
Time replace Power Supply	< 1 minute (front access, hot swap)	Estimated at 1 hour (inside PA module)
Time to replace PA module	< 1 minute with 1 person (front access)	< 1 minute with 2 persons (front access)
Broadband Design	Yes (1 PA up to 750MHz)	No, 7 bands across UHF (parts change)



Comparison between GatesAir and Main Competitor



Item	GatesAir	Competitor
High Efficiency Design	Yes	Yes
50 Volt LDMOS	Yes, newest device	Yes, last generation device
PA Complexity	Simple single gain stage, higher MTBF	More complex, much harder to repair, lower MTBF
Web GUI included in transmitter	Included in price	Extra cost option
GPS Receiver option	Yes	Yes
Exciter easily accessible	Yes	No, located in top of rack
Common spare parts between Liquid and air cooled transmitters	Yes, Power supplies, PA pallets, exciter boards	Power supplies are different - increases network spares cost





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Thank you for attending

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GatesAir, Mason, Ohio USA
martyn.horspool@gatesair.com
www.gatesair.com