



Spectrum Repack

Your RF Plant and What to Consider

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Featuring
GatesAir's



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Spectrum Repack – Your RF Plant and What to Consider

unleash

anytime

anywhere

connected technologies • immersive experiences • redefined revenue



Martyn J. Horspool
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Change is Coming – Like it or Not!



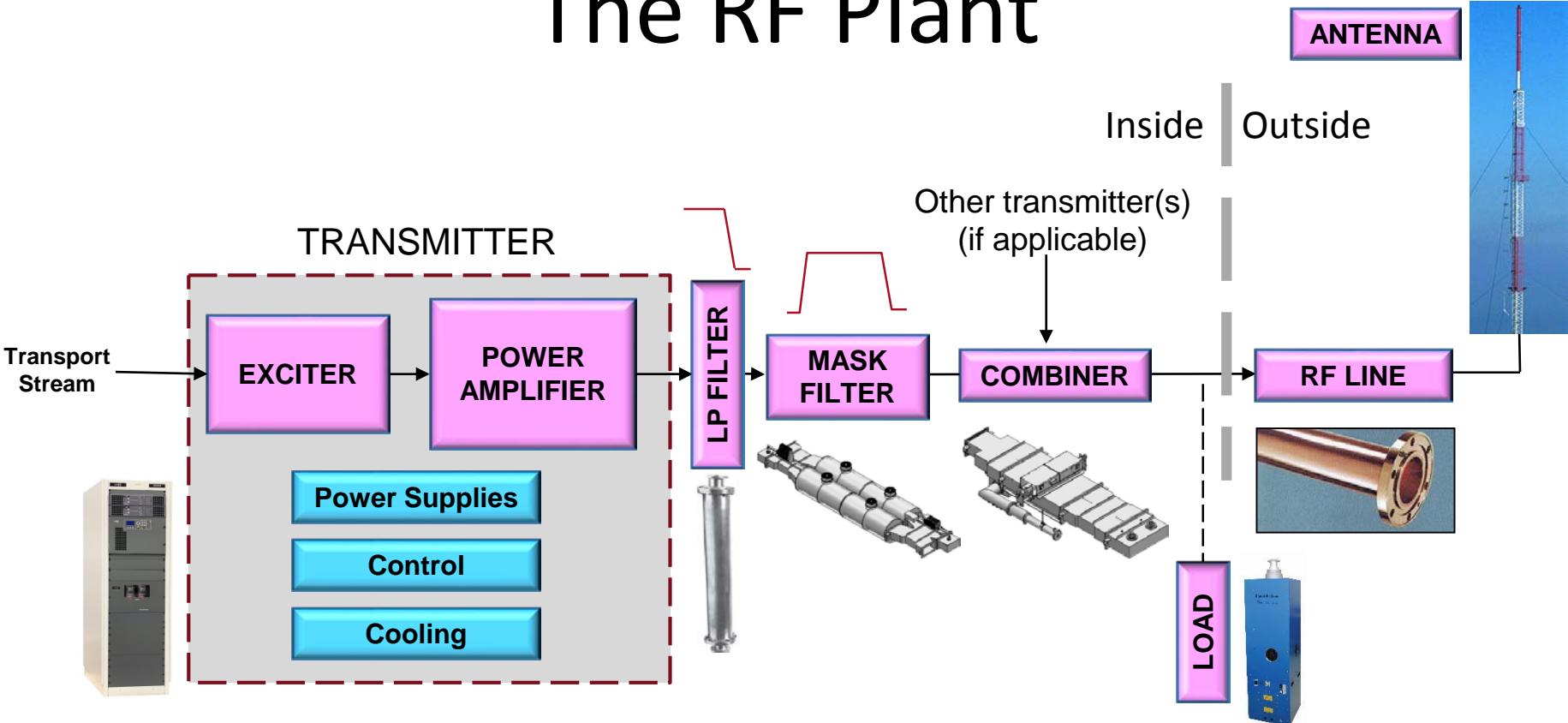
Will I Be Impacted By Repack?

- Repacking *could* affect any station, on any channel, in any market.
- Likely impact: 800 to 1100 TV stations
- So what items in my RF plant could be impacted?

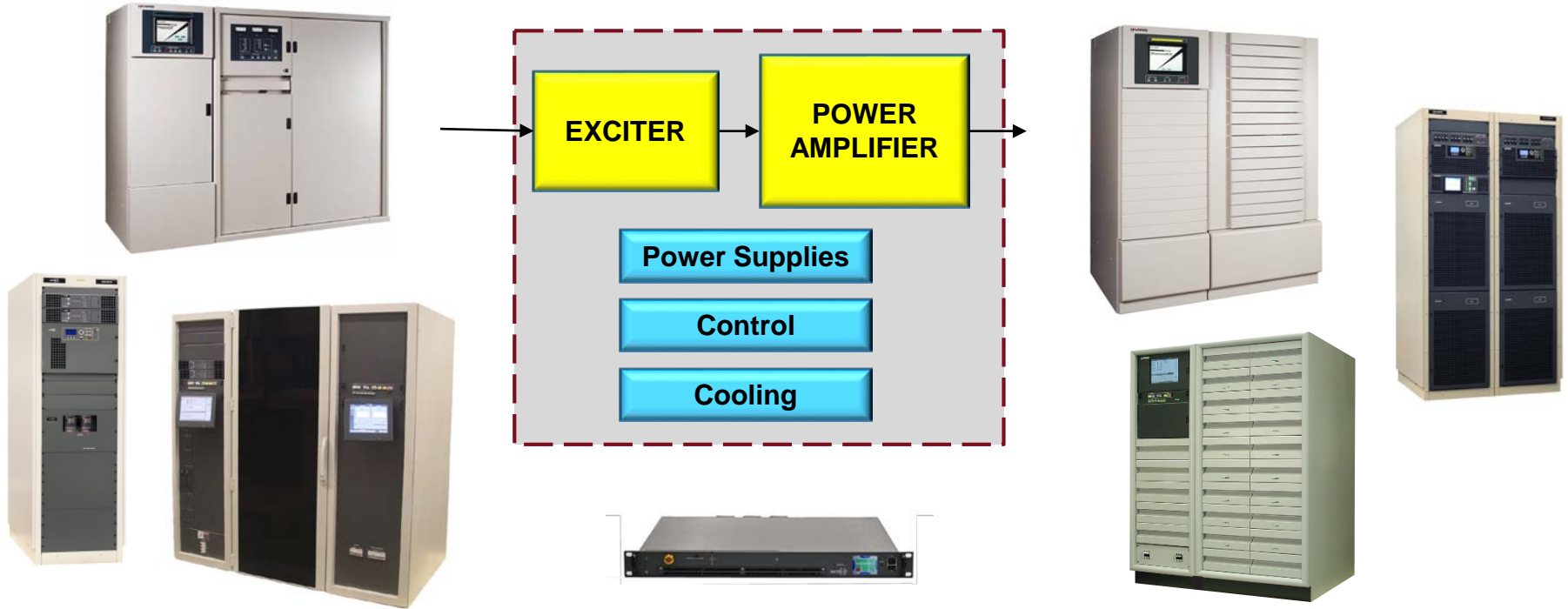
***ALMOST
EVERYTHING !***



The RF Plant



Transmitter



Transmitter Channel Changing



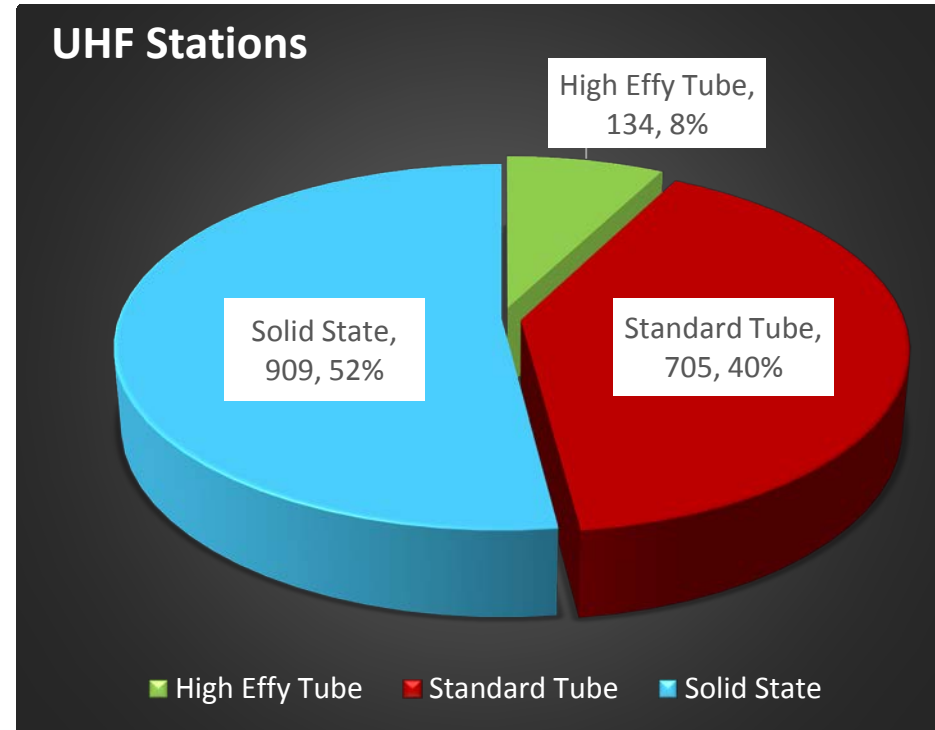
Transmitter Channel Changing

- Channel Change Checklist:
 - ✓ Can my transmitter be channel changed?
 - ✓ Is it worth doing & how hard is it to do?
 - ✓ Is the manufacturer still around?
 - ✓ Is it still in production?
 - ✓ Is it near EOL?
 - ✓ How efficient is it?
 - ✓ Operating cost vs. new tx?



Current Technology Mix

- 2,261 TV Stations in USA
 - Low V: 53
 - High V: 460
 - UHF: 1,748
- VHF: All Solid State
- UHF Technology Mix:
 - 909 Solid State / 839 IOT
 - 705 Standard IOT's (approx.)
 - 134 MSDC IOT's (approx.)



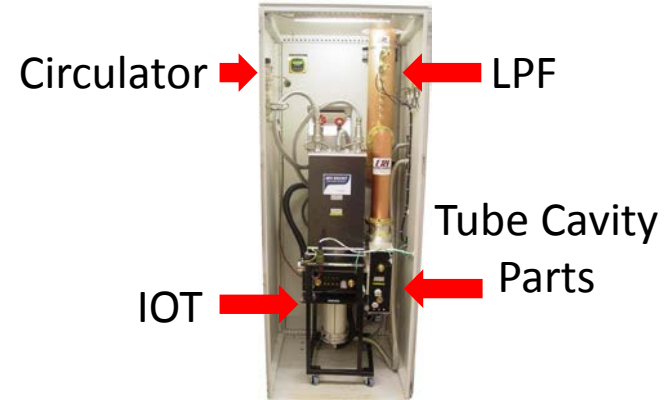
Standard IOT Channel Change

- Most models out of production now
- Parts potentially impacted:
 - Exciters
 - IPA/Driver may be “banded”
 - Circulators (2 or 3 bands)
 - Special input cavity Ch 38-40 for E2V 2100, or 2130 tubes
 - IOT Coupling Loops and Cavity Domes
 - RF System Components:
 - Low Pass filter, fine matchers
 - Mask Filter, Magic Tee, etc.
- Re-tuning and power calibration



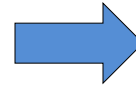
MSDC IOT Channel Change

- A few tx models are still in production
- Wideband in general, only a few issues with a channel change
- Circulators (Typically 2 or 3 bands)
- Low Pass Filters (2 bands):
- Tube variations:
 - Check with tube supplier
 - E2V Ch 50 was a problem - special tubes supplied
 - Cavity coupling loops and domes (same as std. IOT)
- Retuning and Power Calibration

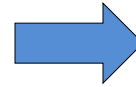


Solid State Channel Change

- Many early solid state ATSC systems are not fully broadband



- Newer transmitters are broadband, or can be changed very easily



Note: Size difference -
New tx is actually more
powerful than the old one

Solid State Channel Change

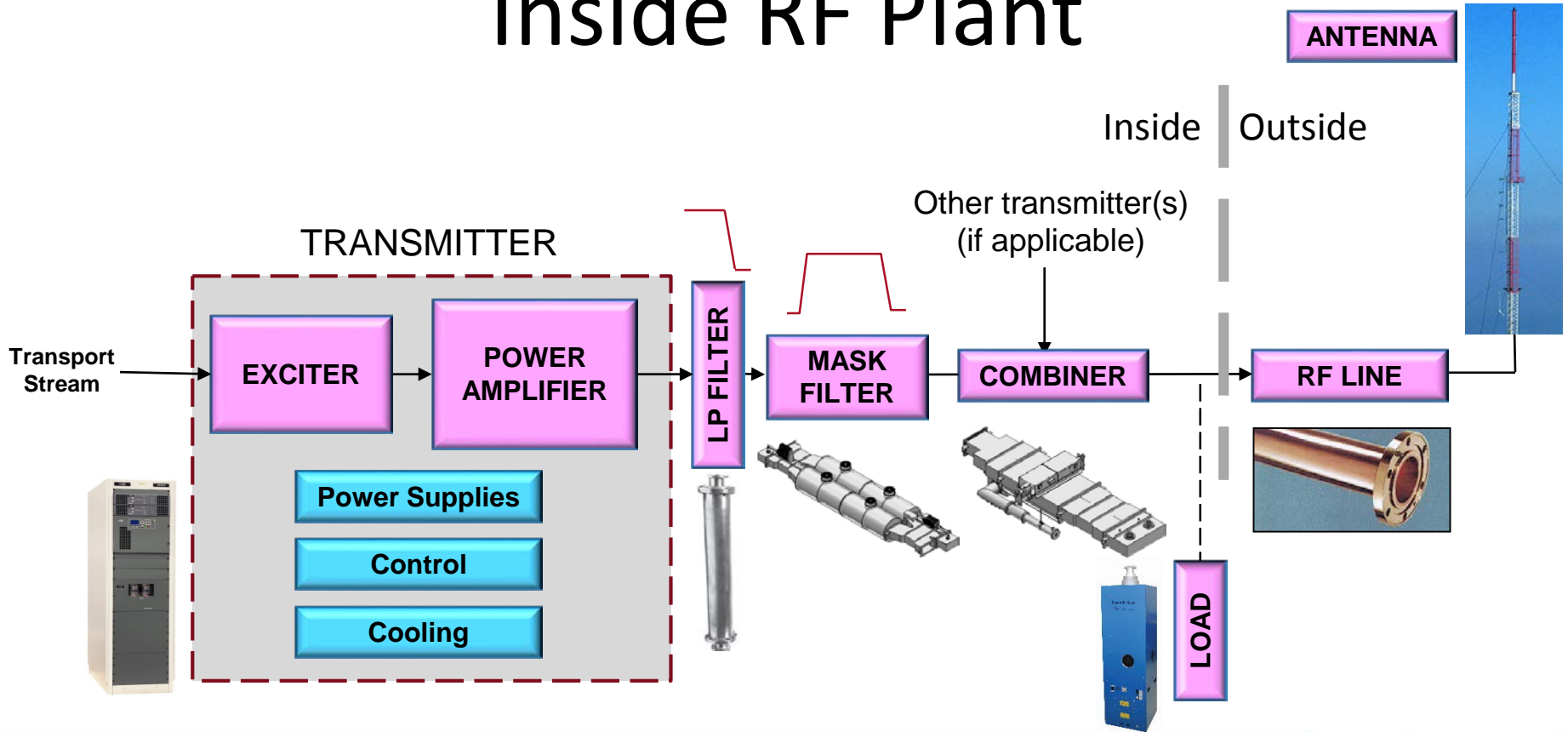


Early ATSC Tx - Example: GatesAir DiamondCD

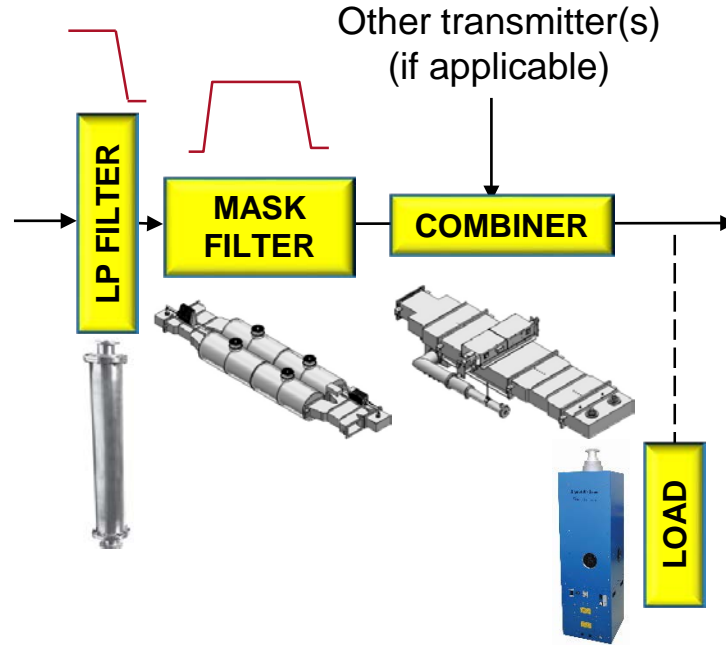
- Circulators -3 Bands, can be replaced
- PA Modules - 3 Bands, **cannot** be replaced (not in production)

PA Modules	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		38	39	40	41	42	43	44	45	46	47	48	49	50	51
Circulators	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		38	39	40	41	42	43	44	45	46	47	48	49	50	51

Inside RF Plant



Inside RF Plant



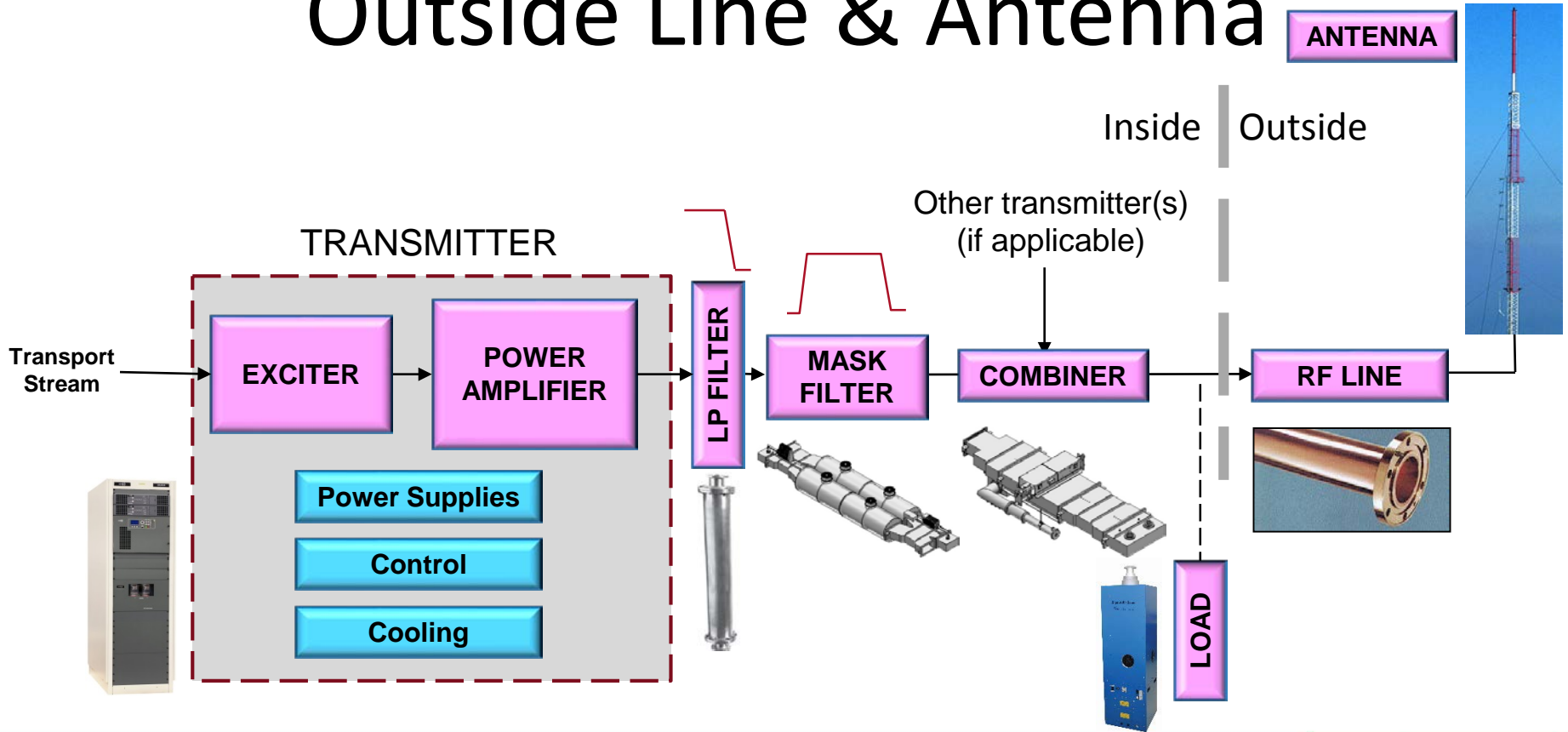
Inside RF Plant

- Items likely to be channel-specific
 - Mask filters
 - Some newer types are tunable - mostly lower power
 - Most in service today are *not tunable* – REPLACE
 - Combiners/Magic Tee's
 - Channel specific – MAY be possible to move +/- 1 channel
 - Consult with manufacturer for details

Inside RF Plant

- Other items that may be channel-specific
 - Low Pass (Harmonic Filters)
 - Usually 2 or more bands in UHF (check)
 - Directional Couplers
 - Check coupling values – sweep
 - Test Load
 - Should be okay but may have fine matchers (re-tune)

Outside Line & Antenna



Outside Transmission Line

- Long runs of rigid line are not fully broadband!!

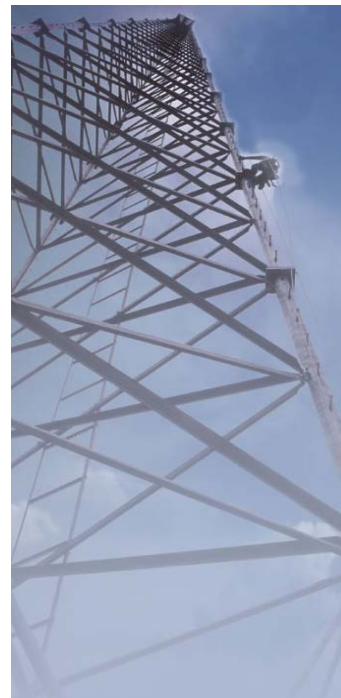
COAXIAL LINE STICK LENGTHS, 1.5MHz GUARD BAND																				
Line Size	Channel																			
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
20				■				■				■				■				
19-3/4	■				■				■				■				■	■		
19-1/2		■				■				■					■			■	■	

Line Size	Channel																			
	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	
20	■				■	■			■	■			■	■			■	■		
19-3/4		■	■		■	■	■			■	■				■				■	
19-1/2			■	■	■			■				■				■	■			

■ Prohibited Channel per Catalog

Antenna & Tower

- About 90% of the UHF installed base in USA are pylon (slot) antennas
 - May work one channel down, ***but no more***
- As frequency goes down, antennas get larger and heavier (for same gain)
- New ANSI/TIA-222- revision G in effect
 - Structural analysis likely required
- Think carefully about VHF (big antennas)



Tx - Replace or Channel Change?

- Evaluate the cost of channel changing versus buying a new tx
- Estimate Total Cost of Ownership
- Remember that new transmitters are generally *much* more efficient than those built only a few years ago
- Many other factors – redundancy, size, safety, etc...



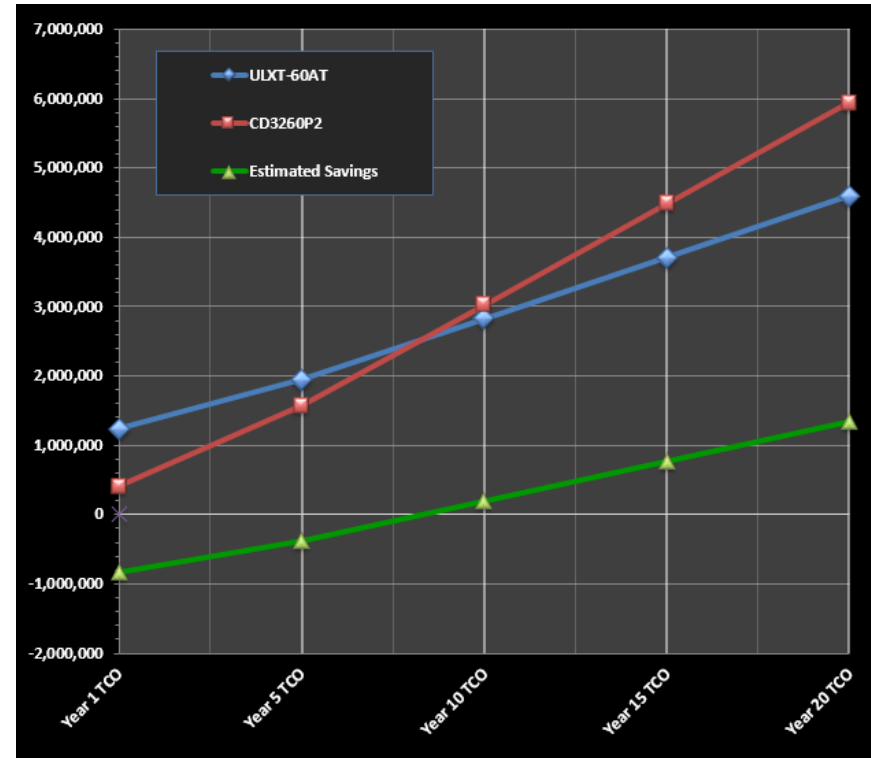
26% to 29%
Typical
Efficiency

42% up to 50%
Efficiency



TCO Analysis Tool

- Calculates the total cost of ownership of a transmitter system
- Compares TCO of a new GatesAir transmitter versus your existing transmitter
- Adjust utility costs and other factors to match your scenario
- Calculate total savings over time
- Estimates a break-even period
- ROI will vary depending on many factors, including cost for new equipment, AC power cost, maintenance, room heat load, etc.

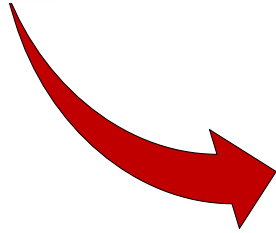


Example 1- Std. IOT to Solid State



50kW TPO

Std. IOT Transmitter
AC-RF Efficiency ~ 29%



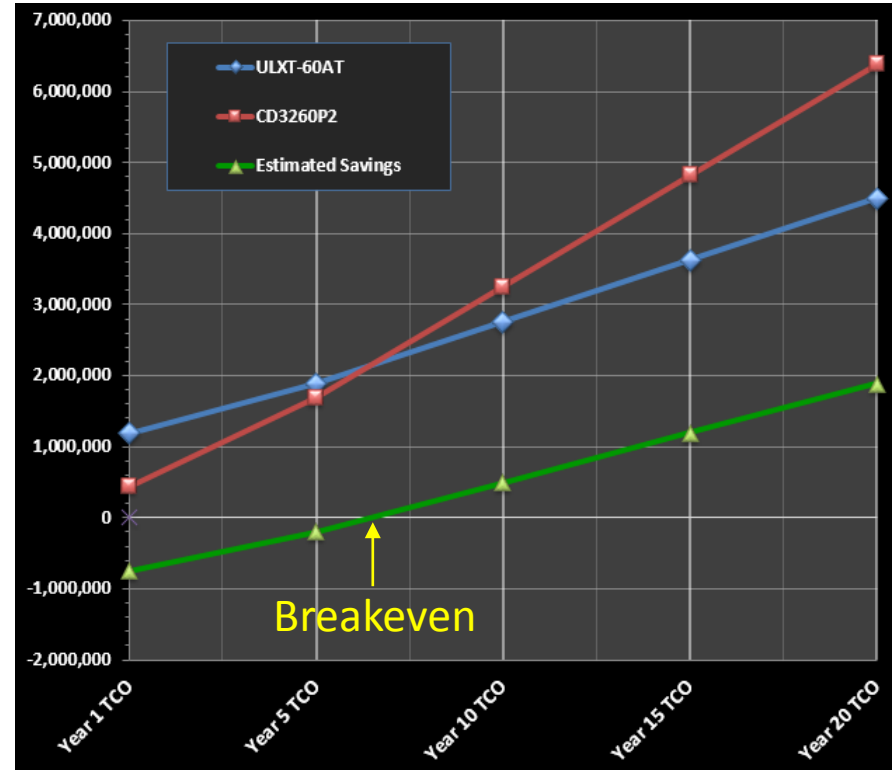
New Generation Tx
AC-RF Efficiency ~ 47%



- AC power savings
- Smaller footprint
- No high voltages
- No “tuning”
- Less expertise needed
- Minimal servicing

Example 1- Std. IOT to Solid State

- Old tx efficiency 28.6%
- New Tx Efficiency 47%
- Power cost 17¢/kW-hr
- New Tx cost \$1.1M
- Breakeven in 6.4 years



Example 1 - Effect of Power Cost

<u>Power Cost</u>	<u>Payback</u>
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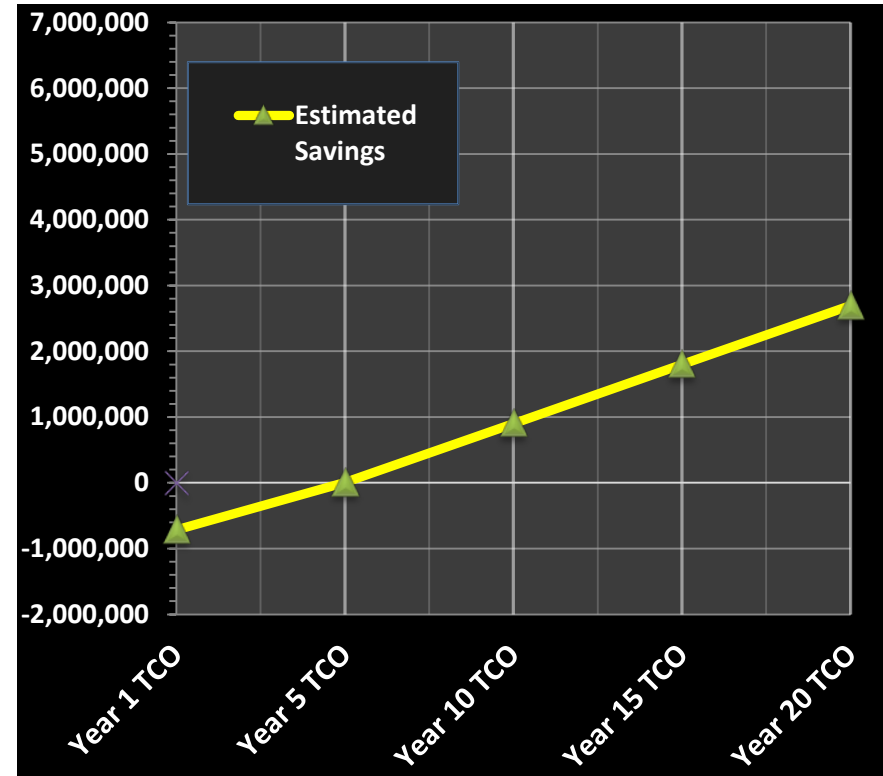
8 c/kW-hr	13.4 Years
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10 c/kW-hr	10.8 Years
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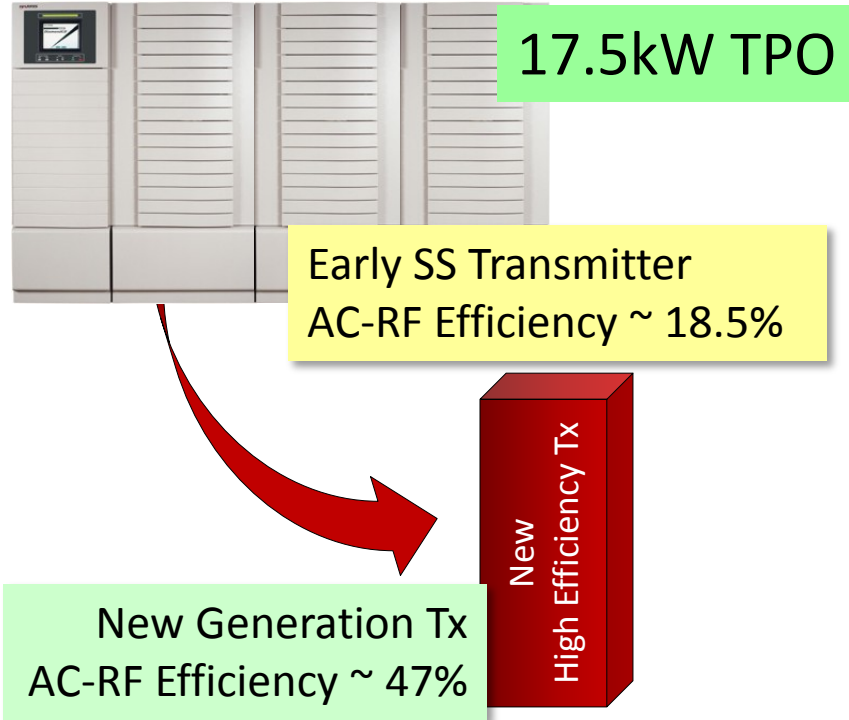
14 c/kW-hr	7.8 Years
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18 c/kW-hr	6.0 Years
------------	-----------

22 c/kW/hr	5.0 Years
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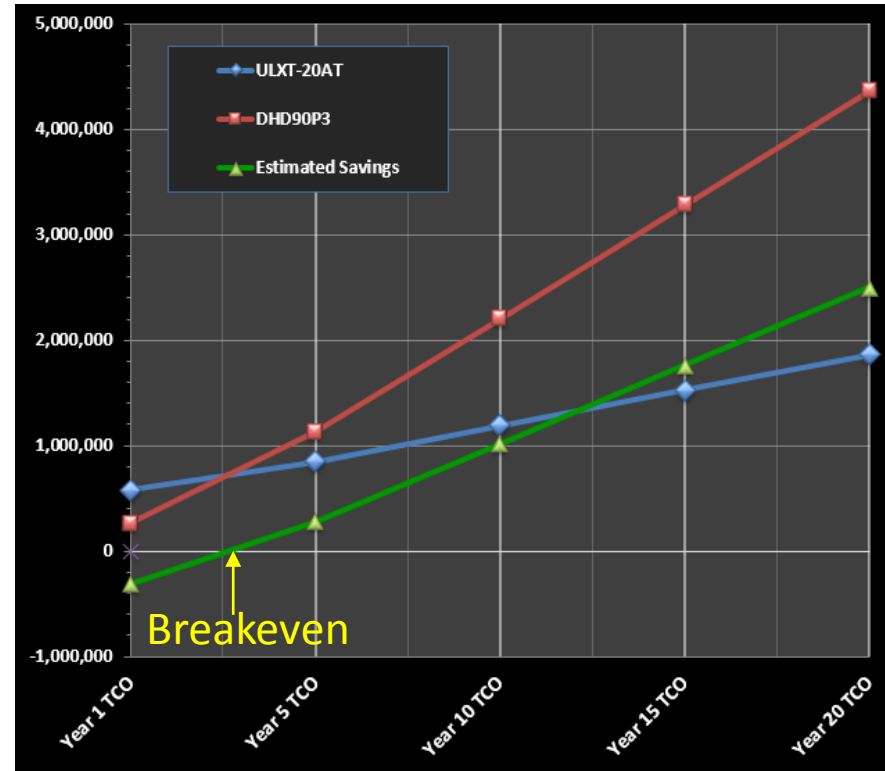
Ex. 2- Solid State to Solid State



- Older Tx very inefficient
- AC power savings
- Change from Air-cooled to Liquid-cooled
- Far Smaller footprint
- Minimal servicing

Ex. 2- Solid State to Solid State

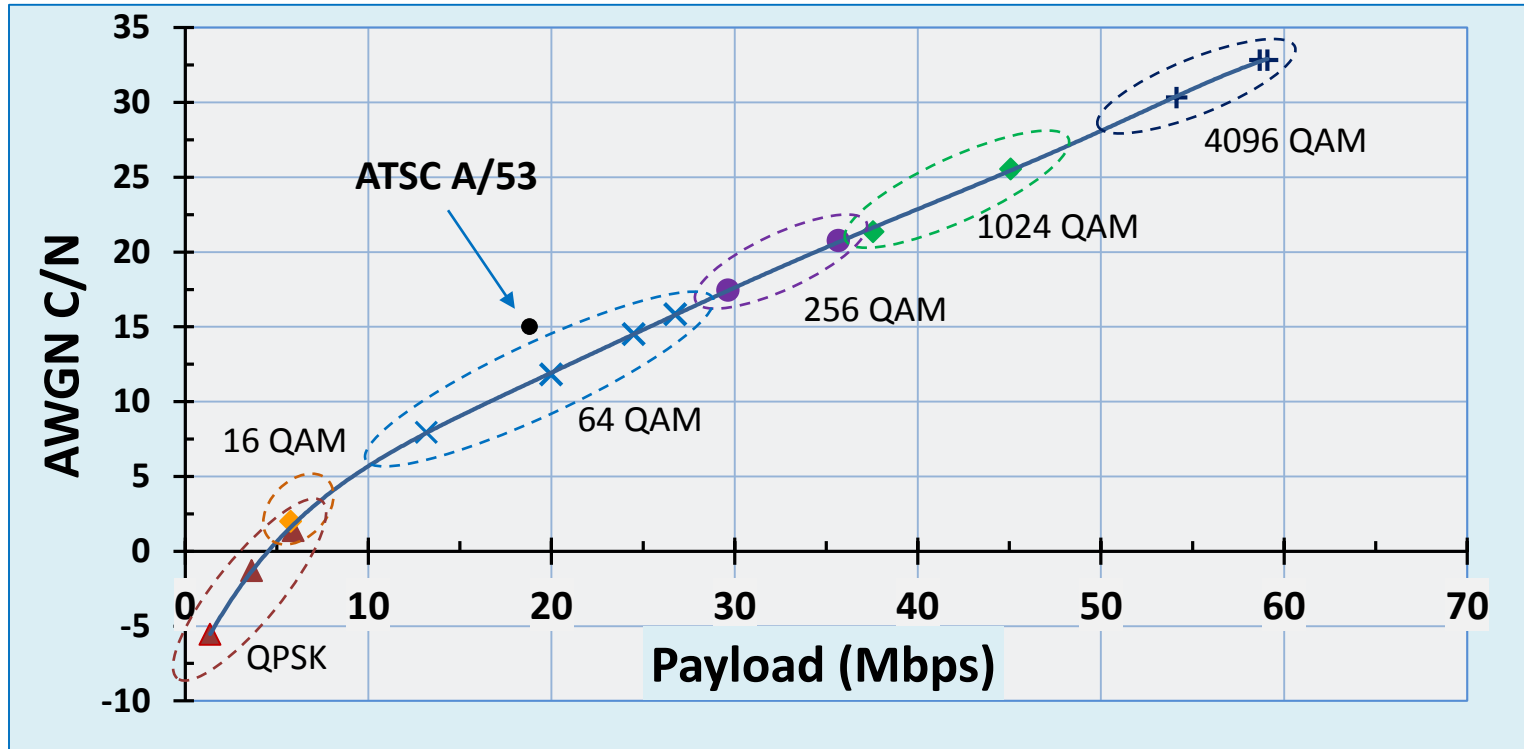
- Old tx efficiency 18.5%
- New Tx Efficiency 47%
- Power cost 17¢/kW-hr
- New Tx cost \$500k
- Breakeven in 3.1 years
(4.2 years at 12 c/kW/hr)



Repack and ATSC 3.0

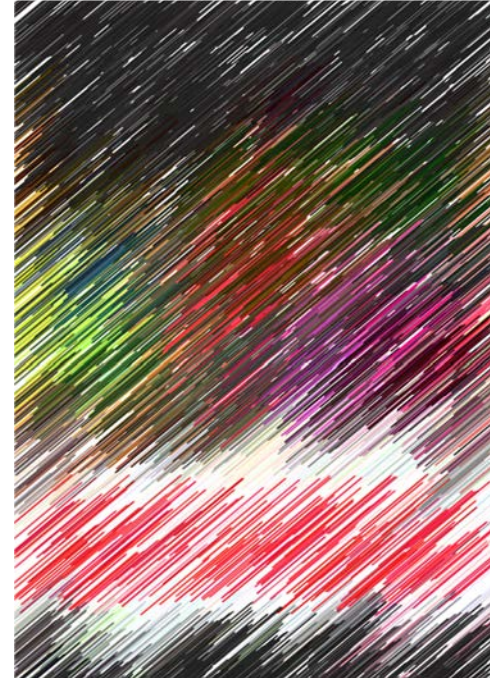
- Repack and ATSC 3.0 on different timelines
- Can I do anything now to make the transition to 3.0 easier?
 - Purchase equipment that is 3.0 Ready
 - Plan ahead for the power level required (*if known yet*)
 - Different PAR's, 6dB vs. 8dB impact on pk. voltages throughout RF chain (Transmitters, Filters, Line, Loads, Antenna)
 - Consider V-Pol for future mobile services
 - Many variable parameters versus none for ATSC 1.0 (next slide)

ATSC 3.0 - Payload vs. C/N



Repack Recap

- Can my existing transmitter, mask filter, RF line, antenna and other items be used on another channel?
- Is my existing transmitter still in production and can it still be serviced and supported properly?
- Consider energy savings and TCO
- Do you have a plan for staying on air during the channel change?
- If possible, when updating or replacing equipment, check if it can be used (or easily updated) for use with ATSC 3.0.



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Questions?



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