

#### **Modulation Dependent Carrier Level**





# Agenda

## Overview

- ✓ Theory
  - What is it?

#### ✓ Benefits

- Why do it?
- ✓ Implementation
  - How do we get it?



Jeff Welton, CBRE Regional Sales Manager Central U.S.



Cris Alexander, CPBE Director of Engineering Crawford Broadcasting Corporation

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## Your questions please?

(if you don't see the control panel, click on the orange arrow icon to expand it)

Please enter your questions in the text box of the webinar control panel (remember to press send)



Remember: The completion of a Nautel webinar qualifies for ½ SBE re-certification credit, identified under Category I of the Re-certification Schedule for SBE Certifications.



# Timeline

Forms of MDCL (also known as DCC – Dynamic Carrier Control) have been used for decades in ham radio.

DCC or variations have been used in European AM broadcast since the 1980s and have been available for Nautel transmitters since 1995.

At NAB2009, Nautel presented a white paper on MDCL.

In late 2010, Alaska Public Radio was granted experimental authorization to begin testing MDCL on several of its stations.

In September 2011, the FCC issued a Public Notice (DA 11-1535) approving the use of MDCL and leaving the specific algorithm up to the individual broadcasters.

Since then, several US broadcasters have implemented MDCL and have reported power savings of 20-40%



# Glossary

### **MDCL: Modulation Dependent Carrier Level**

- general name for the set of technologies, where carrier amplitude is varied relative to modulation

### AMC: Amplitude Modulation Companding

- reduces both carrier and audio amplitude at high mod depths. Maintains S/N ratio

#### DAM: Dynamic Amplitude Modulation

reduces carrier only at low mod depths. Higher savings but at the cost of increased S/N (fringe coverage affected)

### **DCC: Dynamic Carrier Control**

- a version of DAM (although the term DCC is also occasionally used to refer to the overall technology.



# Theory

The AM carrier does not contain any information, yet contains more than 2/3 of the total transmitted power.

Effectively, MDCL involves analyzing mod depth and dynamically adjusting carrier level (and audio level to maintain mod depth) to reduce peak power level.







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## **Customer Feedback**

"For both November and December of 2011, our energy usage was reduced by 21% over the same period in 2010."

"I have had the opportunity to evaluate the effects of the MDCL operation on the signal firsthand and ... well... I haven't detected any. The signal is strong and robust, maybe even louder than before "



# Other benefits

- Reduced peak power
- Less stress on components, especially with aging infrastructure





# **Observations from Cris**

- Used AMC to keep AGC active in receivers full power at low mod keeps AGC from increasing gain and attendant noise.
- Listening tests showed no perceived impact on signal strength or quality, even in fringe areas, using AMC3
- 50kW stations typically saving 1000-1500.00/mo... converting tower lights to LED increased even further
- If you are in an area with demand billing, running an aux transmitter can wipe out the month's savings... keep an eye on that!
- MDCL requires a lot less generator. KBRT is 50kW with AMC3 MDCL and the entire site runs on a 70kW generator, transmitter, lights, A/C and 120V loads!



# Specifics

- -A waiver of 73.1560(a) is required. This can be requested by letter to the FCC
- -Some effect on audio quality and/or coverage may be seen with different algorithms
- -There are several algorithms available (5 from Nautel), user selectable, for least impact on coverage/audio



#### On Nautel NX series transmitters, it's as simple as turning it on

aute <b>e</b> Preset	s: Cu	Reflected O Pr rrent S	ettings (	•.10 kw	- Ana	log)
Load	General	A84	kg Settings	Digital B	ettings 👘	Audia Loss
	AM Source		Unused			
Format Analog Band			Mone L + R	-		
		vidth	10000		Hr	
	Preemphasis Dynamic Carrier Control		Off None			
save new						
Delete	AM88		None			
			AMC			
			EAMC			
			DAM DAM Full			
			TRIDCC			

**Dynamic Carrier Control -** selects the DCC mode, as applicable. Options are None, AMC, EAMC, DAM or DAM Full. Default is None. When a DCC mode is selectedm a Max DCC Compression level can also be entered. See "Selecting the DCC mode", on page 2-60 for more information on each mode.



On ND, XL and XR series transmitters running AM-IBOC, it requires a firmware or platform upgrade.



>> AM Mode	list	8 choices displayed on separate screens: Mono AM, DCC2, DCC1, Full DAM, Basic DAM, EAMC, AMC, AM Stereo C-QUAM. See <u>Selecting</u> the DCC Mode, on page 4-17 for carrier versus modulation graphs for the available DCC modes.
>> DCC Compression	number	Sets the maximum DCC compression level. Accepted Values: -6 dB to 0 dB Edit Interval: 0.1 dB Default: depends on AM Mode setting



For XR series transmitters NOT running AM-IBOC, an external DCC unit is required.





For older ND and XL series transmitters not equipped with AM-IBOC, some upgrades are required.

- RF and Mod (PDM) drivers need to be replaced

- an interface board needs to be installed to interface to a DCC unit
- a DCC unit will need to be installed



## **Measured Power Consumption in various modes**



Enter values into the green cells to estimate your savings.

Assumption: 30% savings in energy consumption when using MDCL

	Select Modulation Density			Heavy 🔻	
	Current	NX Power	10 🔻	With MDCL	
Cost per kW/h (US cents)	12	12		12	
Power of Transmitter in kW	10	10		10	
Rated Efficiency	55	86%		86%	
Modulation Factor	1.4	1.4		1.4	
Consumption in kW/H	25.50	16.30		11.40	
Hours of Operation / Day	24	24		24	
Days of Operation / Year	365	365		365	
Total Yearly Consumption in kW/H	223,380.00	142,788.00		99,864.00	
Total Transmitter Energy Cost (USD)	\$26,805.60	\$17,134.56		\$11,983.68	
Transmitter Power Savings / Year		\$9,671.04		\$14,821.92	
A/C Costs may add 10-15%	\$4,020.84	\$2,570.18		\$1,797.55	
Total Energy Cost	\$30,826.44	\$19,704.74		\$13,781.23	
Total Energy Savin	gs / Year	\$11,121	.70	\$17,045.21	

#### nautel.com/am-mdcl-savings/



# Questions?



## **Online Information**

• Nautel Waves Newsletter

http://www.nautel.com/newsletter/

• Webinars

http://www.nautel.com/webinars/

• YouTube

http://www.youtube.com/user/NautelLtd





