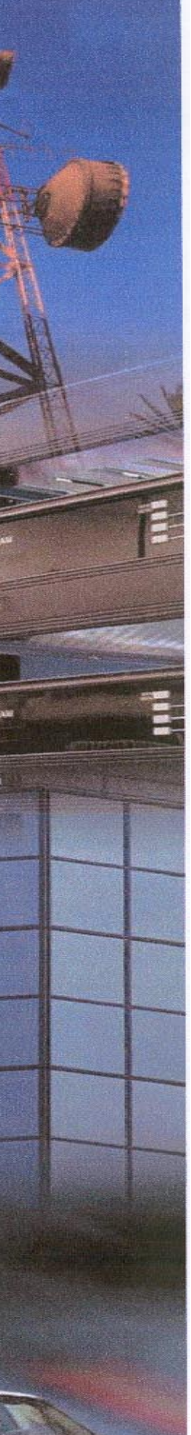


MICROWAVE RADIO COMMUNICATIONS

Innovative Transport Solutions

"Electronic Newsgathering Utilizing the Broadcast Auxiliary Services (BAS) Spectrum"

ITU-R Study Group 6

Electronic Newsgathering Seminar

March 8th, 2006

Informative Reference – BAS Relocation Effort

- **US Broadcasters currently planning their transition for the reduction of 2GHz BAS Spectrum from seven "17MHz" channels to seven "12MHz" channels**
  - www.2ghzrelocation.com - more info.
  - Transition to digital modulation usage
  - COFDM widely accepted and adopted

Received Picture Quality

- **Picture Quality**
  - FM analog modulation – 1Vpp – 4 MHz deviation
    - Function of receive carrier level (rcl) over microwave link
    - RCL vs. video S/N
    - Most ENG shots at around rcl of –50 to –55 dbm
      - 67 – 62 db video S/N

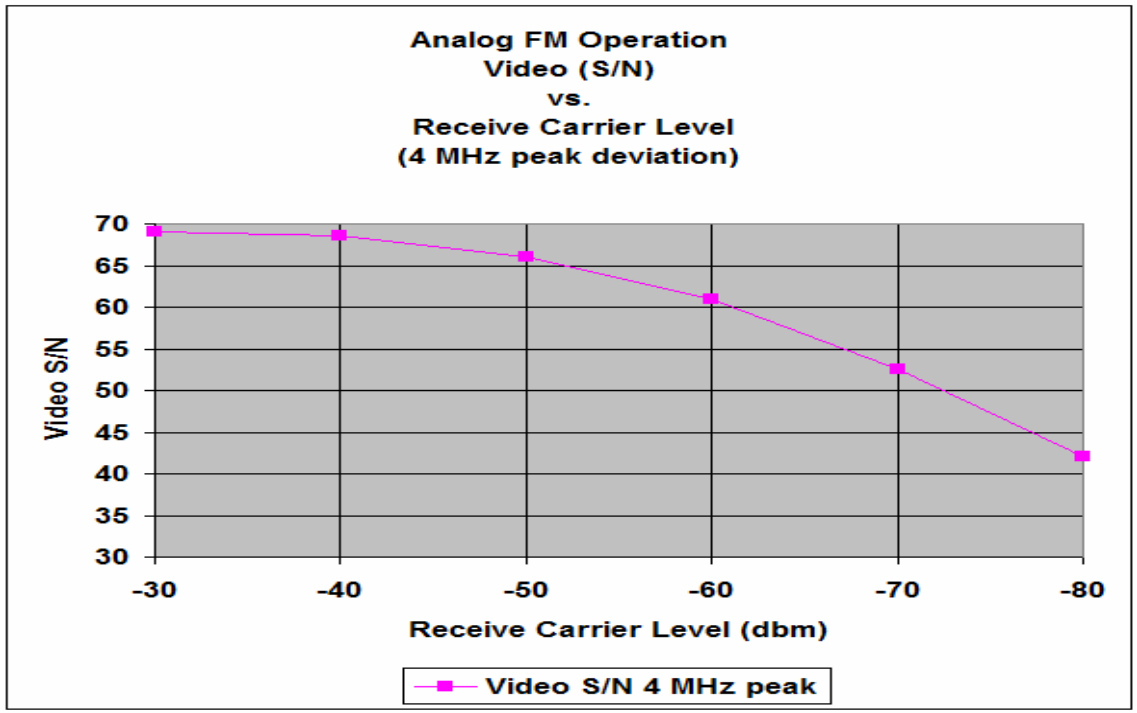


Fig. 1
Analog Video S-N vs. RCL

www.mrcbroadcast.com

Received Picture Quality (2)

- **Picture Quality**
  - FM analog modulation – 1Vpp – 4 MHz deviation
  - Optimum Video equipment performance objectives
  - Go to air with less than premium quality

Video Performance Objective	Specification Requirement
Video Signal –Noise	>68 db (weighted per RS-250C)
Differential Phase	1 degree
Differential Gain	1 %
Chroma/Luminance Gain	4 %
Chroma/Luminance Delay	+/-20nsec
Threshold (2GHz)	-87dbm@37db video S/N
Threshold (7GHz)	-86dbm@37db video S/N
Video Tilt	1%

Table 1
Analog Video Performance

Received Picture Quality (3)

- **Digital Application**
  - Function of application – post editing or live transmission
  - Function of MPEG2 compression bit rate over link
    - PSNR (Peak Signal to Noise Ratio) - Video

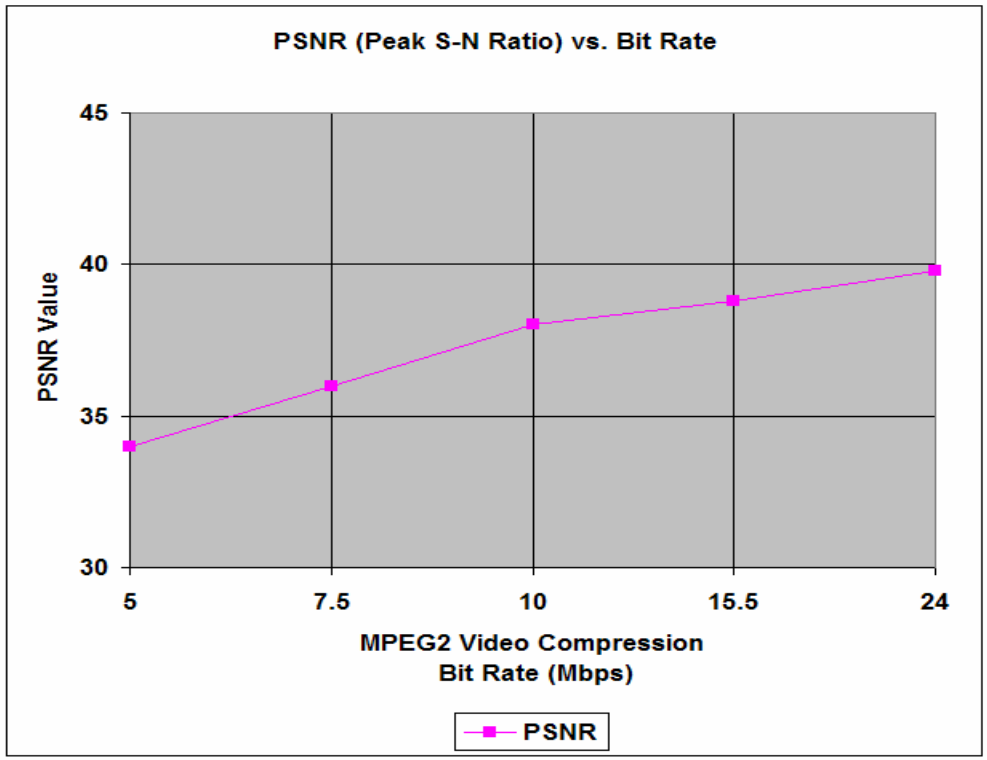


Fig. 2 -PSNR vs. Bit Rate

Received Sound Quality & Number of Channels

- **Typical FM Analog Operation**
  - 0.5 % THD (40Hz- 15KHz) @ Threshold
  - Audio S/N – 68 db (Min.)

- **Typical Digital Operation – MPEG2**
  - 0.5 % THD (20Hz – 19.8KHz)
  - Audio S/N >68 db
  - MPEG layer II
  - 48KHz sampling

- **Typical FM Analog Operation**
  - Audio sub carrier frequencies above video signal – 4.83Mhz/5.2MHz

- **Typical Digital Operation – MPEG2**
  - MPEG2 Encoder product setting
    - Stereo or Mono

Latency

- **MPEG Latency**
  - Function of GOP, chroma sampling and bit rate
  - Fixed low delay setting –90msec
  - Standard delay – function of bit rate

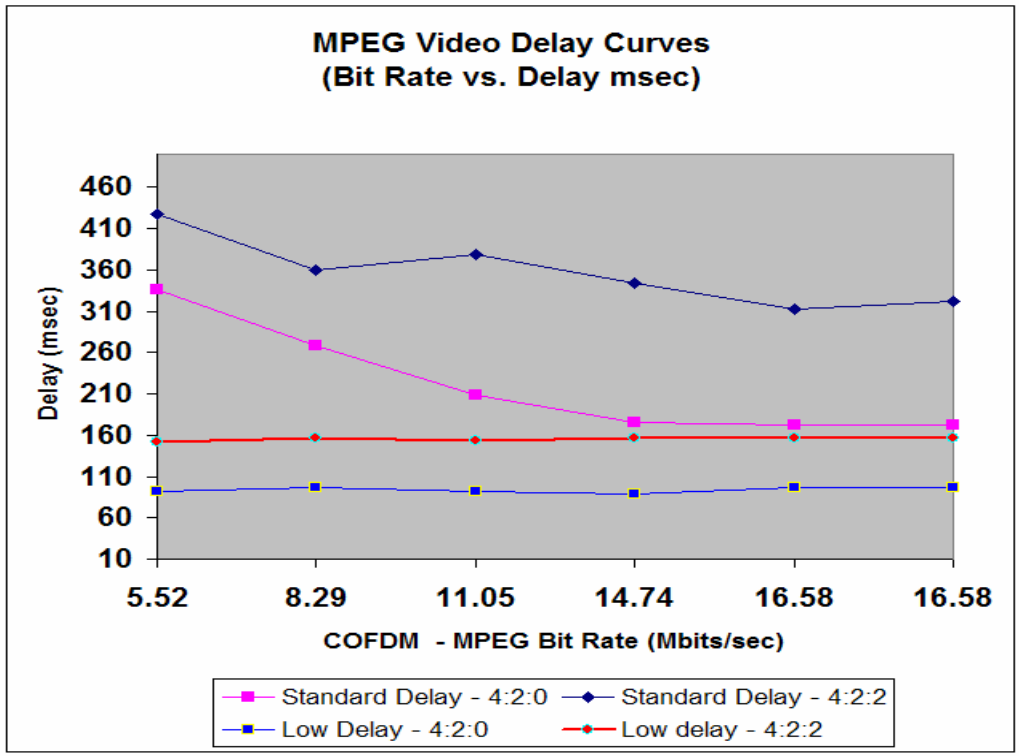


Fig. 3
MPEG Video Delay

Transmission Channel Bandwidth

- **FCC currently allocates specific frequency bands for ENG**
  - Part 74 rules
  - SBE (Society of Broadcast ENG) co-ordinates local channel frequency usage
  - 2GHz band primarily used for ENG – propagation advantages

Frequency Band (MHz)	Number of Channels Allocated in Band	Maximum Authorized Bandwidth
2025.0 – 2110.0	7	12MHz[3]
2450.0 – 2483.5	2	17MHz
6425.0 – 6525.0	4	25MHz
6875.0 – 7125.0[4]	10	25MHz
12700.0 – 13250.0	22	25MHz

Table 2
BAS Frequency Bands

Transmission Channel Bandwidth(2)

- **2GHz relocation band plan changes**
  - Reduction of 35MHz of spectrum

Plan	Channel Edges	Channel Center	New Plan	Channel Edges	Channel Center
A1	1990 - 2008	1999.0	A1r	2025.5 – 2037.5	2031.5
A2	2008 - 2025	2016.5	A2r	2037.5 – 2049.5	2043.5
A3	2025 - 2042	2033.5	A3r	2049.5 – 2061.5	2055.5
A4	2042 - 2059	2050.5	A4r	2061.5 – 2073.5	2067.5
A5	2059 - 2076	2067.5	A5r	2073.5 – 2085.5	2079.5
A6	2076 - 2093	2087.5	A6r	2085.5 – 2097.5	2091.5
A7	2093 - 2110	2101.5	A7r	2097.5 – 2109.5	2103.5

Fig. 4
2GHz – Band Plan Changes

Transmission Channel Bandwidth(3)

- **COFDM Applications**
  - ETSI EN300-744 – 8MHz – bit allocation
  - Superior reliability - multi-path environment
  - 5Mbps – 10 Mbps – SD
  - 18Mbps - 22Mbps - HD

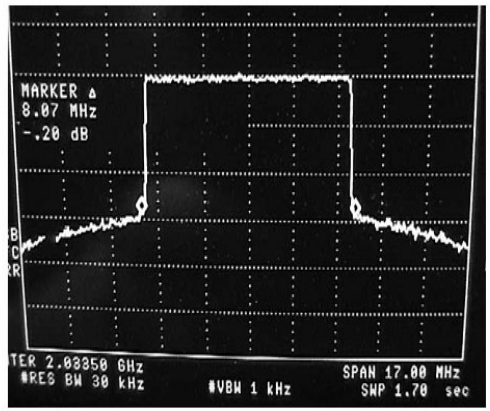


Fig. 5
COFDM – 8MHz Pedestal

Table 17: Useful bitrate (Mbit/s) for all combinations of guard interval, constellation and code rate fo non-hierarchical systems for 8 MHz channels

Modulation	Code rate	Guard interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	4,98	5,53	5,85	6,03
	2/3	6,64	7,37	7,81	8,04
	3/4	7,46	8,29	8,78	9,05
	5/6	8,29	9,22	9,76	10,05
	7/8	8,71	9,68	10,25	10,56
16-QAM	1/2	9,95	11,06	11,71	12,06
	2/3	13,27	14,75	15,61	16,09
	3/4	14,93	16,59	17,56	18,10
	5/6	16,59	18,43	19,52	20,11
	7/8	17,42	19,35	20,49	21,11
64-QAM	1/2	14,93	16,59	17,56	18,10
	2/3	19,91	22,12	23,42	24,13
	3/4	22,39	24,88	26,35	27,14
	5/6	24,88	27,65	29,27	30,16
	7/8	26,13	29,03	30,74	31,67

Table 3
ETSI Bit Allocation Table

Transmission Channel Bandwidth(4)

- **Emerging technology for digital ENG**
  - Single carrier modulation (SCM)
    - QPSK, 16QAM, 32QAM, 64QAM
    - Expand data thru put
    - Fit spectrum into allocated bandwidth

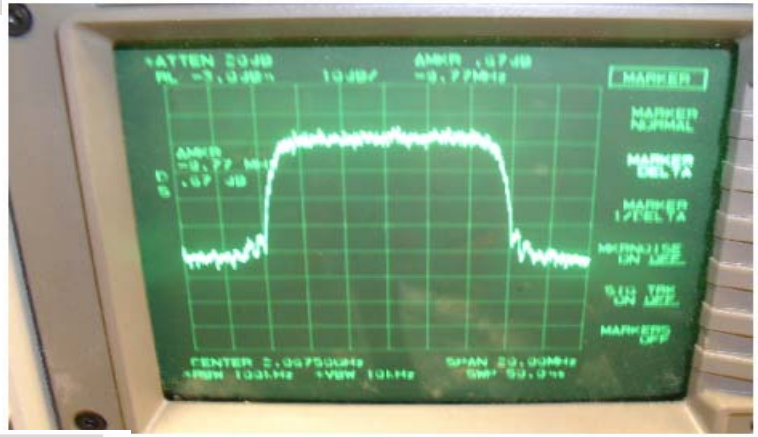


Fig. 6
SCM Spectrum

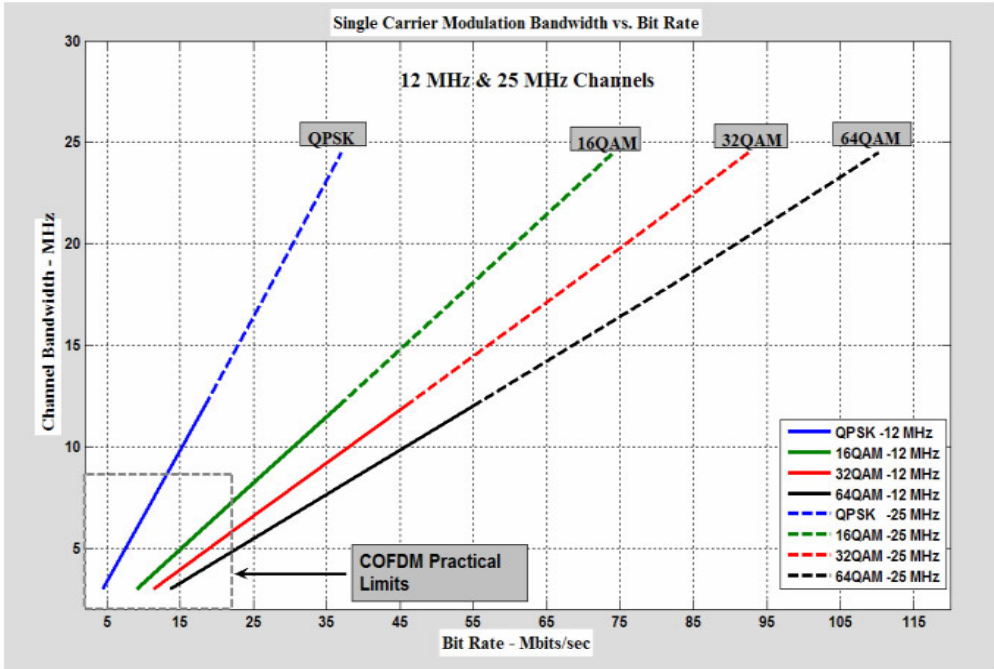


Fig. 7
SCM Bit Rate vs. Bandwidth

Transmission Equipment -Overview

- **Microwave TX Van Equipment**
  - two units – indoor baseband unit and RF head
  - 70 MHz IF/DC/ control interconnection between boxes utilizing triax cable up the mast
  - Indoor base band unit – support analog & digital modulation – MPEG2 compression
  - Outdoor unit – frequency agile transmitter – 5 Watt digital output at 2 GHz
  - Dual Band support – 2 & 7 GHz, 2 & 13 GHz
  - Integrated front panel controls
  - Antenna support – offset feed - 15” X 30”- 20 dbi @ 2GHz, 30 dbi @ 7 GHz, 35dbi@13GHz

Fig. 8
TX ENG Van Package

Transmission Equipment –Overview(2)

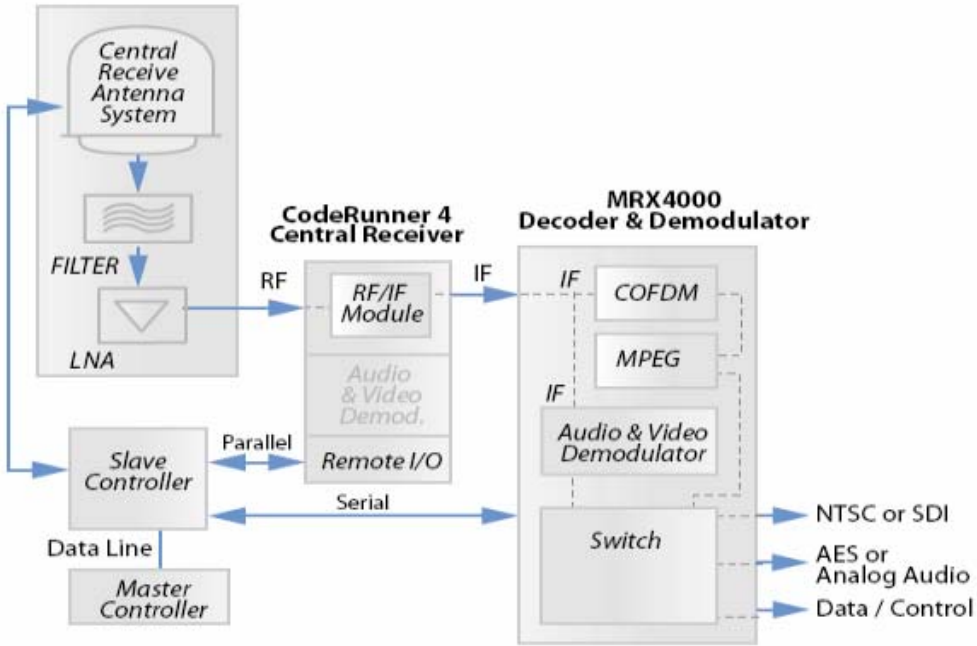
- **Microwave Central RX Equipment**
  - High gain central receive antenna system – 26dbi(2GHz), 36dbi(7GHz), 41dbi(13GHz)
  - Frequency agile -2GHz and 7 GHz & 13 GHz band support
  - Selectable IF filter support – adjacent channel rejection
  - Direct antenna controller interface
  - Support for analog & digital modulation
  - Enhanced digital link monitoring capabilities – LQ (Link Quality), S/N, BER,, spectrum viewer

Fig. 9
High Gain Antenna

Fig. 10
Central Receiver

Transmission Equipment –Overview(3)

- **Microwave Central RX Equipment - Configuration**



MRX4000 Demodulator/Decoder shown integrated into existing receive site with CodeRunner 4 Receiver

Fig. 11
Central Receive Configuration

Transmission Equipment –Overview(4)

- **Portable Microwave TX & RX Equipment**
  - Lightweight tripod mount connection
  - Twist lock direct antenna connection
  - Frequency agile - 2GHz and 7 GHz & 13 GHz band support
  - Selectable RX IF filter support – adjacent channel rejection
  - Support for analog & digital modulation techniques
  - DC Input - +11V - +36 V

Fig. 12
Portable Microwave

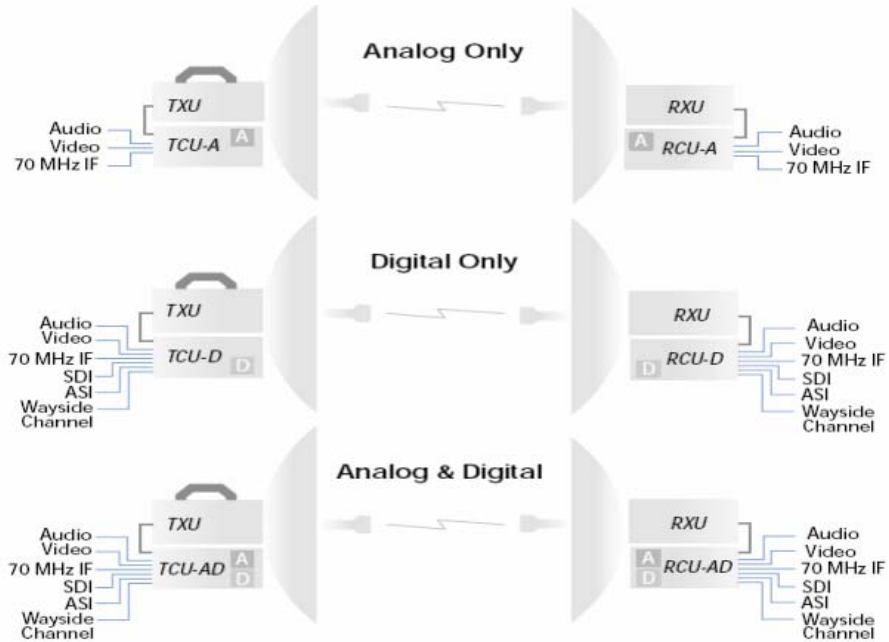


Fig. 13
Portable Microwave Configuration