FluX on: E.A.S.

(Emergency Alert System)

Presented By:

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DEF CON 16

Las Vegas, NV

Track 2, 12:00-12:50, Saturday, August 9, 2008



WARNING:



Shut down all transmitters with active microphones in the room.

Do not re-transmit ‘Hot’ audio.

Saturday Night Live, TV Funhouse, Fun With Real Audio ©1997 by NBC, Inc.

About the Author

- Matt Krick
- “DCFluX”
- Video Editor
- Broadcast Engineer
  - 1998 to Present
- K3MK
  - Licensed to Transmit, 1994 to Present



Video Advantage ©2002 by Media Concepts, Inc.

Warning Systems

1. CONELRAD
2. EBS
3. EAS
4. EAS: The Next Generation

1. CONtrol of ELectromagnetic RADiation



- 1951 - 1963
- All FM, TV and most AM stations sign-off
- Some AM stations required to broadcast on 640 kHz or 1240 kHz
- All radios marked with CONELRAD indicators on frequency dials
- Carrier on and off in 5 second intervals
  - 1000 Hz alert tone for 20 - 25 seconds

1. CONtrol of ELectromagnetic RADiation



Photo by: Trevor Paglen
Department of Geography, University of California at Berkeley

1. CONtrol of ELectromagnetic RADiation



- CONELRAD Stress Test
  - Transmitter power supply failure
  - Local electrical substation failure
  - Transmitter output network failure
  - Transmitter carrier tube failure
  - Transmitter modulator tube failure

2. Emergency Broadcast System



- 1963 - 1997
- Introduction of ‘Two-Tone’ alert
  - 853 & 960 Hz for 20 - 25 seconds
- Required 24 / 7 manned stations to relay alerts

2. Emergency Broadcast System



- EBS Stress Test
  - Transmitter power supply failure
  - Local electrical substation failure
  - Transmitter modulator tube failure

3. Emergency Alert System



- 1997 - Present (1994)
- Administered by FEMA, FCC & NOAA
- Introduction of “SAME” encoded digital message headers
  - EAS uses 853 & 960 Hz Alert Tone
  - SAME uses 1050 Hz Alert Tone
- Fully automated

3. Emergency Alert System



- Emergency Action Notification (EAN)
- Emergency Action Termination (EAT)
- National Information Center (NIC)
- National Periodic Test (NPT)
- NOAA Weather Alerts
- AMBER Alert (CAE)
- Local Emergencies

3. Emergency Alert System



- Participating Stations
  - (-AM), (-FM), (-TV), (-DT)
  - Class A TV (-CA)
  - LPTV (-LP) if originating
  - LPFM (-LP) if originating
  - Cable TV
  - Satellite DBS TV (National Only)
  - XM, Sirius Satellite Radio (National Only)

*** FCC Rules, Part 11.11**

3. Emergency Alert System



- Non Participating Stations
  - Sign off during alert
- Exempt Stations
  - LPTV Translators
  - LPFM Translators

*** FCC Rules, Part 11.11, Part 11.19**

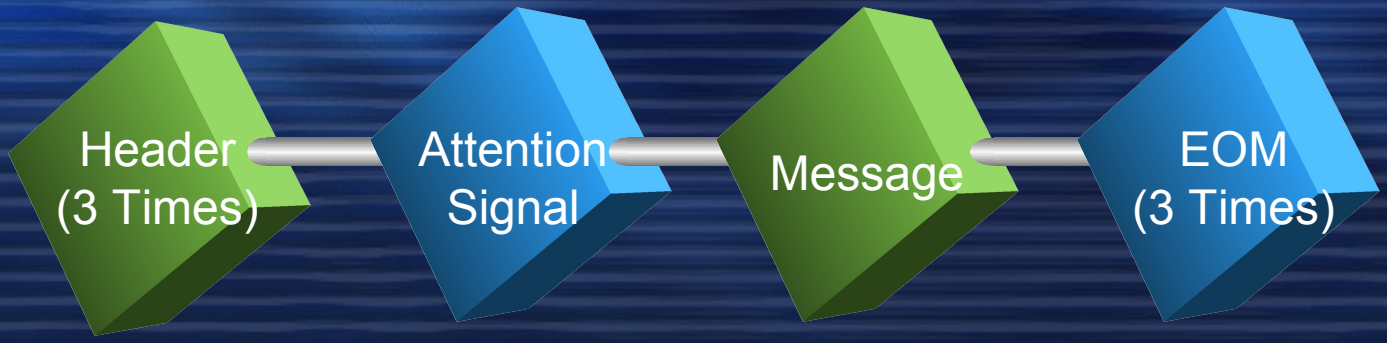
Harris / SAGE EAS ENDEC

- AMD 80C188
- ADSP-2115
- 6 Receivers
- 6 Com Ports
- AFSK Encode
- AFSK Decode
- Computer I/O



http://www.broadcast.harris.com/support/sage/

EAS Protocol



[PREAMBLE] ZCZC- ORG- EEE- PSSCCC +TTTT- JJJHHMM- LLLLLLLL- 1 sec. pause	853 & 960 Hz 8 - 25 sec.	Transmission of audio, video or text messages 120 sec. 1 sec. pause	[PREAMBLE] NNNN 1 sec. pause

*** FCC Rules, Part 11.31(c), Part 11.33(a)(3)**

[PREAMBLE]

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is a consecutive string of bits (sixteen bytes of AB hexadecimal [8 bit byte 10101011]) sent to clear the system, set AGC and set asynchronous decoder clocking cycles. The preamble must be transmitted before each header and End Of Message code.

*** FCC Rules, Part 11.31(c)**

ZCZC-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is the identifier, sent as ASCII characters ZCZC to indicate the start of ASCII code.

*** FCC Rules, Part 11.31(c)**

ORG-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is the Originator code and indicates who originally initiated the activation of the EAS.

EAN - Emergency Action Network

PEP - Primary Entry Point System

CIV - Civil authorities

WXR - National Weather Service

EAS - EAS Participant

*** FCC Rules, Part 11.31(c), Part 11.31(d)**

EEE-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is the Event code and indicates the nature of the EAS activation. The Event codes must be compatible with the codes used by the NWS Weather Radio Specific Area Message Encoder (WRSAME).

EAN - Emergency Action Notification

EAT - Emergency Action Termination

*** FCC Rules, Part 11.31(c), Part 11.31(e)**

PSSCCC

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

- This is the Location code and indicates the geographic area affected by the EAS alert. There may be up to 31 Location codes in an EAS alert.
- P defines County Subdivisions
- SS defines State
- CCC defines Individual Counties or Cities

*** FCC Rules, Part 11.31(c), Part 11.31(f)**

+TTTT-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This indicates the valid time period of a message in 15 minute segments up to one hour and then in 30 minute segments beyond one hour; i.e., +0015, +0030, +0045, +0100, +0430 and +0600. Up to +9930.

*** FCC Rules, Part 11.31(c)**

JJJHHMM-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is the day in Julian Calendar days (JJJ) of the year and the time in hours and minutes (HHMM) when the message was initially released by the originator using 24 hour Universal Coordinated Time (UTC).

*** FCC Rules, Part 11.31(c)**

LLLLLLLL-

[PREAMBLE]ZCZC-ORG-EEE-PSSCCC+TTTT-JJJHHMM-LLLLLLLL-

This is the identification of the EAS Participant, NWS office, etc., transmitting or retransmitting the message. These codes will be automatically affixed to all outgoing messages by the EAS encoder.

Use **WOPR/JR**, not **WOPR-JR**

*** FCC Rules, Part 11.31(c), Part 11.31(3)(b)**

NNNN

[PREAMBLE]NNNN

This is the End of Message (EOM) code sent as a string of four ASCII N characters. 

*** FCC Rules, Part 11.31(c)**

Example EAN

[PREAMBLE]
ZCZC-
PEP- (Primary Entry Point)
EAN- (Emergency Action Notification)
011000 (All of District of Columbia)
+2400- (Valid for 24 Hours)
2220000- (Day 222 00:00 HRS)
POTUS -

*** FCC Rules, Part 11.31(c)**

Modulation Standards

	BELL 103	BELL 202	EAS *
Technique	AFSK	AFSK	AFSK
Characters	ASCII	ASCII	7 bit ASCII
Baud Rate	300 BPS	1200 BPS	520.83 BPS
Space Tone	1070 Hz (2025)	1200 Hz	1562.5 Hz
Mark Tone	1270 Hz (2225)	2200 Hz	2083.3 Hz
Spacing Time	3.333 mS	0.833 mS	1.92 mS
Serial Format	Any	Any	8, N, 0
Attention Signal	None	None	853 and 960 Hz

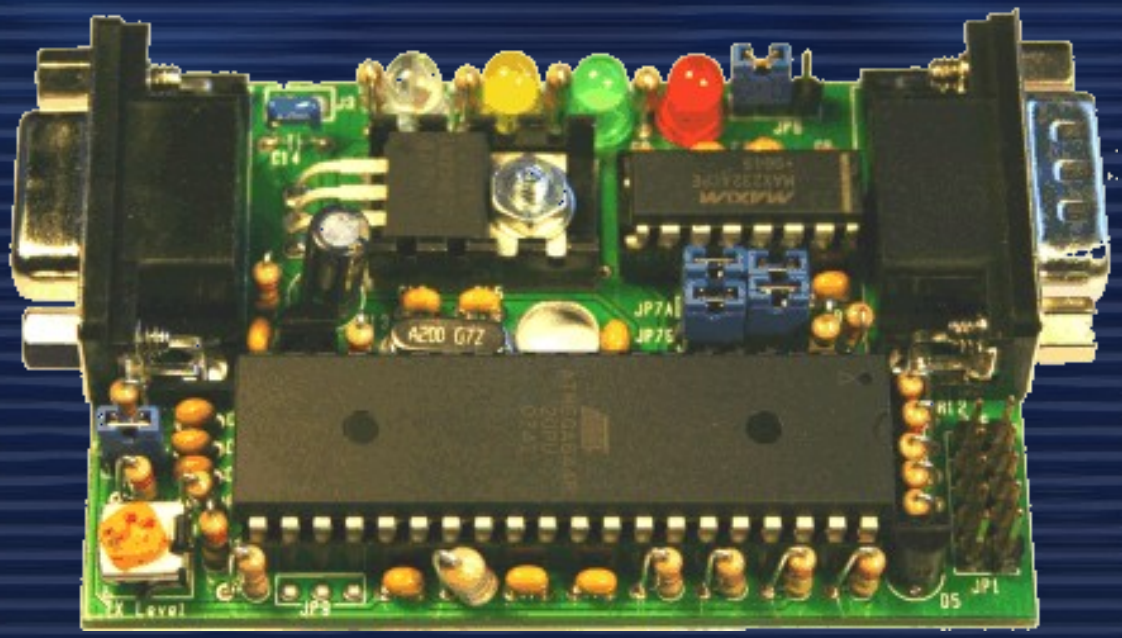
* FCC Rules, Part 11.31(a)(1)

Crystal Division Ratios

	4.0 MHz	16.0 MHz	20.0 MHz
520.83 BPS	7680	30720	38400
1562.5 Hz	2560	10240	12800
2083.3 Hz	1920	7680	9600
1.92 mS	7680	30720	38400
853 and 960 Hz	4689 and 4167	18757 and 16667	23447 and 20833

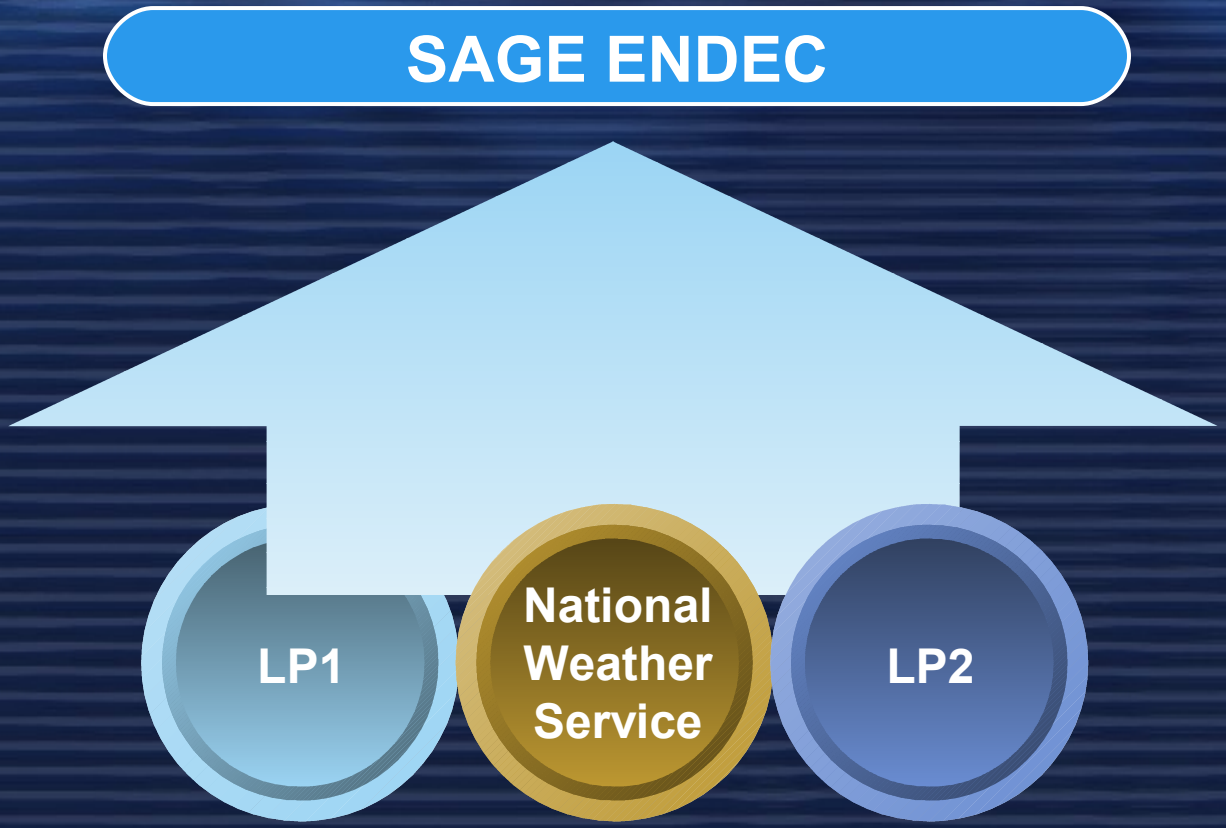
Byonics TinyTrak4

- ATMEGA644P
- 20 MHz Clock
- TX Control
- AFSK Encode
- AFSK Decode
- Computer I/O
- Optional LCD

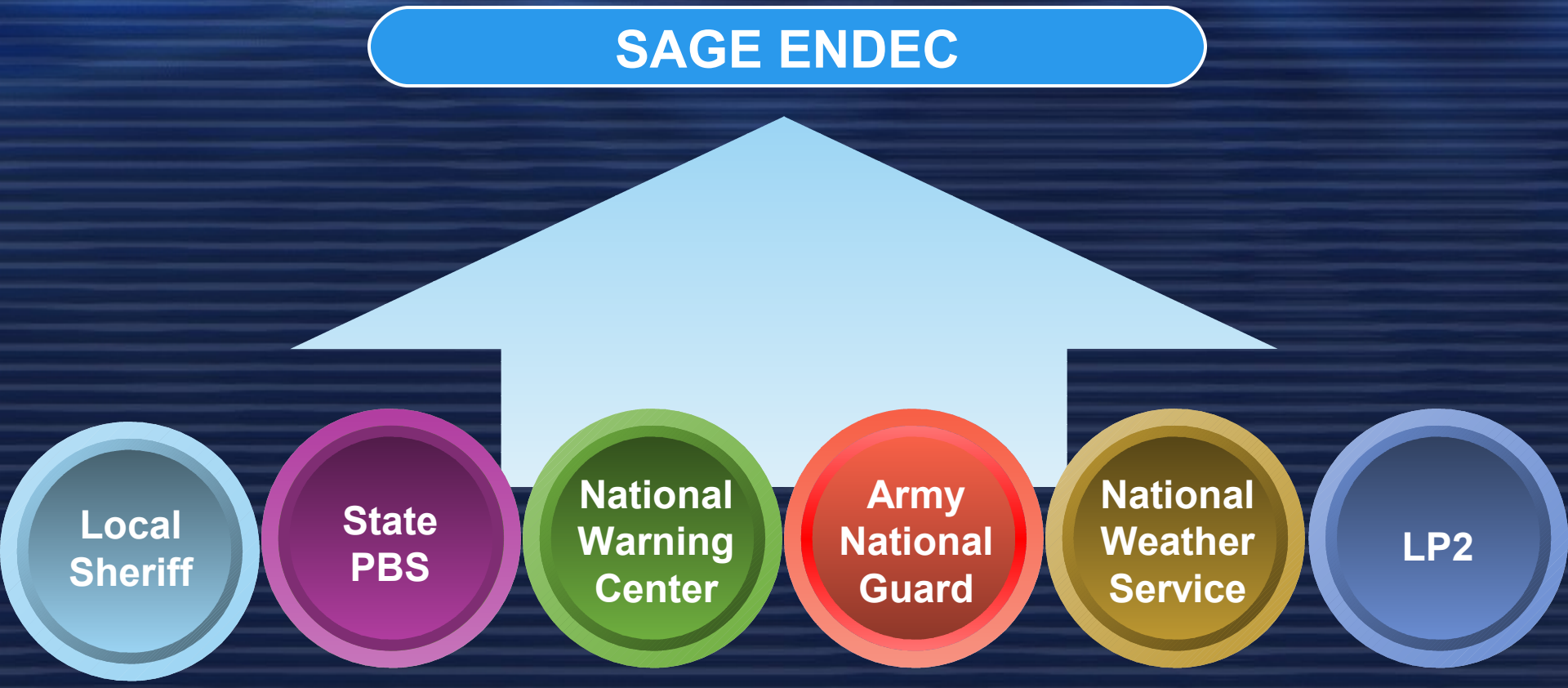


http://www.byonics.com/tinytrak4/

Local Station Monitoring



Local Primary 1 (LP1) Monitoring



Check your local listings



- EAS plans contain guidelines which must be followed to activate the EAS.
- The plans include the EAS header codes and messages that will be transmitted by key EAS sources.
- State and local plans also contain unique methods of EAS message distribution.

*** FCC Rules, Part 11.21**
http://www.fcc.gov/pshs/services/eas/chairs.htm


DANGER

National Primary, Tier 1

- 34 NP Tier 1 stations
  - Diesel backup generator, 30 days fuel
  - Landline, Satellite and HF radio connectivity to FEMA operation centers
  - Special EAS ENDEC with unique codes
  - Located just outside of major city area
  - Fallout shelter with on-site food
  - Special lightning protection

National Primary, Tier 2

- 3 PEP Tier 2 stations
  - All Tier 1 requirements except fallout shelter
- 24 additional Tier 2 stations planned

National Primary, Tier 3

- Direct EAS link from FEMA to Public Radio satellite network
- Direct EAS link from FEMA to XM Radio satellite network
  - XM Radio receivers being added to all Tier 1 and 2 stations
- No special provisions like Tier 1 & 2

FM Capture Effect

- Signal =>15 dB captures receiver, >20 dB preferred
- <15 dB of separation and signals ‘Fight’
- AM and SSB Signals ‘Mix’

Total Power Output

	AM	FM	VHF	TV
Class A	10kW–50kW (+77 dBmW)	<= 6kW (+68 dBmW)	100W (+50 dBmW)	<= 150kW (+82 dBmW)
Class B	250W–50kW (+77 dBmW)	<= 50kW (+77 dBmW)	<= 500W (+57 dBmW)	N/A
Class C	250W – 1kW (+60 dBmW)	<= 100kW (+80 dBmW)	1000W (+60 dBmW)	<= 5MW (+97 dBmW)
Class D	250W–50kW (+77 dBmW)	10W (+40 dBmW)	N/A	<= 150kW (+82 dBmW)

Free Space Attenuation

	AM	FM	VHF	TV
1 Mile	36 dB	76 dB	80 dB	92 dB
2 Miles	42 dB	82 dB	86 dB	98 dB
4 Miles	50 dB	88 dB	92 dB	104 dB
8 Miles	56 dB	94 dB	98 dB	110 dB
16 Miles	62 dB	100 dB	104 dB	116 dB
32 Miles	68 dB	106 dB	110 dB	122 dB
64 Miles	74 dB	112 dB	116 dB	128 dB
128 Miles	80 dB	118 dB	122 dB	134 dB

Subcarrier Power Output

	AM	FM	VHF	TV
Main Audio	0 dB	0 dB	0 dB	-10 dB
IBOC	-12 dB	-20 dB	N/A	N/A
Stereo	0 dB	-3 dB	N/A	-10 dB
SC1, SC2	N/A	-6 dB	N/A	N/A
RDS	N/A	-20 dB ????	N/A	N/A
SAP	N/A	N/A	N/A	-13 dB
PRO	N/A	N/A	N/A	-20 dB

Average Receiver Sensitivity

	AM	FM	VHF	TV
Main Audio	-70 dB	-70 dB	-117 dB	-70 dB

VHF Attack Math

- VHF Class A Station (+50 dBm)
- 16 Miles (-104 dB)
- 3 Element Yagi (+6 dB)
- No Subcarrier

50 - 104 + 6 + 0 = -48 dB

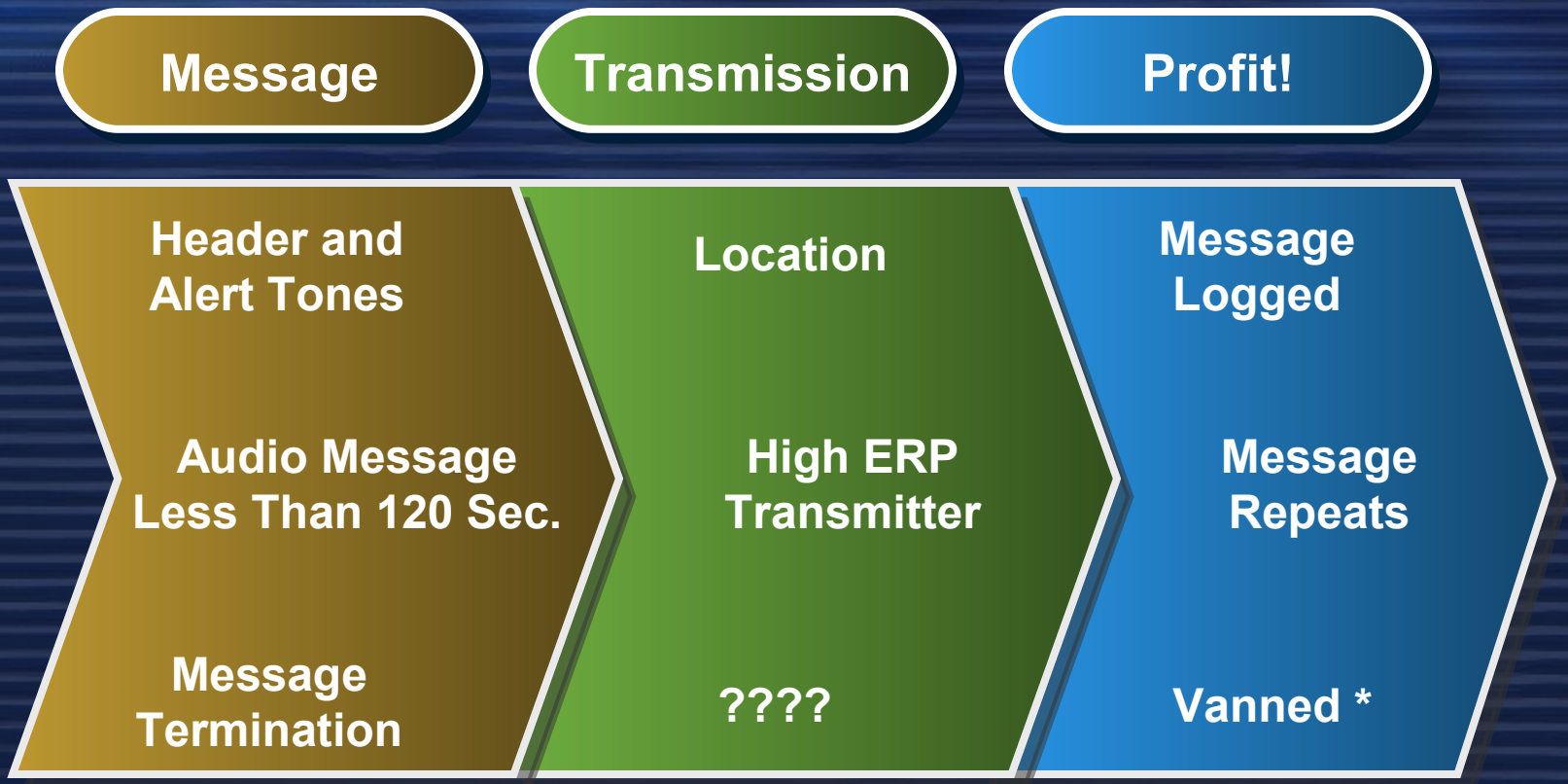
-48 dB + 20 dB = -28 dB

VHF Attack Math

- 100W VHF Mobile Radio (+50 dBm)
- 1 Mile (-80 dB)
- 3 Element Yagi (+6 dB)
- Magnet Mount (+2 dB)
- No Subcarrier

50 - 80 + 6 + 2 + 0 = -22 dB

Taking Over



* FCC Rules, Part 73.1217, Parts 1.80 - 1.95

4. EAS: The Next Generation

- 2007 - ????
- Introduction of “CAP”
  - Common Alerting Protocol
  - Provision for audio, video and text
  - Geographic targeting
  - Digital encryption and signature
- 180 Days to implement
- Delayed by Homeland Security
  - Don’t expect it for 3 years

*** Executive Order 13407, 06/28/2006**

4. EAS: The Next Generation

- Pilot Programs
  - DEAS (Digital EAS)
  - GTAS (Geographical Targeted Alerting System)
  - WARN (Web Alert & Relay Network)

FluX on: E.A.S.

(Emergency Alert System)

Questions?

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FLUX RESEARCH