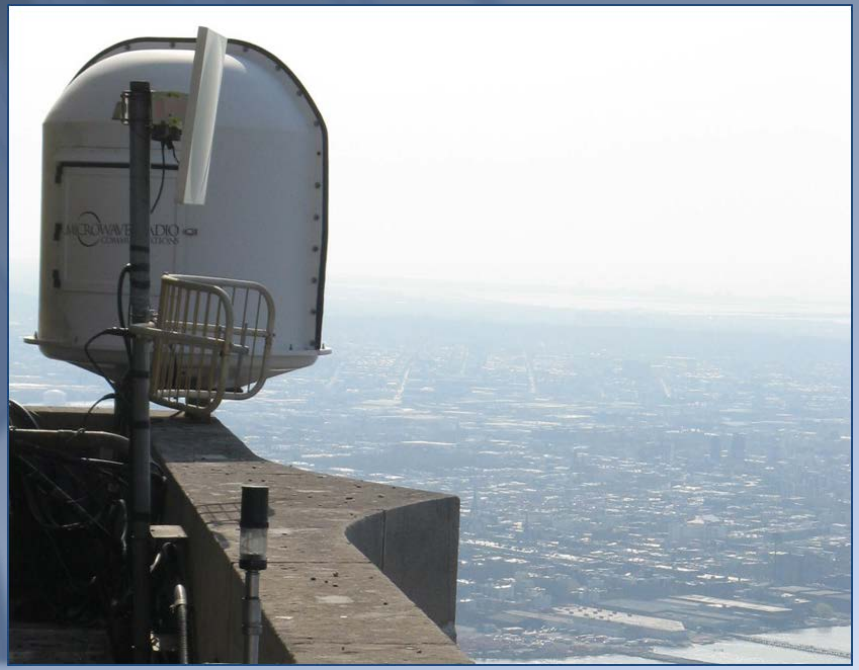
Broadcast Auxiliary Services Spectrum Challenges



CAVELL MERTZ & Associates, Inc.

What are Broadcast Auxiliary Services?

- BAS is unique among FCC radio services
  - Most licenses are associated with a primary broadcast station license.
  - Expiration and renewal is concurrent with the primary station.
  - Association is by Facility ID and FCC Registration Number.

CAVELL MERTZ & Associates, Inc.

What are Broadcast Auxiliary Services?

- BAS includes several radio services and bands
  - Land mobile - remote pickup (RP)
    - HF (26 MHz)
    - High VHF (153 MHz; 161 MHz)
    - UHF (450 & 455 MHz)

CAVELL MERTZ & Associates, Inc.

What are Broadcast Auxiliary Services?

- BAS includes several radio services and bands
  - Aural Intercity Relay (AI)
  - Aural Studio Transmitter Link (AS)
  - 944 - 952 MHz

CAVELL MERTZ & Associates, Inc.

What are Broadcast Auxiliary Services?

- BAS includes several radio services and bands
  - Television Pickup (TP)
  - Television Intercity Relay (TI)
  - Television Studio Transmitter Link (TS)
    - 2 GHz (2025 – 2110 MHz)
    - 2.5 GHz (2450 – 2487.5 MHz)
    - 7 GHz (6425 – 6525 and 6875 – 7125 MHz)
    - 13 GHz (12.70 – 13.25 GHz)
    - UHF TV channels (No longer acceptable for filing)

CAVELL MERTZ & Associates, Inc.

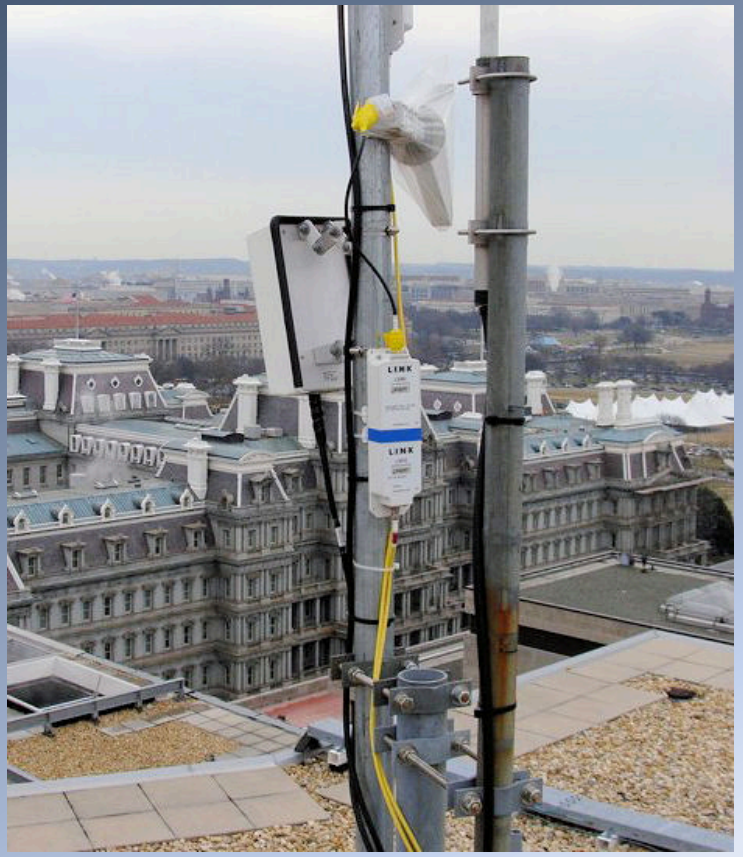
BAS Common Uses

- 2-Way communications (dispatch, cues, etc.)
  - Portable handheld radios
  - Vehicular radios (often in company vehicles)
- Wireless microphones
- Mix minus; Interruptible Fold Back (IFB)
- Transmitter telemetry & control

CAVELL MERTZ & Associates, Inc.

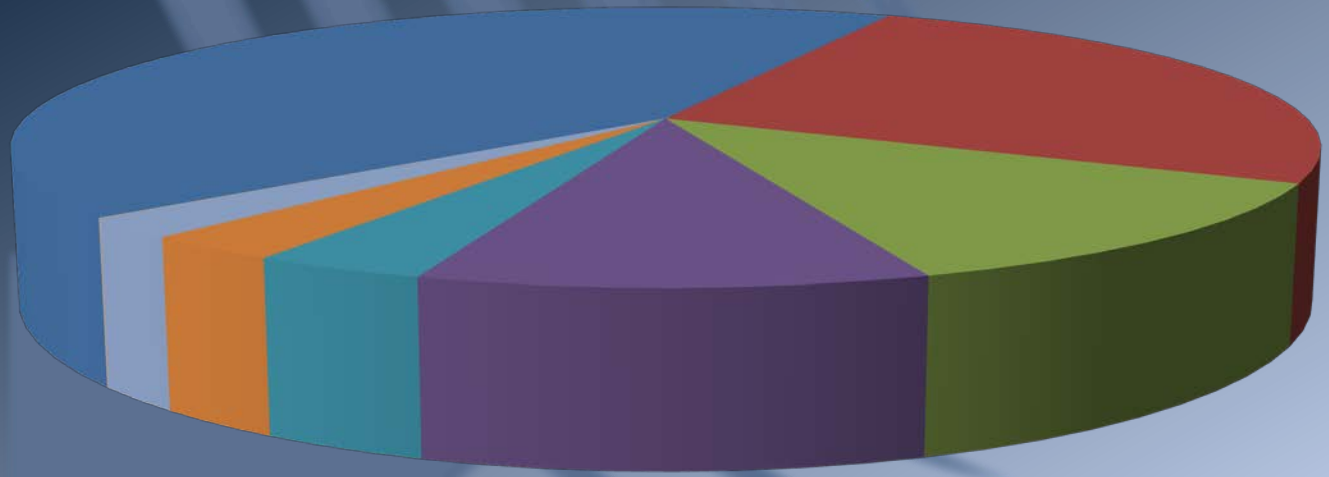
BAS Common Uses

- Radio remote broadcasts (Marti)
- Television remote broadcasts (ENG)
- Studio Transmitter Links (STL)
- External studios, bureaus (ICR)
- Remote production (Camera back transmitters, etc.)



CAVELL MERTZ & Associates, Inc.

Types of Broadcast Microwave Stations



- AS Aural Studio Transmitter Link
- TI TV Intercity Relay
- TS TV Studio Transmitter Link
- TP TV Pickup
- AI Aural Intercity Relay
- CT Local Television Transmission
- TT TV Translator Relay
- TB TV Microwave Booster
- AB Aural Microwave Booster

CAVELL MERTZ & Associates, Inc.

Who Can Use BAS

- Remote Pickup
  - Broadcast stations (AM, FM, LPFM, TV, LPTV, International)
- Aural Microwave
  - Radio stations (AM, FM, FM Translators, LPFM - Secondary)

CAVELL MERTZ & Associates, Inc.

Who Can Use BAS

- Television Microwave
  - Television broadcast stations (TV, TV Translators, LPTV - secondary)
  - Broadcast network entities
  - (Not radio stations)
  - Some bands are shared with Cable Television (CARS) and Common Carrier Television (LTTS) licensees.

CAVELL MERTZ & Associates, Inc.

Who Can Use BAS

- Low Power (Wireless Mics, etc.)
  - Radio, TV, and international broadcast stations
  - Broadcast network entities
  - Cable system operators that produce programming
  - Motion picture producers
  - Others (See 74.832)

CAVELL MERTZ & Associates, Inc.

What is BAS Spectrum Worth?

- Broadcasters may take the value of this spectrum for granted but…
  - It is in limited supply
  - Spectrum is in great demand
  - “Buy land. They’re not making it any more!” (Mark Twain)

CAVELL MERTZ & Associates, Inc.

Spectrum is in Great Demand

- National Broadband Plan, in March 2010…
  - Recommends making 300 MHz available for broadband use in the next five years.
  - Recommends making 500 MHz available for broadband use in the next ten years.

CAVELL MERTZ & Associates, Inc.

Spectrum is in Great Demand

- The 2 GHz band is *beachfront property.*
  - The broadcast industry just lost 35 MHz to MSS/AWS. (1990-2025 MHz, the bottom of the old 2 GHz band)
  - CTIA (the wireless association) recently proposed to reallocate 15 MHz for commercial broadband use. (2095-2110 MHz, the top of the 2 GHz band)

CAVELL MERTZ & Associates, Inc.

Spectrum is in Great Demand

- The 2 GHz band is *beachfront property.*
  - There is a proposal to auction some or all of the 1755-1850 MHz band for broadband use, displacing 95 MHz of Federal users from that band.
  - A March, 2011 NTIA report identified the 2 GHz BAS band as the "preferred option" for those users.
  - The potential for sharing the band with broadcasters is being explored as a possibility.

CAVELL MERTZ & Associates, Inc.

Spectrum is in Great Demand

- The 2 GHz band is *beachfront property.*
  - DoD has recently been sharing (through coordination with broadcasters) the 2 GHz band for satellite tracking, telemetry, and control.
  - Due to geographic isolation and high-gain antennas typically aimed above the horizon, SBE has described this use as a potentially good sharing arrangement.

CAVELL MERTZ & Associates, Inc.

The 2 GHz Band is in Particularly Great Demand

- Immediately below the existing AWS-1 Band (2110 - 2155 MHz)
- Immediately above PCS G Block, AWS-2 and AWS-4 band frequencies (1990-2025 MHz)
- Along with AWS, is Contiguous with Existing PCS Bands (1850-1995 MHz)

CAVELL MERTZ & Associates, Inc.

Contiguous Spectrum is Desirable

- Smart phones are tiny and packed with electronics.
- Filters and additional electronics are needed to support multiple bands and take up valuable space.
- Operation by multiple carriers in adjacent bands reduces hardware cost due to common designs and wider, mass production.

CAVELL MERTZ & Associates, Inc.

Financial Overview

- What's the 2 GHz Band Worth?
  - A 2011 Forbes Article Values Similar Spectrum from $0.17 to $0.69 per MHz-POP
  - 2 GHz Band Spans 2025 - 2110 MHz; Is 85 MHz Wide
  - US Population ~316,580,600 People
  - Value at $0.17 per MHz-POP = $4,574,589,670
  - Value at $0.69 per MHz-POP = $18,567,452,190
  - For Discussion Purposes, Let's Split the Difference:
  - At $0.43 per MHz-POP, 2GHz is Worth $11.6 Billion

CAVELL MERTZ & Associates, Inc.

Financial Overview

- Here's Another Way to Look at the Value of 2 GHz:
  - The Greater Madison, Wisconsin Metro Area Consists of about 850,000 people.
  - 85 MHz of Spectrum over 850,000 people at $0.43 per MHz-POP is $31 Million – just for this Market

CAVELL MERTZ & Associates, Inc.

Financial Overview

- The 7 GHz Bands (6,425 – 6,525 MHz and 6,875 – 7,125) MHz and is 350 MHz Wide.
- The 13 GHz band (12,700 – 13,200 MHz) has a bandwidth of 500 MHz.
- In total, this is ten-times the bandwidth at 2 GHz.
- Even if valued at only $0.05 per MHz-POP, that's another $13.5 billion for the United States; with $36 million of that in Madison.
- Along with 2 GHz, the approximate United States BAS spectrum value is $24.5 Billion, with $67 Million here in the Madison market.

CAVELL MERTZ & Associates, Inc.

Financial Overview

- What does the Broadcast Industry pay for this spectrum?
  - Nothing.
  - Nada.
  - Zilch.
  - (Minor regulatory fees but no spectrum fees)
- But the industry does pay for this spectrum. Here's how…

CAVELL MERTZ & Associates, Inc.

Financial Overview

- The Broadcast Industry Provides the Public with Free, Over-the-Air Radio and Television.
- Every Day, Broadcasters Provide:
  - News
  - Emergency Alerts
  - Sports
  - Entertainment

CAVELL MERTZ & Associates, Inc.

Broadcast Spectrum Losses

- Over the years, broadcasters have lost significant expanses of valuable spectrum
  - Entire 18 GHz aural band (lost to satellite; 2000)
  - 35 MHz of the 2 GHz band (lost to MSS; 2000)
  - 198 MHz of UHF broadcast band (Lost to Various, 1996)

CAVELL MERTZ & Associates, Inc.

Broadcast Spectrum Losses

- Over the Years, Broadcasters Have Lost Significant Expanses of Valuable Spectrum
  - 7 and 13 GHz BAS bands are now shared in certain areas with Part 101 point-to-point Private and Common-Carrier Fixed Service microwave users.
    - FS link not permitted to cross BAS operational areas.
    - Requires broadcasters to register 7/13 GHz fixed central receive sites.
    - Thankfully, eliminates “Final Link” rule that prohibited broadcasters from using Part 101 frequencies as STLs.

CAVELL MERTZ & Associates, Inc.

Financial Bottom-Line

- Spectrum is limited and in great demand.
- Others are clamoring for BAS spectrum – and getting it.
- Broadcasters “Pay” for spectrum by providing free, public interest benefits to viewers.
- Conclusion: Broadcasters must use spectrum wisely and efficiently.

CAVELL MERTZ & Associates, Inc.

Use Spectrum Wisely

- Present Land Mobile Issues
  - Incompatible frequency and bandwidth
  - Communications users on broadband channels
- Chronic Microwave Issues
  - Incorrect or inaccurate license data
  - Missing ENG receive site data
  - “Zombie” licenses – frequency hoarding
- Only licensees can fix these problems

CAVELL MERTZ & Associates, Inc.

Chunks – VHF and UHF Land Mobile

- "New" Rules (Circa 2003) changed land mobile channels.
  - Most VHF channels are assigned using up to four 7.5 kHz-wide segments. (Was up to six 5 kHz-wide segments.)
  - Most UHF channels are assigned using up to eight 6.25 kHz-wide segments. (Was up to Ten 5 kHz-wide segments.)
- Most licenses are still using old rule channel segments.

CAVELL MERTZ & Associates, Inc.

Chunks – VHF and UHF Land Mobile

- Here's a graphical depiction of a "typical" 25 kHz bandwidth UHF channel.
- This channel has a center frequency of 455.3250 MHz.

CAVELL MERTZ & Associates, Inc.

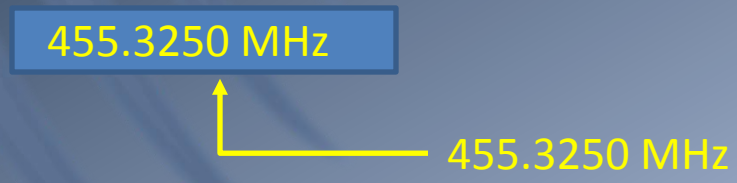
Chunks – VHF and UHF Land Mobile

455.3000 MHz	455.3250 MHz	455.3500 MHz

- There are other licensees in the area, also on 25 kHz channels, located immediately below and above our hypothetical 455.3250 license.
- This is a very common example of a channel plan in many U.S. markets.
- Unfortunately, it's inconsistent with the FCC Rules as of 2002.
- What's wrong with this picture?

CAVELL MERTZ & Associates, Inc.

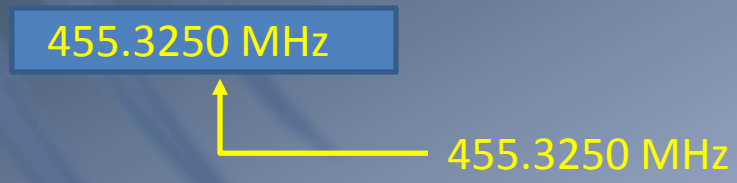
Chunks – VHF and UHF Land Mobile



- The center frequency of 455.3250 is listed in 74.402(b)(4) as a legitimate center frequency.
- The 25 kHz bandwidth is evenly divisible into four 6.25 kHz segments. Therefore, 25 kHz is a legitimate bandwidth under the current Rules.
- Notably, in this hypothetical case, the 25 kHz bandwidth was originally licensed as five 5 kHz segments under the old Rules.

CAVELL MERTZ & Associates, Inc.

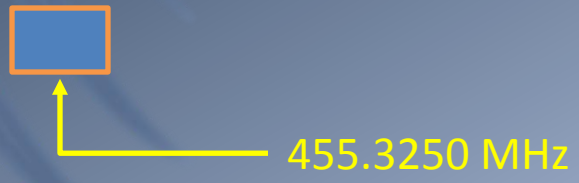
Chunks – VHF and UHF Land Mobile



- Let's take a closer look at what 74.402(b)(4) permits a licensee to do with 6.25 kHz segments centered on 455.3250 MHz.

CAVELL MERTZ & Associates, Inc.

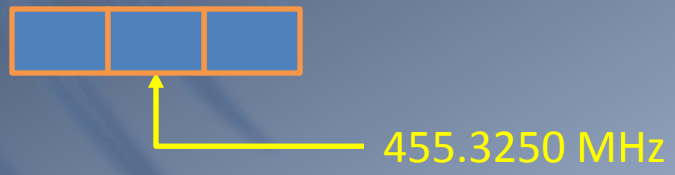
Chunks – VHF and UHF Land Mobile



- One 6.25 kHz segment centered at 455.3250 MHz
  - Resulting Bandwidth: 6.25 kHz

CAVELL MERTZ & Associates, Inc.

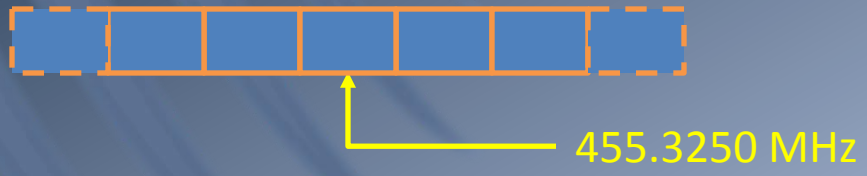
Chunks – VHF and UHF Land Mobile



- Three 6.25 kHz segments centered at 455.3250 MHz
  - Resulting Bandwidth: 18.75 kHz

CAVELL MERTZ & Associates, Inc.

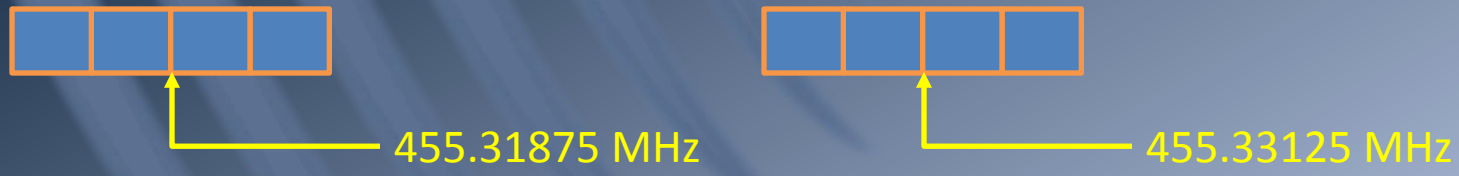
Chunks – VHF and UHF Land Mobile



- Five or seven 6.25 kHz segments centered at 455.3250 MHz
  - Resulting Bandwidth: 31.25 kHz (5 segments)
  - Resulting Bandwidth: 43.75 kHz (7 segments)

CAVELL MERTZ & Associates, Inc.

Chunks – VHF and UHF Land Mobile



- Or, for 25 kHz bandwidth using 6.25 kHz segments, an unconventional center frequency is required.
- Some equipment can't be programmed for unconventional frequencies.
  - Radio and TV stations often use Part 90 (Industrial Business) 2-way equipment for dispatch and communications.
  - This equipment typically doesn't support these unconventional center frequencies.

CAVELL MERTZ & Associates, Inc.

Chunks – VHF and UHF Land Mobile

- SBE has petitioned the FCC to permit 3.125 kHz segments to permit conventional bandwidth and frequencies to remain.
- This approach eliminates the tendency of applying for five segments when only four are needed.

CAVELL MERTZ & Associates, Inc.

Chunks – VHF and UHF Land Mobile

- Under present rules, if you need to change a Land Mobile license, you may be faced with this challenge.
- In VHF bands, operation on non-standard frequencies and bandwidths makes licensee secondary. (See 74.402(e)(10)).

CAVELL MERTZ & Associates, Inc.

Communications Use of Broadband Remote Pickup Channels

- Television stations have access to three microwave bands for ENG (television remote pickup) purposes.
- Television stations can also use 161/450/455 MHz frequencies, which is commonly used for dispatch, IFB, and control room communication.

CAVELL MERTZ & Associates, Inc.

Communications Use of Broadband Remote Pickup Channels

- The only practical bands for radio station remote broadcasting are 161/450/455 MHz.
- The Rules set aside several wide bandwidth 450/455 MHz channels for program audio transmission.
- When a such a channel is used for dispatch, cues, etc., the broadband nature of the channel is wasted.

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- Many Engineering Managers conduct regular audits of their spectrum use and licenses.
- There's much more to this task than checking whether a license exists for each transmitter.
- It is vital that each license is accurate!

CAVELL MERTZ & Associates, Inc.

Why is Accuracy Important?

- Interference Protection
  - New systems are designed every day
  - Frequency coordination is no longer done by local SBE coordinators who are familiar with your facilities.
  - Instead, well-intentioned commercial coordinators must depend on accurate information in the FCC database.

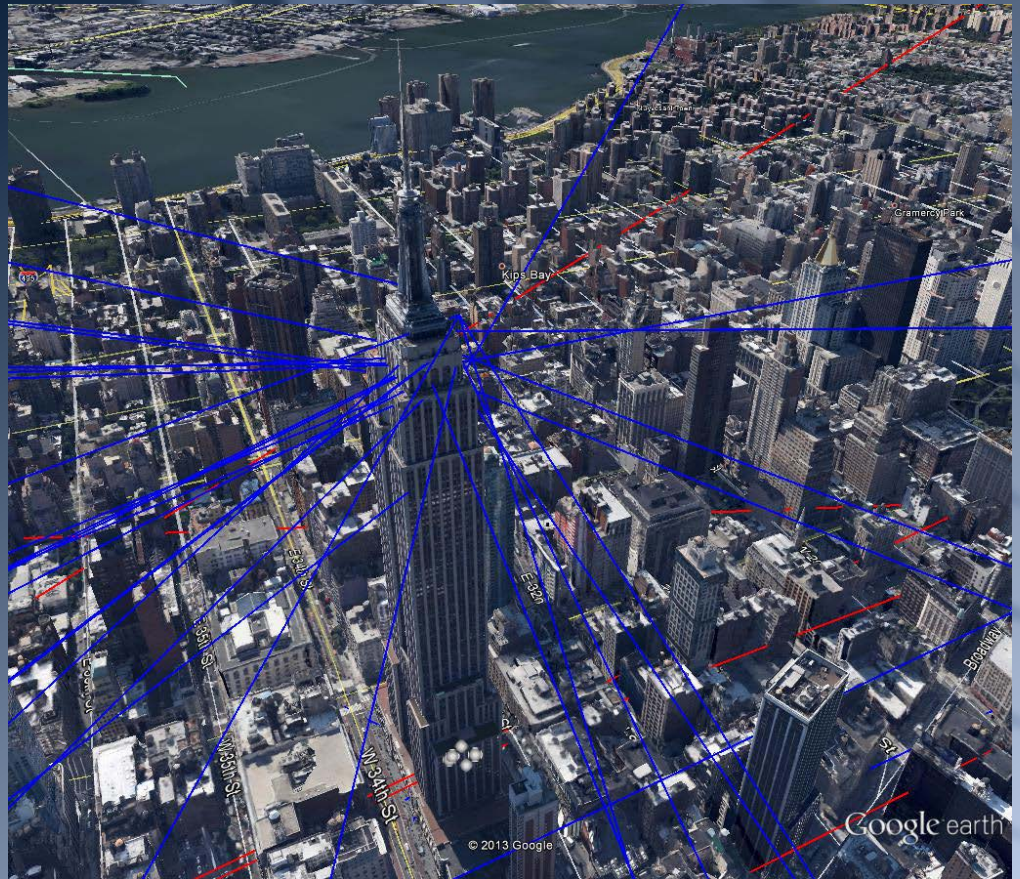
CAVELL MERTZ & Associates, Inc.

Why is Accuracy Important?

- Interference Protection
  - Commercial coordinators are also depending on you… to review and respond (when necessary) to Prior Coordination Notifications.
    - Even if they're 81 pages long.
  - That review is the last "sanity check" before a license application is filed and granted.

CAVELL MERTZ & Associates, Inc.

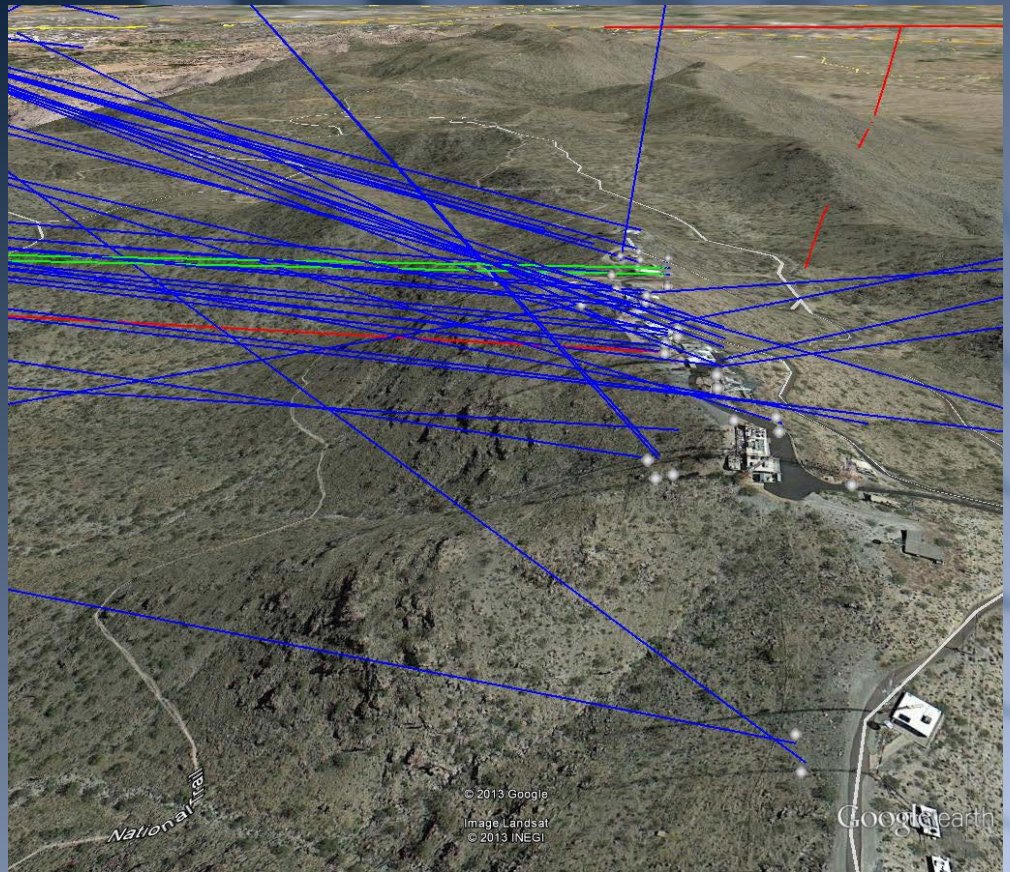
Why is Accuracy Important?



- Premiere broadcast sites may have significant channel congestion.
  - There are many 950 MHz, 7 GHz and 13 GHz Paths at Empire State Building, New York.
  - Not shown: Incoming television pickup (ENG)

CAVELL MERTZ & Associates, Inc.

Why is Accuracy Important?

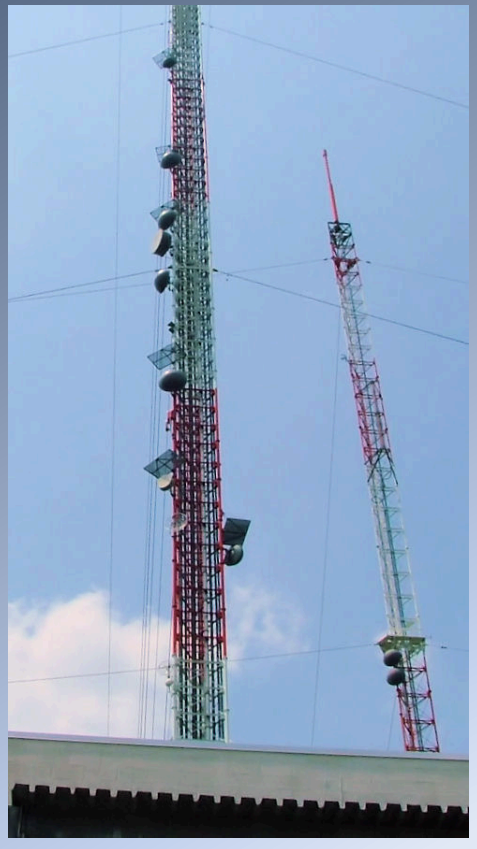


- Premiere broadcast sites may have significant channel congestion.
  - There are many 950 MHz, 7 GHz and 13 GHz paths at South Mountain, Phoenix
  - Not shown: Incoming television pickup (ENG)

CAVELL MERTZ & Associates, Inc.

Why is Accuracy Important?

- Interference Protection
  - Interference occurs at the receiver.
  - Accurate interference prediction and mitigation depends on accurate receiver coordinates and antenna data.
  - Most license data problems relate to omissions in receive site data.



CAVELL MERTZ & Associates, Inc.

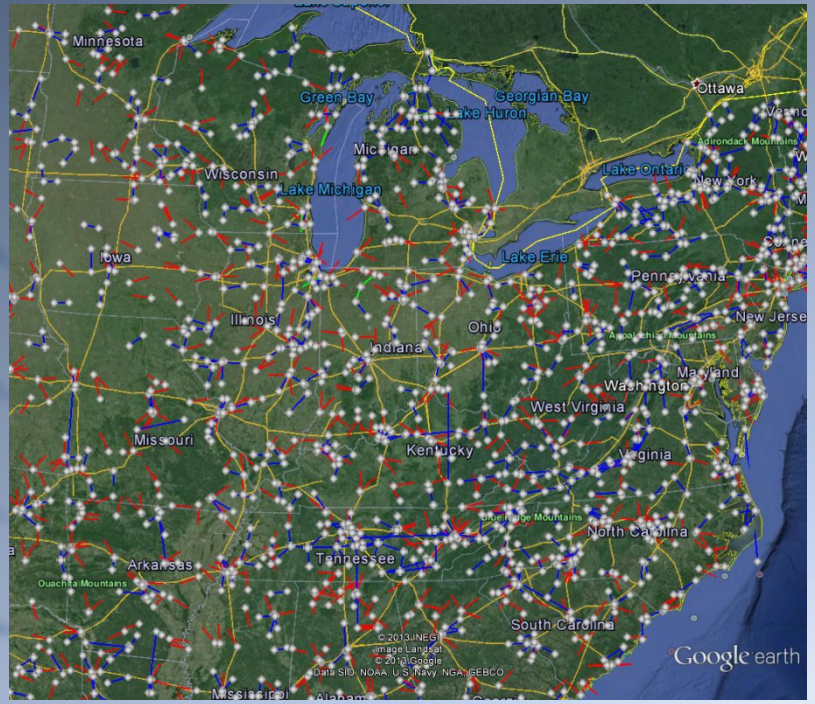
Why is Accuracy Important?

- Interference Protection
  - This argument may not help: "But I was here *first*!"
    - FCC's "First In" policy has proven ineffective when there are omissions or errors in the "First In" license.
    - We are aware of a California radio station that became the victim of interference from a new microwave system.
    - Errors in the radio station license invalidated their "First In" argument and ultimately resulted in the radio station searching for a new frequency.

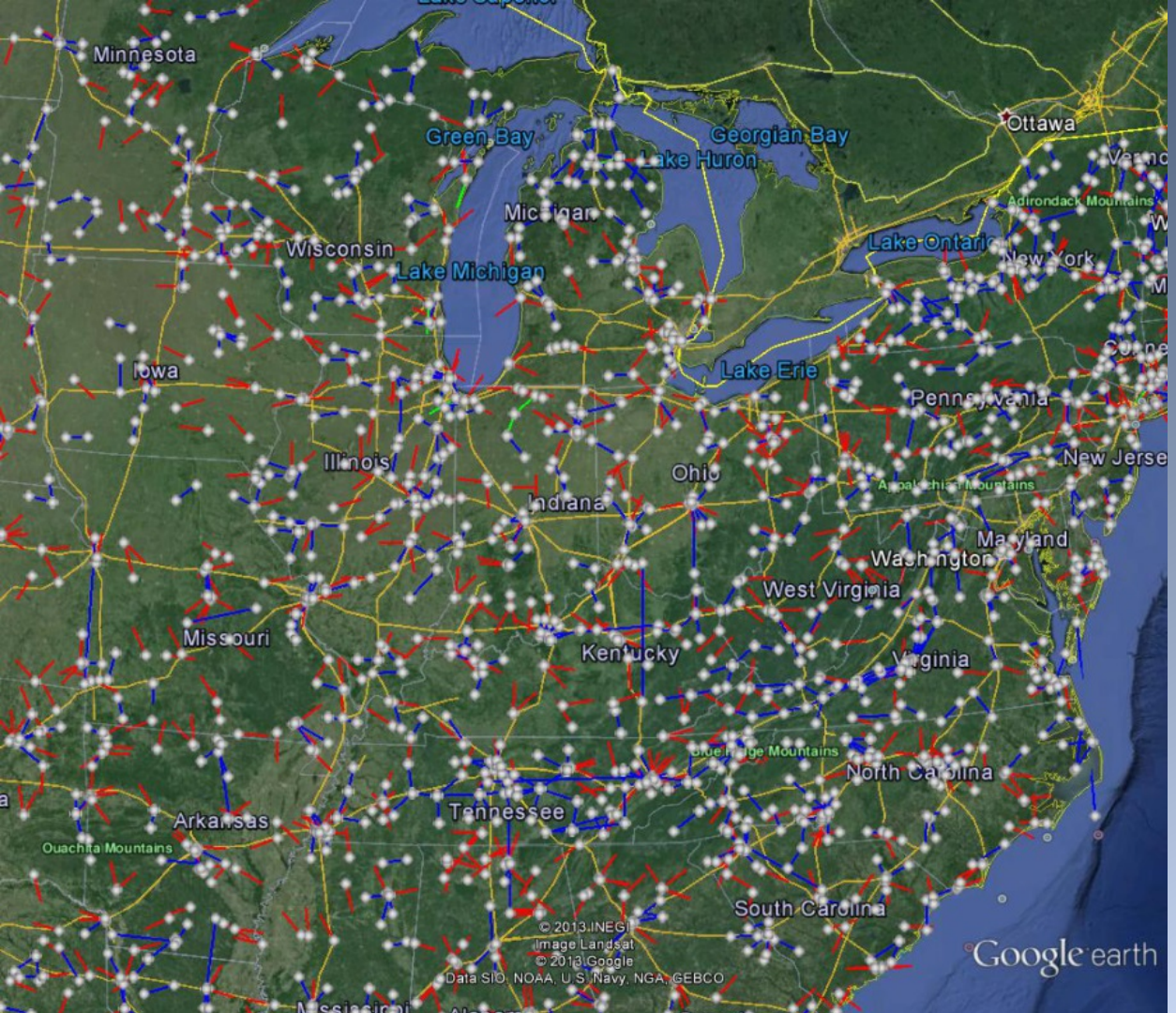
CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- 950 MHz has many fixed links with missing receive locations are shown here.
  - Blue paths have receive location coordinates
  - Red paths are missing receive coordinates but have an azimuth.
  - Paths missing receive coordinates and missing azimuth aren't shown.



CAVELL MERTZ & Associates, Inc.



- 950 MHz Band:
  - Blue: Receive coordinates exist.
  - Red: Receive coordinates are missing but azimuth exists.
  - Not Shown: Paths missing receive coordinates and missing azimuth.

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- A recent CM&A audit of the 7/13 GHz band found 1,961 licenses with obvious problems:
  - Fixed links with missing receive locations
  - Fixed links with receive location coordinates matching the transmit location coordinates
  - Fixed links with transmit azimuth – receive location discrepancies.

CAVELL MERTZ & Associates, Inc.

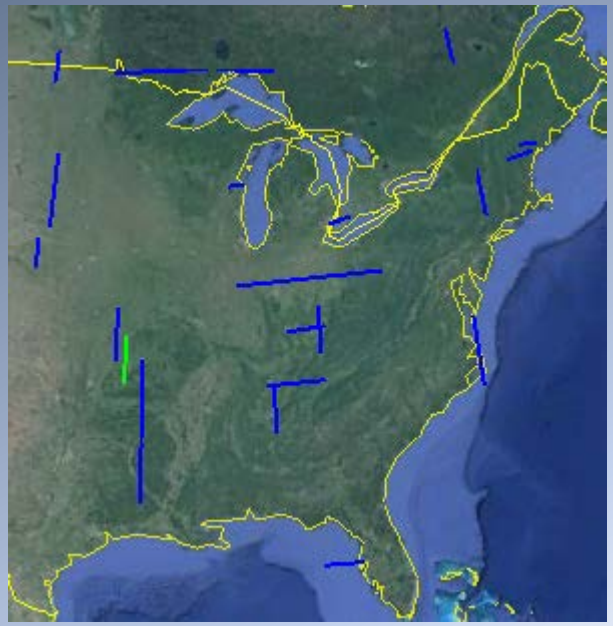
Inaccurate Microwave Licenses

- A Recent CMA audit of the 7/13 GHz band found 1,961 licenses with obvious problems:
  - ENG licenses missing receive locations and specs
    - Now required for 7 GHz and 13 GHz
      - Useful for new industrial microwave users to protect ENG receive sites.
    - Not required for 2 GHz – but recommended.
      - SBE argued for ability to include this data in ULS
      - Useful for new AWS and MSS licensees in adjacent bands to protect ENG receive sites.

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

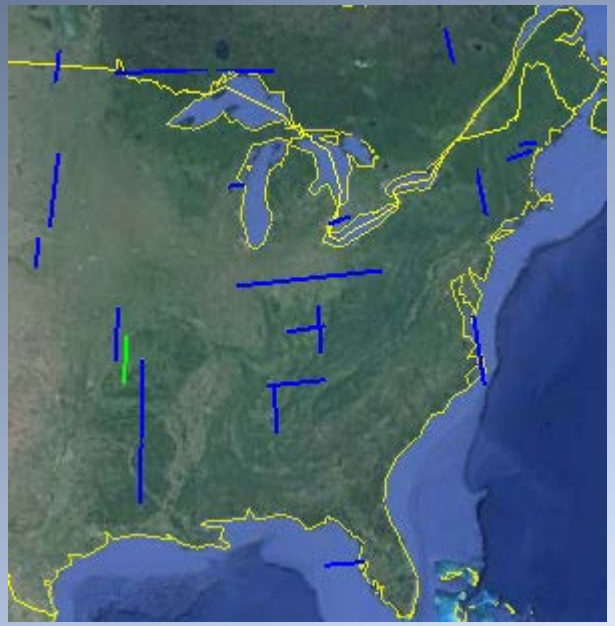
- The audit didn't check for these common but less obvious problems:
  - Missing receive antenna specs
    - Make and model
    - Height above ground
  - Sensible path lengths (Coordinate typos)



CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- The audit didn't check for these common but less obvious problems:
  - STLs that don't originate from the current studio
  - STLs that don't transmit to the current transmitter
  - STLs with Multiple Receive Sites (to Main and Aux Broadcast Tower) that show just one receive site.



CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- The audit didn't check for these common but less obvious problems:
  - Fixed Point-to-Point with TX/RX coordinates reversed
  - Licenses associated to a sister station
    - Once a common practice to associate all AM/FM BAS licenses with AM station.
    - Translator licenses associated with the primary station.

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- The audit didn't check for these common but less obvious problems:
  - Common radio station emission designator discrepancies
    - FM composite (Stereo) modulation on a monophonic FM license
    - Digital modulation on analog license (and vice versa)
    - Digital main STL having an analog backup STL with a single emission designator
    - Incorrect bandwidth (Many options available)
    - Exaggerated transmit power (transmission Line Loss Ignored; makes received signal appear more robust.)

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- The audit didn't check for these common but less obvious problems:
  - Common television station emission designator discrepancies
    - Twinstream® transmitter now operating in all-digital mode under an analog/digital license
    - Digital transmitter operating on an analog license (not uncommon with intercity-relay backhauls)
    - Dyslexia between common designators ending in W7D (COFDM) & D7W (QAM)

CAVELL MERTZ & Associates, Inc.

Inaccurate Microwave Licenses

- The audit didn't check for these common but less obvious problems:
  - Common Installation Discrepancies
    - Polarization Backwards
    - Unrealistic EIRP on license – line loss ignored
    - Peaking microwave antenna on a side-lobe

CAVELL MERTZ & Associates, Inc.

Trends in Electronic News Gathering

- Reduction in mast heights
  - In-Vehicle Pneumatic: 55 feet
  - Roof-Mounted Mast: 15 feet
  - Either way, it's high enough if the path clears obstructions.
- Reduction in antenna gains
  - Traditional ENG: 20 dBi
  - Roof-Mounted Mast: 16 dBi

CAVELL MERTZ & Associates, Inc.

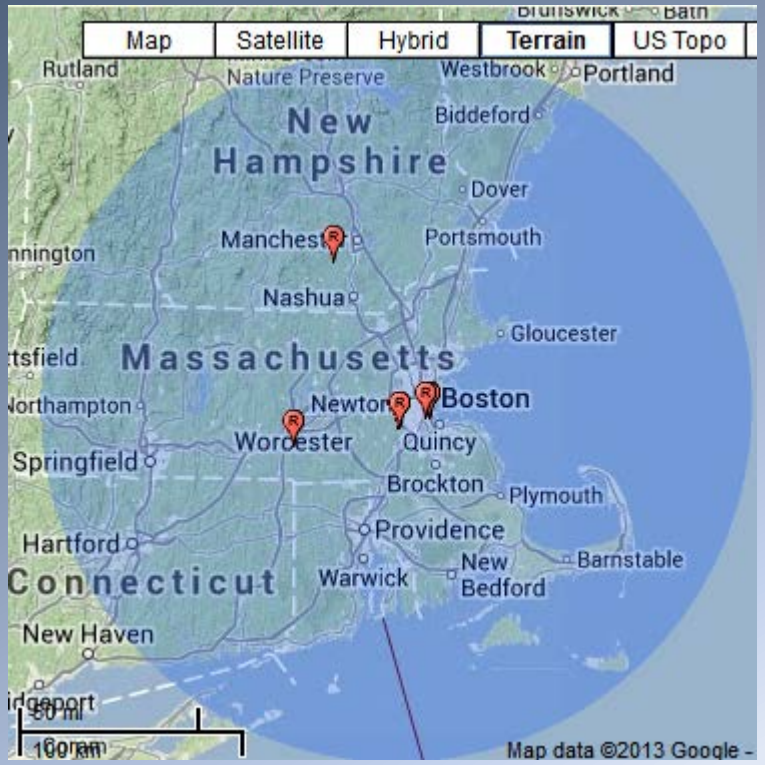
Trends in Electronic News Gathering

- Low height, log gain transmit antennas may make sense when the central receive antenna has great height.
- Even with tall receive sites, path blockage by nearby buildings can be a significant.

CAVELL MERTZ & Associates, Inc.

Trends in Electronic News Gathering

- Suburban central receive sites are becoming more common.
- Less distance to the site reduces signal losses, making low-gain transmitters practical.
- Permits increased efficiency through channel reuse.



CAVELL MERTZ & Associates, Inc.

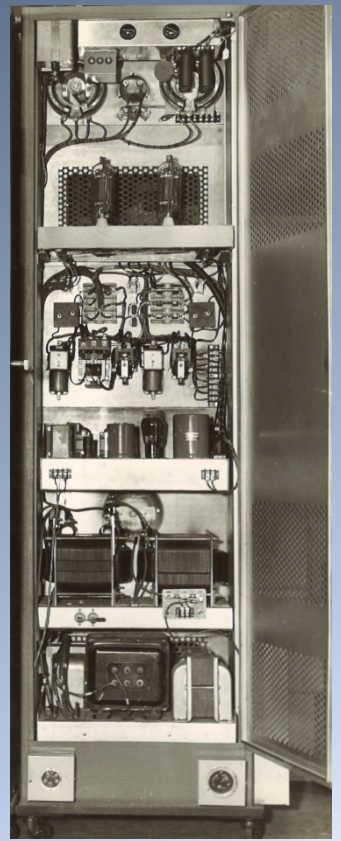
Trends in Electronic News Gathering

- 3G, 4G, WiFi
  - Claimed to go where ENG and satellite signals are impractical.
  - Shared with public, bandwidth isn't always available.

CAVELL MERTZ & Associates, Inc.

Trends in Electronic News Gathering

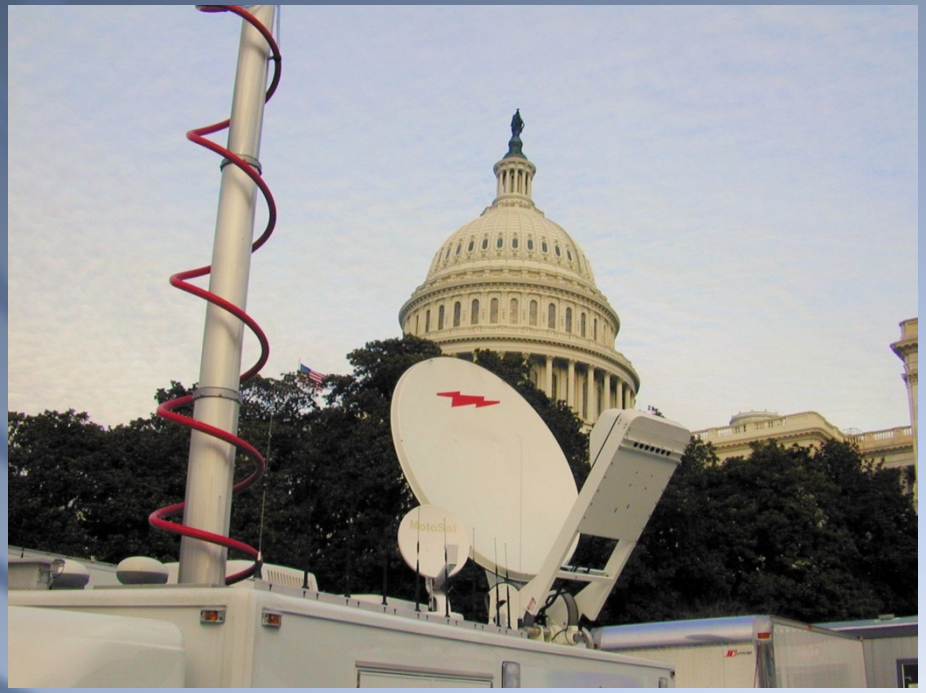
- It's brilliant to use capabilities of "smart phones."
- However, it can be dangerous to become dependent on networks you don't control.
- A client regularly has a "cell phone free Fridays" to test their traditional IFB and communications systems.
- The news staff may complain about using older technology but this is the only way to verify that the equipment works and that the staff knows how to use it.



CAVELL MERTZ & Associates, Inc.

Trends in Electronic News Gathering

- Combination of BAS and Satellite Technology.
  - ENG for “first mile” and satellite backhaul to a distant studio.



CAVELL MERTZ & Associates, Inc.

Questions?

CAVELL MERTZ & Associates, Inc.