

Getting Content to and from the Transmitter Site



Agenda

- Four different technologies:
 - Microwave IP
 - Digital UHF
 - Hardware Codec
 - Composite Codec
- Key Criteria:
 - Cost: Initial / Ongoing
 - Reliability: Outages / Hack
 - Audio Performance
 - SFN suitability
- Your questions



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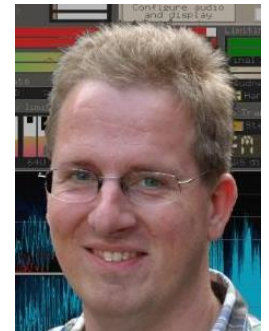
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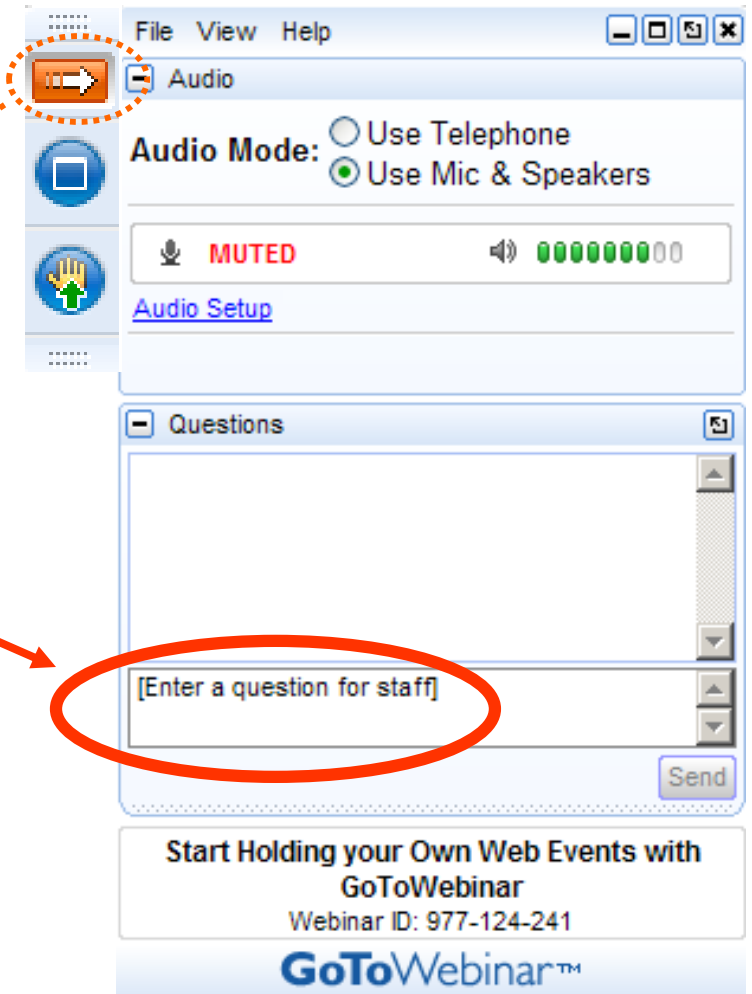
Your questions please?

(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.



Not too many years ago...

You really didn't have many choices:

1. Copper (with EQ if you're lucky)
2. Mono or Stereo VHF or UHF STL, discrete or composite
3. DSL

And the above were often the weak link in the station airchain, both from the reliability and audio performance standpoint

Today however, there are many excellent choices – let's examine them!



950 MHz Digital STL

Moseley

- Advantages
 - Purchase cost moderate – no recurring expense
 - Station owns and maintains and controls
 - Low susceptibility to backhoe and other network outage
 - Channel is licensed and reasonably secure from interlopers
 - Audio performance is crystal clear with a bit identical copy of the input at the output
 - Negligible delay in uncompressed audio
 - With modern compression 4, 6, and 8 channel configurations possible
 - Data channels for HD Radio™ / RDS / μ MPX available
 - Antennas are grids – Many accessories are available
- Disadvantages
 - Limited bandwidth
 - One way by definition STL- No bidirectional data possibilities
- SFN Application Great - negligible throughput latency or jitter
- Security/Hacking – not much vulnerability



900 MHz Data Radio

Moseley

- Advantages
 - Extend the LAN to the transmitter site
 - No license - easy to deploy
 - Uses existing antenna infrastructure
 - Same as the 950 MHz STL control
 - Moderate capital cost - negligible recurring expense
- Disadvantages
 - No license potential for interference
 - Limited bandwidth 1 MB
- Security:
 - You would need another identical radio, spread code, password protection.



LanLink HS900-D



Digital Composite 950 MHz

Moseley

- Advantages
 - Most of the advantages of the 950 digital STL
 - Purchase cost moderate – negligible recurring expense
 - Digital sampled greater than 20 dB system gain advantage over old Analog Composite systems
 - Processing and SCAs injected at studio
 - Can be repeated
- Disadvantages
 - Limited capacity to single station
- SFN Application
 - You can split the composite signal for identical distribution to multiple sites.



Topanga

T1/E1 STL/TSL

Moseley



- Advantages
 - No distance or terrain limitations & Bidirectional
 - Audio performance is crystal clear with a bit identical copy of the input at the output
 - Negligible delay in uncompressed audio
 - With modern compression 4, 6, and 8 channel configurations possible
 - Bidirectional Ethernet data for extending LAN/WAN to TX
 - Data channels for HD Radio / RDS / μ MPX available
- Disadvantages
 - Modest purchase price – high recurring costs
 - Susceptibility to backhoe and other network outage out of station control
 - Limited bandwidth
- SFN Application Great - negligible throughput latency or jitter
- Security/Hacking – not much vulnerability

Starlink SL9003T1



SHF Microwave Links

Moseley

- 6, 11, 18, 23, 26 GHz - Licensed
- Advantages
 - High bandwidth and bidirectional
 - Multiple station audio capacity
 - Channel is licensed and reasonably secure from interlopers
 - Negligible latency
 - AES192 over IP capable
 - Ethernet network applications
- Disadvantages
 - Higher cost – no recurring expense
 - Larger solid dish antennas
 - Somewhat shorter paths
- SFN Application Good - negligible throughput latency or jitter
- Security/Hacking – not much vulnerability



Nx-Gen-T



IP Audio Codecs for Primary and Back-Up STL BRIC-Link & ACCESS: Optimization & Setup



Five Tips for Implementation of IP Audio:

1. Always used a wired, dedicated line when possible
2. Get the best circuit you can afford
3. Ask your service provider for a Service Level Agreement
4. Employ Network Redundancy/Wireless Back up
5. Research the “Secret Sauce”

BRIC-Link & ACCESS: Optimization & Setup

Secret Sauce -- Everybody's Got It



- Dynamic Buffer Management
- High Quality, Low Delay Algorithms
- Error correction techniques such as FEC
- NAT Traversal
- SIP based Interoperability (more efforts being made on this)
- Some level of redundancy

BRIC-Link & ACCESS: Optimization & Setup



Comrex Secret Sauce:

BRIC Technology

BRUTE (BRIC UDP Transmission Enhancement)

UDP Reliability Mode

- Resend-based error correction or ARQ

- Uses TCP based NACK but with dramatically reduced overhead

Congestion Avoidance Mode

- Encoder throttling at request of decoder

The Power of the Profile

<http://74.94.151.149/>

BRIC-Link & ACCESS: Optimization & Setup



A Few Words on Security:

1. Change the Default Password
2. Don't put the codec on an IP with searchable URL
3. Secure the Web Interface (TCP80) behind firewall with VPN
4. Use Connection Password functionality
5. If not in use, disable SIP/EBU 3326, HTTP, SSH and RTP. Change SIP Port.
6. Apply an encrypted VPN to both ends of your connection
7. Flash Exploits: Use a dedicated non-Flash app



CrossLockTM VPN



Allows simultaneous use of multiple networks to increase bandwidth and improve reliability

Includes the “next generation” of BRUTE reliability tools

- Improved Congestion detection

- Redundant Transmission

- FEC

- Deadline sensitive transmission

Adaptive Management Engine

- Monitors each network link

- Applies the most appropriate tools for network conditions





CrossLockTM VPN



CrossLock Modes

Bonding

Best choice for unreliable networks like 4G

“Bonds” multiple data channels

FEC and ARQ do the bulk of the work

“Quarantines” bad networks

Redundancy

Best choice for reliable, high bandwidth networks

Employs ARQ, FEC and Throttling as necessary



CrossLockTM VPN



Available in Firmware Version 4.0 for
ACCESS 2USB

ACCESS Rackmount

BRIC-Link and BRIC-Link II codecs

Advantages of an IP STL



- Bi directional
- Layer 2
- Extending your LAN
 - Radio and/or TV Audio and Video
 - VOIP
 - Video Security
 - Remote Control Data

So many options, Where do I start?



- **Unlicensed**
 - High Throughput
 - Low Latency 5-10ms
 - Possible Interference
- **Licensed**
 - High Throughput
 - Ultra Low Latency <1ms
 - No Interference
- **Piggyback**
 - Using your existing 950Mhz STL to add IP
 - Low Throughput

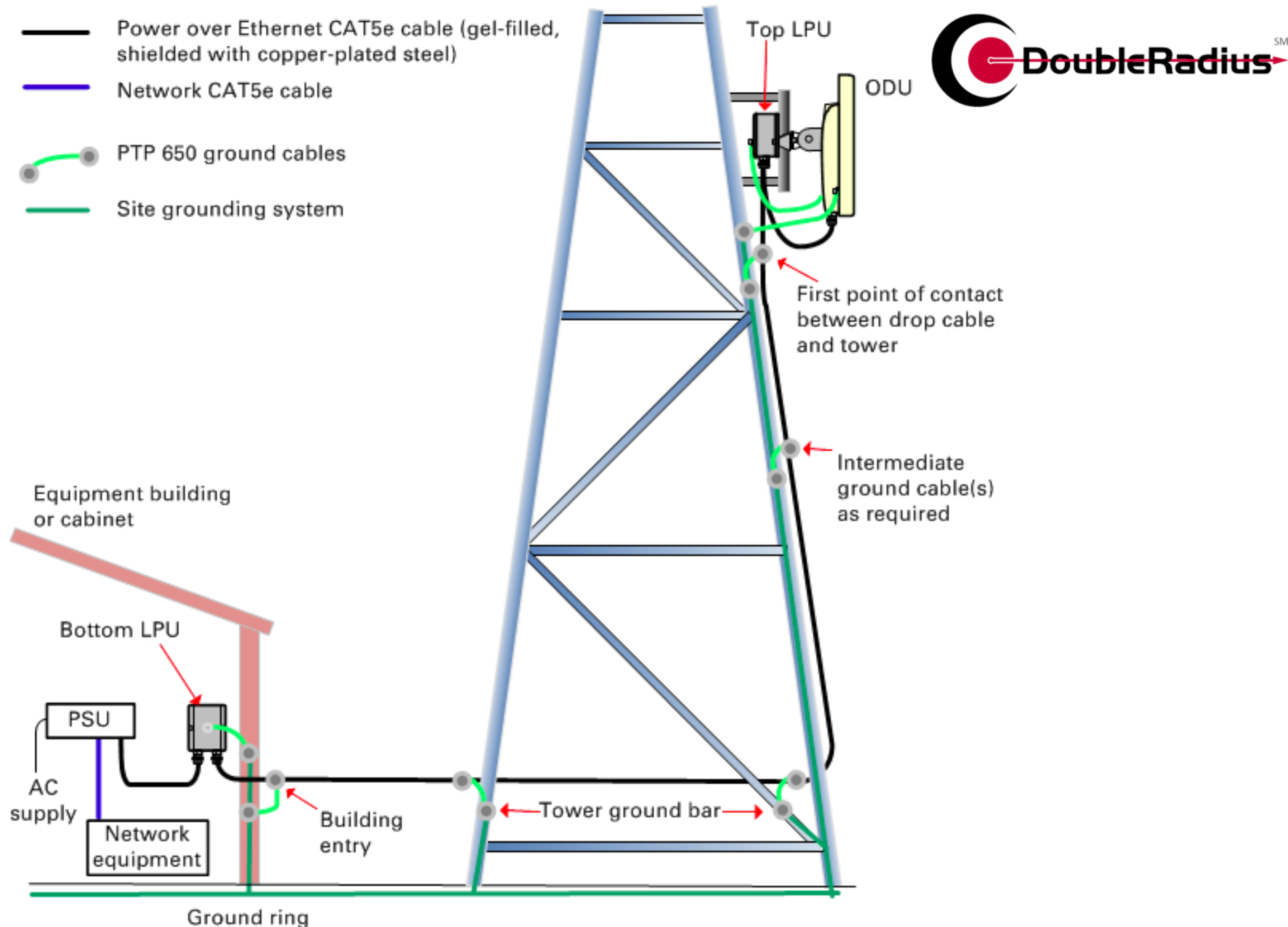
Deployment Options



- All outdoor
 - Radio mounted with antenna
 - Usually POE
 - Lowest cost of ownership
- All Indoor
 - Radio mounted indoors
 - Most reliable
 - Highest cost of ownership
- Split System
 - Radio mounted with Antenna
 - CA5, TDM, SFP, and ASI ports on the ground
 - Middle road cost of ownership

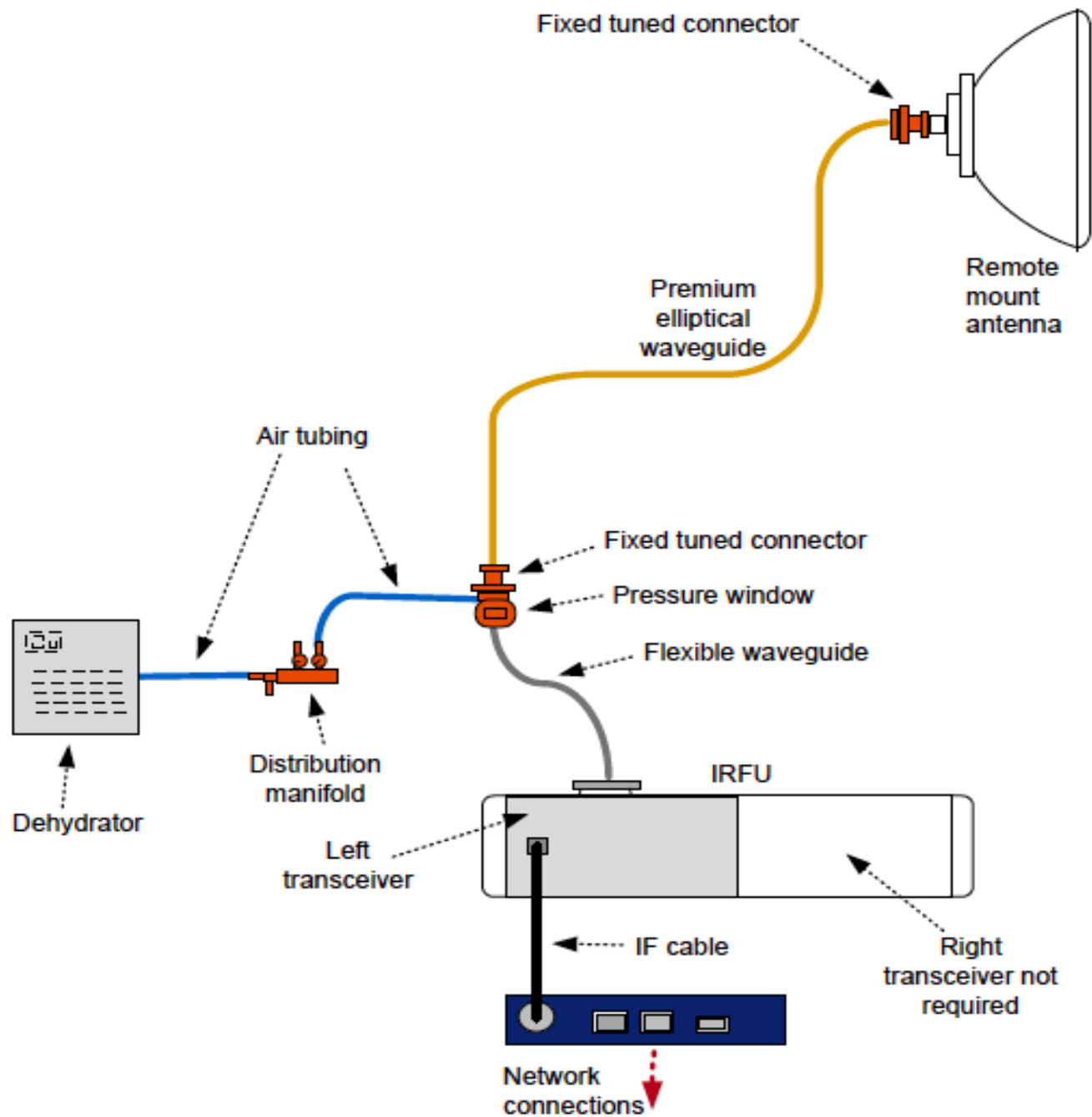
All Outdoor

- Cat5 POE
- Fiber and DC



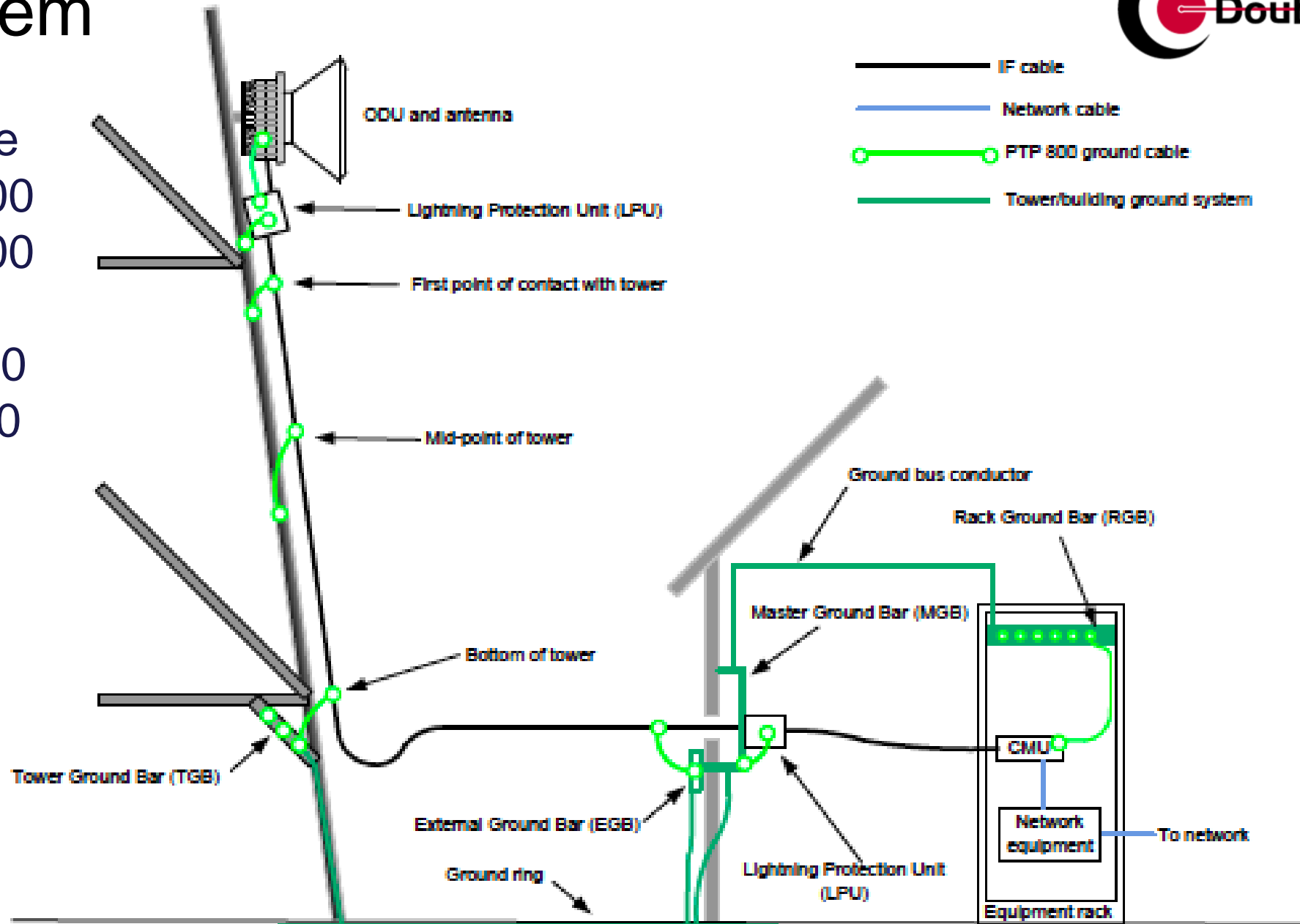
All Indoor

Elliptical Waveguide

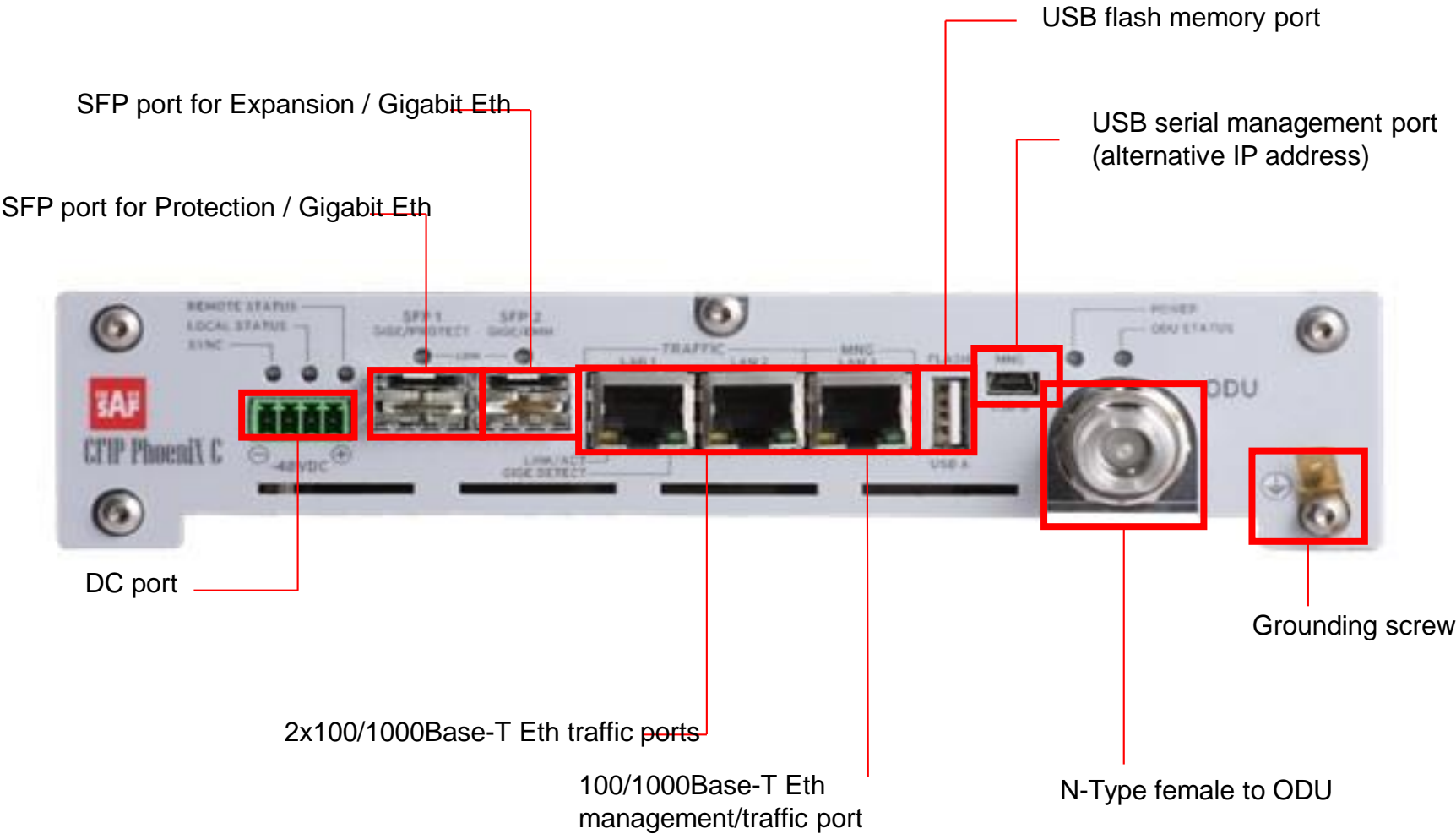


Split System

- Coax Cable
 - LMR 400
 - LMR 600
- Heliax
 - LDF4-50
 - FSJ4-50



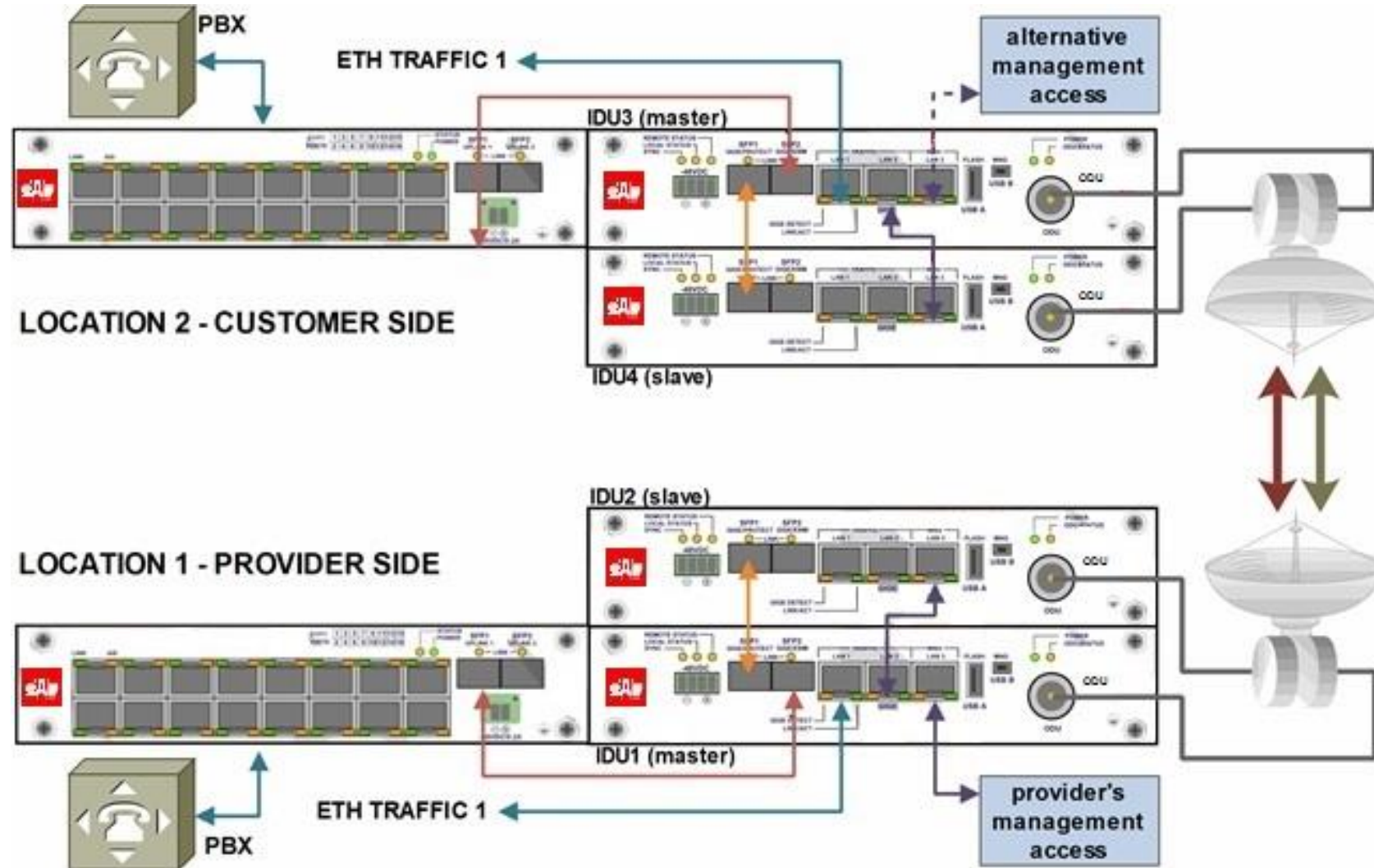
Typical Indoor Unit



1+1 Frequency Diversity



- Universal RF protection scheme
- Simple SW reconfiguration from Master to Slave IDU mode
- Two frequencies must be used
- Hitless Rx and Tx switchover
- HW protection for analog components: ODU and IF connections



Bottom Line

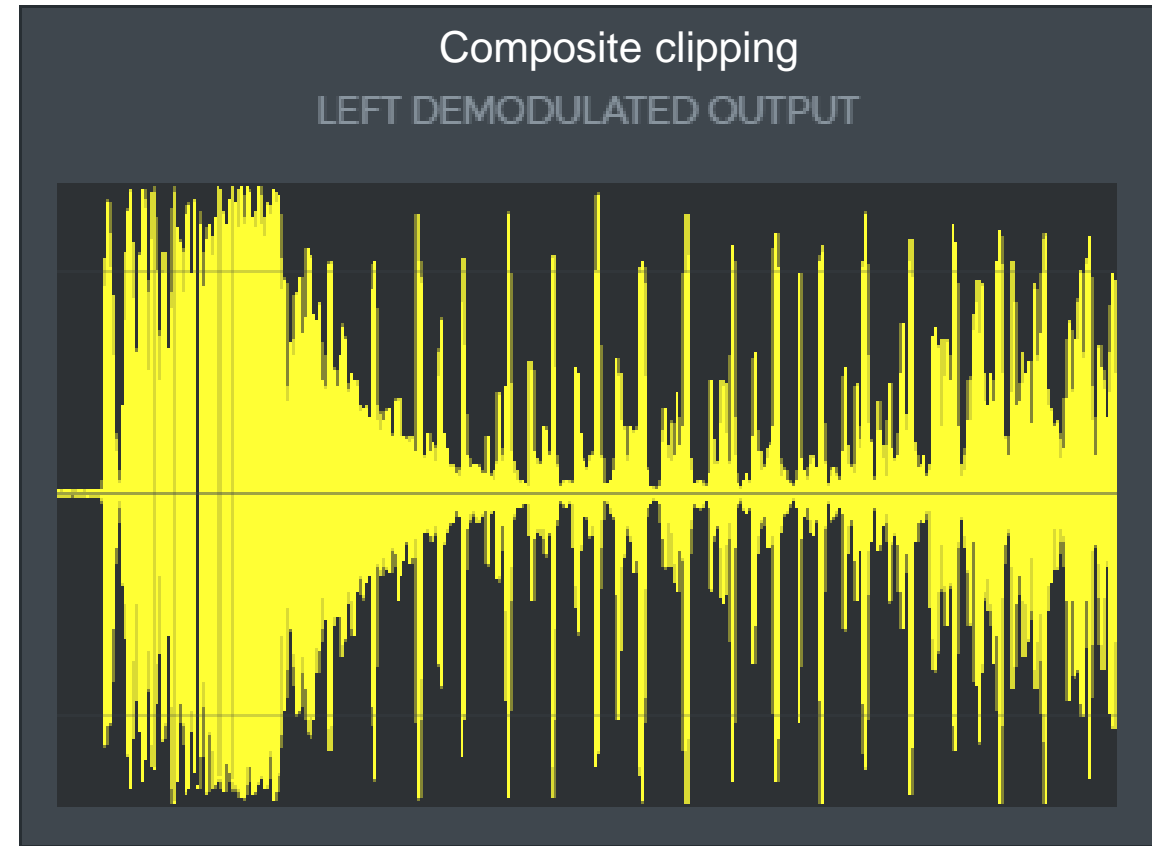
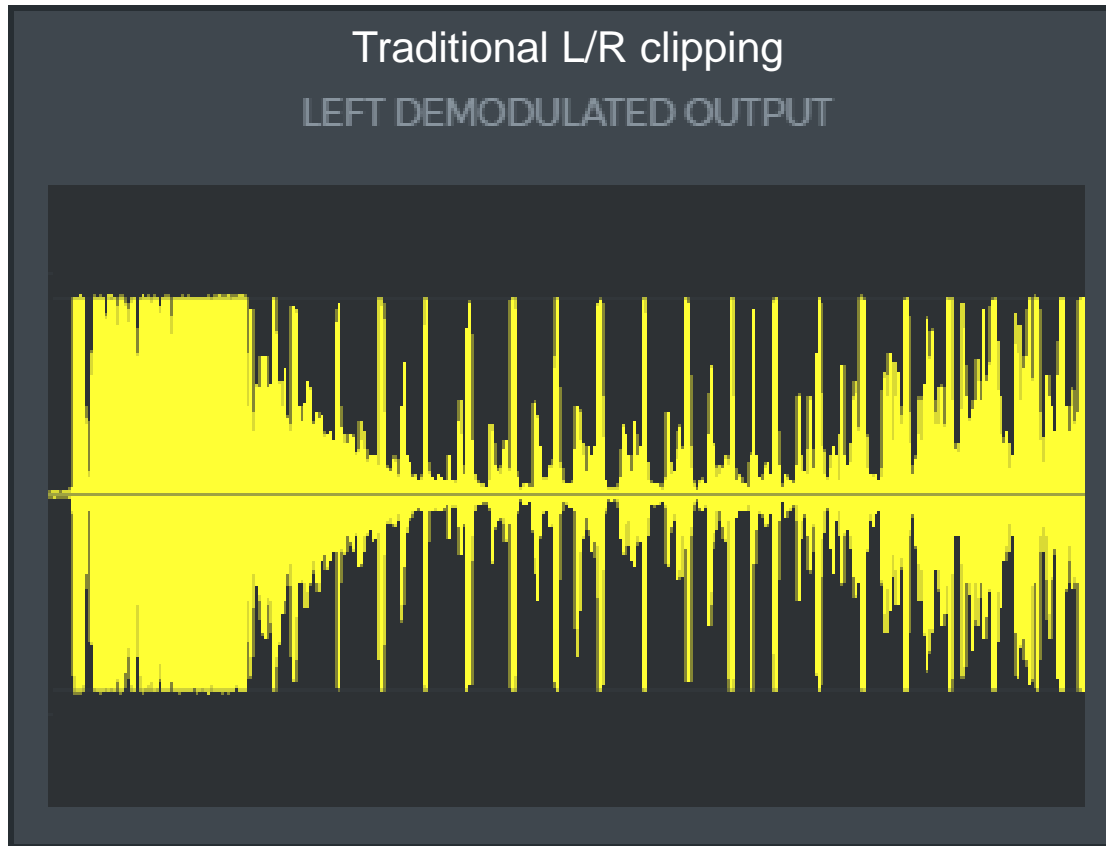


1. Do a Path Calculation
2. Have someone else do the same path calculation from scratch
3. Call Jeff

Finally- Ask questions about the differences

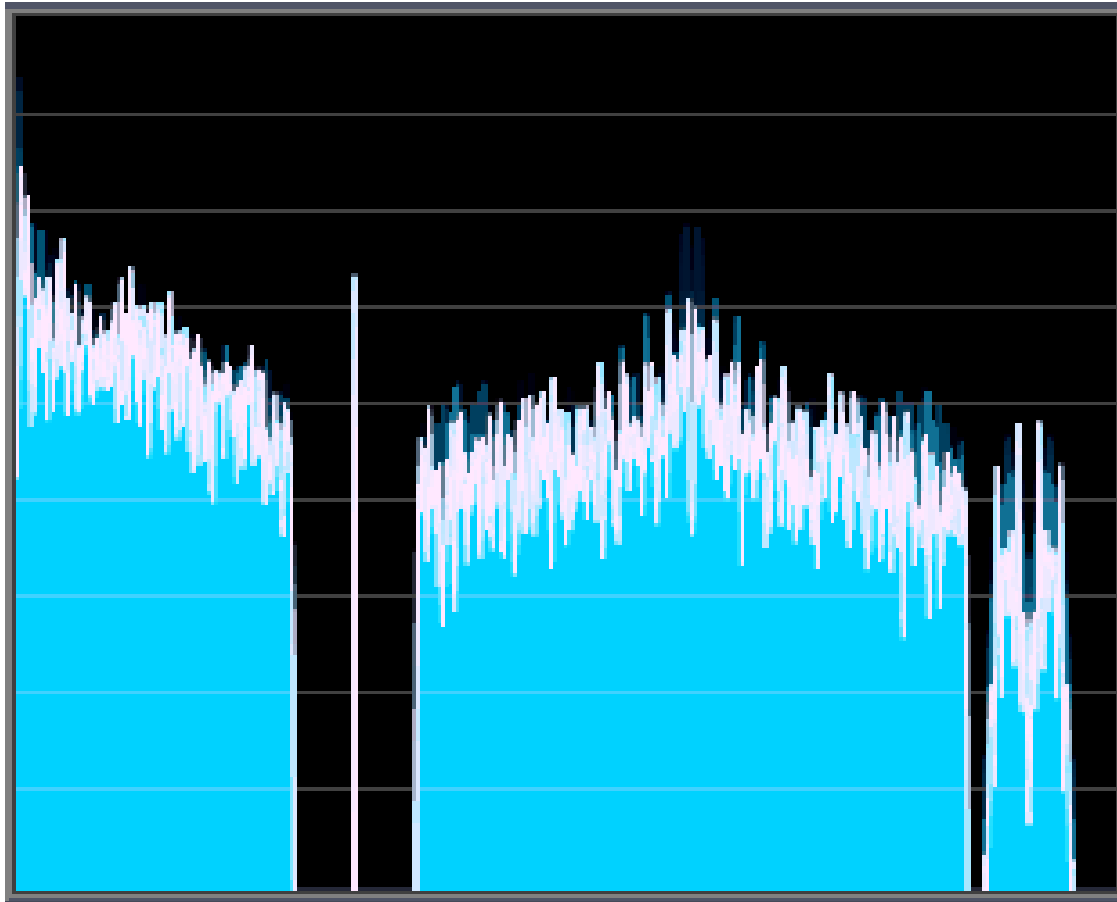
Composite clipping

- Louder & more dynamic: Typically 2-3 dB more highs
- Clipper can optimize MPX signal for better reception, less multipath



Effect on reception

Clean MPX signal → bigger stereo reception area



MPX over IP: Typical bandwidth requirements

- **Full MPX spectrum including pilot and RDS**

PCM 192 kHz x 16 bits = **3 Mbit/s**

PCM 128 kHz x 16 bits = **2 Mbit/s**

PCM 128 kHz x 12 bits = **1.5 Mbit/s**, increased noise floor

+ error correction data

+ network overhead



μMPX bandwidth requirements

- **μMPX: 320 kbit/s**

+ error correction data
+ network overhead



Send it over any IP connection, including over satellite, multiple μMPX streams over a single 950 MHz connection, etc.

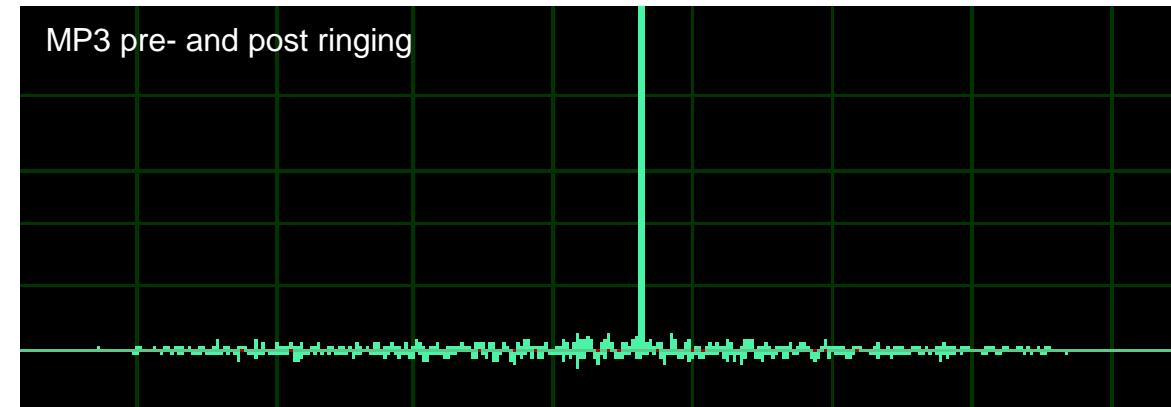
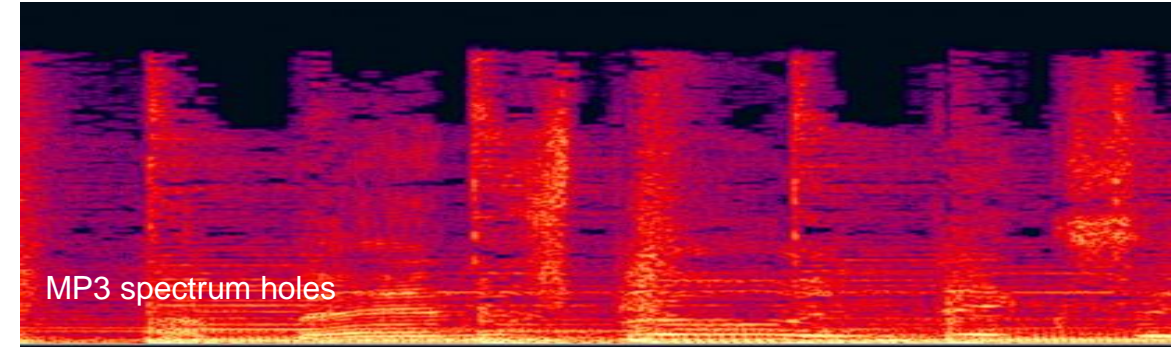
μMPX advantages

Designed specifically for FM!

- No holes in the spectrum
- No pre- and post ringing
- Perfect peak control
- > 100 dB pilot and RDS protection

Artifacts:

- White noise only, easily masked on FM
- Level more than 6 dB lower than MP3 artifacts at 320 kbit/s



μMPX redundancy, security and other features

Current version:

- Forward error correction
- Redundant links via multiple connections (cables, providers)
- Unicast and multicast

Planned:

- Stream password protection (next version)
- SFN support
- Lower bitrates

μMPX pricing and availability

Software:

- As software, list price for each encoder or decoder is \$395
- In with Omnia SST (\$995 without μMPX, \$1395 with encoder + decoder)

Hardware:

- Omnia.9 (next update) and Omnia.7 (planned)

Future:

- Hardware encoders and decoders
- Built into transmitters...



End User Expectations... and Reality



Expectations:

- Must work at all times (7 nines reliability)
- Must not introduce any coding artifacts that the listener can interpret as a problem with the station
- Must have the ability to be easily serviced
- Must have some form of redundancy
- Security is paramount

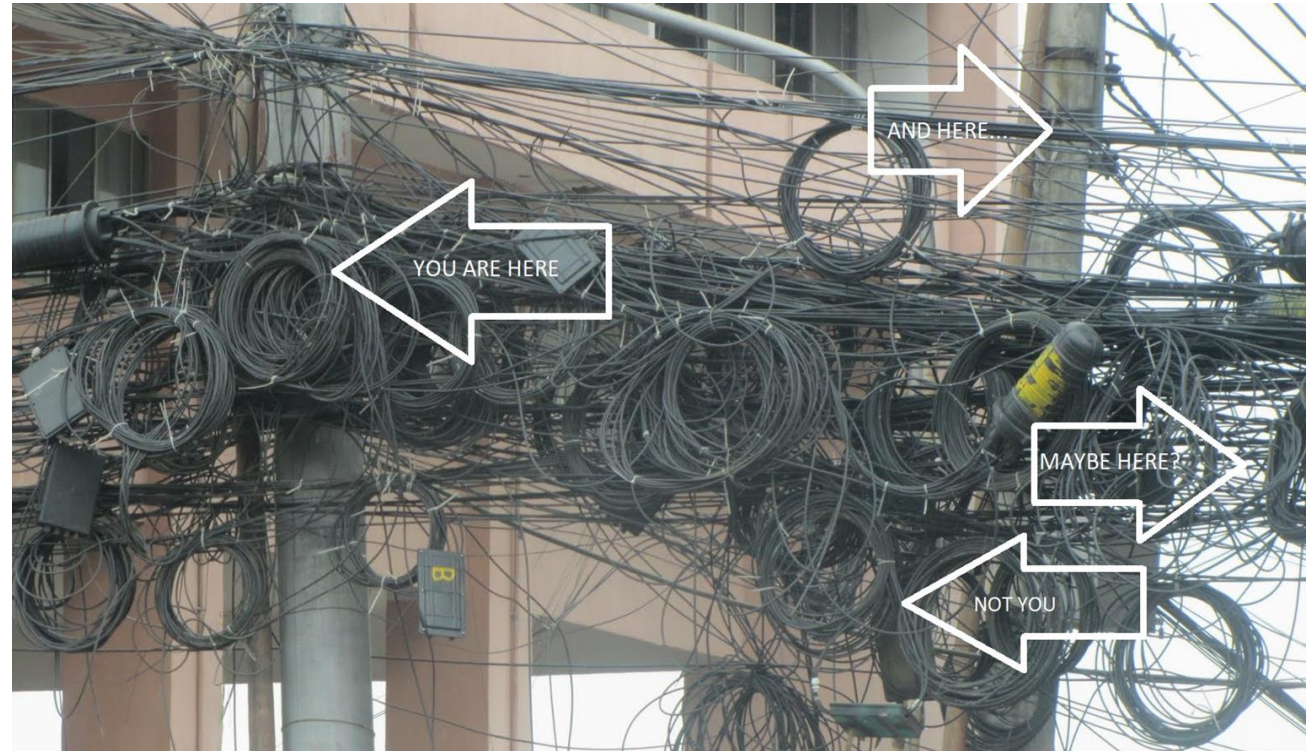


Reality: Pick three...

“Traditional” STLs

T1/E1/ISDN Telco lines - Very expensive, little to no control, whim of the phone company, repair can take WEEKS. Security is generally good.

950Mhz Microwave - Total control over link, bandwidth limited, very reliable... until it isn't. Typically no return path. Proprietary coding keeps the security high.



New World Order

IP STL/TSL “Link” - Total control, inexpensive (generally), bi-directional, IP-Based!

Pros:

- Audio (multiple channels even!)
- Control
- Phone lines
- Remote file storage / Emergency backup
- Studio-to-studio links
- Anything IP based JUST WORKS...

Cons:

- Unlicensed option can have random interference from things like household wifi or other PtP links from commercial sites (WISPs)
- Licensed option can be cost-prohibitive for smaller stations
- Requires some advanced IT knowledge



But, Which One?

Hardware Based Solutions:

AolP plant? Axia iPort - Wheatstone Edge Blade

More traditional? Comrex, Tieline, Worldcast, Moseley.

Pros:

- Setup with minimal configuration
- Factory support
- Standalone unit
- Most have built-in failover link detection systems for redundancy
- PtMP - Network and SFN applications

Cons:

- Interoperability between brands is limited to “standards-based” codecs... maybe.
Depends on implementation.
- Can be expensive - Depending on implementation
- Firmware updates may not address specific issues
- Security concerns require factory intervention



But, Which One?

Software Based Solutions:

OpenOB, uMPX, gstreamer, VLC, OBS, Dante, Livewire, Wheatnet, Shoutcast/Icecast

Pros:

- Very inexpensive compared to hardware
- User community is very common
- Runs on commodity PC hardware
- Redundancies can be built-in to N+1 based on hardware and CDN, even cloud or virtualization options
- PtMP - Network and SFN applications

Cons:

- Very complex implementation and setup
- Support can be non-existent, abandonware
- Security and buffering issues can render it useless



But, Which One?



Answer...



The one that fits you and your comfort level the best.

Security Concerns

Otherwise known as “the problem with all of them”.



- Best practices if using Public Internet or other non-direct link is to use a VPN appliance/router to ensure the link is obfuscated from the public world. Contrary to popular belief, VPNs are **NOT** difficult to configure.
- VPNs add latency overhead due to encryption, Added “X-Factor” for HD/SFN network delay settings.

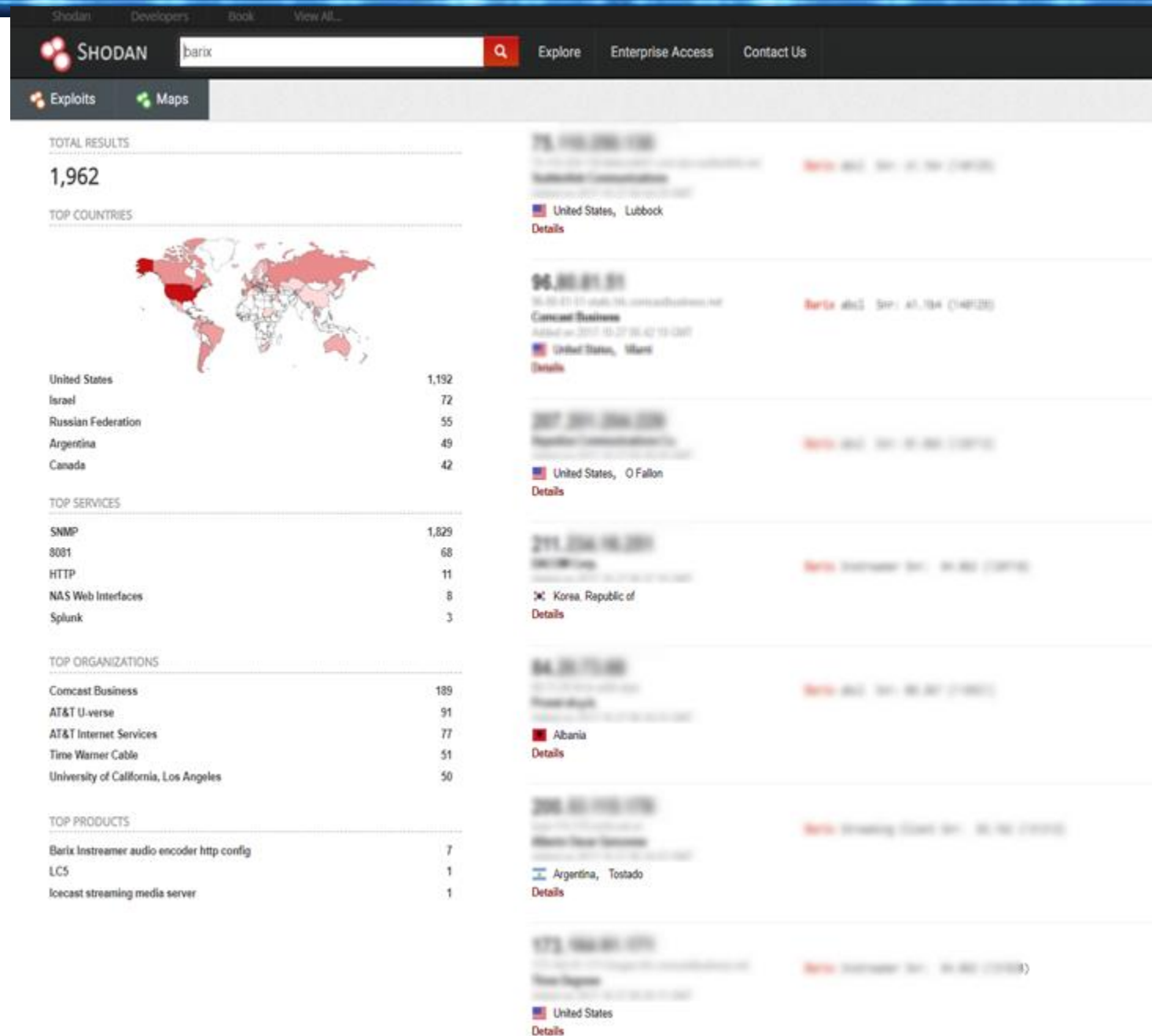
***CHANGE THE DEFAULT
PASSWORD EVEN IF YOU USE A
VPN!***



Security Concerns

Shodan.io knows about you, and your equipment...

- Low hanging fruit.
- Default passwords, public IP's from either poking holes in firewalls or foolishly assigning a static public IP address to equipment leaves you open to attack.
- Hackers can either take over your station, or change settings to require you to reset the hardware, or worse, penetrate your network and give you a very, **very** bad day.

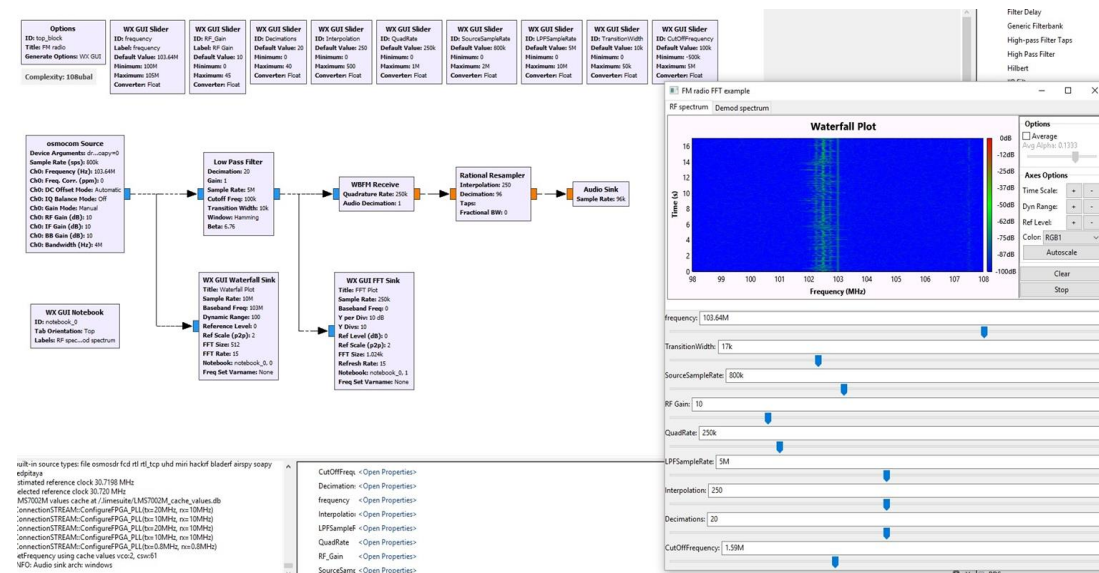


The screenshot displays the Shodan search engine interface. At the top, there's a navigation bar with links for 'Shodan', 'Developers', 'Book', and 'View All...'. Below this is a search bar containing the query 'barix'. To the right of the search bar are links for 'Explore', 'Enterprise Access', and 'Contact Us'. Below the search bar, there are tabs for 'Exploits' and 'Maps'. The main content area is divided into several sections: 'TOTAL RESULTS' showing 1,962 results, 'TOP COUNTRIES' with a world map and a list of countries (United States, Israel, Russian Federation, Argentina, Canada), 'TOP SERVICES' (SNMP, 8081, HTTP, NAS Web Interfaces, Splunk), 'TOP ORGANIZATIONS' (Comcast Business, AT&T U-verse, AT&T Internet Services, Time Warner Cable, University of California, Los Angeles), and 'TOP PRODUCTS' (Barix Instreamer audio encoder http config, LCS, Icecast streaming media server). On the right side, there are several search results listed, each with a country flag, a name, and a 'Details' link.

Security Concerns

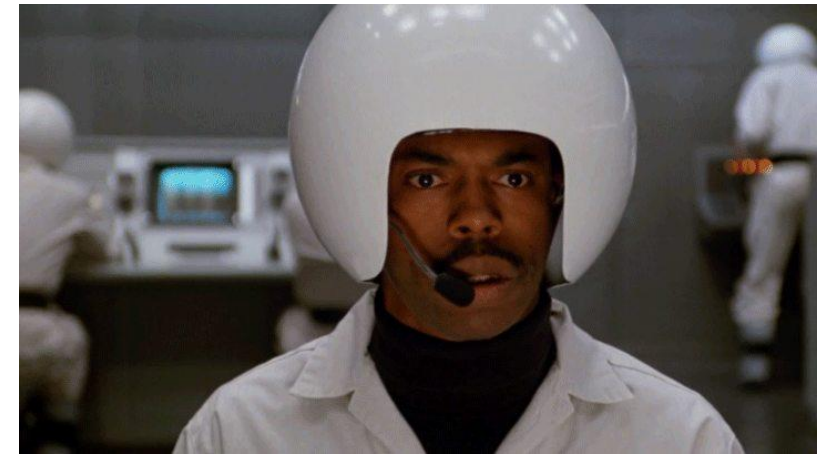
RF hacking, the final frontier...

- Common SDRs and other WiFi tools are available to “sniff” the air nearby or even miles away with directional antennas to decode passwords.
- WPA recently determined to be insecure due to protocol flaw.
- Ubiquiti uses a different modulation scheme to obfuscate from other devices (AirMax)



Realities Realized Your Mom was right...

- Nothing's perfect. Nobody has it completely right, but they're getting closer.
- Hackers will build a bigger hammer and have better tools than you do in your IT warchest.
- Gone are the days of 7-Nine's worth of uptime. You will have off-air time here and there.
- The guys who know what ISDN and a T1 is, have retired.
- The phone company doesn't want to be a phone company anymore.
- Backups only work if you test them regularly.
- IP STLs can do a lot more than traditional systems of yesteryear.

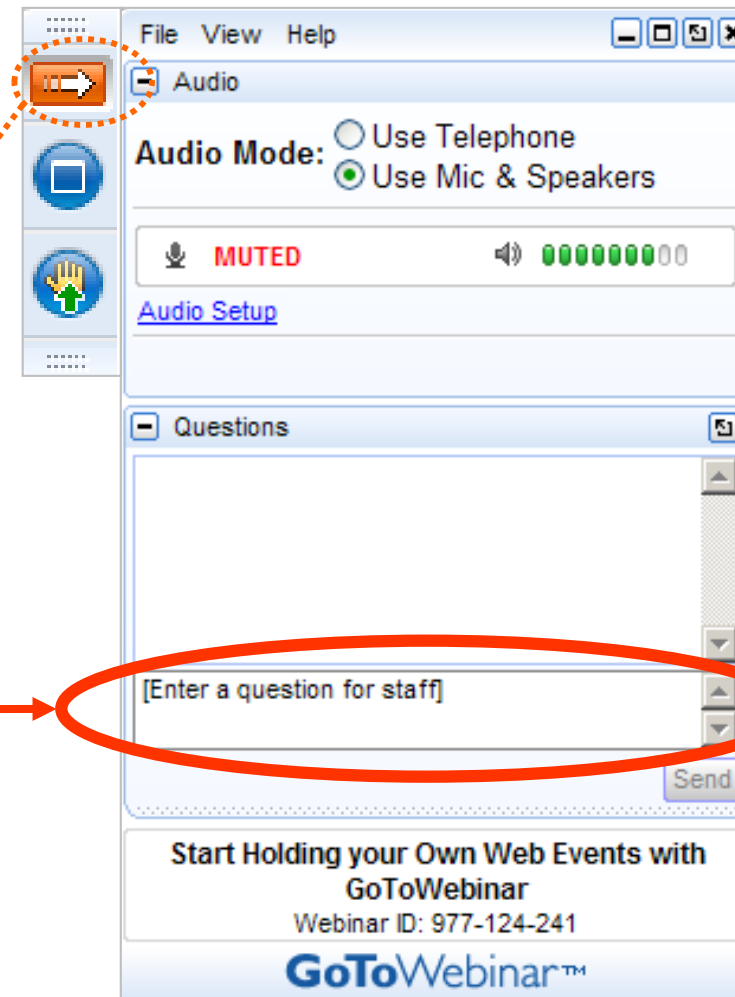


1-2-3-4-5 is still a bad password for your luggage, and your transmitter.

Questions?

Click on  to open/close webinar panel

Enter questions here
...then press **Send**



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In this issue
Introducing the New DV Series 3.5 - 66 kW



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