

Radio Frequency Interference

**Regional Preparatory Workshop for
WRC-15**

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**US FAA Spectrum Engineering
Services**



**Federal Aviation
Administration**

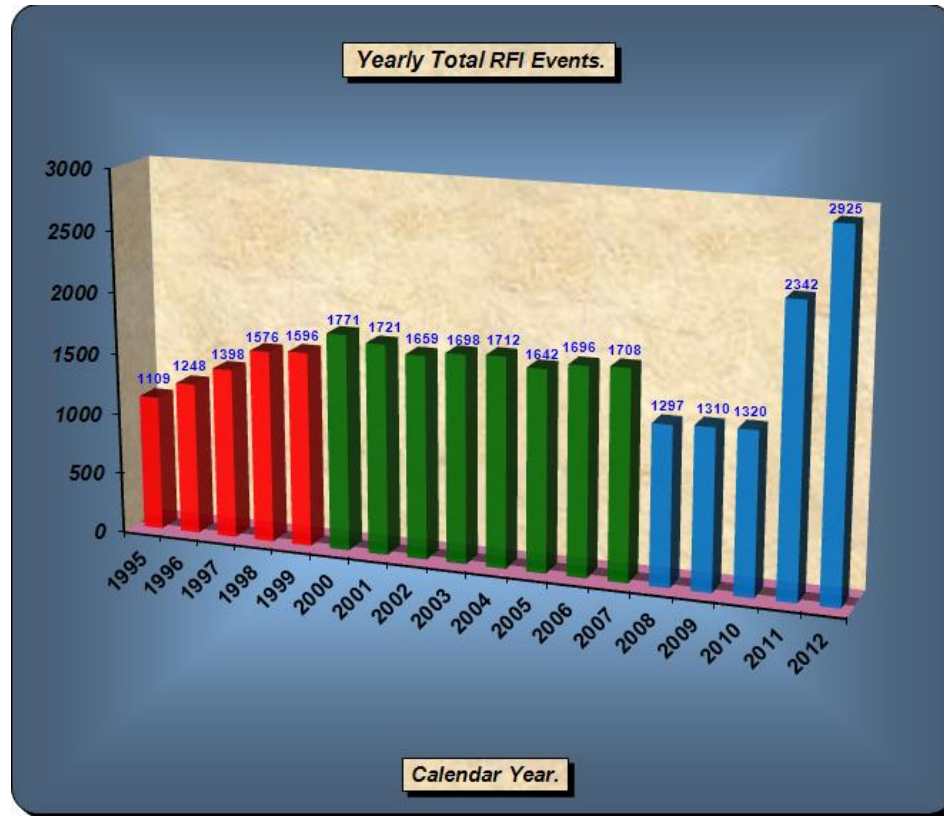


What is Radio Frequency Interference (RFI)?

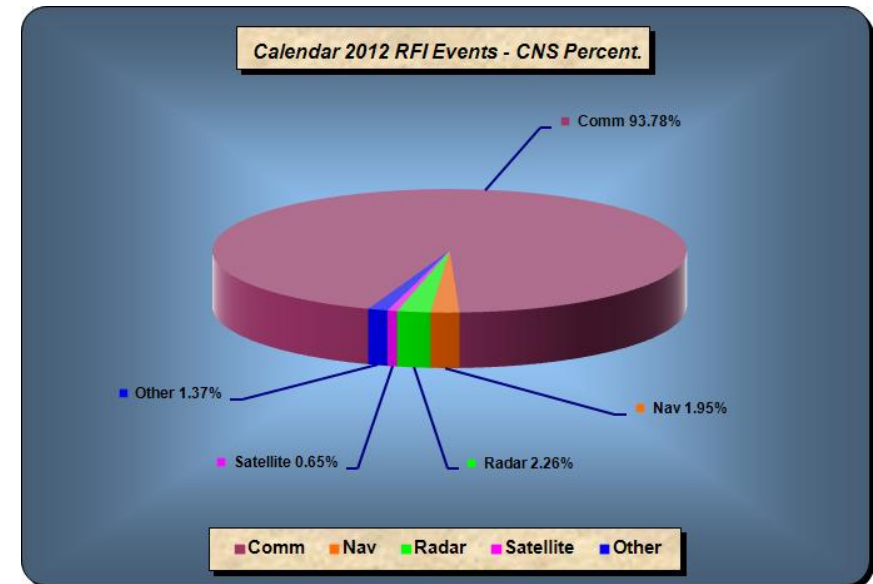
- **ITU Definition:** The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.
- **Criteria to mitigate inter-system interference are established as an element of ICAO SARPs.**
 - E.g., 8 dB D/U for co-channel DME assignments



US RFI Yearly Activity Statistics



- Maintenance Management System (MMS) Data
- Event Manager System (EMS) Data
- Spectrum RFI Tracking System (RFIT) Data



RFI Categories

→ Authorized Transmissions

→ Properly Licensed (i.e. FM, AM, TV)

→ Unauthorized Transmissions

→ Wireless Video Cameras



→ High Power Cordless Telephones

→ Unlicensed Pirate FM Stations Spurious

→ Intentional

→ Unauthorized Jamming

→ "Phantom" Controllers

→ Unintentional

→ Spurious Transmissions



RFI Sources

→ Citizens Band (CB) Radios (5th harmonic)

→ Paging Systems 

→ Stuck Microphone Transmissions

→ Cell phone Spurious Emissions 

→ Electronic Attack (EA) Missions 

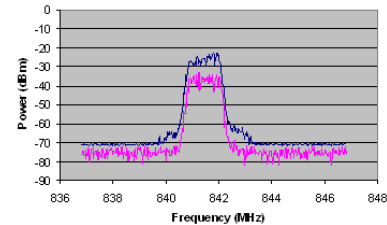
→ Power line Noise (Broadband Noise)

→ Anomalous Propagation

→ Atmospheric Conditions

→ Amateur “HAM” Radio

→ Land Mobile/Dispatch 



US National Airspace System RFI

→ **Most Common Source of RFI:**

- Unauthorized Transmissions
- Pirate FM Broadcast Spurious

→ **Most Common FAA Victim:**

- VHF/UHF Voice Communications

→ **Most Difficult RFI to Resolve:**

- High Altitude Pilot Only Reported RFI
- Intermittent RFI (Airborne/Ground)
- Broadband RFI on Many Frequencies
- Phase Shift Keying RF Transmissions



US RFI Investigation Resources

→ **FAA Personnel and Organizations:**

→ **ATO Spectrum Engineering Services**

- **Headquarters**

- **Technical Center**

- **Command Center**

→ **Frequency Management Officers (FMO)**

- **Technical Operations Service Areas**

- **Aeronautical Center**

→ **Technical Support Field Specialists (Technicians)**

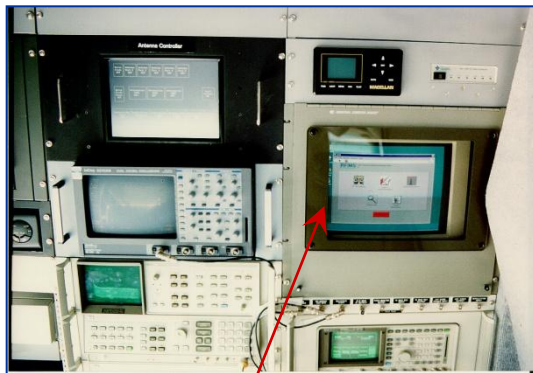
→ **Aviation System Standards (Flight Inspection)**

- **One International FIO**

- **Six National FIOs**

RFI Investigation Resources

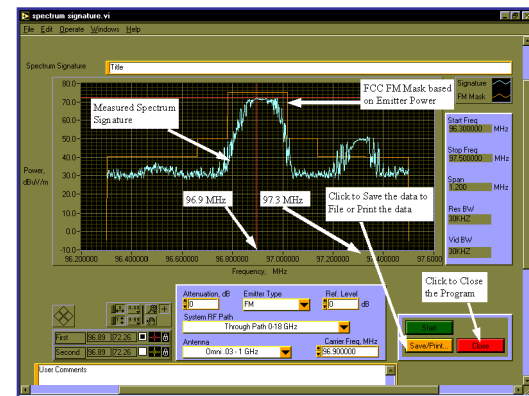
- ✈ **FAA Assets and Software Tools**
- ✈ **Radio Frequency Interference Monitoring (RFIM) Vans**



**Automated or Manual
Full Equipment Suite**

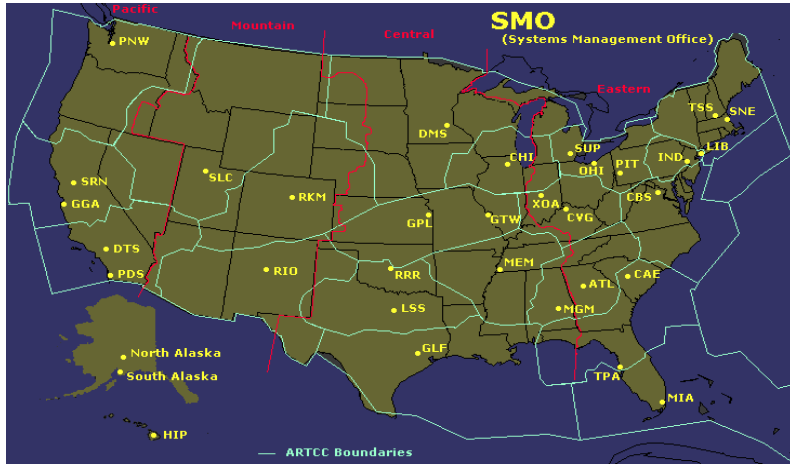


**DF Control/Mapping
20 - 3000 MHz**



**Regional Used mainly by FMOs
Most Complete Measurement System**

Portable DF (RFID)



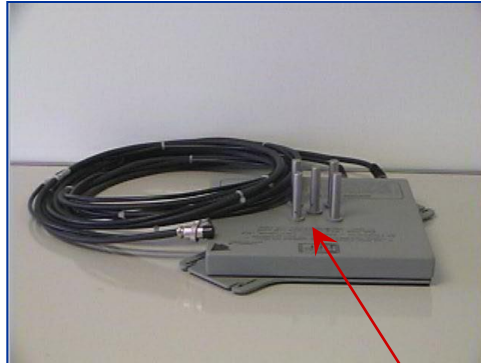
Regional

Automated Vehicle mounted mobile DF

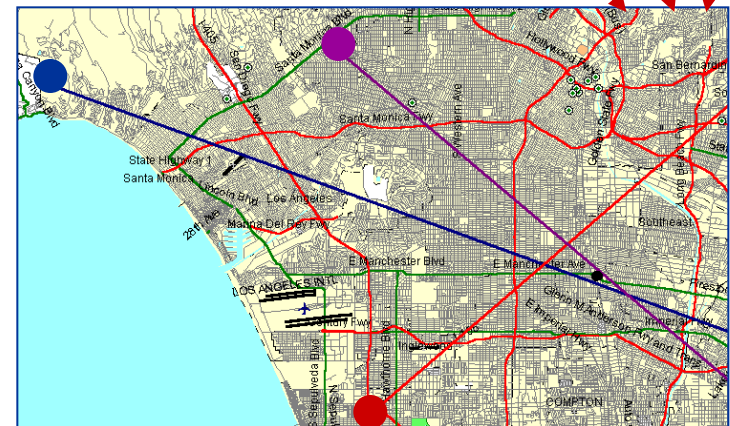
Detection Band 20-2000 MHz



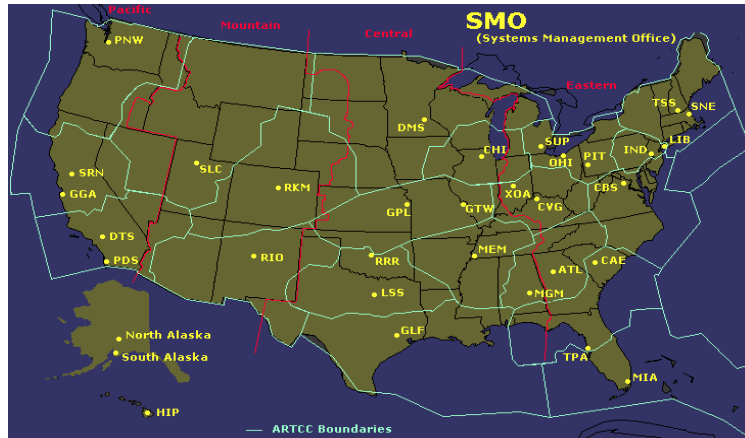
29 RFID Systems



GPS DF Antenna
L1 - 1575.42 MHz



Handheld DF (K95-103)



**Regional System Management Office
(SMO)**

33 Offices in the NAS

K95-103 Detection Coverage

20 – 3000 MHz

Typically 2 miles



**Approx. 300
K95-100 Systems**



**GPS DF Antenna
L1,L2,L5**



**VHF Yagi Antenna
Directional**

Regional

**Most Cost effective
First choice
instrument for
technicians**

Airborne DF



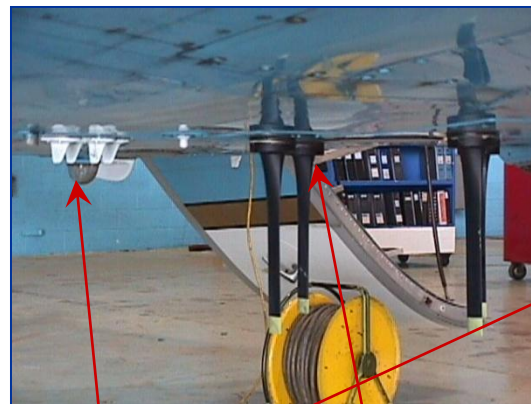
AVN

**Flight Check
NASE/RFI
Program to
assist in
locating
RFI/GPS
sources**

**First Choice
when High
Altitude
PIREPS
ONLY**



**DF Control/Mapping
Operated Automation**



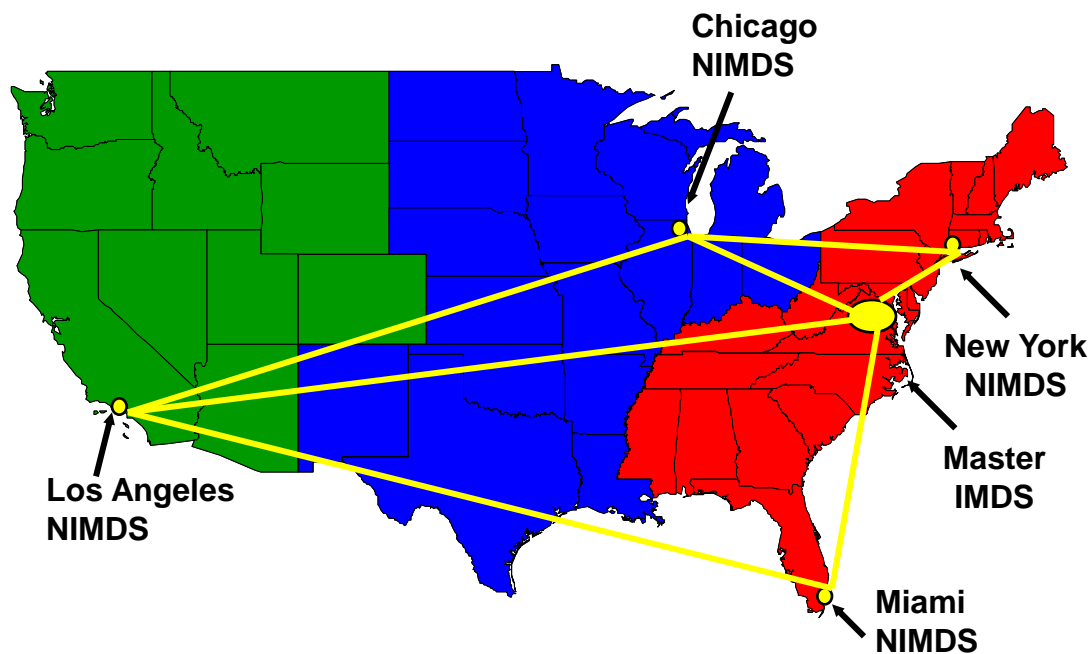
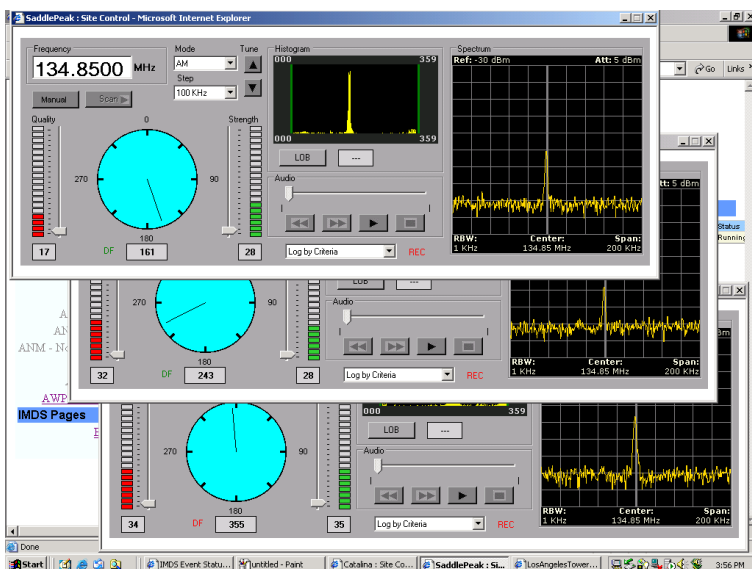
**GPS DF Array & VHF DF Array
L1,L2,L5 & 108 - 174 MHz**



National RFI Initiative

→ FAA Assets and Software Tools

- Los Angeles (LAX), Chicago (ORD), New York (JFK), Miami (MIA)
- FAA Intranet Web based Graphical User Interface (GUI)
- Web Browser Control of Fixed DF and Spectrum Analyzer



Interference Monitoring Detection System (IMDS)

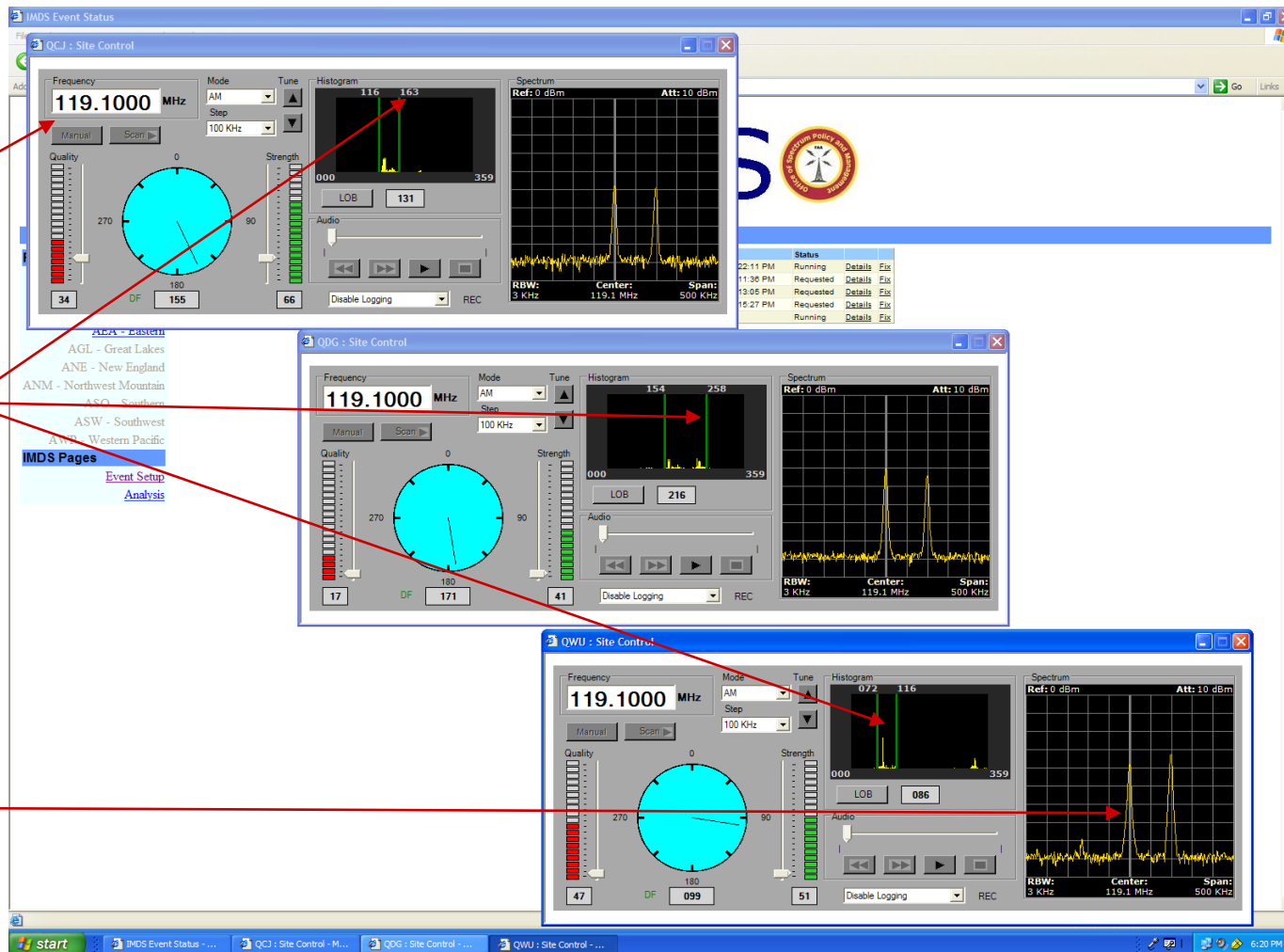
WEB IMDS

Receiver
Tuned
Frequency

DF Processor
Bearing
Averaging
Triangulation

Multiple Audio
Playback
Capability

Synchronized
Spectrum
Analyzer
Spectral View



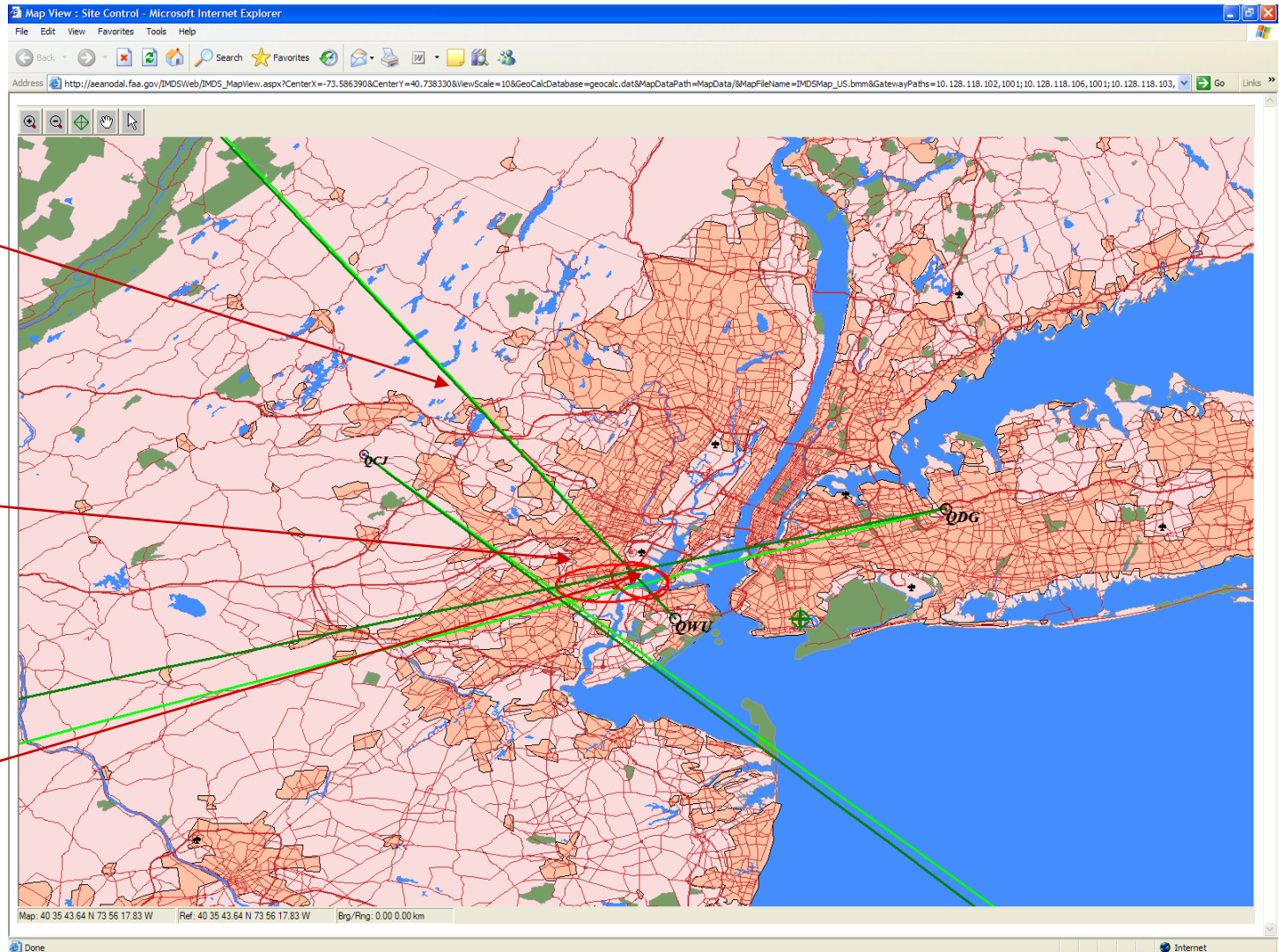
Mapping Triangulation

WEB IMDS

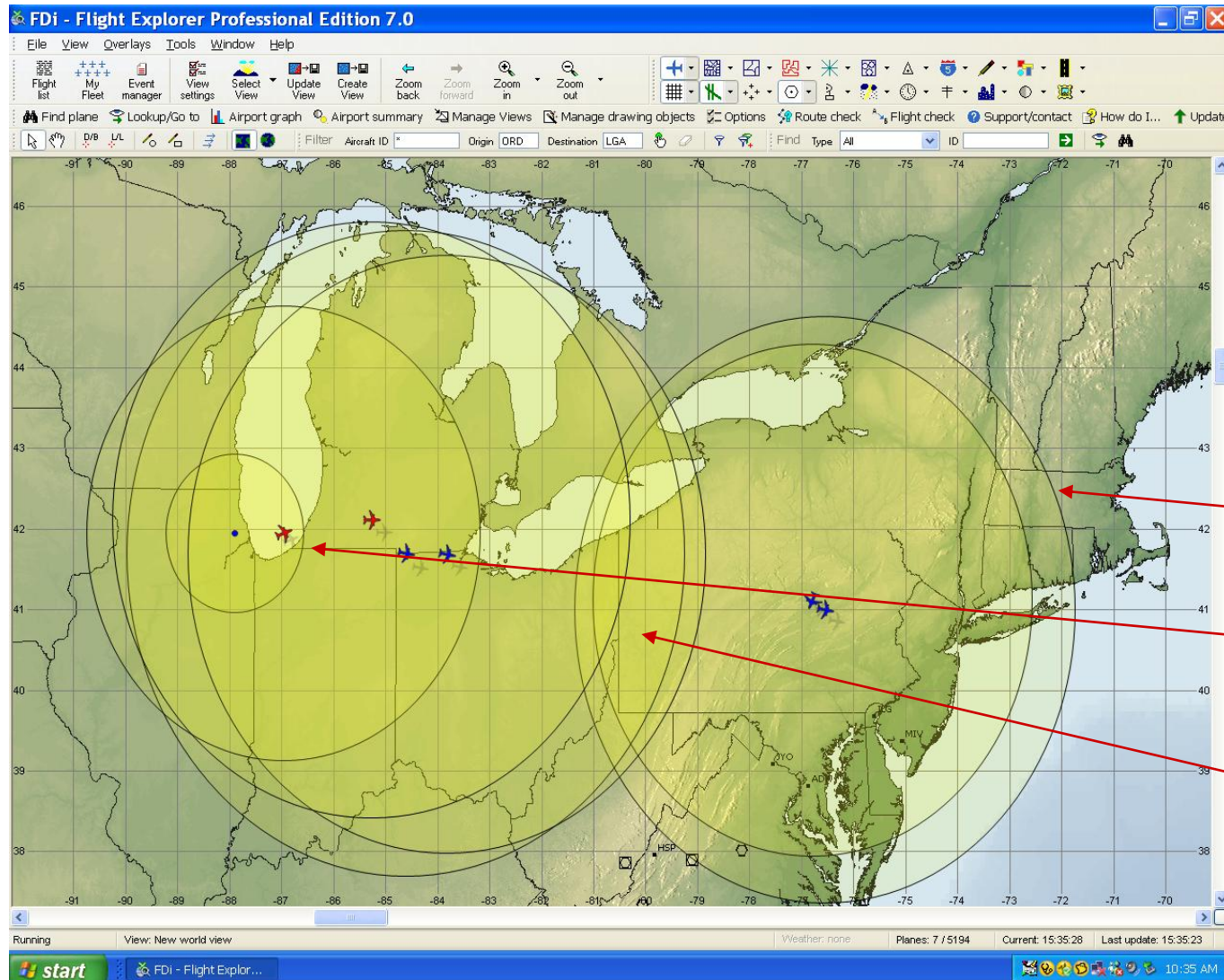
Triangulated
Bearing
Averages
Overlay on
Map

Increases Fix
Calculation
Ellipse
Accuracy

Multiple
Ellipse
Calculation for
Smaller Ellipse



Flight Explorer ASD



**Aircraft
Situation
Display
(ASD)**

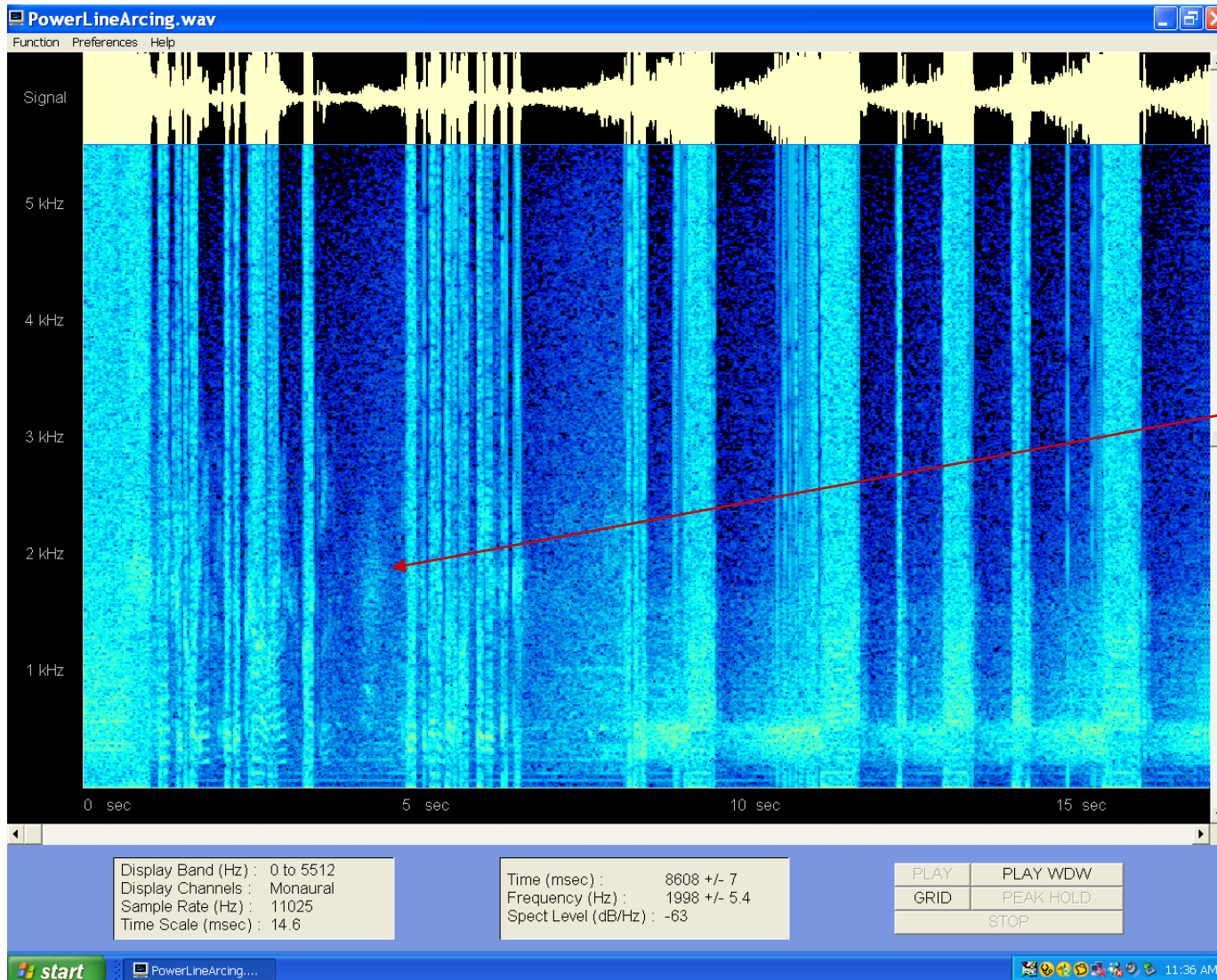
**Traffic Flow of
potential aircraft
PIREPS**

RLOS Footprint

**Lowest Aircraft
Altitude**

**VENN Diagram
Overlay Area**

Audio Spectrogram Analysis



**Audio
Detection
Visual
Intensities**

**Used for
Matching with
known
sources**

**Audio
Spectral
Views**