CORF
SOCORRO
2006

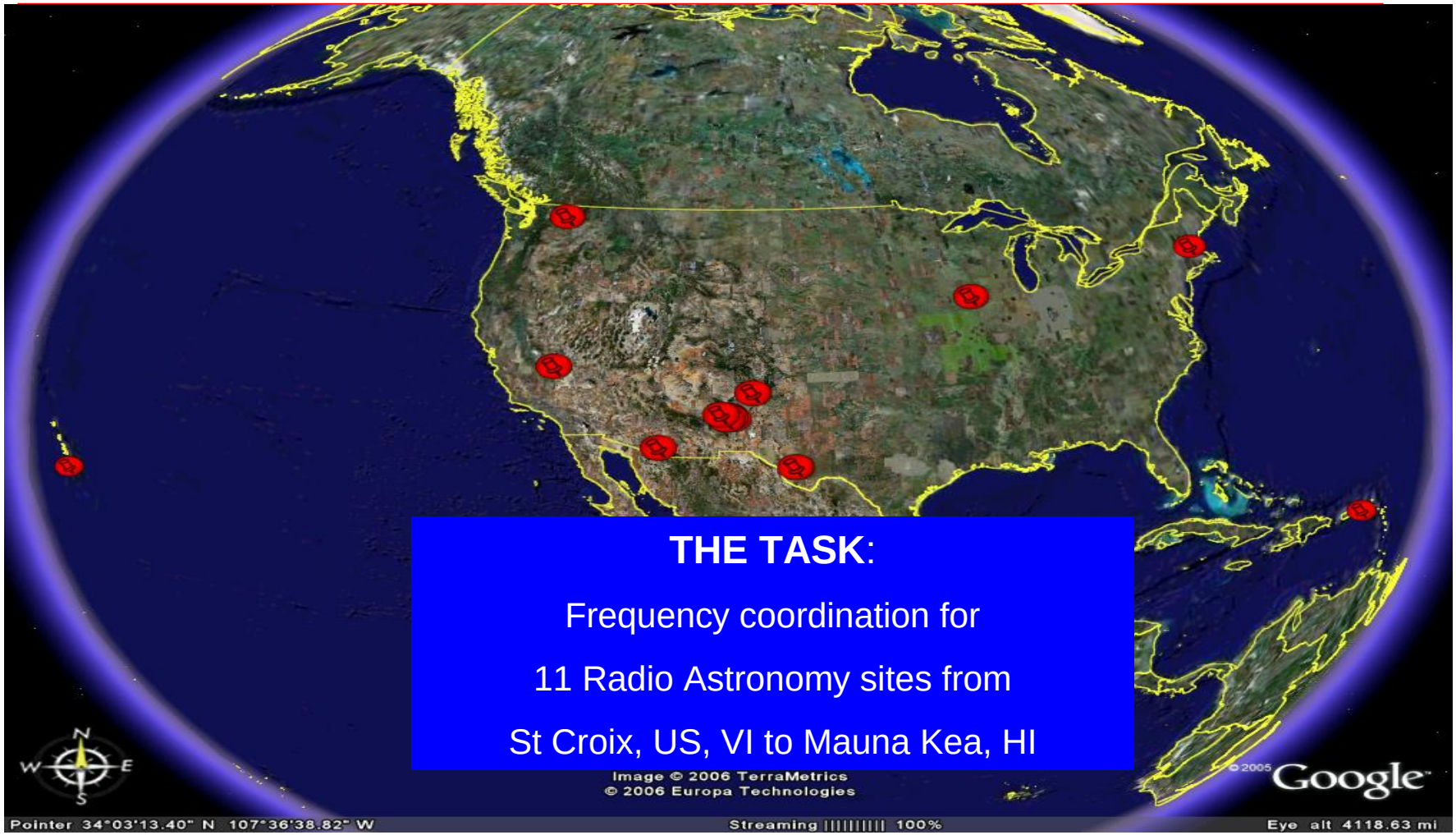
Frequency Coordination for the NRAO VLA and VLBA Sites

Presented By

Mark McKinnon

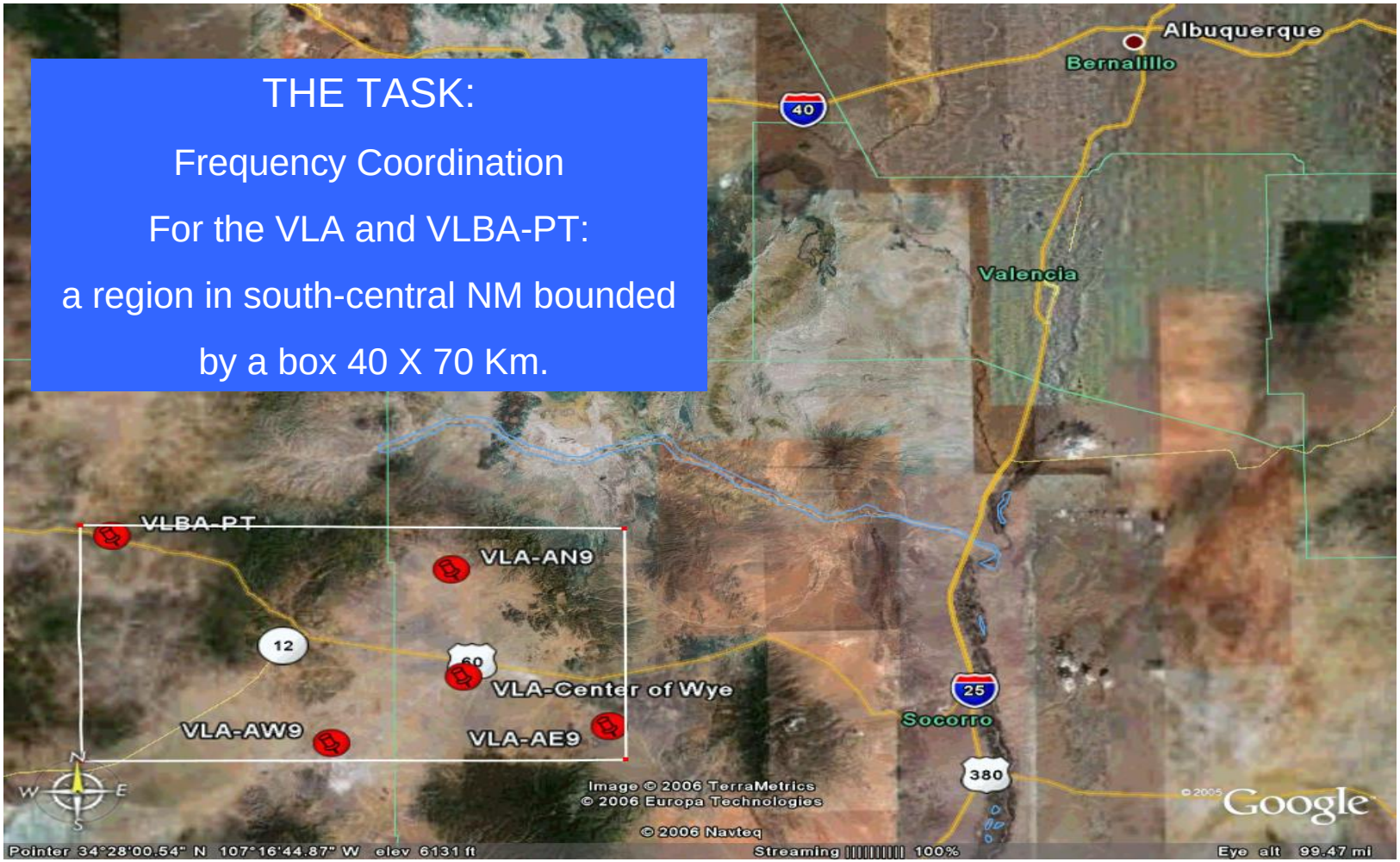
Geographic Range: VLBA

CORF
SOCORRO
2006



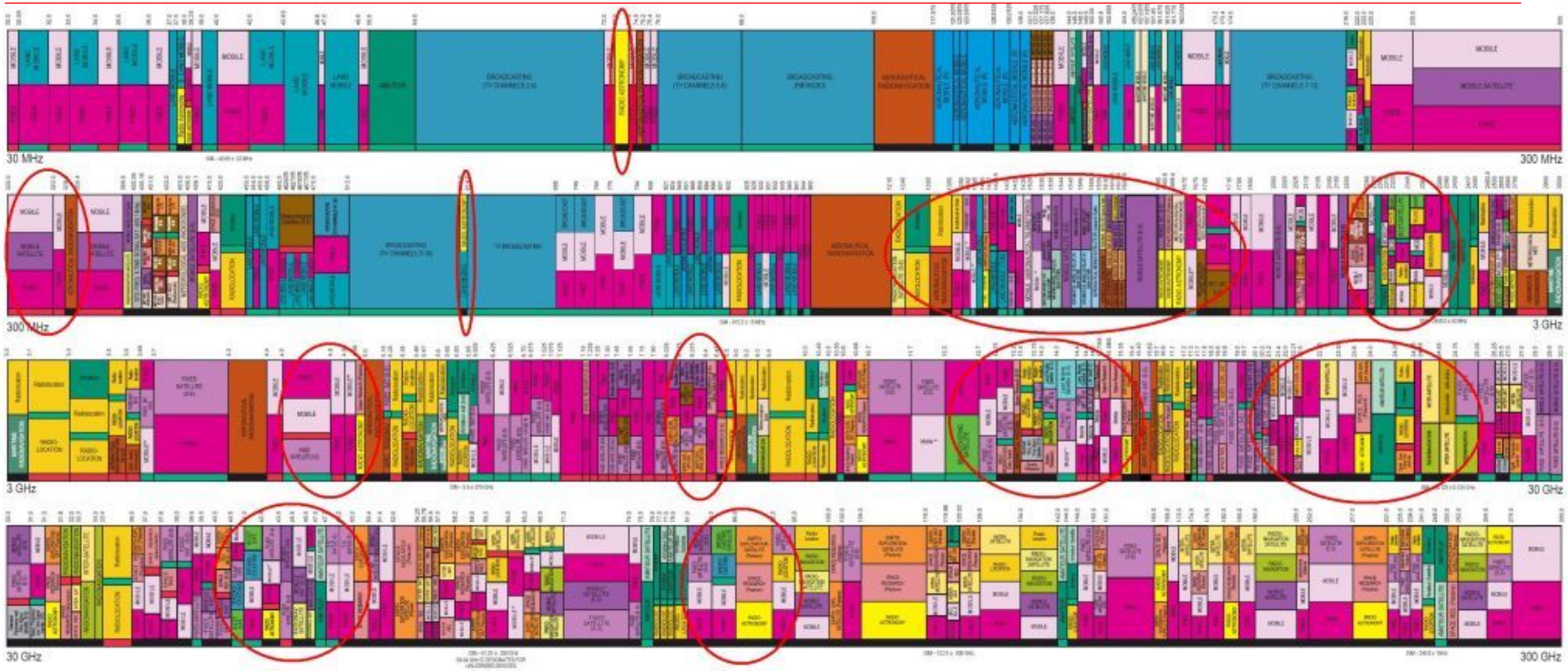
Geographic Range: VLA

CORF SOCORRO 2006



The Task:

CORF
SOCORRO
2006



- Current: Protection and coordination (where possible) of the 11 VLA and VLBA receiver-coverage bands from 74 MHz to 96 GHz.
- Future: Protection of the EVLA full-coverage 1 – 50 GHz receiver system.

The Sources: "Near" VLA/PT

CORF SOCORRO 2006

The VLA radio "view":

1 major, commercial ES,

1 minor, commercial ES,

4 minor Public Safety ES,

3 missile launch sites,

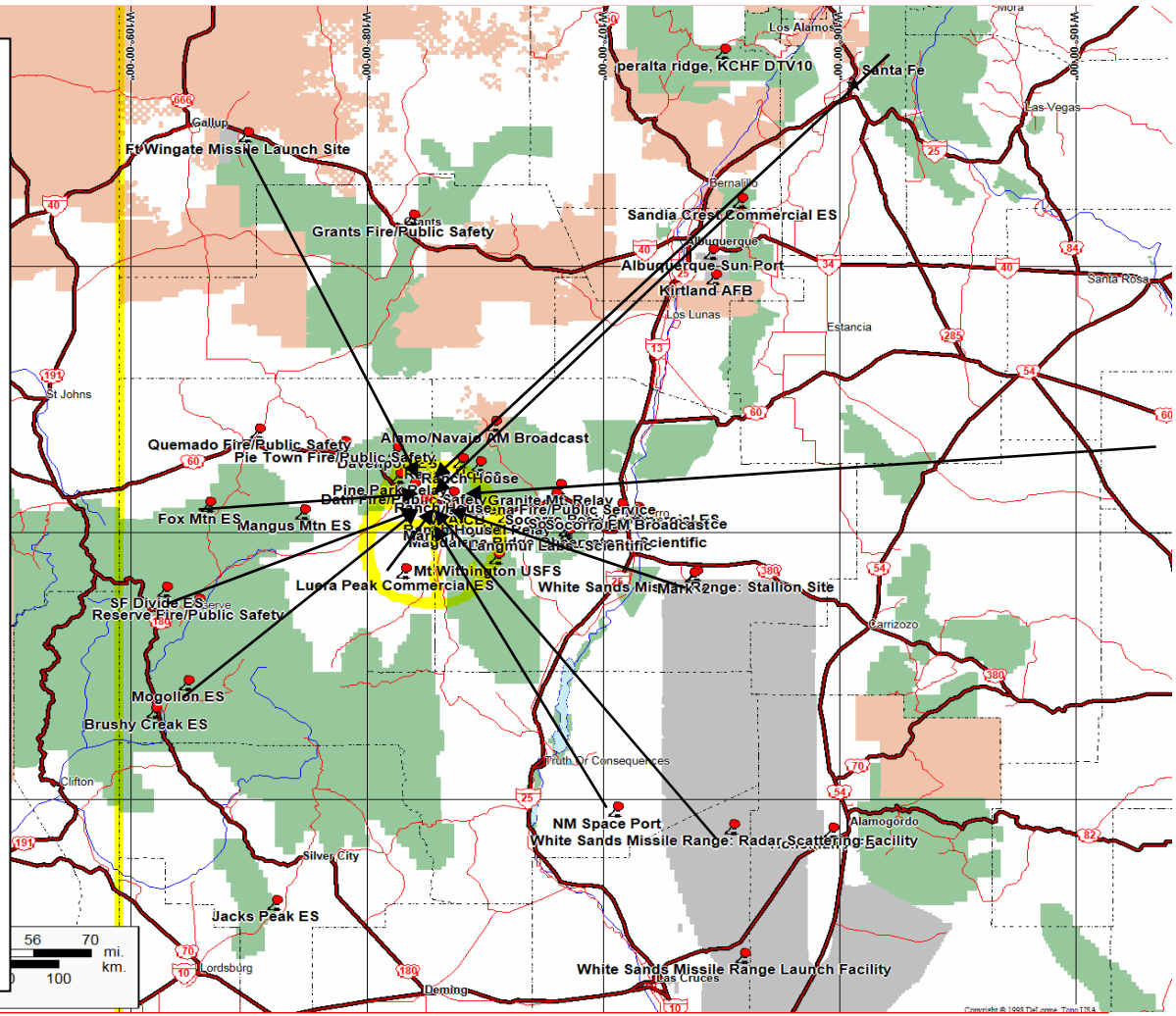
1 major military test range,

3 major USAF bases,

2 major scientific research sites,

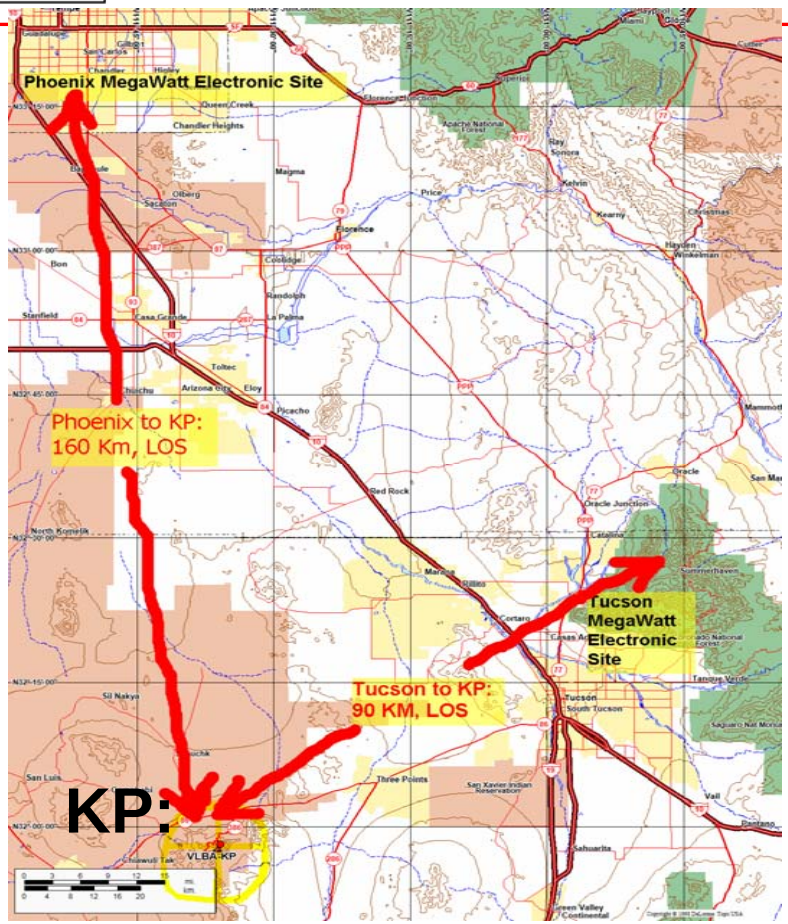
1 AM & 2 FM local broadcast stations,

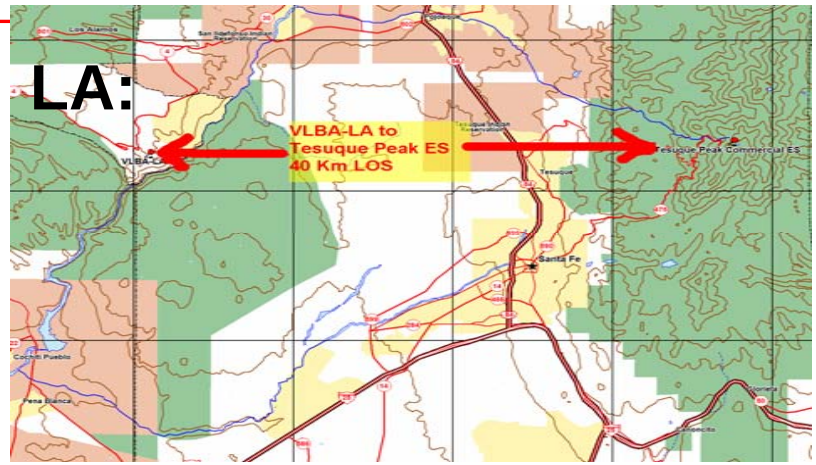
4 microwave repeater complexes.



The Sources: KP, LA, HN

CORF SOCORRO 2006





Major Electronics Sites Line-of-Site to VLBA sites

On-Going Coordination Efforts: Overview

CORF SOCORRO 2006

- WSMR, Holloman AFB, NM Space Port, CSBF
- GPS-L3, Melrose Range, McGregor Range, Hanscom AFB
- Tethered Aerostat RADAR Systems (TARS)
- Wireless Medical Telemetry (WMTS)
- DTV
- 4.9 GHz “Public Safety” Band
- Broadband over Power lines (BPL)
- Regional VHF Public Service
- 14.5 – 15 GHz ViaSat, Boeing
- Iridium/GlobalStar

On-Going Coordination Efforts: WSMR, Holloman AFB, NMSP, CSBF

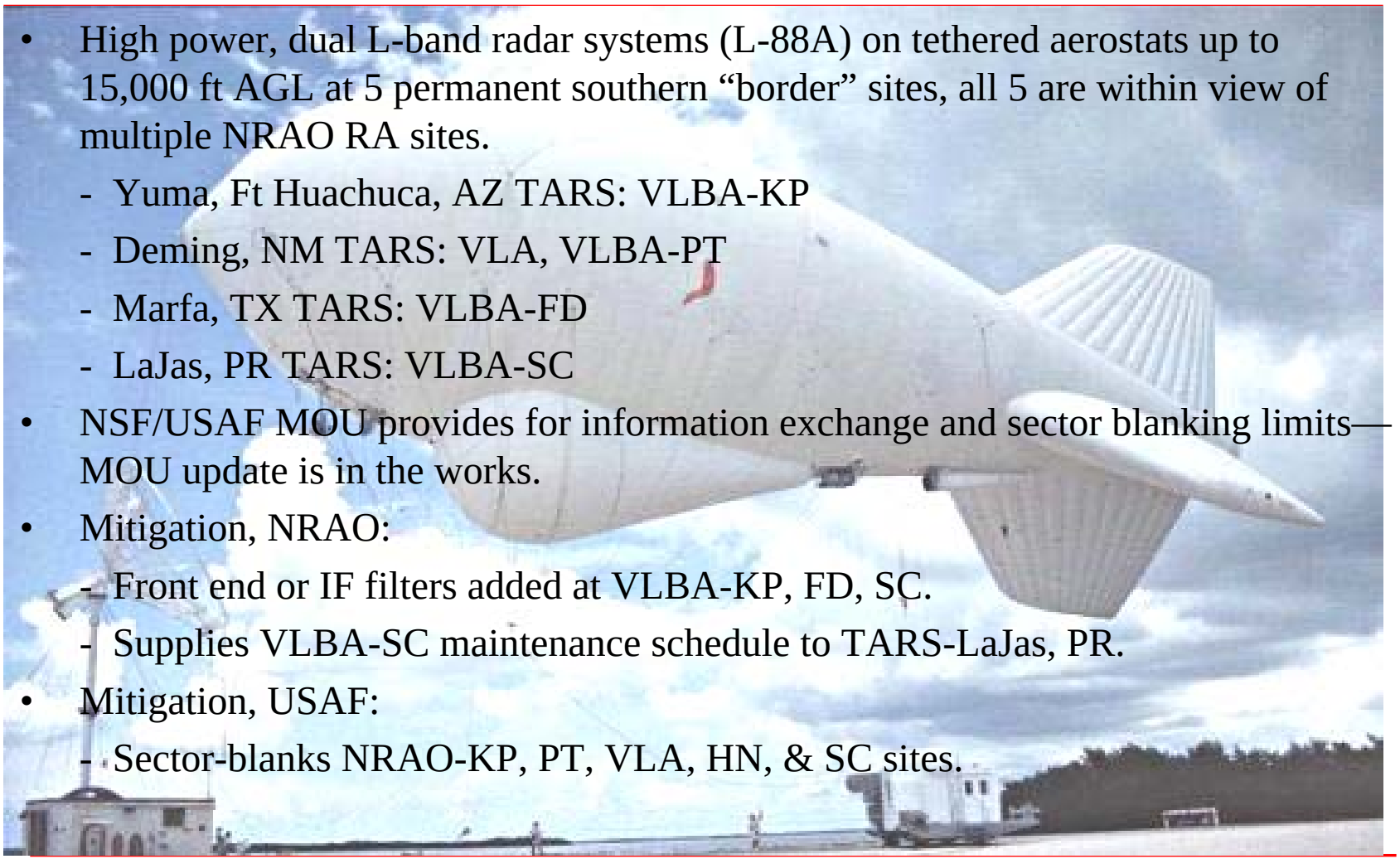
CORF SOCORRO 2006

- White Sands Missile Range (WSMR):
  - Excellent cooperation with DoD Area Frequency Coordinator.
  - They notify NRAO of special events.
  - They were emailing a daily, frequency-use schedule. (Suspended due to DoD manpower and security concerns.)
  - They email their GPS jamming schedule to NRAO.
  - We have a "stop activity" number—not yet used.
  - We email them VLA/VLBA UHF & S band schedule excerpts.
- Columbia Scientific Balloon Facility (CSBF):
  - Good but not timely notifications emailed to VLA/VLBA Ops.
  - 1 day notice of L and S band balloon telemetry.
  - Frequent false alarms due to weather conditions.
  - Significantly affects L-band observations in Spring and Fall.
  - We have a "stop activity" number—not yet used.

On-Going Coordination Efforts:

Tethered Aerostat RADAR Systems (TARS)

CORF SOCORRO 2006



- High power, dual L-band radar systems (L-88A) on tethered aerostats up to 15,000 ft AGL at 5 permanent southern "border" sites, all 5 are within view of multiple NRAO RA sites.
  - Yuma, Ft Huachuca, AZ TARS: VLBA-KP
  - Deming, NM TARS: VLA, VLBA-PT
  - Marfa, TX TARS: VLBA-FD
  - LaJas, PR TARS: VLBA-SC
- NSF/USAF MOU provides for information exchange and sector blanking limits—MOU update is in the works.
- Mitigation, NRAO:
  - Front end or IF filters added at VLBA-KP, FD, SC.
  - Supplies VLBA-SC maintenance schedule to TARS-LaJas, PR.
- Mitigation, USAF:
  - Sector-blanks NRAO-KP, PT, VLA, HN, & SC sites.

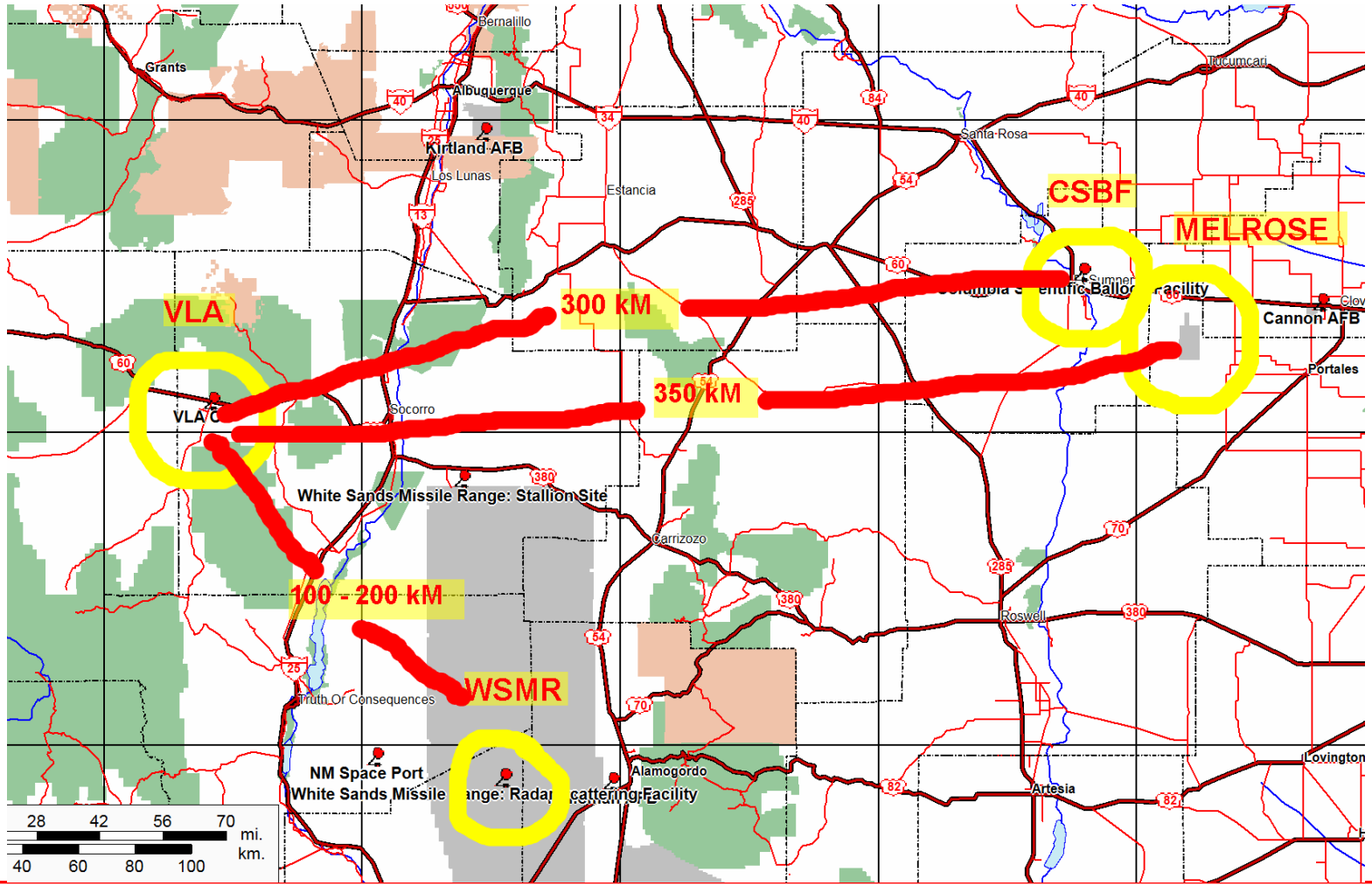
On-Going Coordination Efforts: GPS-L3, NM Ranges, Hanscom AFB

CORF SOCORRO 2006

- USAF 1381 MHz GPS L3 (satellite):
  - Very responsive to our concerns, but still interfere occasionally.
  - Their frequency use is limited by NSF/USAF MOU.
  - They send 1-2 month advance notice of scheduled tests.
  - We send VLA/VLBA & Arecibo 1381 MHz frequency use schedule.
- Cannon AFB/Melrose & McGregor Ranges:
  - Good but not timely notifications emailed to VLA/VLBA Ops
  - USAF sends 1-2 day advance notice of ECM activity.
  - No correlation yet between activity and VLA RFI.
- New Mexico Space Port:
  - We reviewed their Environmental Impact Statement.
  - No separate POC yet—probably WSMR.
- Hanscom AFB:
  - Special 2cm imaging radar demonstrator flights over Boston metro & western MA
  - We send VLBA-HN 2cm observation schedule each month
  - We have a "stop activity" number—not yet used.

On-Going Coordination Efforts: NRAO and WSMR, CSBF, Melrose

CORF SOCORRO 2006



On-Going Coordination Efforts: Wireless Medical Telemetry (WMTS)

CORF SOCORRO 2006

- Significant "discussions" with Comsearch Frequency Coordinators.
  - Comsearch advocates strongly for their medical clients.
  - Requests by Comsearch for medical establishments near VLBA:

    HN: Catholic Medical Center, Manchester, NH: Disallowed.
    NL: Mercy Medical Center, Cedar Rapids, IA: Disallowed.
    NL: St Lukes Hospital, Cedar Rapids, IA: Disallowed.
    NL: Mercy Hospital, Iowa City, IA: Disallowed.
    LA: Los Alamos Medical Center, Los Alamos, NM: Disallowed.
    KP: Tucson Medical Center in Tucson, AZ: Disallowed.
- The coordination system seems to be working, but requires significant effort when cases are brought-up.
- Off-the-record remarks by hospital administrators suggest that WMTS systems are installed and used before, and in-spite of application rejection by NRAO. No on-site follow-ups yet.

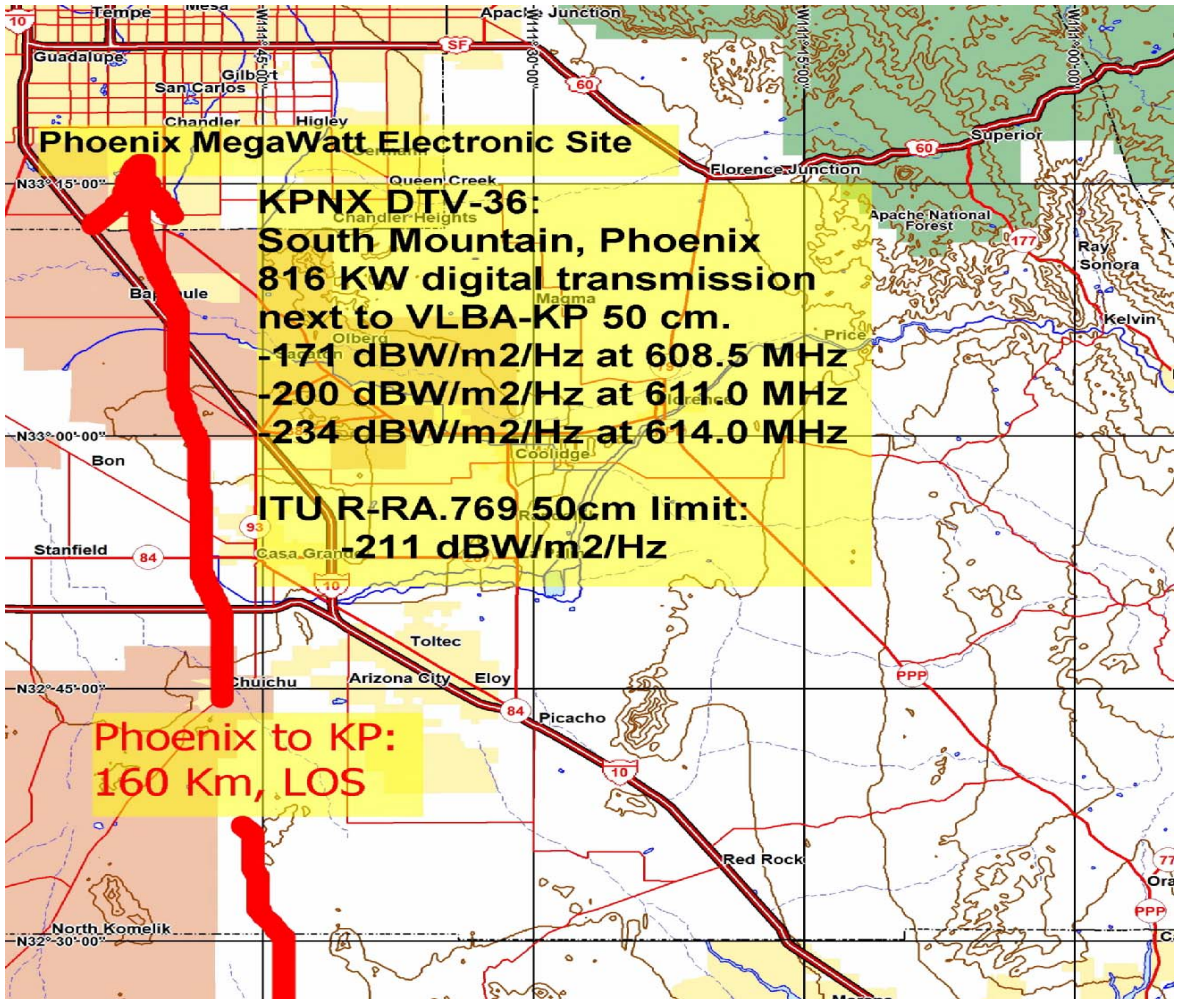
On-Going Coordination Efforts: DTV Transition

CORF SOCORRO 2006

- Reviewed proposed channel allocations in the late 1990, were to filter-out TV36 or TV39 allocations within range of RA sites, but one channel 36 assignment for Phoenix, KPNX NBC DTV36 (affecting VLBA-KP) was missed.
- Attempts at changing channel assignments were at first fruitful, (excellent cooperation with station engineer), but later fell victim to business schedules, cost concerns, and station owner (Gannett) intransigence.
- 50cm observing at VLBA-KP is essentially lost. No recovery mechanism planned.

On-Going Coordination Efforts: DTV Transition: KPNX, Phoenix

CORF SOCORRO 2006



On-Going Coordination Efforts: DTV Transition: 2m @ VLA

CORF SOCORRO 2006

- EOR 2m receiver installation at the VLA:
  - The plan: 27, 300K receivers for 185 – 200 MHz, 1 per antenna.
  - PI: Lincoln Greenhill of SAO.
  - RFI environment: Multiple ATV and 2 DTV stations in-band.
- Coordination results:
  - Excellent coordination cooperation with existing local DTV stations.
  - KCHF (SBN, DTV10) Willing to turn-off for hours at a time. (Some procedural coordination problems.)
  - KNMD (PBS, DTV09) Willing but bureaucratic.
  - Installation scrubbed--RFI environment too difficult, and current VLA correlator hardware unable to provide needed spectral resolution. (As shown by analysis of data from prototype systems.)

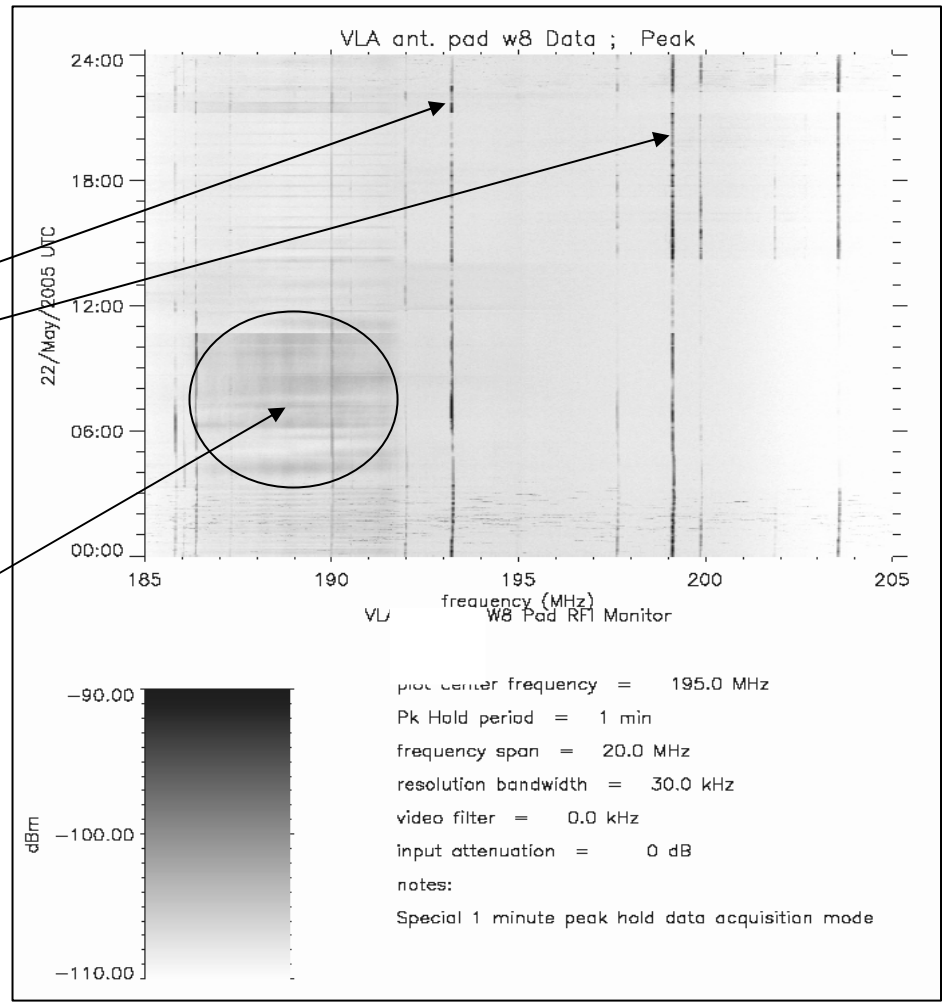
On-Going Coordination Efforts: DTV Transition: 2m @ VLA

CORF SOCORRO 2006

- 2m frequency usage at the VLA:

  - Note moderately-strong analog TV carriers at 193.25 (ATV10 video) & 199.25 MHz (ATV11 video) .

  - Note weak DTV signal from 187 – 193 MHz (KNMD DTV09).



On-Going Coordination Efforts: 4.9 GHz "Public Safety" Band

CORF SOCORRO 2006

- "Newly" released spectrum to law enforcement agencies and other public safety spectrum users from 4940 – 4990 MHz is in "prime" VLA and VLBA C-band observing.
- Coordination with RA is required, handled through Dr. Liszt @ CV.
- Coordination efforts to date:
  - HN: Boston: Initially wanted for DNC in 2004.
    Officially, a geographic compromise was found—No follow-up.
  - KP: Phoenix: Wanted for helicopter telemetry by City of Phoenix.
    Officially, a geographic compromise was found—No follow-up.
  - KP: Tucson: Proposed—recommended against.
- The coordination system seems to be working, but requires significant effort when cases are brought-up.

On-Going Coordination Efforts: Broadband over Power lines (BPL)

CORF SOCORRO 2006

- No plans for BPL by Socorro Electric Coop (VLA, VLBA-PT).
  (They believe it is not economically feasible for rural distribution.)
- We have a list of all electric service providers at the 10 VLBA sites.
  There is no indication yet that any of them are planning a BPL system.
- Most rural broadband consumers appear to be going satellite—eg: HughesNet, Wildblue, or wireless—eg: 802.11b (2401 – 2473 MHz).
- We believe BPL is unlikely to be a concern for the VLA or VLBA.

On-Going Coordination Efforts: Regional VHF Public Service

CORF SOCORRO 2006

- X2 harmonic falls in VLA P-band (90cm) observing band.
- Regional VHF "Government/Public Service" repeaters surround the VLA: Mangus Mtn, Davenport, Frisco Divide, Brushy Creek, etc.
- Most are on US Forest Service land, and require USFS coordination.
- We have had excellent cooperation with the USFS, the State Communications Office, and SpectraSite Communications.
- They have been willing to coordinate remote-site tests with us where the potential for interference exists.
- Complete survey/inventory started, but not yet completed.
- Contact list maintained.
- Random monitoring initiated.

On-Going Coordination Efforts: 14.5 – 15 GHz ViaSat, Boeing

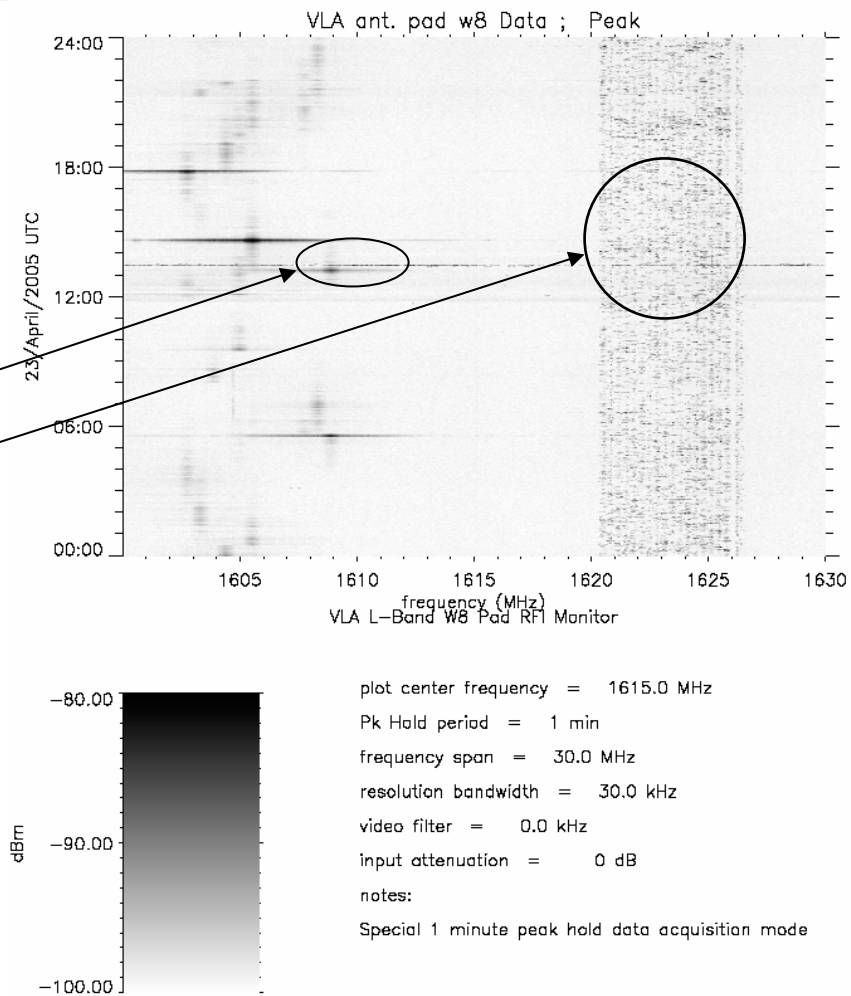
CORF SOCORRO 2006

- Coordination required by NSF/Boeing, NSF/ViaSat MOUs.
  - 2cm is a low-use band at the VLA or VLBA, with very infrequent use of the protected RA band at 14470 – 14500 MHz.
  - NRAO may forward requests for protection of 2cm observing to POC @ Connexion By Boeing.
  - Coordination rights not yet exercised.

On-Going Coordination Efforts: Iridium, GlobalStar, Glonass

CORF SOCORRO 2006

- Iridium TDMA signal at 1621 – 1627 presents a problem for the VLA AGC system.
- Coordinated tests with Motorola/Iridium in 1998 resulted in an NRAO/Iridium MOU that limits their PFD toward RA sites.
- NRAO installed 1611 -1613 MHz pass band filters to allow OH~ (only) observing. Despite Glonass and Iridium signals within the VLA passband. (used infrequently, but successfully).
- Occasional attempts at continuum observations in the 1635 – 1660 MHz range are still interfered with.
- Reports of Iridium LLC's demise were pre-mature—see April, 2005 monitor plot, right.



Summary

- Frequency coordination efforts (and opportunities!) abound, but are manpower intensive.
- DTV proliferation greatly limits future VHF/UHF use by Radio Astronomy, even in remote areas like New Mexico!
- Commercial and US government pressure on available spectrum continues to increase—eg: DTV, ISM band 802.11b/a, 4.9 GHz video surveillance links, 14.4 GHz satellite downlinks, etc.
- NSF & NRAO agreements and MOUs with external spectrum users help, but are not always followed up on due to manpower limitations and coordination problems.
- EVLA 1-50 GHz continuous coverage will pose new “challenges”.
- NRAO, Socorro/GB is currently focusing strongly on keeping our own sites clean as digital electronics proliferate and become ubiquitous.

Questions?