# The Mobile VLBI Chronology



1970's - Pioneering work at JPL by Pete MacDoran, Don Trask and George Resch starting with 30' "ARIES" (later called MV-1) military surplus antenna operating at JPL, Mt. Otay and the Presidio. Later came a more mobile system (now called MV-2) with a 12' rigid dish mounted on a Nike RADAR mount. Early observations at a single frequency using the Mark-2 recording system.

1979 - NASA begins the Crustal Dynamics Project (CDP).

1980-82 - The JPL ARIES program is merged into the CDP and the GSFC VLBI group begins getting more involved in the mobile program. The new Mark-III VLBI system, dual-S/X operation and Hydrogen Masers become an integral part of the mobile systems.

1980-83 - JPL develops the MV-3 "ORION" mobile system with a 5m antenna for operational use. MV-3 includes Mark-III, Hydrogen maser and cryogenic receivers.

1983 - NASA CDP develops the old ATS facility at Goldstone with 12m antenna as a dedicated, permanent geodetic facility (Mojave Base Station) to serve western regional mobile measurement programs. In the west, Mojave augments the NGS-sponsored Ft. Davis POLARIS station and the radio astronomy facilities at Hat Creek (U.C.Berkeley) and Owens Valley (CalTech).

1983 - NASA CDP develops standardized cryogenic receiver using GaAsFETs to improve system sensitivity.

1983 - MV-1 9m antenna moved permanently to Vandenberg AFB.

1983 - CDP VLBI program enters an era with observations at a large number of sites suggested by CDP investigators.

1983-84 - As per interagency coordination plan, JPL phases out of operational role in mobile VLBI program. Operational responsibilities for MV-1, MV-2, MV-3 and Mojave transferred to NOAA/NGS.

1984 - NGS "POLARIS" network expands to Europe (Wettzell) which in turn provides reference frame so that VLBI baselines can make use of the transverse component in addition to length. This in turn leads to a decision that mobile VLBI systems no longer need to be paired at opposite ends of a baseline. When combined with strong networks of base stations, mobile VLBI enters the "point positioning" era.

1984 - CDP mobile program expands to Alaska and Canada with 8 mobile sites plus a new base station at Gilmore Creek (near Fairbanks, now called GCGO) plus the Canadian Algonquin Park facility.

1984-85 - VLBI detects first motions in California.

1986 - CDP and investigators decide to place emphasis on making more measurements at a smaller number of sites. The Yuma-Monument Peak ("YUMP") experiments emphasize one particular southern California baseline.

1986-87 - NOAA/NGS establishes first epoch measurements at National Crustal Motion Network (NCMN) sites in WA, TX, OK, MT, IN, GA and Bermuda.

1986 - MV-2 gets a significant upgrade. The old rigid 12' dish is replaced with a field erectable 10' diameter dish plus a "CDP Standard" cryogenic receiver. The new combination now easily fits a KC-130 and also requires no special "wide load" permits to drive down the highway. Performance of the newer (and slightly smaller) antenna is about twice as good as the old system.

1987 - Clark *et al* paper ("Determination of Relative Site Motions in the Western US ...") in JGR provides cm/yr (or better) velocity data at ~20 sites. VLBI has been significant in resolving the "San Andreas Discrepancy" and the North American - Pacific plate motion rate.

1987-88 - Due to budget constraints, NASA phases down its use of MV-3 in favor of the more mobile MV-2 system.

1987-88 - MV-2 and MV-3 are used as "local surveying tools" to provide ties between the permanent VLBI antennas and GPS/SLR markers at Mojave, OVRO and Fort Davis. MV-3 travels to Maui to provide a Haleakala SLR -to- Kokee Park VLBI tie.

1988 - VLBI measures 9 cm of motion at Capae Yakataga due to two major Gulf of Alaska earthquakes during the 1987-8 winter.

1989 - The European community working with NOAA/NGS conduct the highly successful EUREF measurement series with MV-3 at sites in Germany, Finland, Norway, Scotland, Belgium and France. Data from these measurements is used to establish European fiducial network for GPS densification. The MV-3 electronics trailer is involved in the infamous "Reindeer Incident".

1989 - CDP and NGS mount a highly successful (albeit unplanned) measurement campaign following the October 17th Loma Prieta earthquake. VLBI data (especially from Fort Ord) provides unique constraints on the dynamics of the rupture.

1990 - NASA budget cuts force the closing of MV-1 at Vandenberg early in the year. Later in 1990 (in FY '91) additional cuts force the closing of MV-2. A total of about 12 contractors (Bendix Field Engineering Corp.) who operated the mobile systems out of Mojave are RIFed. The final MV-2 campaigns were the 1990 Alaska/Canada measurements and a final set of Basin & Range measurements.

1990-91 - Canadian VLBI program finds new vigor! The Canadian geodetic community regains control of the 150' Algonquin Park antenna which had been in mothballs since 1985, with hardware purchased from CDP. The old MV-1 (Vandenberg) antenna is donated to the Canadians for permanent use at Yellowknife. During the "last fling" 1990 Alaska mobile VLBI campaign, two sites in British Columbia (Penticton and the new GPS fiducial site at Victoria) were occupied.

1990-91 - Despite budget cuts, the US geodetic VLBI sponsors (NASA, NOAA & USNO) rallied around the concept of the Mark-IV VLBI system which will allow state-of-the-art performance with a small dish antenna. Coupled with the Mark-IV, design began on a new 5m-class transportable antenna to meet the measurement needs of the 1990's. NOAA and NASA agreed on the use of the MV-3 system as a development test-bed and MV-3 has been moved to the Goddard Optical Research Facility (GORF). The Mark-IV/Transportable concept was presented to the community at the April '91 Chapman Conference. The German, Canadian and Norwegian geodetic groups promised support.

1991 - Despite budget cuts, NASA & NOAA plan a "mini-burst" mobile campaign during July to re-visit the Loma Prieta earthquake sites (Vandenberg, Fort Ord, Presidio and Point Reyes).

1992 + + The role of mobile VLBI is clearly changing!! GPS is supplanting the need for VLBI measurements on scales shorter than 500-1000 km. VLBI will be needed to provide a stable global Terrestrial Reference Frame at new locations in remote parts of the world -- thus the need for a new high-accuracy transportable system which will stress accuracy rather than mobility.

1992 + + Mobile systems (like MV-2) are needed for the next few years to provide a "seamless" transition from the VLBI legacy into the GPS world. They will also be needed for special problems (like the Mojave, OVRO and Ft. Davis "ties" of 1987-88).