The Pioneer Station (DSS-11), a 26-meter polar-mounted antenna was the first deep space antenna to be constructed at Goldstone. Completed in 1958 in time to support the Pioneer 3 mission, DSS-11 became the prototype antenna for the Deep Space Network. ***Image Credit: NASA/JPL-Caltech***

Origins of the Deep Space Network

By Erik Conway

Dec. 24, 2023 marks the 60th anniversary of the formation of NASA's Deep Space Network.

The name itself is somewhat older. It had been in use informally for a number of years to refer to the combination of JPL's Deep Space Information Facilities, the communications lines connecting them to JPL (which belonged to the then-new Goddard Space Flight Center), and the network control center then nearing completion at JPL, the Space Flight Operations Facility.

The renaming in 1963 represented the end of a somewhat ad hoc period of telecommunications development in the midst of rapidly changing institutional arrangements. The basic technology employed by JPL for its early space missions, the phase locked loop, dated to 1952. It had been developed to serve as a tracking filter for the Corporal missile. It was improved to handle very low power signals by Eberhart Rechtin and Walter Victor at JPL, and became a key component of JPL's CODORAC guidance system for the Sergeant missile.

The Army hadn't wanted CODORAC for Sergeant, though, and instead, elements of the system had been re-employed in the Jupiter ballistic missile program. For the Re-Entry Test Vehicle flights, JPL had placed ground stations in Florida and on the island of Grand Turk. Known as "Microlock," these stations were based on CODORAC and were also portable. They were moved to various other sites for a few years before permanent sites were chosen and built.

Microlock was not the only tracking system used for the Explorers, though. The Naval Research Laboratory developed a ground system called Minitrack that was the official tracking network for the International Geophysical Year satellite program. Because the tracking and engineering telemetry functions within the Jupiter missiles and Explorer satellites used Microlock, the Minitrack ground stations were hybrids, using elements of both systems. After NASA was created, Minitrack became the basis of

NASA's Earth orbit telecommunications infrastructure, which was called STADAN (Spaceflight Tracking and Data Acquisition Network).

For a brief period in the key year 1958, a new player steered interplanetary telecommunications development. A few days after the launch of Explorer 1 on January 31, 1958, but before the creation of NASA late the same year, President Eisenhower had created the Advanced Research Projects Agency (ARPA). ARPA funded a new set of out-of-Earth orbit missions, the Pioneers, and it had assigned JPL the task of studying what an appropriate telecommunications network for these future deep space missions would look like. The result of this study was ARPA's Tracking and Communications (Extraterrestrial) network, or TRACE. It was also known as World Net.

According to JPLer Nicholas Renzetti, who became chief of the Communications Engineering and Operations section in 1960, World Net was also sometimes referred to as the Deep Space Network even in 1958.

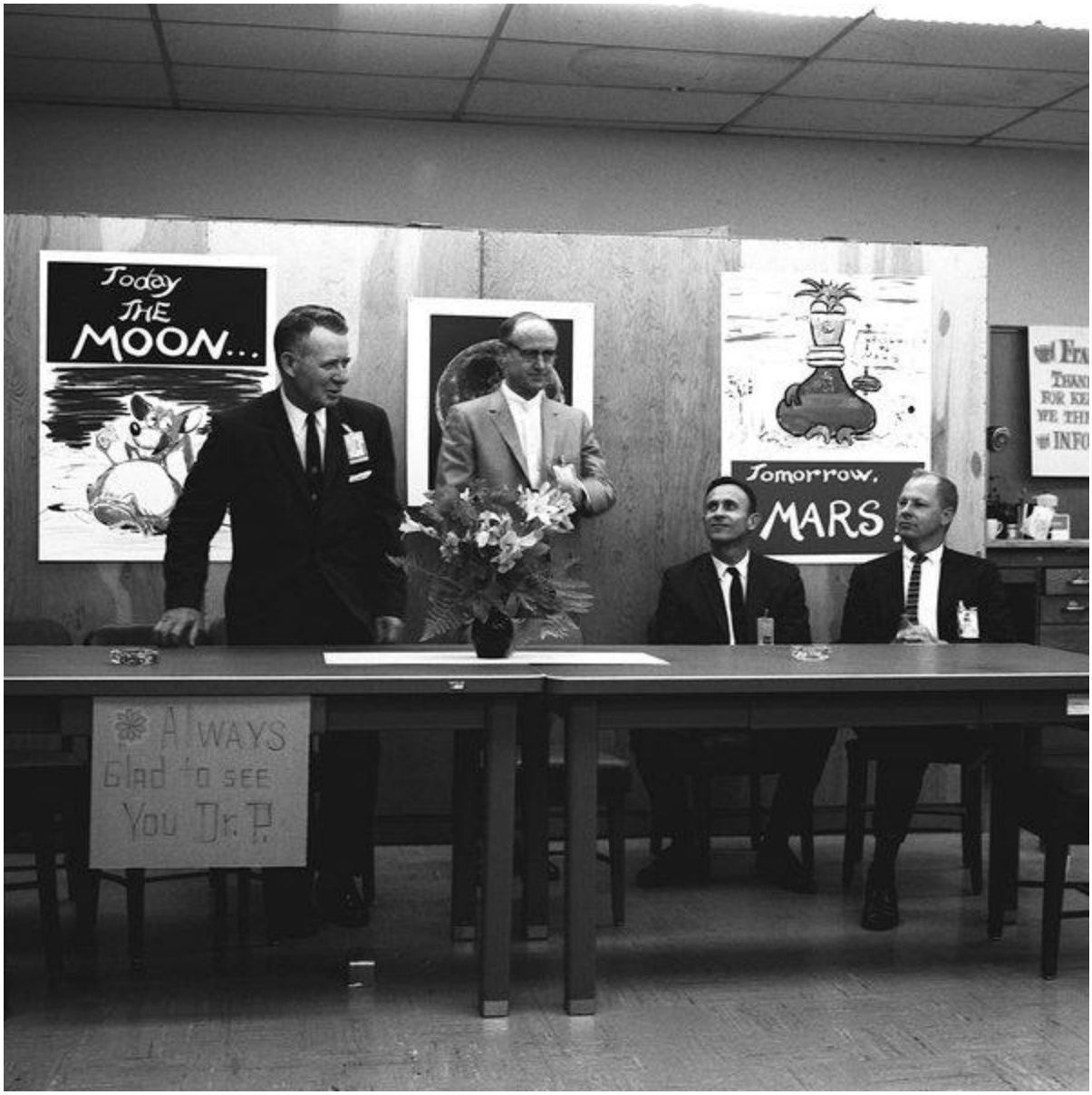
The Microlock station in Mayaguez, Puerto Rico, in 1958. ***Image Credit: JPL/Caltech***

It's during the brief World Net period that JPL and ARPA chose Goldstone as the permanent North American station, and the famous Pioneer antenna (DSS-11) was built at the site. JPL's studies for ARPA in 1958 also suggested that stations located in Spain and South or Central Australia would make the most orbits available to future deep space missions, though it took a number of years to select specific locations and make the necessary diplomatic arrangements to establish those sites.

After NASA formed in October 1958, JPL's ground stations received the name Deep Space Information Facilities (DSIF). At JPL, there was not yet a permanent network control facility; instead, each project set up its own control center. Missions were short lived and their operational phases did not overlap. So there

was little impetus to drive an effort towards a permanent, standalone organization to serve many missions operating simultaneously.

That impetus, according to Eberhart Rechtin, who JPL Director William Pickering made the first Assistant Laboratory Director for Tracking and Data Acquisition at JPL in October 1963, came from William Giberson. He was the manager of the Surveyor lunar lander program. Unlike JPL's Ranger and Mariner spacecraft, which used pre-loaded command sequences much as JPL does now, the Surveyors were to be controlled on the lunar surface in real time. They needed considerably more ground infrastructure—and space to put it in—than the Rangers did. Surveyors were also expected to operate at the same time Langley Research Center's Lunar Orbiters and JPL's Mariners were, so scheduling of network time would also become necessary.



Celebrating the success of Ranger 7 in 1964 at the Goldstone DSN station. Left to right: Deputy Director Alvin Luedecke, Director William Pickering, Assistant Lab Director Robert Parks, and Ranger project manager Harris "Bud" Schurmeier. ***Image Credit: JPL/Caltech***

The Surveyor program bore the initial cost of developing JPL's Space Flight Operations Facility (Building 230), and organizationally, it was located in Division 31, the Systems Division, while the DSIF belonged to Division 33, the Telecommunications Division. But as it became apparent to JPL and NASA leadership that both the new SFOF and the existing DSIF needed to begin operating independently of any specific project, Rechtin launch discussions with officials in NASA's Office of Space Science and Applications,

which funded the missions, and Office of Telecommunications and Data Acquisition, which funded the infrastructure, about how to organize and fund a mission-independent infrastructure. These discussions included the communications links between the DSIF stations and JPL because Rechtin thought the entire system should have a single leader, and therefore point of accountability.

Rechtin explained in a 1967 interview that he intended the new entity to be run as a "central core with mission independent peripheral areas which were assigned to the projects and within which they could do pretty much as they pleased."

The ultimate agreement, announced at JPL in October 1963, had JPL establish a new Office of Tracking and Data Acquisition (mirroring NASA's own terminology) at the Directorate level, with Rechtin as its head. A JPLer named William Bayley became the first General Manager of the Deep Space Network. The DSIF and SFOF were moved into that organization. NASA shifted the communications lines to JPL late in 1963, too, completing the basic shape of the network.

"Effective immediately, the Deep Space Network is established by combining the Deep Space Instrumentation Facility, Interstation Communications, and the mission-Independent portion of the Space Flight Operations Facility," Pickering wrote in his Dec. 24, 1963 interoffice memo.

Rechtin commented later that he didn't know why the labels DSIF and DSN had both been hung on NASA's deep space communications infrastructure by NASA. NASA officials had used the names interchangeably in Congressional testimony, even though prior to December 1963, no such thing as DSN had existed. "If you look into the Congressional Record," he said, "you will find DSN pretty commonly before this formal amalgamation of the various parts."

Pickering probably wrote his memo in part to clarify the issue of names—DSN became used for the 'amalgamation,' as Rechtin put it, while for many years the term DSIF continued to be used to refer to the DSN's major ground stations. The last use of DSIF in JPL's employee newspaper, the Lab-Oratory, was in 1973.