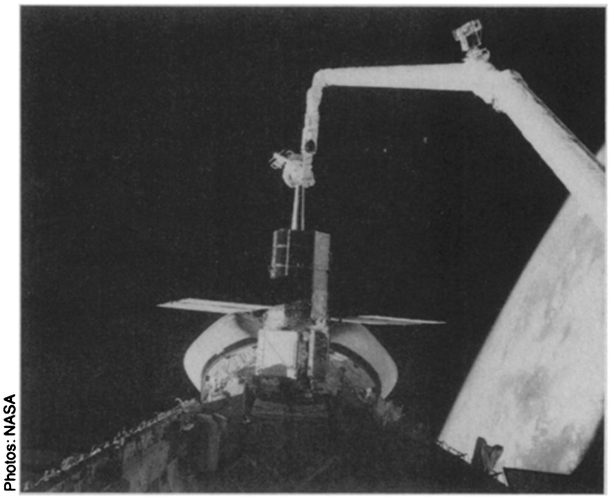
Solar Max: Pioneer of a fix-it future

"The era of throwaway spacecraft has ended."

Frank Cepollina's pronouncement last week came as the astronauts of the space shuttle Challenger were carrying out their dramatic retrieval, repair and re-deployment of the Solar Maximum Mission satellite. The modular, easy-fix design on which Solar Max is based grew out of studies that began at the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Md., as long ago as 1968. Yet last week's technological coup was the first such exercise in the 26-plus years of the Space Age.

Even now, NASA is studying the use of the shuttle for a similar treatment of the ailing Landsat 4 earth-observations satellite, built on the same modular system. Meanwhile, notes Cepollina, who managed the Solar Max "rescue" mission for Goddard, several other satellites now under development for NASA, the Defense Department and private industry are being designed around the same subsystems and components.

Both Solar Max and Landsat 4 (as well as Landsat 5, now orbiting in good health) are based on a system called the Modular Multimission Spacecraft (MMS), which began with Cepollina's group at Goddard in 1972 and was unveiled about four years later (SN: 2/28/76, p. 140). By shuffling the modules for attitude control, data handling, power supply and other functions, the group envisioned the MMS in 41 different versions, with missions ranging from astronomy to biology. Though using the same core elements, the hypothetical MMS payloads ran the gamut from a cubic foot to the size of a large bus, with weights from 200 pounds to four tons and electrical needs from 50 watts to a kilowatt or more.



Photos: NASA

Astronaut George Nelson, riding the end of the space shuttle Challenger's 50-foot manipulator arm, prepares to work on the Solar Maximum Mission satellite, which is berthed in the shuttle's cargo bay. The arm was previously used to grasp the satellite and bring it in for service.

Solar Max was the first, then Landsats 4 and 5. One of the MMS core elements is to be part of an Upper Atmosphere Research Satellite now awaiting approval in NASA's fiscal 1985 budget request, and two of the standard MMS power modules (at 1,200 watts apiece) will go in a Gamma Ray Observatory already under development. A proposed commercially operated orbiting instrument platform called Leasecraft, Cepollina says, will use four of the power modules. Other MMS bits will appear in the forthcoming Space Telescope, and are envisioned for such space-borne observatories as the Advanced X-ray Astronomy Facility and the Shuttle Infrared Telescope Facility (SIRTF, which may become a free-flying satellite of its own).

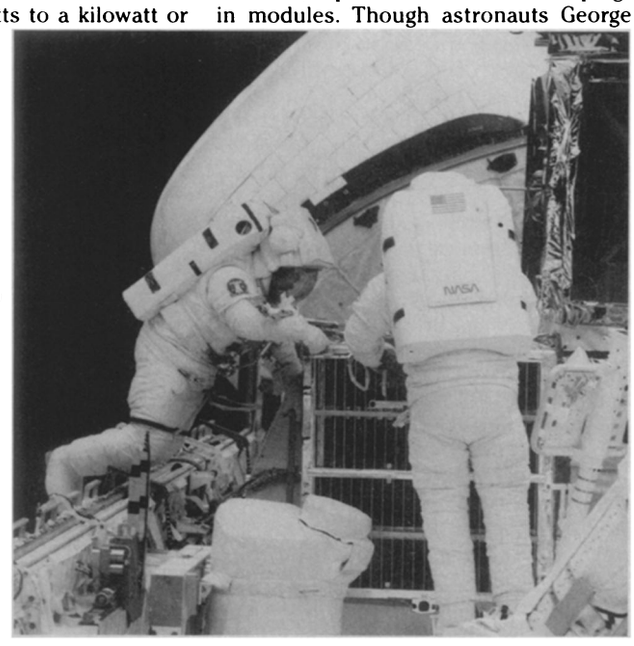
T-shirt proclaims Nelson's new trade.

Not all of NASA's satellite repair plans, however, depend on the existence of plug-in modules. Though astronauts George Nelson and James van Hoften last week easily replaced Solar Max's modular attitude-control system, they also made relatively short work of swapping the main electronics box of the satellite's coronagraph/polarimeter, a considerably more elaborate task. "I'd say, of course, it's a little more difficult to work on something that wasn't designed to be fixed in orbit," said van Hoften afterward, "but ... once you've practiced it so many times, everything went exactly as we planned. If we had to go out and do something on a vehicle we didn't understand beforehand, and didn't have all the tools and parts to work with, it may be a little bit more difficult. But it's just a matter of spending a proper amount of time."

Another option — which was prepared but not needed for Solar Max — would be to bring a satellite back and fix it on the ground. Two recently shuttle-launched communications satellites (Indonesia's Palapa B2 and Western Union's Westar 6) were left in incorrect orbits when their upper-stage rockets malfunctioned. NASA has been talking with the owners (Indonesia appears to be the more interested of the two) about the possibilities of retrieving the devices by shuttle, refurbishing them on earth if they need it, and launching them again.

The plug-in aspects of the MMS, meanwhile, are not its only economic advantage, Cepollina says, since the mere standardization of some subsystems can save research and development money. But the MMS, he notes, is "not all things to all people." Some satellites are simply too small; others, such as some interplanetary probes, need to be so weight-conscious that virtually every component must be optimized to the cause rather than confined to a pre-existing specification. Even at MMS's beginnings, Cepollina says, "we were fighting 'business-as-usual' attitudes" from conservative engineers who feared that the R & D of MMS would add to its cost. Yet with Solar Max, he says, even though it included much of the cost of developing the MMS itself, "we were able to give back money."

— *J. Eberhart*



Orbiting fix-it team of Nelson (left) and fellow astronaut James van Hoften works in the cargo bay to replace Solar Max's faulty attitude-control module, which succumbed to blown fuses nine months after the satellite's 1980 launching. Thanks to its modular construction, the task took little more than half an hour.