- Chapter Two -
- Computers On Board The Apollo Spacecraft -

The Apollo computer systems

[30] The mission profile used in sending a man to the moon went through several iterations in the early 1960s. For a number of reasons, planners rejected the direct flight method of launching from the earth, flying straight to the moon, and landing directly on the surface. Besides the need for an extremely large booster, it would require flawless guidance to land in the selected spot on a moving target a quarter of a million miles away. A spacecraft with a separate lander would segment the guidance problem into manageable portions. First, the entire translunar spacecraft would be placed in earth orbit for a revolution or two to properly prepare to enter an intercept orbit with the moon. Upon arriving near the moon, the spacecraft would enter a lunar orbit. It was easier to target a lunar orbit window than a point on the surface. The lander would then detach and descend to the surface, needing only to guide itself for a relatively short time. Alter completion of the lunar exploration, a part of the lander would return to the spacecraft still in orbit and transfer crew and surface samples, after which the command module (CM) would leave for earth.

With a lunar orbit rendezvous mission, more than one computer would be required, since both the CM and the lunar excursion module (LEM) needed on-board computers for the guidance and navigation function. The CM's computer would handle the translunar and transearth navigation and the LEM's would provide for autonomous landing, ascent, and rendezvous guidance.

NASA referred to this system with its two computers, identical in design but with different software, as the Primary Guidance, [31] Navigation, and Control System (PGNCS pronounced "pings"). The LEM had an additional computer as part of the Abort Guidance System (AGS), according to the NASA requirement that a first failure should not jeopardize the crew. Ground systems backed up the CM computer and its associated guidance system so that if the CM system failed, the spacecraft could be guided manually based on data transmitted from the ground. If contact with the ground were lost, the CM system had autonomous return capability. Since the lunar landing did not allow the ground to act as an effective backup, the LEM had the AGS to provide backup ascent and rendezvous guidance. If the PGNCS failed during descent, the AGS would abort to lunar orbit and assist in rendezvous with the CM. It would not be capable of providing landing assistance except to monitor the performance of the PGNCS. Therefore the computer systems on the Apollo spacecraft consisted of three processors, two as part of the PGNCS and one as part of the AGS.