5 EVOLUTION OF NAS CAPABILITIES

5.1 Introduction

In each major operating area or domain of the NAS, new technologies and accompanying procedures and training will provide new capabilities to NAS users and service providers. This section presents an overview of these capabilities and presents illustrations that, taken together, provide snapshots of NAS modernization over the course of this architecture (1998–2015). A more detailed discussion and illustrations also appear in Appendix D. Figure 5-1 contains a chart of the modernization phases and the capabilities that will be implemented in each phase.

The schedule developed for delivery of the capabilities in the NAS architecture is constrained by the ability to transition to new technology in NAS operations and availability of funding. The resulting capability lists divide the implementation into three phases. Phase 1 covers 1998 through 2002, Phase 2 covers 2003 through 2007, and Phase 3 covers 2008 through 2015.

5.1.1 Phase 1 (1998–2002)

During Phase 1, current systems and services will be maintained while advanced services and upgraded systems are introduced. New technologies—such as the Global Positioning System and Wide Area Augmentation System (GPS/WAAS), User Request Evaluation Tool core capabilities limited deployment (URET CCLD), automatic dependent surveillance broadcast (ADS-B), and Center Terminal Radar Control Approach Control Automation System (CTAS) (consisting of the passive Final Approach Spacing Tool (pFAST) and traffic management advisor single center (TMA SC))—will be integrated through a logical series of changes.

Controller-pilot data link communications (CPDLC) implementation will begin a phased approach to develop en route aeronautical telecommunications network (ATN)-compliant data link services. CPDLC Build 1 and 1A will use very high frequency digital link (VDL)-2 for the air-ground subnetwork and will provide data link coverage to aircraft at 10,000 feet and above. However, voice communication will remain the primary method of information exchange during this period.

The principal goal of traffic flow management (TFM) is to increase airspace and airport capacity through strategic planning, tracking, and efficient tactical control of aircraft. TFM will focus on building collaborative decisionmaking support services that will allow the FAA to interact with airlines in real-time to resolve traffic congestion. Collaborative decisionmaking capabilities will be enhanced by ration-by-schedule and control-by-time-of-arrival capabilities, which will augment current ground delay procedures. Additionally, airline operations center (AOC) automation will be directly linked to FAA TFM to support real-time decisionmaking between airlines and the FAA.

The following activities will be included in Phase 1:

- Complete commissioning of airport surface detection equipment (ASDE) with the Airport Movement Area Safety System (AMASS)
- Implement the Traffic Information Service (TIS) on Mode-S to provide data link traffic information to pilots
- Deploy weather on display system replacement (DSR) to enable integration of next-generation weather radar (NEXRAD) weather information into en route controller displays
- Deploy ITWS stand-alone to selected airports
- Initiate use of flight information service (FIS) to the cockpit
- Implement multisector oceanic data link (ODL) at Oakland and New York facilities
- Upgrade the en route, oceanic, and the TFM systems
- Begin deploying the Standard Terminal Automation Replacement System (STARS) and DSR
- Begin deployment of Free Flight Phase 1 Core Capabilities Limited Deployment (FFP1 CCLD), including collaborative decisionmaking (CDM), initial surface movement advisor (SMA), URET CCLD, TMA SC, and pFAST

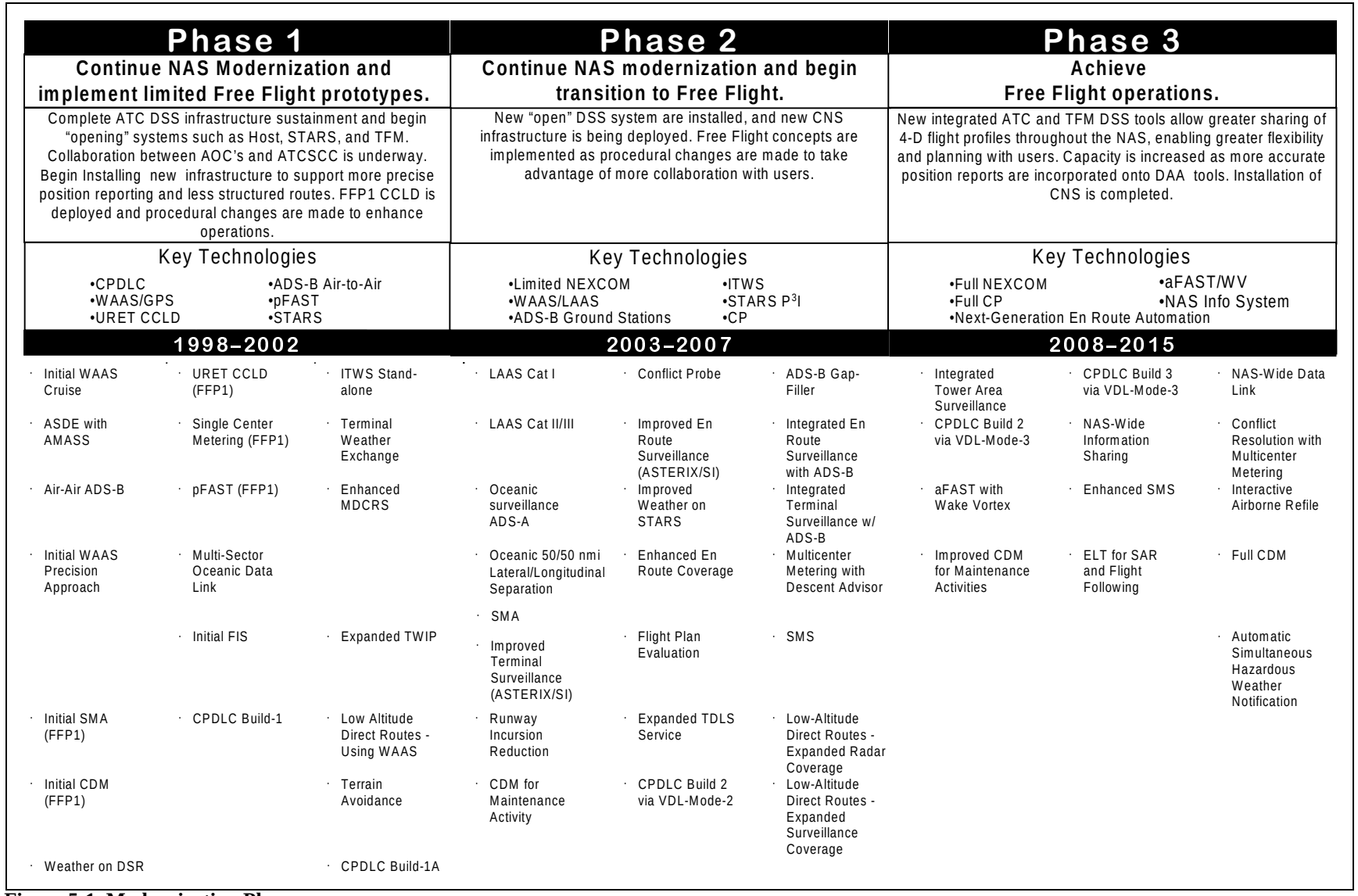

Figure 5-1. Modernization Phases

- Begin initial collaborative decisionmaking between AOC and the air traffic control system command center (ATCSCC)
- Deploy initial WAAS navigation system
- Initiate use of ADS-B air-air for improved cockpit situational awareness
- Begin deployment of CPDLC Build 1 and Build 1A with ATN-compliant air traffic control (ATC) data link services (e.g., CPDLC) in en route airspace using VDL-2 for the air-ground subnetwork.

5.1.2 Phase 2 (2003–2007)

Phase 2 automation enhancements include upgrading and expanding CTAS, STARS preplanned product improvements (P^3I) development, and en route automation upgrades. STARS P^3I includes the capability to improve arrival traffic sequencing using time-based separation techniques.

Free Flight concepts will be implemented with procedural changes to take advantage of increased collaboration capabilities with users. CPDLC services will include Build 2 that provides International Civil Aviation Organization (ICAO)/ATN-compliant services using VDL-2 air-ground network. Build 2 will bring the Future Air Navigation System (FANS) and domestic CPDLC message sets closer together in format and capability.

The following activities will be included in Phase 2:

- Implement flight plan evaluation to increase collaboration with users
- Deploy surface management system (SMS) service provider tools to improve surface traffic movement operations
- Deploy runway incursion reduction at selected airports
- Implement improved weather data on STARS
- Transition to digital radios for voice in high-altitude en route sectors
- Provide 50/50 separation services to oceanic aircraft
- Deploy CTAS TMA multicenter (MC) and complete pFAST deployment
- Deploy conflict probe (CP) nationally
- Implement a new communication, navigation, and surveillance (CNS) infrastructure featuring the GPS, WAAS, and Local Area Augmentation System (LAAS), providing virtually universal navigational coverage and instrument approaches
- Begin implementing CPDLC Build 2 providing ICAO-ATN compliant services using VDL-2 air/ground network to provide data link services between users and en route facilities
- Accommodate both FANS-1/A- and ATN-equipped aircraft in oceanic airspace.[1]
- Begin using oceanic data link and automatic dependent surveillance (ADS) to reduce separation between suitably equipped aircraft flying oceanic routes
- Begin use of GPS/ADS-B data for surveillance service in nonradar and radar areas
- Implement Free Flight capabilities as procedural changes are developed.

5.1.3 Phase 3 (2008–2015)

Phase 3 automation upgrades will fully integrate all technologies into air traffic management. This phase will introduce the enhanced en route/oceanic system and full implementation of digital communications and air traffic planning tools that incorporate weather prediction and advisories. The oceanic and en route domains will employ similar procedures and separation methods.

Users will have the flexibility to file new, NAS-wide 4-dimensional flight profiles. This allows the user to meet any flight objective while providing maximum strategic planning for service providers. As the phase-in of new technology reaches completion, obsolete navigation systems will be phased down. Increased capabilities of the modernized NAS will eventually allow increased capacity utilization through VFR-like flight operations in IFR conditions.

1. Note that service-provider-operated communications services may be retained for data link that supports oceanic ATC operations and potentially as a backup capability in domestic airspace.

Maximum runway utilization rates, aircraft performance characteristics, and departure traffic schedules are balanced to produce a constant and efficient flow of arriving traffic to the runway. DSS tools will assist in determining the most advantageous descent point from cruise altitude, so each aircraft can fly the optimum descent profile for fuel efficiency. Airport, weather, TFM, and ATC system performance data will be available to aircraft via service provider data link.

The following activities will be included in Phase 3:

- Provide NAS-wide information sharing
- Provide interactive airborne refile to enable increased collaboration with users
- Provide integrated tower area surveillance for tower and surface
- Deploy enhanced SMS to fully integrate operations between surface and arrival/departure operations
- Deploy aFAST with wake vortex at TRACONs
- Provide conflict resolution with multicenter metering to evaluate requested flight path amendments across center boundaries
- Deploy NAS-wide data link via full next-generation air-ground communication system (NEXCOM) and CPDLC Build 3 via VDL-Mode-3 at all high-altitude en route and high-density terminal and tower facilities
- Begin using 4-dimensional (longitudinal, lateral, vertical, time) flight profiles to enable greater flexibility and planning with users and providers
- Employ full use of digital communications for voice and data in the en route environment
- Provide common en route and oceanic services
- Conduct visual flight rules (VFR)-like operations under IFR conditions.

5.2 Capabilities Overview

5.2.1 Background

In 1997, a concept of operations for a new NAS air traffic control system was generated. Two documents were developed: the *Government/Industry Operational Concept for the Evolution of Free Flight* was developed by the FAA and aviation community through the RTCA. The RCTA concept provides a joint view of how service provider and user interact in the new NAS. The FAA's concept is consistent with this document. *A Concept of Operations for the National Airspace System in 2005*, generated by FAA Air Traffic Services and approved September 30, 1997, presents the operational concept for the NAS from the perspective of the service providers, including detailing how they interact with air traffic. Together these make up the NAS concept of operations for the future, commonly referred to as the CONOPS.

The CONOPS does not address all aspects of the NAS. It assumes that many current capabilities will remain in place and address only those services and capabilities that need to be changed.

The NAS architecture is derived from the requirements of the CONOPS, and the NAS modernization architectural diagrams show the functional decomposition of the NAS. These diagrams are the basis for more detailed engineering diagrams that describe the implementation of capabilities in terms of specific functions and systems, their interdependencies and interfaces.

5.2.2 Assumptions

The following assumptions were made to define the scope of the capabilities.

First, the capabilities addressed are derived from the CONOPS, which focuses on changing capabilities and assumes that existing capabilities not addressed will remain as they are today.

Second, functions are assigned to phases and addressed. It is not assumed that all sites, or even all geographic areas, of the NAS will have the capabilities by that time phase. The precise number of sites or geographic areas where the improvements will be in place has not been established. In some cases, single installations and prototype systems are included to better show the progress of the NAS modernization.

Third, aircraft equipage (i.e., data link, satellite navigation equipment, etc.) is not to be mandated. Traditional voice radios and ground-based navigation aids will be available far into the future. However, benefits from NAS modernization will

be made available to aircraft commensurate with the avionics equipage of the aircraft.

Fourth, for the purposes of illustration, most capabilities have been depicted in five phases of flight. They are:

- *Flight Advisory/Preflight*: Includes flight planning and preflight and postflight coordination activities
- *Tower/Airport Surface*: Includes takeoff, landing, gate activities, and taxi and ramp operations
- *Departure/Arrival*: Includes climb-out, descent, approach, and other terminal operations
- *En Route/Cruise*: Includes all operations between and above terminal areas
- *Oceanic*: Includes oceanic and offshore operations.

5.2.3 Sample Illustration of NAS Capability Diagram

Top-level diagrams showing the major components and the data flows between these components are available for each capability identified in the NAS Modernization Capabilities matrix (see Figures 5-2 through 5-4). These diagrams illustrate the changes anticipated in the NAS during the modernization phases as well as various phases of flight on a capability-by-capability basis. Short textual descriptions follow each diagram to provide a clearer picture of what takes place during that phase.

The differences in the capability "Increased Navigation/Landing Position Accuracy and Site Availability" for two modernization phases for Arrival/Departure are shown in Figures 5-2 and 5-3. Figures 5-2 and 5-4 illustrate the differences in Phase 1 between en route/cruise operations and arrival/departure operations.

A complete set of diagrams addressing the changes in the NAS capabilities throughout NAS modernization is included in Appendix D. The systems engineering of all NAS capabilities is an ongoing process and the diagrams will be updated periodically.

These updates will be posted to the FAA Web site (http//www.faa.gov) as they become available.

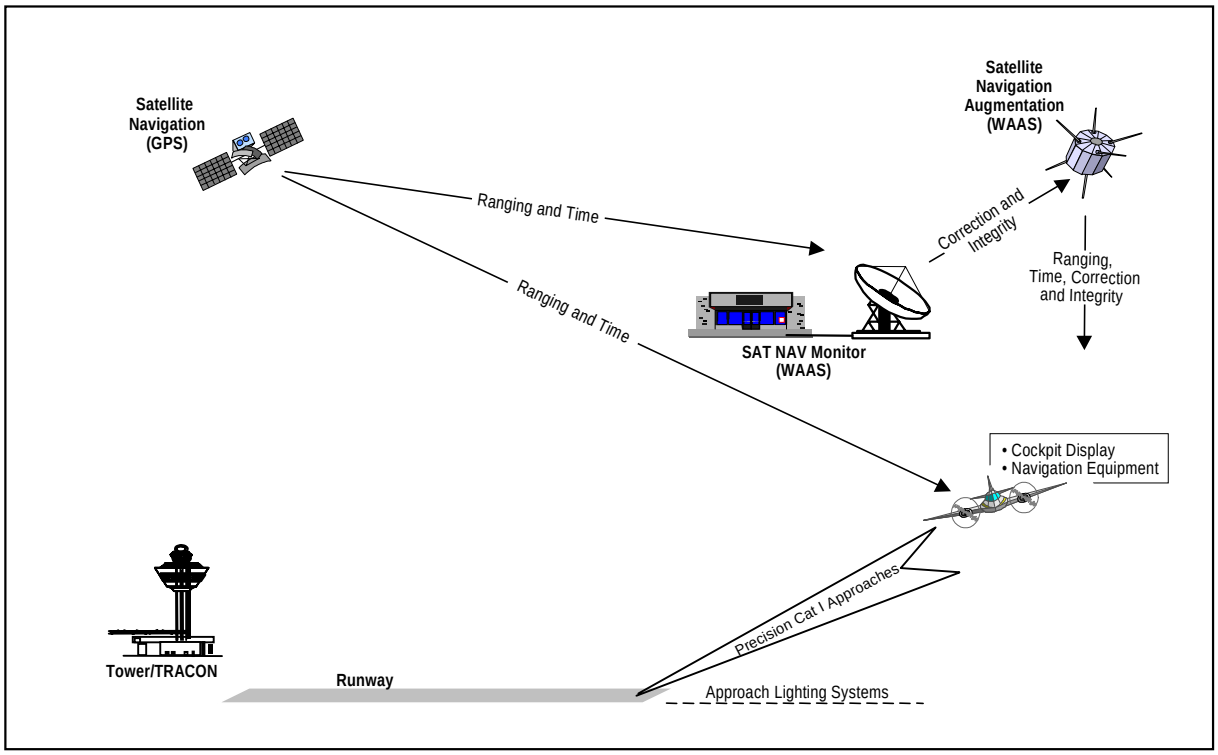

Figure 5-2. Increased Navigation/Landing Position Accuracy and Site Availability, Air Traffic Services Arrival/Departure, Phase 1 (1998–2002)

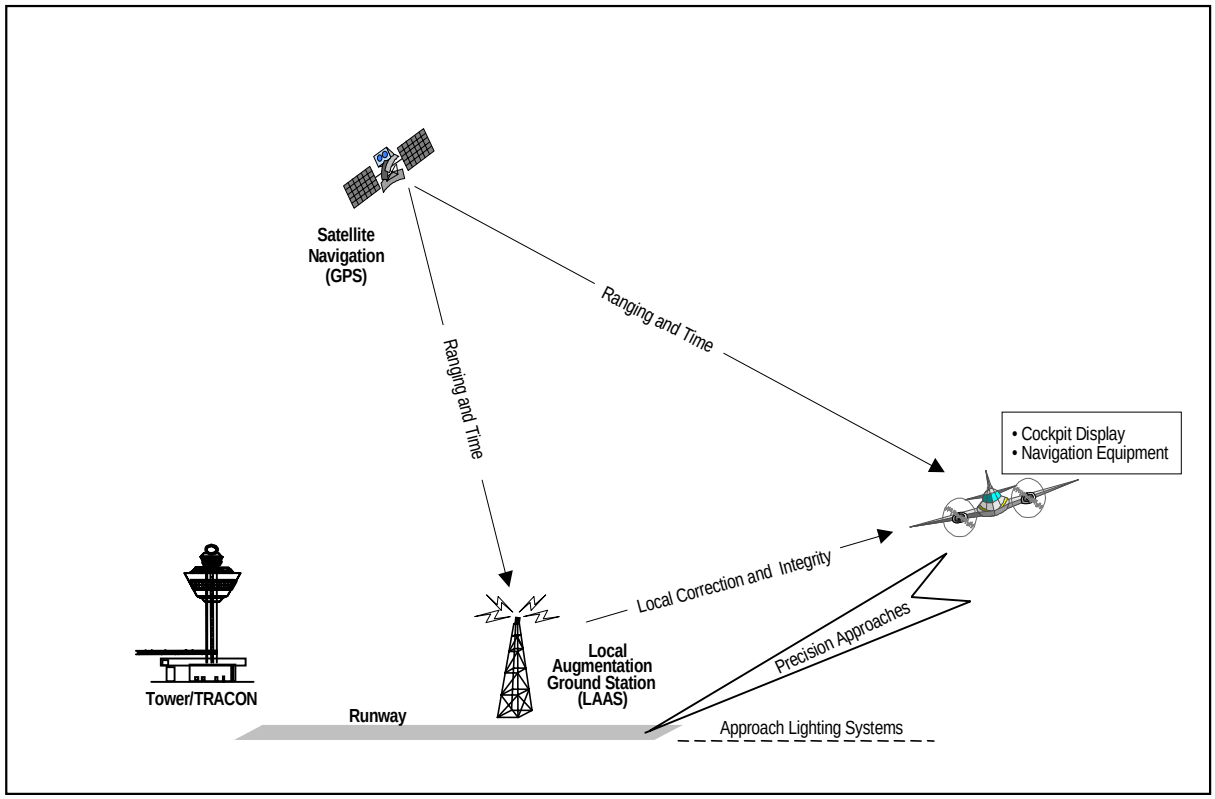

Figure 5-3. Increased Navigation/Landing Position Accuracy and Site Availability, Air Traffic Services Arrival/Departure, Phase 2 (2003–2007)

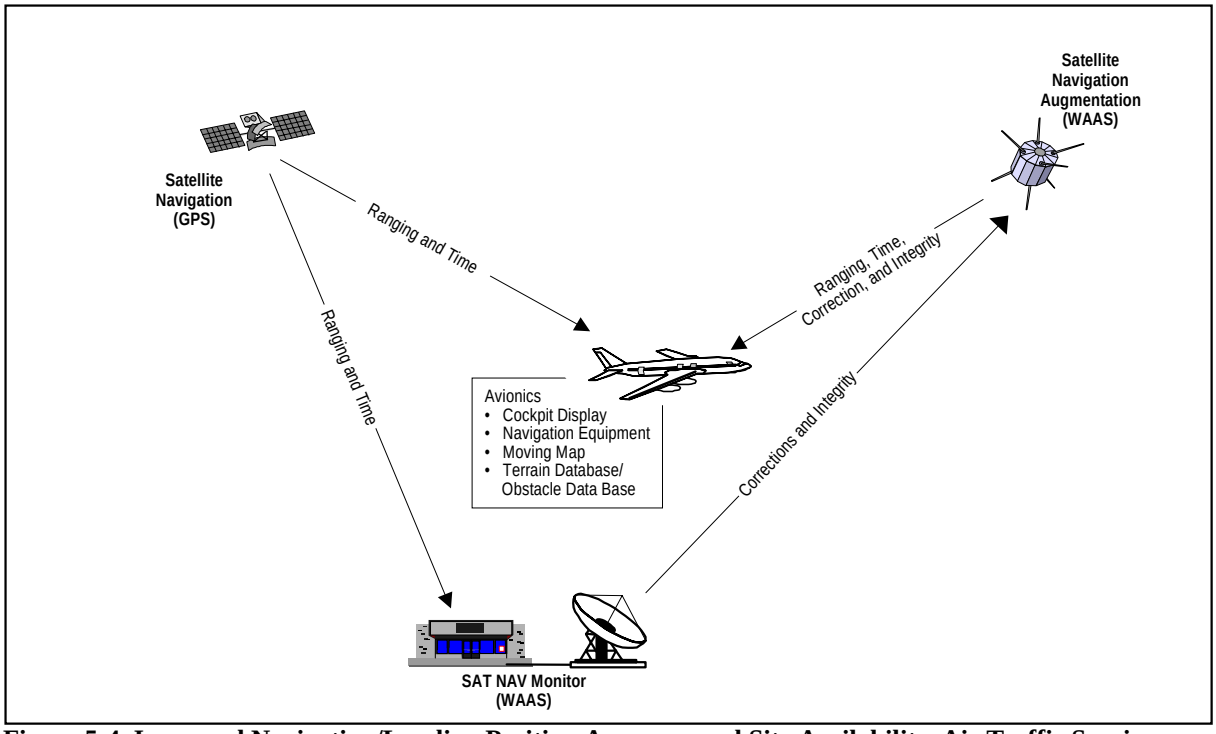

Figure 5-4. Increased Navigation/Landing Position Accuracy and Site Availability, Air Traffic Services En Route/Cruise, Phase 1 (1998–2002)

Appendix D also contains a capability matrix, which addresses air traffic service capabilities throughout the active phase of flights and NAS management services that cross domains of flight or involve infrastructure management issues.

5.3 Summary

Viewing NAS modernization in terms of the capabilities provides insight into the complex integration that must be accomplished to advance the NAS towards Free Flight. New systems by themselves do not provide new services. Capabilities emerge only when combined with training, procedures, and certification/regulation, where applicable.

In the next section, risk management is examined. Many NAS modernization concepts have never been proven in operational use. Strategies to mitigate the risks of trying new technologies and procedures are discussed.