Enroute Charts Part 2 and Procedures

- Some review
- PROCDURES

IFR Altitudes

Minimum Enroute Altitude (MEA)

- guarantees both obstruction clearance and navigation signal coverage
- where two segments of an airway have different MEAs…
  - climb to the higher MEA should occur
  - after passing the point where the new MEA applies

Minimum Obstruction Clearance Altitude (MOCA)

- guarantees obstruction clearance
- but guarantees signal coverage only within 22 NM of VOR
- May be assigned by ATC within 22 NM of the VOR

Minimum Altitudes for IFR Flight

- When you are operating on off-airway, direct routes, you are responsible for your own minimum altitude using the following criteria:
  - Non-mountainous areas
    - 1,000 ft above the highest obstacle
  - Mountainous areas
    - 2,000 ft above the highest obstacle
  - within 4 NM either side of your route

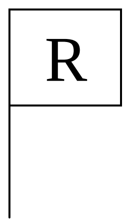
Other IFR Altitudes

Maximum Authorized Altitude (MAA)

– maximum altitude you can fly along a route
– because of possible signal interference from other VORs

Minimum Reception Altitude (MRA)

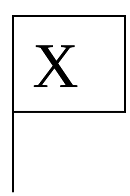
– lowest altitude that will ensure reception of all signals forming an intersection or other fix
– denoted on NOS charts by the symbol



Other IFR Altitudes

Minimum Crossing Altitude (MCA)

- the minimum altitude at which you must cross a fix
- unlike changes in MEAs
  - you must begin your climb *before* reaching the fix to which the MCA applies
  - so as to cross the fix at or above the MCA



Summary Altitudes Acronyms

MEA- Minimum Enroute Altitude is the lowest published altitude between radio fixes which ensures acceptable nav signal coverage and obstacle clearance

MOCA- Minimum Obstacle Clearance Altitude between fixes, acceptable nav signal within 22 NM

MCA- Minimum Crossing Altitude

MRA- Minimum Reception Altitude

MAA- Maximum Authorized Altitude

OROCA- Off Route Obstruction Altitude

Contacting an ATC Facility

Upon *initial contact* you should…

- State the name of the facility you are calling
- State your aircraft ID
- Report you altitude(s)
  - If level, report your current altitude
  - If changing altitude, give you current <u>and</u> assigned altitudes
- Report your heading *if you are being vectored*
- Examples:
  - “New York Departure, Arrow 83125, leaving 1,500 climbing to 3,500, heading 010.”
  - “Boston Center, Arrow 83125, level 5,000.”
  - “Bradley Approach, Arrow 83125, leaving 5,000 descending to 2,200.”

Reporting Procedures (General)

- Always report leaving an altitude when climbing or descending to a new altitude
  - Newly assigned altitude by ATC
  - Changing altitudes when VFR-on-Top
- Report the time and your altitude upon *reaching and leaving* a holding fix or clearance limit
- Report a missed approach, followed by your intentions
- Report changes in aircraft performance
  - Inability to maintain a 500 fpm climb
  - TAS change by 5% or 10 kts., whichever is greater
  - Any equipment malfunctions (e.g, DME, ADF, VOR, flight instruments)
- Any unforecasted weather conditions
- Any requested report by ATC

Reporting Procedures (*Non-radar*)

Position reports

- Compulsory reporting points
  - depicted on IFR charts by solid triangles (▲)
  - on direct course, each point defining the route is a compulsory reporting point
  - also applies to VFR-on-Top operations

- Revised estimate if different by more than 3 minutes from a previously given estimate

- Time leaving the final approach fix inbound

RADAR/NONRADAR REPORTS

These reports should be made at all times without a specific ATC request.

Leaving one assigned flight altitude or flight level for another	*"Cessna 45132, leaving 8,000, climb to 10,000."*
VFR-on-top change in altitude	*"Cessna 45132, VFR-on-top, climbing to 10,500."*
Leaving any assigned holding fix or point	*"Cessna 45132, leaving FARGO Intersection."*
Missed approach	*"Cessna 45132, missed approach, request clearance to Chicago."*
Unable to climb or descend at least 500 feet per minute	*"Cessna 45132, maximum climb rate 400 feet per minute."*
TAS variation from filed speed of 5% or 10 knots, whichever is greater	*"Cessna 45132, advises TAS decrease to140 knots."*
Time and antitude or flight level upon reaching a holding fix or clearance limit	*"Cessna 45132, FARGO Intersection at 05, 10,000, holding east."*
Loss of nav/comm capability (required by FAR 91.187)	*"Cessna 45132, ILS receiver inoperative."*
Unforecast weather conditions or other information relating to the safety of flight (required by FAR 91.183)	*"Cessna 45132, experiencing moderate turbulence at 10,000."*

NONRADAR REPORTS

When you are not in radar contact, these reports should be made without a specific request from ATC.

Leaving FAF or OM inbound on final approach	*"Cessna 45132, outer marker inbound, leaving 2,000."*
Revised ETA of more than three minutes	*"Cessna 45132, revising SCURRY estimate to 55."*
Position reporting at compulsory reporting points (required by FAR 91.183)	*See figure 5-17 for position report items.*

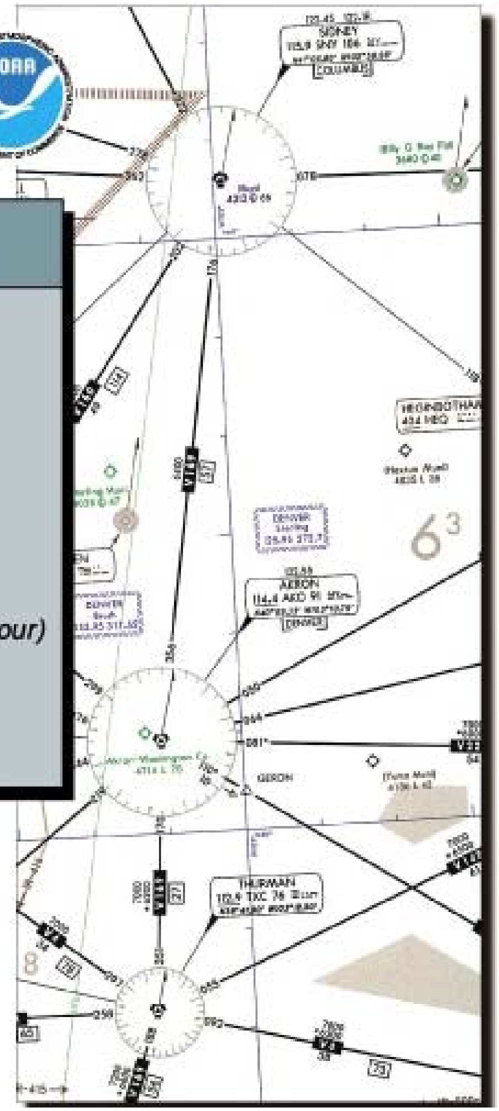
GPS IFR ENROUTE AND TERMINAL REQUIREMENTS

Operation	GPS Requirements
Domestic GPS IFR Enroute and Terminal Area	• GPS[1] • Traditional navigation equipment (VOR, DME, TACAN, and/or NDB) appropriate to the route of flight must be installed and operational, but it does not need to be on and monitored unless RAIM fails. • All the compatible underlying navaids along the route of flight must be operational.
Oceanic GPS IFR Route Type: • Routes that require dual long range navigation systems (suchg as dual INS or dual OMEGA	• GPS[1] • One other long range navigation system compatible with the route of flight
• Routes that require only one long range navigation system	• GPS[1] • One other means of navigation compatible with the route of flight

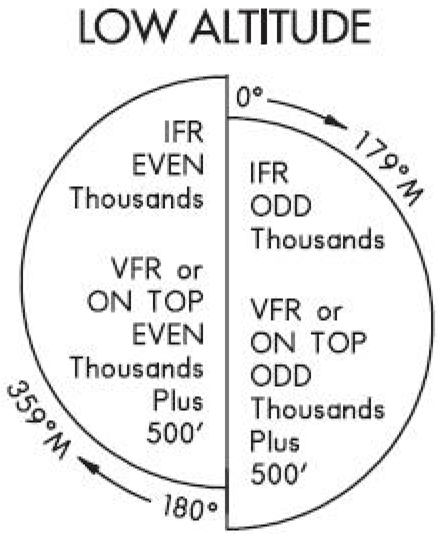
[1]GPS units that are approved, in accordance with FAA TSO C129, for IFR enroute, terminal, and approach procedures

Position Reports

Position Report Items	
Identification	*"Cessna 45132,*
Position	*Sidney*
Time	*15, (minutes after the hour)*
Altitude/Flight Level	*9,000,*
IFR or VFR (in a report to an FSS only)	*IFR,*
ETA over the next reporting fix	*Akron 35, (minutes after the hour)*
Following reporting point	*Thurman next."*
Pertinent remarks	*(If necessary)*



IFR Altitudes / Altitude Changes

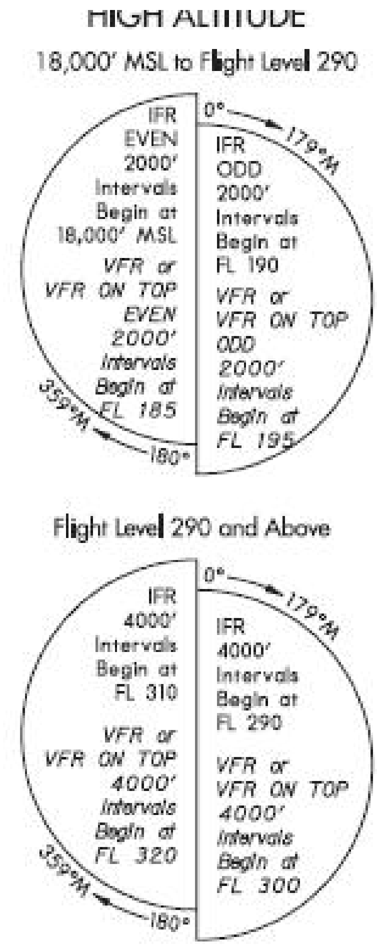


VFR above 3000′ AGL
unless otherwise authorized by ATC

IFR outside controlled airspace

IFR within controlled airspace as assigned by ATC

All courses are magnetic



NO VFR FLIGHTS WITHIN CLASS A AIRSPACE

VFR above 3000′ AGL
unless otherwise authorized by ATC

IFR outside controlled airspace

IFR within controlled airspace as assigned by ATC

All courses are magnetic

Descent at pilot's discretion means

- You may begin descent whenever you like
- You may level off at intermediate altitudes
- Once you leave an altitude, you may *not* return to it
- A crossing restriction is a clearance to descend at pilot's discretion, as long as you comply with the restriction,

Enroute Navigation Using GPS

If you have a panel mounted GPS with RAIM capability and updated with the most recent database, you may avoid VOR-TACAN-VORTAC-NDB navigation routing, and fly direct point-to-point routing between airports. Obviously one very important altitude is the OROCA since you will not be utilizing Victor for Jet airways. It is unlikely that you will be flying low enough to be concerned with OROCA but be aware of it as well as other altitudes should the GPS fail and you have to fall back on traditional airway navigation.

Unlike traditional navigation equipment such as VOR, basic operation, receiver presentation, and capabilities of GPS units can vary greatly. Most models have similar functionality but bottonology can be quite varied.

Before departure, make sure that you receive and review appropriate GPS NOTAMs to alert you to any satellite outages.

"Automatic Dependent Surveillance Broadcast"

A – **A**utomatic in that it is Always On

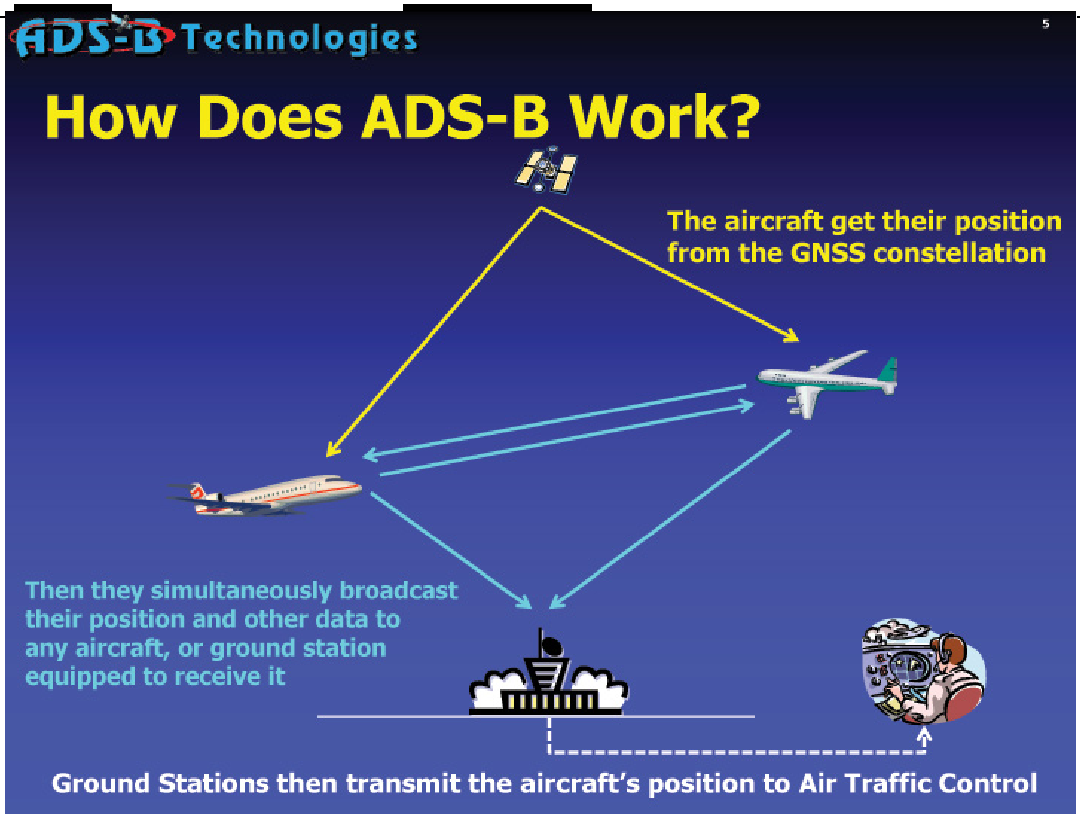
D - **D**epends on accurate Global Navigation Satellite Systems (GPS for us)

S - Radar like **S**urveillance

B - Continuous **B**roadcasting position and other data to aircraft and ground stations if ADS-B equipped.

ADS-B represents the Next Generation Airspace Navigation System (NextGen) in the future with National Airspace System reconfigured no later than 2020. The system is operational at this time.

"*Ins* and *Outs* of ADS-B



ADS-B enables broadcast of identification, position, altitude and speed to aircraft and ATC. This is **ADS-B OUT** services. Mandatory equipment compliance by 2020.

ADS-B The receipt by an aircraft or vehicle of ADS-B data is know as **ADS-B IN** services.

NOW **available** across the National Airspace System everywhere there is radar coverage.

- Directly from other aircraft that are using the same link and are flying within receiving range.

- From other ADS-B-equipped aircraft on the opposite link via ADS-R (**R**ebroadcast)

- Via **T**raffic **I**nformation **S**ervices-**B**roadcast (TIS-B)

TIS-B is a rebroadcast of data from ATC radar. That data will be directly displayed on the data displays in the cockpit (integrated into MFDs). This is neither designed nor intended to be a collision avoidance system like Traffic Collision Avoidance Systems (TCAS). It serves only to "enhance" situational awareness and to aid in the visual spotting of other aircraft.

Where will it be used?

"ALL aircraft operating within Class A, B, C airspace, and some portions of Class E airspace (essentially everywhere you need a transponder) will be required to meet the prescribed performance standards for positional integrity and other criteria associated with ADS-B avionics."

ALL aircraft flying in ADS-B airspace will need a transponder and an ADS-B Out modification or upgrade to make them compliant ADS-B Out requirements, possibly eliminating the need for a separate ADS-B Out device. Check with your avionics shop for details.

Equipment Choices

In the U.S., ADS-B equipped aircraft and vehicles exchange information on one of two frequencies: 1090 or 978 MHz.

The 1090 MHz link is already used by Mode A/C and S transponders and Traffic Collision Avoidance Systems. ADS-B extends the message elements of Mode S with additional information about the aircraft and its position. This is known as the "Extended Squitter" and is referred to as **1090ES**.

Universal Access Transceiver (UAT) equipment operates on 978 MHz. The UAT link is the U.S. regional link mainly used for Flight Information System-Broadcast (FIS-B) services. FIS-B will uplink textual and graphical weather information for display on the cockpit MFD.

ADS-B ground-based radio stations process the message data received on each frequency and send them back out again on the opposite frequency. This process is known as ADS-B Rebroadcast (ADS-R)

Commercial airliners and larger business jets will be required to have Mode S and TCAS installed but general aviation will only need upgrade of transponders to 1090ES and may choose to equip with UAT equipment.

Performance Based Navigation (PBN)

PBN will **replace** traditional navigation is ground based (VOR-NDB).

"PBN simply defines the aircraft navigation capabilities and required performance necessary to operate on a given air traffic route, instrument approach, or in a defined airspace." Predefined performance requirements!

The foundation concepts for PBN are Area Navigation (RNAV), and Required Navigation Performance (RNP).

RNAV AND RNP

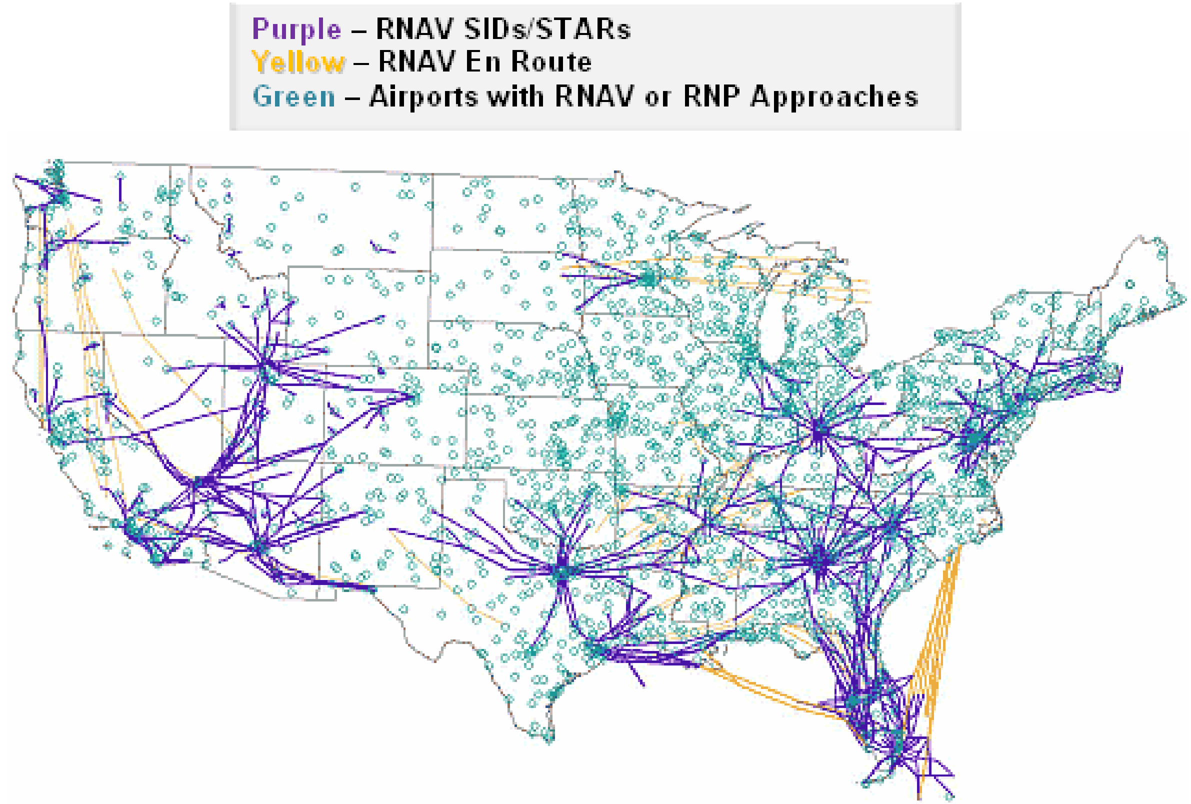
RNAV provides flexibility. It can be used for station-based nav such as DME, or Coordinate-based systems such as GPS, or self-contained systems such as INS.
It provides greater safety, more flexibility, shorter routes and reduced time enroute.

REQUIRED PERFORMANCE NAVIGATION

RPN = <u>RNAV + Navigation System Performance Monitoring and Alerting</u>

RPN is RNAV with enhanced knowledge of how the aircraft navigation system is performing (RNAV on steroids). **Onboard monitoring and alerting capability** improves pilot's situational awareness, and can also enable <u>reduced obstacle clearance or closer route spacing without ATC surveillance</u>. Like GPS RAIM (receiver autonomous integrity monitoring), ***RPN monitors itself and is a safety critical characteristic***.

With regard to airspace or a specific operation, the associated RPN states the performance navigation for the operation as a distance in NMs from the intended centerline of a procedure or route. To read more you may want to read the 2006 FAA publication titled "*Roadmap for Performance-Based Navigation*."
The framework is GLOBAL and has the basis embodied in the International Civil Aviation Organization (ICAO) setting criteria for RNAV 1 Departure and Arrival Procedures, and RNAV 2 Q & T Routes. The U.S. implementation will also have RPN and RPN-AR Approach procedures (Special Aircraft and Aircrew Authorization Required).



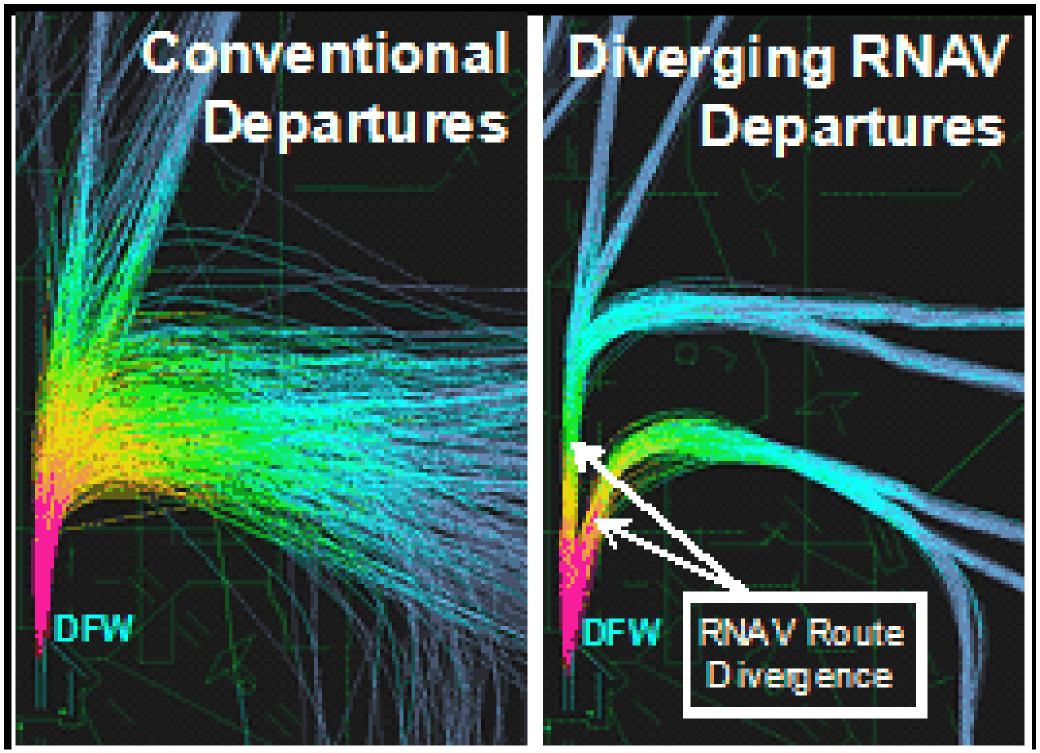
RNAV procedures can provide benefit in all phases of flight, including departure, en route, arrival, approach, and transitioning airspace. For example, Standard Terminal Arrivals (STARs) can:

- Increase predictability of operations
- Reduce controller/aircraft communications
- Reduce fuel burn with more continuous vertical descents
- Reduce miles flown in Terminal Radar Approach Control (TRACON) airspace
- Reduce interaction between dependent flows in multiplex airspace

Optimized Profile Descent (OPD)

As a component of its Trajectory-Based Operations NextGen initiative, FAA has authorized development of arrival procedures with vertical profiles optimized to facilitate a continuous descent from the top of descent to touchdown. OPD is designed to reduce fuel consumption, emissions, and noise during descent by allowing pilots to set aircraft engines near idle throttle while they descend.

Departures Also optimized



Utilizing RNAV, DFW implemented initially diverging, fanned routes in September 2005. These new RNAV SIDs resulted in benefits of:

45% reduction in delay during peak demand
$25 million in operator benefits through 2008
10 additional departures per hour per runway

RNP AR

RNP AR approach procedures offer design flexibility and enhanced performance, allowing us to deconflict traffic, mitigate obstacles, and stabilize vertically-guided approaches as illustrated in the approach to Colorado's Garfield County Regional Airport (RIL) depicted below. *High terrain on both sides of approach path to RIL Runway 8*

NextGen information is available for each phase of flight including:

PLANNING

DEPARTING

CLIMB-CRUISE

DESCENT-APPROACH

LANDING-TAXI

Emerging Technologies

- **System-Wide Information Management (SWIM)**
- **Data Communications (Data Comm)**
- **NextGen Network Enabled Weather (NNEW)**

System-Wide Information Management (SWIM)

It is the information technology standards base that will help to make sure that every NextGen application is compliant within the NAS. The goal of SWIM is to improve operational decision making by allowing easier data exchange between systems..

Information technology standards base that will help to make sure that every NextGen application is compliant within the NAS. The **goal of SWIM is to improve operational decision making by allowing easier data exchange between systems**. The program's first segment will focus on applications related to fight and flow management, aeronautical information management, and weather data dissemination.

Data Communications (Data Comm)

Initially, data communications will be a supplemental means for two-way exchange between controllers and flight crews for air traffic control *clearances, instructions, advisories, flight crew requests, and reports*. As the system matures, **the majority of air-to-ground exchanges will be handled by data communications for appropriately equipped users.**

NextGen Network Enabled Weather (NNEW)

Serves as the infrastructure core for aviation weather support services, **providing access to a NAS-wide common weather picture**. NNEW will identify, adapt, and use standards for system wide weather data formatting and access. **The FAA is calling this collaboratively built, but centrally accessed, data source the "4-D Weather Data Cube,"** where aviation weather information from multiple agency sources will be developed and stored. The Cube will provide a **single national—and eventually global—picture of the atmosphere, updated as needed in real-time and distributed to authorized users and systems**.

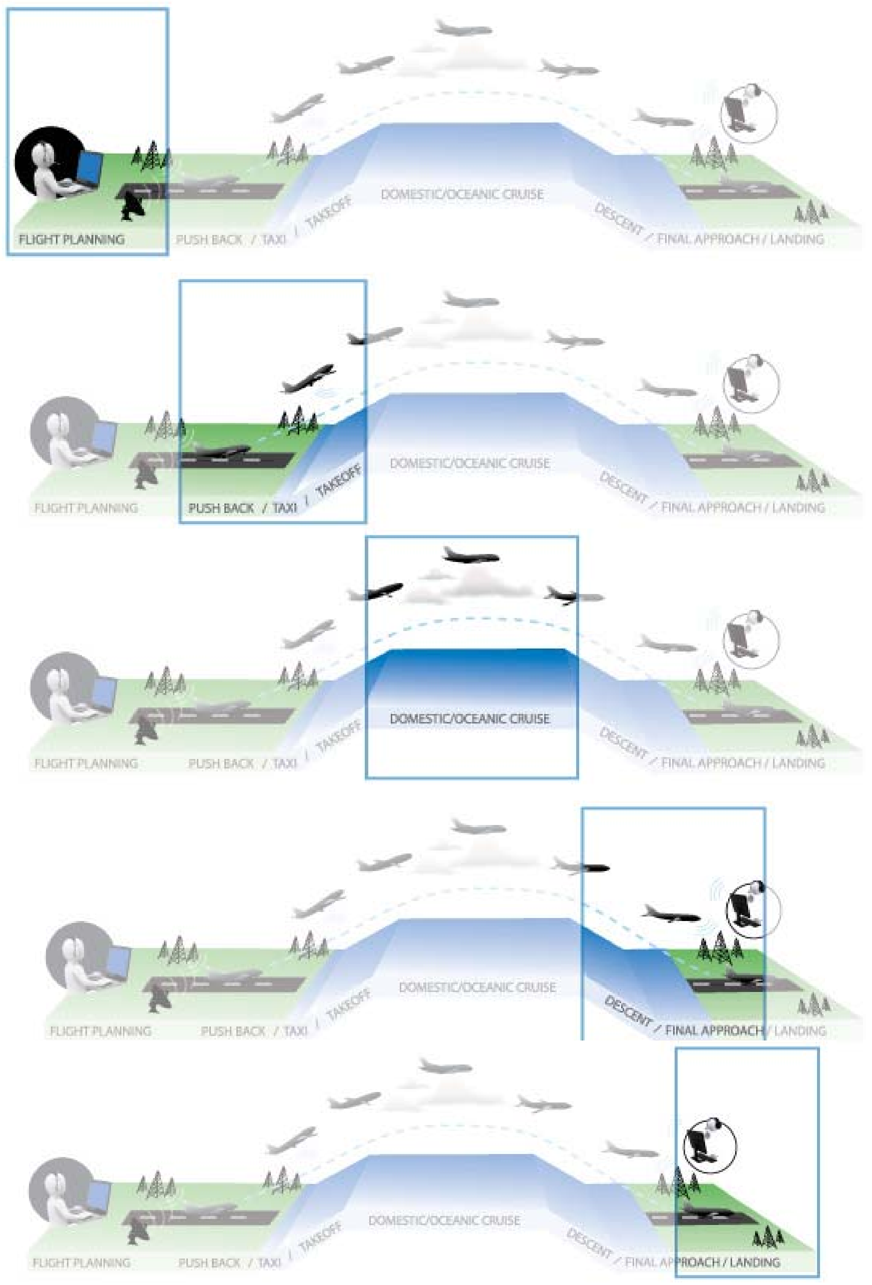
The **NWS will have primary responsibility for operational management of the Cube, while the FAA will define requirements and coordinate and implement changes to FAA infrastructure that support it.**

National Airspace System Voice Switch

(NVS) is a program to replace current voice switches, some of which are more than 20 years old. With the current voice architecture, linkages do not support sharing of airspace within and across facility boundaries, reconfiguration capability of controller position to radio frequency and volume of airspace is inflexible, and reconfigurations are laborious and time consuming. HENCE movement to PBN. Expect details soon on:

PBN Based

- Planning
- Departing (pushback, taxi, takeoff)
- Climb – Cruise (domestic & oceanic)
- Descent – Approach
- Landing - Taxi



NextGen Flight Planning

Flight planners in the mid-term will have <u>increased access to relevant information on the status of the National Airspace System through a shared network-enabled information source</u>. Operators will have access to current and planned strategies to deal with congestion and other airspace constraints. New information will include **airspace blocked for military, security or space operations**. It will describe other **airspace limitations**, such as those **due to current or forecast weather or congestion**. It also will show the status of properties and facilities, such as **closed runways, blocked taxiways and out-of-service navigational aids**.

This shared information will <u>enhance the ability of users to plan</u> their flight operations according to their personal or business objectives. Updates will be available as individual flight-planning objectives are affected by changes in airspace system conditions. Operators will plan their flights with a **full picture of potential limitations, from ground operations to the intended flight trajectory**. An outcome of this planning process will be an **electronic representation of the operator's intended flight profile, updated for changing conditions that might affect the flight's trajectory.**

NextGen Push Back, Taxi and Departure

As the time for the flight approaches, the flight crew will receive the final flight path agreement as a data message. **Data communications will provide pre-departure clearances that allow amendments to flight plans**. When the aircraft taxis out, the flight crew's situational awareness will be improved by **flight deck displays that portray aircraft movement on a moving map that indicates the aircraft's position on the airport surface, and at busy airports, the position of other aircraft and surface vehicles**. In the tower, improved ground systems, such as surface-movement displays, will enable controllers to manage taxiways and runways more efficiently, choosing the best runway and taxi paths for the departing aircraft's intended flight path and the status and positions of all other aircraft on the airport surface and in the terminal area.

Departure performance will be improved by using **multiple precise departure paths from each runway end through Area Navigation (RNAV) and Required Navigation Performance (RNP) procedures**. Multiple departure paths will enable controllers to place each aircraft on its own separate track, **avoiding known constraints, thunderstorms and other severe weather near the airport.**

NextGen Climb and Cruise

As the aircraft climbs into the en route airspace, **enhanced processing of surveillance data will improve position information and enable the flight crew and controllers to take advantage of reduced separation standards**. Because the flight crew will be able to **monitor the position of other aircraft** from their own aircraft's flight deck, air traffic personnel will be able to assign spacing responsibility to the flight crew as the aircraft climbs to its cruising altitude. The aircraft will be able to merge into the overhead stream with a minimum of additional maneuvers.

If a potential conflict with other aircraft, bad weather, homeland security interventions or other constraints develops along the aircraft's planned path, automation will identify the problem and provide recommended changes in trajectory or speed to eliminate the conflict.

NextGen Descent and Approach

NextGen capabilities will provide a number of improvements to terminal area operations that **save fuel, increase predictability and minimize maneuvers such as holding patterns and delaying vectors**. Enhanced traffic management tools will **analyze flights approaching an airport *from hundreds of miles away***, across facility boundaries, and **will calculate scheduled arrival times to maximize arrival performance**. These advances will improve the flow of arrival traffic to maximize use of existing capacity. Improvements in calculated schedule arrival times will enhance system-wide planning processes. Controllers will gain automated information on airport arrival demand and available capacity, enabling them to **improve sequencing and the balance between arrival and departure rates**.

The FAA will provide users with **better options** to manage departure and arrival operations safely **during adverse weather**, maintaining capacity that otherwise would be lost. Poor-visibility conditions dramatically reduce the capacity of closely spaced runways, and the capacity losses ripple as delays throughout the airspace system. NextGen capabilities will make it possible to continue using those runways safely, by providing **better-defined path assignments and appropriate separation between aircraft.**

NextGen Landing, Taxi, Gate Arrival

Before the flight lands, **the assigned runway, preferred taxiway and taxi path to the assigned parking space or gate will be available to the flight crew <u>via data communications</u>.** This capability will be enabled by a ground system that recommends the best runway and taxi path to controllers, **based on the arriving aircraft's type and parking assignment, and the status and positions of all aircraft on the airport surface.**

Flight deck and controller **displays will monitor aircraft movement and provide traffic and incursion alerts, using the same safety and efficiency tools as during departure operations**. This will **<u>reduce the potential for runway incursions</u>**. Appropriate surface and gate-area vehicle movement information will be shared among air traffic control, flight operations centers and the airport operator. Airport and airline ramp and gate operations personnel will know each inbound aircraft's projected arrival time at the gate. Operators will be able to coordinate push backs and gate arrivals more efficiently.

Enroute Procedures Summary Checklist

- During a radar handoff, the controller may advise you to give the next controller certain information, such as a heading or altitude.
- If you cannot establish contact using a newly assigned frequency, return to the one previously assigned and request an alternate frequency.
- You should make the following reports to ATC at all times: Leaving and Altitude, An altitude change if VFR-On-Top, Time and Altitude upon reaching a holding fix or clearance limit. Leaving a holding fix or clearance limit, Missed approach, Inability to climb or descend at a rate of at least 500 feet per minute, and Change in True Airspeed by 5% or 10 knots (whichever is greater).
- You are required by regulation to report a loss of airplane navigation capability. Unforecasted or hazardous weather conditions, and any other information related to the safety of flight.
- If radar contact has been lost or radar service terminated, the FARs require you to proved ATC with position reports over compulsory reporting points.
- The standard position report includes your identification, current position, time, altitude, ETA over the next reporting fix, the following reporting point, and any pertinent remarks
- In nonradar environments, you should report when you reach the final approach fix inbound on a nonprecision approach, and when leaving the outer marker inbound on a precision approach. Also when it is apparent that the ETA submitted to ATC will be in error of more that THREE MINUTES.

Enroute Procedures Summary Checklist

- To use panel-mounted, IFR enroute-approved GPS as your primary means of point-to-point navigation, your aircraft must be equipped with an alternate means of navigation, such as VOR-based equipment, appropriate to the flight.
- Active monitoring of alternate navigation equipment is not required if the GPS receiver uses receiver autonomous integrity monitoring (RAIM).
- ATC usually does not issue an IFR route clearance the crosses an active restricted area, but inactive areas are often released for use.
- Though you may request and be assigned any altitude in controlled airspace, most pilots file flight plan altitudes that correspond to the hemispheric rule. (normal IFR/VFR flight altitudes)
- Lowest usable altitudes are specified for use above 18,000 feet MSL, when the barometric pressure is below certain values.
- When you are given a descent clearance "…*at pilot's discretion*." you are authorized to begin the descent whenever you choose, and level off temporarily during the descent, but you cannot return to an altitude once you vacate it.
- Be familiar with ADS-B and take advantage of its in/out capabilities. Consider using such devices as Stratus2 as a supplement to situational awareness.