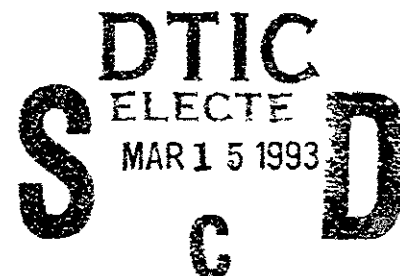


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# Conversion of the CTA, Inc., En Route Operations Concepts Database Into a Formal Sentence Outline Job Task Taxonomy

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16. Abstract  FAA Air Traffic Control Operations Concepts Volume VI: ARTCC-Host En Route Controllers (1990) developed by CTA, Inc., a technical description of the duties of an En Route air traffic control specialist (ATCS), formatted in User Interface Language, was restructured into a hierarchical formal sentence outline. To ensure that none of the meaning associated with a task or task element was lost during the conversion, the revised document was reviewed by subject matter experts (SMEs) consisting of five groups of six En Route controllers and a quality assurance subject matter expert. SMEs looked for words, phrases, or acronyms not commonly used by En Route controllers, and illogical sequencing of duties described in the document. Appropriate suggestions for change were implemented into the document before the next review. Five-hundred seventy-five changes were made to the document, with only two of these changes made during the final review, confirming that an improved document resulted from the research. The restructured document is intended to assist in the identification of tasks not performed or performed incorrectly during the commission of an operational error. However, an easily understood, detailed description of duties performed by an En Route ATCS has potential not only for use by researchers interested in En Route ATCS tasks, but also by quality assurance investigation teams and training personnel.			
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# CONVERSION OF THE CTA, INCORPORATED, EN ROUTE OPERATIONS CONCEPTS DATABASE INTO A FORMAL SENTENCE OUTLINE JOB TASK TAXONOMY

## INTRODUCTION

Lack of an easily understood detailed description of the duties of an En Route air traffic control specialist (ATCS) limits the ability to conduct research on ATCS tasks. Such a description should be detailed enough so that every aspect of the job is well-defined and divided into its fundamental components. The *FAA Air Traffic Control Operations Concepts Volume VI: ARTCC-Host En Route Controllers* (1990), (*Operations Concepts*) developed by Computer Technology Associates (CTA), Inc., defines the operational duties of an En Route air traffic controller. The document presents a series of operations concepts, which focus on requirements for information exchange between an En Route controller and the Host Computer System. *Operations Concepts* was developed to assess the operational suitability of the bidding contractors' design of the Advanced Automation System (AAS). *Operations Concepts* was formatted in a complex manner to accommodate these purposes; however, it is rather difficult to use in other applications. For instance, many of the terms used in the *Operations Concepts* were not recognized by experienced ATCSs; therefore, the *Operations Concepts* required modifications to improve its readability for use as a research tool. The research described in this document details the restructuring of the CTA taxonomy into an easily understood, hierarchically-structured, formal sentence outline to facilitate ATCS tasks research.

The *Operations Concepts* document attempts to describe not only the duties of an En Route controller, but also how the controller performs the job. The document includes composition graphs, which show the logical flow of operational tasks, a series of task characterization analyses, a User Interface Language (UIL), which aggregates system input and output messages in a hierarchical organization, and a decomposition of tasks into their constituent procedural elements. The data were designed to be generated and maintained using the Computer-Human Operational Requirements Analysis System (CHORAS), a proprietary data base management system.

The *Operations Concepts* was developed by identifying and defining the air traffic events to which En Route controllers respond. These responses were identified and reduced to the task element level. Non-operational tasks such as administrative tasks and tasks related to training were not included in the *Operations Concepts*. Data were collected through document reviews, site visits, and performance observations. Validation of the data was performed by a user review team (Sector Suite Requirements Validation Team), which contained members representative of the controller work force in terms of facility type, facility size, geographic location, and operational position. The data were also reviewed and validated by a group of En Route staff representatives of the Federal Aviation Administration (FAA) Academy. This document applied only to FAA En Route controllers, although CTA developed other volumes for other types of controllers.

The result was a description of the cognitive and behavioral actions involved in performing the duties of an En Route controller in the form of activities, sub-activities, tasks, and task elements. Activities were defined as top-level operational job functions. Sub-activities described work performance actions at the next level of detail. Tasks, at the next level, were units of work performance. Task elements were components of tasks, describing the systematic steps and actions required to accomplish a task. In the *Operations Concepts*, each level of performance was stated with an action verb, object of the action, and modifiers to describe why, how, where, or when the action was performed.

The information used to develop the restructured taxonomy was extracted from the Task List (Appendix B) and the Task Element Report (Appendix E) of the *Operations Concepts*. The Task List contained activities, sub-activities, and tasks; the Task Element Report contained tasks and task elements. The document was written in User Interface Language (UIL), which used

symbols to link together the verbs, objects, and modifiers to yield a descriptive and technical assessment of the controller-system interface. Each item on the Task List was numbered beginning with the prefix "EC," which indicated the task was an En Route controller task. The numbers that followed were separated by a decimal and indicated whether the task was at the activity, sub-activity, task, or task element level (e.g., EC.1.1.1 indicated the item was at the task or third level). The Task Statement was a brief summary of the task to be performed. Descriptive information in the task statement was preceded by an asterisk as follows:

Verb-(modifier)-Object-(modifier)-(\*descriptive information\*)

The Task Element Number and the Task Element Statement were formatted the same as the Task Number and the Task Statement.

The *Operations Concepts* contained most of the information needed to develop an easily understood, detailed description of the duties of an En Route controller. To achieve this, the activities, sub-activities, tasks, and task elements in Appendices B and E of the *Operations Concepts* were combined into a single document. In addition, the Task and Task Element statements were restructured into a hierarchically arranged formal sentence outline. The Coordination Media, Coordinatees, and Position columns in Appendix B (Task List) were a tabular presentation of the means of communication and positions involved in performing the task; that presentation was redundant to information contained in the corresponding task element statements and, therefore, was excluded from the restructured document. The Objects and Number of Objects columns in Appendix E (Task Element Report) were a tabular summary of the objects listed in the corresponding task element statement and the number of instances a controller would encounter the object in a generic En Route facility and time scenario, and were also excluded from the restructuring of the document.

## METHOD

Appendix E from the *Operations Concepts* (Change 2, August 31, 1990) was obtained from CTA, Inc. in ASCII format, which was converted into a WordPerfect 5.0 file. The information in Appendix B, activities and sub-activities, was manually entered into the document, and the verbs at the sub-activity level were changed from gerund to singular form to remain consistent with the rest of the document. The numbering system was replaced with an alpha-numeric outline format, as follows:

- I. Activity
  - A. Sub-activity
    - 1. Task
      - a. Task element

The Verb + Object + Modifier format was maintained in the conversion; however, conjunctions and punctuation were added to form complete sentences. Descriptive information preceded by an asterisk in the original document was put in parentheses in the restructured format, as shown in Figure 1. Figure 1 shows the original format of the Task List and Task Element sections of the *Operations Concepts* at the top of the figure with the restructured equivalent in the box at the bottom of the figure.

To ensure that the meanings of the Task and Task Element statements were maintained during the conversion, subject matter expert (SME) review teams composing three groups of six En Route controllers from the Atlanta Air Route Traffic Control Center (ARTCC) and two groups of six En Route instructors from the FAA Academy in Oklahoma City reviewed the restructured taxonomy during individual trials. An En Route Quality Assurance (QA) SME from the FAA Academy also reviewed the restructured taxonomy and made a determination between each review trial as to which comments were appropriate for inclusion in the document. There were two periods of review (preliminary and formal), which differed in regard to the procedure that was used.

## ORIGINAL FORMAT

### TASK LIST

Task Number	Task Statement	Coordination Media			Coordination Steps												Positions		
		Voice	Function	Message	Host/Term Controller	Area Supervisor	Area Manager	Flight Service	Traffic Management	Resolution Coordinator	Systems Engineer	Network Analyst/AC	Pilot	Tower Controller/Sup	Aeronautical Radio	Military Operations	Other Coordination	Radar Controller	Radar Associate
EC.2	RESOLVE AIRCRAFT CONFLICTS																		
EC.2.1	PERFORMING AIRCRAFT CONFLICT RESOLUTION																		
EC.2.1.2	DETERMINE VALIDITY OF POTENTIAL AIRCRAFT CONFLICT NOTICE OR INDICATION																		

### TASK ELEMENT REPORT

TASK NUMBER / ELEMENT NUMBER	TASK STATEMENTS / DATA AND TASK ELEMENT STATEMENTS	OBJECTS				NO. OF OBJECTS
EC.2.1.2	DETERMINE VALIDITY OF POTENTIAL AIRCRAFT CONFLICT NOTICE OR INDICATION	TASK TYPE: R/A	COORD MEDIA:	FREQUENCY: HI	CRITICALITY: EXT	
EC.2.1.2.1	ACQUIRE Target Symbol, Data Block on Radar Display for information to validate the aircraft conflict indication or notice			Target Symbol	Data Block	38
				Radar_Display		27
						1
EC.2.1.2.2	EXTRACT Full Data Block or Conflict Data Block, Target Symbol, Velocity Vector, Aircraft_Hole of the aircraft involved			Full Data Block	Conflict Data Block	2
				Target Symbol		1
				Velocity Vector		2
				Aircraft_Hole		2
EC.2.1.2.3	EXTRACT Special Condition Indicator aircraft pair in conflict, Altitude, Altitude Qualifier, Ground Speed			Special Condition_Indicator		1
				Altitude		1
				Altitude Qualifier		1
				Ground_Speed		1
EC.2.1.2.4	EXTRACT available Range/Bearing Time Readout			Range/Bearing_Time_Readout		1

### RESTRUCTURED FORMAT

#### II. Resolve aircraft conflicts.

##### A. Perform aircraft conflict resolution.

1. Determine validity of potential aircraft conflict notice or indication.
  - a. Acquire target symbol and data block on radar display for information to validate the aircraft conflict indication or notice.
  - b. Extract full data block or conflict data block, target symbol, velocity vector, and J ring (of the aircraft involved).
  - c. Extract special condition indicator (aircraft pair in conflict), altitude, altitude qualifier, and ground speed.
  - d. Extract available range/bearing time readout.

FIGURE 1. Original format of the *Operations Concepts* compared to the restructured equivalent.

## BACKGROUND & INSTRUCTIONS FOR SUBJECT MATTER EXPERT REVIEW OF MODIFIED CTA TASKS TAXONOMY

The following is an outline of activities involved in performing the job of an en route air traffic controller. These activities were extracted from *FAA Air Traffic Control Operations Concepts Volume VI: ARTCC - Host En Route Controllers*, which was prepared by Computer Technology Associates (CTA), Inc., in Colorado Springs, Colorado. The document is based on data gathered during site visits to en route centers by a team of currently active controllers and supervisors. The result is a description of the job activities of an en route air traffic controller in coordination with the Host Computer System in a "generic" ARTCC.

Each job activity has been broken down into sub-activities, tasks, and task elements. In some cases, task elements are performed sequentially and others may be performed simultaneously. The task elements may be performed more than once during the activity, but not all task elements are performed on every position or in all sectors. **This document is not intended to tell how an en route air traffic controller should do the job, but to describe in detail the actions that occur while the job is being performed.**

Originally, the document was not written in a narrative format, and the activities, sub-activities, tasks, and task elements were not organized in a formal outline manner. For research purposes, the Performance Assessment Section (AAM-514) has changed the format of the original document to one that is narrative and hierarchical in nature. Changes were made in wording, and punctuation was added to make the document more readable.

Each person has 1 of 6 sections of the complete document. We would like you to read your section of the document and look for unfamiliar phrases or acronyms or statements that seem redundant within a task element. Please write any comments or suggestions in the margins. It should take approximately 1 1/2 hours to review the document. Thank you for your time and comments.

FIGURE 2. Instructions given to Subject Matter Experts.

### *Preliminary Review*

During the preliminary review, there were three trials consisting of reviews by SME teams from the Atlanta En Route Center, the FAA Academy, and the QA SME. During a trial, one controller on each team reviewed one of the six sections of the restructured taxonomy except for the QA SME, who reviewed the entire document. They were instructed to look for words, phrases, or acronyms not commonly used by En Route controllers, and redundant statements within a task, as well as tasks and task elements that appear to be out of sequence. Each member of the two 6-member preliminary review teams was given a section of the restructured taxonomy to take

back to his or her worksite and was instructed to complete the review at his or her convenience some time during that day and write comments or suggestions in the margins of the document. After each of the two trials of the preliminary review, a determination was made by the QA SME as to the appropriateness of the comments and suggestions provided by the reviewers for inclusion in the document. Those changes deemed appropriate were implemented into the document before printing it for the next trial. Following the first two trials, the QA SME reviewed the entire document and offered comments and suggestions as part of the preliminary review.



		Section of Document						
Review		1	2	3	4	5	6	Total
Preliminary Review	ZTL-1	16	36	91	212	39	112	506
	ACA-1	0	0	0	2	0	4	6
	QA SME	5	2	3	6	0	0	16
	<b>Total</b>	21	38	94	220	39	116	528
<b>% of Total Document Change</b>		91	95	92	97	85	85	
Formal Review	ACA-2	0	2	0	7	4	14	27
	ZTL-2	2	0	7	0	2	7	18
	ZTL-3	0	0	1	0	1	0	2
	<b>Total</b>	2	2	8	7	7	21	47
<b>% of Total Document Change</b>		9	5	8	3	15	15	
<b>Grand Total of Changes Implemented</b>		23	40	102	227	46	137	575

**TABLE 1. Frequency of Suggested Changes Implemented into the Restructured Job Task Taxonomy.**

### ***Formal Review***

During the formal review, the remaining FAA Academy SME team and two Atlanta ARTCC SME teams reviewed the document. The formal review teams were provided written instructions (see Figure 2), and the Glossary of Controller Task Action Verbs and Task Element Verbs from Appendix C of the *FAA Air Traffic Control Operations Concepts Volume I: ATC Background*

*and Analysis Methodology* (see Appendix A) in addition to the restructured taxonomy. They were given approximately an hour and a half to complete the review, and an experimenter monitoring the review was present in the room. Suitable changes were made to the document between each trial as approved by the QA SME.

## RESULTS

Since the individual sections of the restructured taxonomy are not directly comparable to each other due to differences in subject matter, length, and procedural differences between the preliminary and formal reviews, a descriptive presentation of the results of this research was deemed most appropriate. Table 1 contains the frequency of suggested changes that were incorporated into each section of the document and for each trial within the period of review, as well as the percentage of changes incorporated into the document across section of document and period of review.

Depending on the section of document, between 85% and 97% of the changes were made during the preliminary review. Indeed, Table 1 shows that the majority of the changes occurred from the suggestions made during the first trial of the preliminary review (88.0%). Additionally, less than 0.35% of the total document changes resulted from suggestions made during the last trial of the formal review. The final version of the restructured taxonomy is presented in Appendix B.

## DISCUSSION

*Operations Concepts* is an excellent description of the duties performed by an En Route controller; however, the complex format makes it difficult to use for purposes other than which it was originally intended. *Operations Concepts* was primarily meant to be used with the CHORAS software routines developed by CTA to evaluate the operational suitability of the bidding contractors' design of the AAS. The intent was to ensure that the suggested design provided for effective dialogue between the controller and the automated system throughout the phases of its development. The *Operations Concepts* utilized User Interface Language (UIL) for the presentation of the job task taxonomy, which is unacceptable for use as a training tool or as stimulus materials in a research effort. Additionally, acronyms and terms not familiar to many controllers were used in the original document. For example, "aircraft halo" was replaced with "J ring" in the new document, a term with which En Route controllers were more familiar. Furthermore, several SMEs indicated that some of the tasks performed by a control-

ler were not included in the original document, although some of those tasks were found in other sections of the document that were reviewed by other SMEs. An example of an addition made to the document, in section IV.J., was the task and two task elements which follow:

4. Detect readback of issued clearance.
  - a. Detect whether readback of issued clearance is correct.
  - b. Transmit clearance until readback is correct.

This task may not have been considered vital in evaluating the operational suitability of the contractors' design of the AAS, but was crucial in considering other issues such as the identification of task elements involved in operational errors. Further modifications of the document may be required to meet demands of future research efforts.

The restructuring of the *Operations Concepts* into a formal sentence outline was intended to make the document more useful to persons interested in the tasks a controller performs. It should be noted that redundant information contained in the original document was omitted from the restructured document. Only the activities, sub-activities, tasks, and task elements were included in the restructured taxonomy. The document was reduced in this fashion so as to ensure readability. It should also be noted that those items were contained in two separate appendices of the *Operations Concepts*. The results indicate that the restructuring of the document was a success. The document underwent 575 changes before it was considered to be both free of unfamiliar acronyms and phrases, and complete in regard to the tasks and task elements it details. Suggestions made during the first of the six trials accounted for 88.0% of the total document changes. Whereas suggestions made during the last of the six trials accounted for only 0.35% of the total document changes. This indicates that the document was much more understandable to the subjects used in this investigation after the review trials were completed.

The restructured document has the potential for use not only by researchers interested in En Route ATCS tasks, but also by training personnel and quality assurance investigation teams. One use of the restructured taxonomy, the use for which the restructuring was intended, is to assist in the identification of the tasks and task elements, which were either not performed or were performed incorrectly by an air traffic controller who commits an operational error. By having a detailed description of the duties to be performed, it should be possible to identify those tasks related to operational error involvement. It may be that certain tasks are commonly involved in the commission of an operational error. One possible use for such information would be to provide guidance to further investigation of tasks with regard to their potential for automation or develop an automated aid to assist in performing the tasks.

This information would also be of assistance to quality assurance teams conducting investigations after the occurrence of an operational error. By having a detailed description of the sequence of duties that should be performed in a given situation, it might be easier for the quality assurance team to identify the tasks and task elements not performed or performed incorrectly. This could assist not only quality assurance teams in more definitively describing the circumstances resulting in an operational error, but should also assist the controller who committed the error and other controllers at the facility to become more aware of the problems that develop when a given set of tasks or task elements is not performed or is performed incorrectly. Further research is required to determine the extent to which the document is usable for the identification of tasks involved in the commission of operational errors.

The potential for the restructured taxonomy to be used as a training tool would appear to be an area that also deserves further investigation. If it is possible to identify the tasks that were not performed or were performed

incorrectly during the commission of an operational error, then training exercises could be developed that correspond directly to the tasks in which an ATCS appears to be deficient. Additionally, it might be useful for air traffic control students to see the listing of the tasks they will be expected to perform when they become operational controllers. By providing an organized presentation of the duties students will be expected to perform, a more global understanding of the job might be achieved sooner than if this information had to be obtained from several different sources and across different types of media.

It would appear that a considerably improved document, particularly in regard to readability, has resulted from this research. The document may be used for a number of purposes other than those mentioned in this report. Other CTA job task taxonomies are available for Terminal radar approach control (TRACON) and Tower air traffic controllers. Research is currently underway that utilizes the methodology presented in this report to modify the remaining controller taxonomies to provide controllers, quality assurance teams, and training personnel in these facilities the potential benefits afforded by the restructuring.

## REFERENCES

- Computer Technology Associates, Inc. (1987). *FAA Air Traffic Control Operations Concepts Volume I: ATC Background and Analysis Methodology* (CDRL B112). Englewood, CO: Author.
- Computer Technology Associates, Inc. (1990). *FAA Air Traffic Control Operations Concepts Volume VI: ARTCC-Host En Route Controllers* (CDRL 011). Englewood, CO: Author.

## **APPENDIX A**

### **DEFINITIONS OF VERBS IN THE EN ROUTE FORMAL SENTENCE OUTLINE JOB TASK TAXONOMY\***

\* These definitions were extracted from the *FAA Air Traffic Control Operations Concepts Volume I: ATC Background and Analysis Methodology*.

## Verb Definitions

### ACCEPT

Respond to an originating controller or computer message, indicating that the receiving controller assumes complete or partial responsibility for the requested action, as appropriate.

### ACQUIRE

Gather in or perceive via detection, scanning, search, extraction, or cross-reference.

### ADJUST

Change or fine-tune a data base, controls, display, and/or communication control.

### ANALYZE

Examine methodically so as to determine the nature and components of a matter.

### APPROVE

Respond favorably to a request as a person in authority, as in approving a clearance request.

### ASSESS

Consider via comparison or evaluation.

### ASSIGN

Designate or commit an item such that the computer can act on it, as in assigning a beacon code to an aircraft. Also, modify personnel responsibilities, as in designating a controller to take over a particular control position.

### BRIEF

Give concise preparatory information concerning all sector or position activities and the operational situation to another person, as when turning over responsibility for a position.

### BROADCAST

Transmit a recording or voice message to a general audience (as opposed to contacting a specific person) via radio.

### CALCULATE

Reckon, mentally compute, or computationally determine.

### CHECK

Visually examine a hardware item to establish its operational state or condition.

### CHOOSE

Make a mental decision on a course of action or mentally pick one of several alternatives, as in choosing a desired flow sequence.

### COMPARE

Relate one item to another to note relative similarities and/or differences, as in comparing a maintenance request to a maintenance schedule.

### CONDUCT

Accomplish a series of related actions to achieve a definite goal, as in conducting a radio/radar search for aircraft.

### CROSS-REFERENCE

Accessing or looking up related information, usually by means of an indexing or organized structuring scheme set up for that purpose.

### DECIDE

Arrive at an answer, choice, or conclusion.

### DECLARE

State with emphasis that a situation exists, as in declaring the existence of an emergency event.

### DELETE

Remove an information item (as in deleting the highlighting of an item on a display) or cancel a previous action (as in canceling a request for pilot position reports). This includes verbal actions as well as computer information.

### DENY

Refuse to grant a request.

**DETECT**

Discern visually or aurally a newly occurring fact or item (not being watched for, i.e., not the object of preceding attention), usually from a display, such as an alarm indicator or the action of an aircraft target symbol.

**DETERMINE**

Process information mentally to reach a decision about a situation, state of affairs, or the timing of an action.

**DISCUSS**

Exchange information/ideas on a particular topic with one or more others, typically not involving a resolution of differences.

**ENTER**

Insert data, text, or a system message into the computer system.

**ESTIMATE**

Mentally gauge, judge, or approximate, often on the basis of incomplete data.

**EVALUATE**

Examine and judge the merits of an action or situation for a definite purpose and to reach a decision.

**EXECUTE**

Initiate or activate any of a set of predefined utility or special-purpose functions.

**EXTRACT**

Directed, attentive reading, observing, or listening with the purpose of gleaning the meaning of the contents thereof.

**EXTRAPOLATE**

Assign an approximate value to a future point based upon the value(s) of preceding point(s). Also, mentally extend or estimate the position and/or path of one or more mobile objects in time and space.

**FORCE**

Compel the display of something, as in forcing a Full Data Block or Flight Data Entry that otherwise would not be presented.

**FORMULATE**

Mentally compose or prepare the content of a verbal or computer input message or plan, including all required or pertinent elements thereof, such as an advisory or clearance.

**FORWARD**

Send information verbally or electronically to another position.

**GROUP**

Link together or associate for purposes of identification.

**INFORM**

Impart information to another person.

**INHIBIT**

Prevent the occurrence of a machine function, as in inhibiting an alert function.

**INITIATE**

Begin an action or sequence, as in initiating a handoff or starting a track.

**INSERT**

Make space for and place an entity at a selected location within the bounds of another such that the latter wholly encompasses the former, and the former becomes an integral component of the latter.

**INTEGRATE**

Pull together, and mentally organize, a variety of data elements so as to extract the information contained therein.

**ISSUE**

Distribute or communicate information as guidance to a pilot or vehicle operator by radio, as in issuing clearances, alerts, and advisories.

**NEGOTIATE**

Confer in order to come to a mutually acceptable agreement, as when negotiating with a pilot the technique to be used for accomplishing a flight delay.

**OBSERVE**

Take notice visually or watch attentively something or somewhere for an expected message, object, event, or occurrence of something.

**OFFSET**

Relocate the position of a Data Block in adapted increments in relation to its associated target on the display.

**PERCEIVE**

Recognize an action or situation as it evolves over time in the absence of any specific indicator, such as an aircraft deviation or a tracking fault.

**PERFORM**

Carry out an action.

**PROJECT**

Mentally extend or estimate the position and/or path of one or more mobile objects, such as aircraft or ground vehicles, in time and space.

**QUERY/QUESTION**

Inquire of another person or of a computer to gain information to remove doubt, as in querying a pilot about some element of a flight plan.

**QUICK-LOOK**

Temporarily produce for observation on one's own display the data or visual presentations that are available from another workstation.

**READOUT**

Acquire information from the computer on a specified item, such as range/bearing/time from an aircraft to a fix.

**REASSOCIATE**

Reposition a Data Block with its intended target when it has become disassociated from it.

**RECALL**

Summon or otherwise return personnel to their workstations.

**RECEIVE**

Acquire transmitted messages by seeing or listening, without necessarily taking action to express approval or receipt.

**RECOGNIZE**

Specific, positive identification of an entity.

**RECORD**

Make a permanent or written note of an event or observation, as in recording a weather observation.

**REMOVE**

Excise via cutting or deletion.

**REQUEST**

Ask another individual for information on, approval of, or for receipt of something. Also, direct the system to provide a function such as route readout or beacon code.

**RESEQUENCE**

Rearrange the order of Flight Data Entries displayed.

**RESPOND**

Answer or reply in reaction to a message input.

**RESTORE**

Bring back into being or remove an inhibit of a function such as MSAW or the display of certain information.

**RETRACT**

Take back, negate, or withdraw the start of an action already begun, such as a handoff.

**REVERT**

Go to the use of an alternate procedure, such as backup operations.

**REVIEW**

Look over and study conditions or situations, or reexamine something, as in reviewing the completeness of a flight plan. Also appropriate for absorbing information to maintain a dynamic picture of present and/or future traffic, or the status of some equipment.

**SCAN**

Glance over quickly, usually looking for overall patterns or anomalous occurrences.

**SEARCH**

Scan/look over a display or area to locate something, such as a particular Flight Data Entry.

**SELECT**

Single out an item in preference to others on a display or panel, or pick one of several available system options or items and inform the system of the choice.

**SET-ASIDE**

Remove entire contents of current (active) work area and store in a readily accessible buffer for future recall.

**SIGN OFF**

Carry out a standard procedure to inform the system that one is no longer operating at a particular control workstation.

**SIGN ON**

Carry out a standard procedure to establish oneself as operating at a particular control workstation.

**STOP**

Arrest via suspension or termination.

**SUGGEST**

Offer another course of action for consideration when a request is not feasible, such as clearance alternatives to a clearance request.

**SUPPRESS**

Curtail the display of an item, such as a Full Data Block after a pointout. Such display may be restored at some later time.

**SWITCH**

Change a given system condition to another available condition, as when switching communications to a backup frequency.

**SYNTHESIZE**

Mentally produce new information via estimation, interpolation, translation, integration, formulation, or projection/extrapolation.

**TERMINATE**

Bring an action to an end, as in terminating radar service to an aircraft.

**TRANSFER**

Direct the system to convey a Flight Data Entry from one control position to another for display and action at the latter location.

**TRANSLATE**

Convert or change from one form or representational system to another according to some consistent "mapping" scheme.

**TRANSMIT**

Send out a message such as a call, acknowledgment, response, suggestion, direction, information, instruction, or request.

**UPDATE**

Change or modify text or data to make it more up-to-date, as in updating electronic reminder notes.

**VALIDATE**

Determine that an automatic altitude readout varies less than 300 feet from pilot-reported or known altitude.

**VERIFY**

Establish the truth of an activity or matter by confirming that a particular situation or matter is in the expected state. For example, verifying pilot compliance with a clearance, or confirming the occurrence of specific computer actions during transition stages.



## APPENDIX B

### Formal Sentence Outline Job Task Taxonomy

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## ACRONYMS

AIRMET .....	Airman's Meteorological Information
ARTS .....	Automated Radar Terminal System
ATC .....	Air Traffic Control
ATCT .....	Airport Traffic Control Tower
ATIS .....	Automatic Terminal Information Service
BUEC .....	Backup Emergency Communications
CA .....	Conflict Alert
CDC .....	Computer Display Channel
DARC .....	Direct Access Radar Channel
E-DARC .....	En Route Direct Access Radar Channel
E-MSAW .....	En Route Minimum Safe Altitude Warning
FDB .....	Full Data Block
FDP .....	Flight Data Processing
FR .....	Flight Plan Readout Request
FSS .....	Flight Service Station
ID .....	Identification, or Identifier
IFR .....	Instrument Flight Rules
MCI .....	Mode C Intruder
MSAW .....	Minimum Safe Altitude Warning
NAS .....	National Airspace System
NAVAID .....	Navigational Aid
NOPAR .....	Do Not Pass to Radar
NORDO .....	No Radio
NOTAM .....	Notice to Airmen
OTP .....	On Top
PIREP .....	Pilot Weather Report
RX .....	ARTS-NAS Cancellation
SIGMET .....	Significant Meteorological Information
VFR .....	Visual Flight Rules

## **I. Perform situation monitoring.**

### **A. Check and evaluate separation.**

1. Review the radar display for potential violation of aircraft separation standards.
  - a. Acquire target symbol, data block, and geographic map data on radar display for potential violations of aircraft separation standards.
  - b. Acquire route display of aircraft potentially violating separation standards.
  - c. Synthesize altitude, speed, time, and route/direction of flight into a complete mental traffic picture with regard to potential violation of aircraft separation standards.
  - d. Recognize potential violation of aircraft separation standards.
2. Project mentally an aircraft's future position, altitude, and path.
  - a. Search the radar display for target symbol and full data block of aircraft in potential conflict for data to project position.
  - b. Extract obstruction, airspace area, and geographic map data, (i.e. minimum vector altitude), from radar display.
  - c. Extract target symbol, track history, altitude, and velocity vector from the radar display.
  - d. Extract aircraft identification, ground speed, target symbol, primary target, or secondary target from full data block.
  - e. Search the flight progress strip in the flight strip bay.
  - f. Extract flight identification, aircraft type, and requested altitude from the flight progress strip.
  - g. Extract route information, previous posted fix, posted fix, and next posted fix from the flight progress strip.
  - h. Extract time over previous posted fix, calculated time of arrival over posted fix, and remarks from the flight progress strip.
  - i. Extract route information, (i.e. destination), estimated ground speed, and true airspeed from the flight progress strip.
  - j. Synthesize time, location, route, known pilot intentions and altitude information on aircraft into a mental picture of aircraft path.
  - k. Project future location and altitude of aircraft with regard to proximity to other aircraft, obstructions, special use airspace, and weather.
3. Request range, bearing, and/or time message with options.
  - a. Initiate fix/time readout message for information that may assist the assessment of a possible conflict.
  - b. Execute fix/time readout message.
  - c. Extract fix/time readout from the requested message on the computer readout device, (results of fix/time readout message).
  - d. Initiate range/bearing readout message.
  - e. Execute range/bearing readout message.
  - f. Extract range/bearing readout from requested message on the computer readout device, (results of range/bearing readout message).
  - g. Initiate range/bearing/fix readout message.
  - h. Execute range/bearing/fix readout message.
  - i. Initiate request for route readout (for aircraft of concern).

## I. Perform situation monitoring.

- j. Execute request for route readout.
  - k. Detect route of flight readout.
  - l. Extract range/bearing/fix readout from requested message on the computer readout device (results of range/bearing/fix readout message).
4. Force/quick look full data block(s) to examine track information on aircraft.
- a. Initiate quick look message, (to force radar data from adjacent airspace to radar display).
  - b. Execute quick look message.
  - c. Extract forced radar data from full data block on radar display, (results of quick look message).
  - d. Initiate display to force data block message (to force full data block from adjacent airspace onto plan view display).
  - e. Execute display of forced data block message.
  - f. Extract information from forced full data block on radar display, (results of force data block message).
5. Determine whether aircraft may become separated by less than prescribed minima.
- a. Evaluate current and projected mental traffic picture to determine potential situations of less than standard separation.
6. Review the radar display for potential violation of airspace separation standards.
- a. Search target symbol, data block, geographic map data, and airspace area on radar display for information pertaining to potential airspace conflict.
  - b. Extract a mental traffic picture from position symbol, target symbol, velocity vector, and track history on radar display.
  - c. Extract altitude from full data block.
  - d. Extract special use airspace, airspace area boundary, controlled airspace, other airspace area, and geographic map data from radar display.
  - e. Search airspace status in status information area for altitude limits and activation periods.
  - f. Extract airspace status from status information area.
  - g. Extract airspace status from controller note.
  - h. Synthesize traffic picture, altitude, route, weather, airspace, and time information into a complete mental traffic picture with regard to violation of airspace separation standards.
  - i. Recognize potential violation of airspace separation standards, and potential airspace conflict.
7. Review the radar display for potential violation of conformance criteria.
- a. Acquire target symbol, data block, and geographic map data on radar display for information on potential violation of altitude, speed, or lateral conformance.
  - b. Extract altitude, altitude qualifier, and ground speed from radar display.
  - c. Acquire flight progress strip in flight strip bay for information pertaining to potential violation of conformance criteria.
  - d. Synthesize route, altitude, and speed information into a complete mental traffic picture with regard to potential violation of conformance criteria.
  - e. Recognize potential violation of altitude, speed, or route conformance criteria.
8. Determine whether airspace separation standards may be violated.
- a. Decide by mentally projecting the traffic picture if the potential exists for less than standard separation between an aircraft and airspace of concern.

I. Perform situation monitoring.

9. Determine whether conformance criteria may be violated.
  - a. Decide by projecting mentally if the potential exists for nonconformance of an aircraft.
10. Determine whether flow restrictions may be violated.
  - a. Decide by projecting mentally if the potential exists for instances of non-compliance with flow control restrictions.
11. Request display of route of flight.
  - a. Initiate request for route display message.
  - b. Execute request for route display message.
  - c. Extract aircraft identification and planned route of flight from the route of flight display on radar display.
12. Observe progress of an aircraft on radar display.
  - a. Search the radar display for full data block or target symbol for aircraft progress.
13. Review flight strip bay for present and/or future aircraft separation.
  - a. Search flight progress strip in flight strip bay for information pertaining to aircraft separation.
  - b. Extract strip marking, reported altitude, and assigned altitude from flight progress strip.
  - c. Extract flight identification and aircraft type from flight progress strip.
  - d. Extract route information, previous posted fix, posted fix, and next posted fix from flight progress strip.
  - e. Extract time over previous posted fix and calculated time of arrival over posted fix from flight progress strip.
  - f. Extract estimated ground speed and true airspeed from flight progress strip.
  - g. Extract route information and departure point from flight progress strip.
  - h. Synthesize position, route, speed, altitude, and time information into a mental picture of aircraft separation.
  - i. Recognize aircraft paths warranting further close monitoring and evaluation.
14. Review displays/records for potential violation of flow restrictions.
  - a. Search the target symbol and data block for information pertaining to potential violation of flow restrictions.
  - b. Extract altitude, ground speed, and altitude qualifier which may potentially violate flow restrictions.
  - c. Search flight progress strip in flight strip bay for information pertaining to potential violation of flow restrictions.
  - d. Extract assigned altitude and requested altitude from flight progress strip.
  - e. Extract flight identification, route information (including destination), previous posted fix, time over previous posted fix, and posted fix from flight progress strip.
  - f. Extract next posted fix, expected departure clearance time, and remarks from flight progress strip.
  - g. Extract calculated time of arrival over posted fix from flight progress strip.
  - h. Extract estimated ground speed and true airspeed from flight progress strip.
  - i. Search traffic management record for traffic management constraints.
  - j. Extract sector metering list from inbound list on list display.

## I. Perform situation monitoring.

- k. Synthesize the mental traffic picture, altitude, route, and traffic management restrictions into a complete mental traffic picture with regard to flow violations.
  - l. Recognize potential violation of flow restrictions.
15. Observe track velocity to project aircraft movement.
- a. Initiate selection of velocity vector length switch for desired setting on radar display.
  - b. Detect velocity vector in full data block for aircraft on radar display.
  - c. Extract track velocity information on aircraft from velocity vector.
- B. Analyze initial requests for clearance.
- 1. Search flight strip bay for inactive flight plan on clearance request.
    - a. Search flight strip bay for flight progress strip of an inactive flight plan.
    - b. Extract flight plan data on flight progress strip.
  - 2. Request flight plan readout (FR).
    - a. Initiate flight plan readout request message for route information on an aircraft.
    - b. Execute flight plan readout request message.
    - c. Detect appearance of flight plan readout on computer readout device or flight progress strip from flight strip printer.
    - d. Extract full route information from flight plan readout of requested message or flight progress strip.
  - 3. Request pilot to file/refile flight plan.
    - a. Transmit air-to-ground or via FSS, and inform pilot to file or refile flight plan.
- C. Process departure/en route time information.
- 1. Enter departure/en route time message.
    - a. Initiate departure message, manually enter departure time into flight data base.
    - b. Execute departure message.
    - c. Detect time over previous posted fix in appropriate flight progress strip (departure strip is result of departure message).
    - d. Detect actual departure time in the appropriate flight progress strip (en route strip is a result of departure message).
    - e. Initiate entrance of progress report message for en route time.
    - f. Execute progress report message.
    - g. Detect appropriate change in time over previous posted fix, calculated time of arrival over posted fix, and next posted fix in the aircraft's flight progress strip.
  - 2. Initiate track manually.
    - a. Detect full data block, limited data block, or primary target on radar display.
    - b. Initiate track message.
    - c. Execute initiation of track message.
    - d. Detect target symbol, position symbol, aircraft identification and full data block on radar display.
    - e. Initiate coast track message.

1. Perform situation monitoring.

- f. Execute coast track message.
    - g. Detect position symbol (coast), and full data block on radar display.
    - h. Initiate departure message.
    - i. Execute departure message.
    - j. Detect full data block on radar display.
  - 3. Observe automatic track start.
    - a. Scan radar display for automatic track start.
    - b. Detect full data block and target symbol; correlated with target.
  - 4. Receive departure/en route time notice.
    - a. Receive ground-to-ground communications; notice of aircraft departure or en route time from other controller or FSS.
    - b. Transmit air-to-ground; notice of departure or en route time from pilot.
    - c. Detect message waiting lamp and associated chime on computer readout device.
    - d. Extract departure notice on computer readout device or from flight progress strip.
- D. Process request for flight following.
- 1. Evaluate conditions for providing flight following.
    - a. Search target symbol and data block on radar display for information pertaining to workload and capability to provide flight following.
    - b. Perceive mental traffic picture from target symbol, position symbol, velocity vector, and track history on radar display.
    - c. Extract aircraft identification and ground speed from full data block on radar display.
    - d. Extract altitude from full data block on radar display.
    - e. Search flight progress strip in flight strip bay for information pertaining to workload and capability to provide flight following.
    - f. Extract assigned altitude, route information, and aircraft type from flight progress strip.
    - g. Extract flight identification, estimated ground speed, and true airspeed from flight progress strip.
    - h. Extract previous posted fix, next posted fix, time over previous posted fix, calculated time of arrival over posted fix from flight progress strip.
    - i. Extract posted fix from flight progress strip.
    - j. Synthesize traffic picture, altitude, speed, route, aircraft special conditions, and weather information into a complete mental traffic picture of current and expected workload.
    - k. Estimate the impact of providing flight following service on current and predicted workload.
    - l. Decide on the feasibility of providing flight following service.
  - 2. Inform the pilot of alternate instructions necessary for flight following service.
    - a. Transmit air-to-ground; advise pilot of alternate instructions to enhance conditions for flight following.
  - 3. Receive request for flight following.
    - a. Receive ground-to-ground communications (request from another controller or FSS for flight following service).
    - b. Transmit air-to-ground (pilot request for flight following service).

## I. Perform situation monitoring.

4. Deny the flight following request.
  - a. Initiate ground-to-ground communications (deny the flight following requested by another controller or FSS).
  - b. Transmit air-to-ground (advise pilot unable for requested flight following service).

### E. Housekeeping.

1. Offset a data block.
  - a. Initiate repositioning of data block offset message to reposition data block.
  - b. Execute repositioning of data block offset message.
  - c. Detect repositioned data block on the radar display (result of data block offset message).
2. Delete (remove) flight plan and track from local host system (RX).
  - a. Initiate ARTS-III NAS cancellation message to delete flight plan and associated track from the local host system.
  - b. Execute ARTS-III NAS cancellation message.
  - c. Detect deletion of track on radar display.
3. Restore data block to radar display.
  - a. Initiate request for data block message for display on radar display.
  - b. Execute request for data block message.
  - c. Initiate display of forced data block.
  - d. Execute display of forced data block.
  - e. Detect appearance of data block on radar display.
4. Obtain flight progress strip.
  - a. Remove flight progress strip from flight strip printer.
  - b. Insert flight progress strip into strip holder.
  - c. Extract/sort information from new flight progress strip.
  - d. Decide on appropriate sort location in selected flight strip bay.
  - e. Insert new flight progress strip and flight strip holder in appropriate flight strip bay location.
5. Resequence flight progress strip manually.
  - a. Remove selected flight progress strip from present location in flight strip bay.
  - b. Insert flight progress strip at another location in flight strip bay.
6. Review flight progress strip to ensure all data have been forwarded to the next controller/facility.
  - a. Assess flight progress strip entries for data transmittal to the next controller or facility.
7. Review flight progress strips for deadwood.
  - a. Assess inactive or proposed flight progress strip appropriateness for removal from flight strip bay (deadwood) based on current time.
8. Update/revise controller note.
  - a. Initiate record/update controller note on controller note.



I. Perform situation monitoring.

9. Suppress data block from radar display.
  - a. Initiate drop track only message for removal of data block from radar display.
  - b. Execute drop track only message.
  - c. Initiate suppressed forced data block message.
  - d. Execute suppressed forced data block message.
  - e. Initiate suppressed data block message.
  - f. Execute suppressed data block message.
  - g. Recognize removal of appropriate data block from radar display.
10. Record strip marking on flight progress strip.
  - a. Record flight strip entry on the flight progress strip.
11. Delete flight plan and track from ATC system.
  - a. Initiate removal of strip message to delete flight plan and associated track from entire ATC system.
  - b. Execute removal of strip message.
  - c. Recognize removal of appropriate data block from radar display.
12. Remove flight progress strip.
  - a. Remove flight progress strip from the strip holder.
  - b. Set aside flight progress strip in the authorized storage unit.
13. Delete controller note.
  - a. Initiate removal of paper record (controller note).
14. Remove obsolete paper records or recorded data.
  - a. Initiate removal of paper record.

## II. Resolve aircraft conflicts.

### A. Perform aircraft conflict resolution.

1. Determine validity of potential aircraft conflict notice or indication.
  - a. Acquire target symbol and data block on radar display for information to validate the aircraft conflict indication or notice.
  - b. Extract full data block or conflict data block, target symbol, velocity vector, and J ring (of the aircraft involved).
  - c. Extract special condition indicator (aircraft pair in conflict), altitude, altitude qualifier, and ground speed.
  - d. Extract available range/bearing time readout.
  - e. Compare conflict data block with limited data block or full data block.
  - f. Search flight progress strip and strip marking in flight strip bay for information to validate the aircraft conflict indication or notice.
  - g. Extract flight identification, aircraft type, and estimated ground speed from flight progress strip of aircraft involved.
  - h. Extract assigned altitude from the flight progress strip.
  - i. Extract true airspeed and route information, including departure point, from the flight progress strip.
  - j. Extract previous posted fix, time over previous posted fix, posted fix, and calculated time of arrival over posted fix from the flight progress strip.
  - k. Integrate information extracted from the radar display and flight strip bay with various non-system information into a mental traffic picture of the current/projected proximity.
  - l. Recognize other factors which may impact on the validation decision.
  - m. Assess validity of relayed notice of potential aircraft conflict in consideration of the mental traffic picture and other factors.
  - n. Assess validity of a conflict alert in consideration of the mental traffic picture and other factors.
2. Receive notice of potential aircraft conflict in the sector.
  - a. Receive ground-to-ground communications (notice of potential aircraft conflict).
3. Inform controller of potential aircraft conflict in his sector.
  - a. Initiate ground-to-ground communications (potential aircraft conflict in other sector).
4. Review the potential conflict situation for resolution.
  - a. Acquire target symbol, full data block, limited data block, conflict data block, and aircraft identification on radar display regarding potential conflict.
  - b. Extract route display from radar display.
  - c. Extract altitude and ground speed from full data block of aircraft involved on radar display.
  - d. Synthesize location, track history, speed, direction, and altitude from limited data block (position symbol and target symbol).
  - e. Extract route information, aircraft type, and remarks from flight progress strip.
  - f. Extract precipitation from radar display (when weather may be a factor to consider).
  - g. Initiate range bearing readout, range bearing/fix readout, or fix/time readout message.
  - h. Execute range/bearing readout, range/bearing/fix readout, or fix/time readout message.

## II. Resolve aircraft conflicts.

- i. Extract range/bearing readout, range/bearing/fix readout, or fix/time readout on computer readout device.
  - j. Integrate the traffic picture with altitude and speed information into a complete mental traffic picture with regard to the separation of the two aircraft potentially in conflict.
  - k. Evaluate the need to resolve potential aircraft conflict.
5. Determine appropriate action to resolve aircraft conflict situation.
  - a. Extract aircraft routes, altitudes, and speeds from the flight progress strip, route of flight display, conflict alert list, full data block, or conflict data block.
  - b. Extract aircraft identification to determine priority handling from full data block.
  - c. Extract aircraft type from flight progress strip.
  - d. Decide upon action needed to resolve aircraft conflict situation considering mental traffic picture, weather, aircraft performance, special conditions, and viable resolution options.
6. Perceive potential aircraft conflict situation.
  - a. Acquire target symbol, full data block, or limited data block on radar display for potential violations of aircraft separation standards.
  - b. Extract aircraft identification, track history, and altitude from full data block or limited data block.
  - c. Search flight progress strip in the flight strip bay for information indicating a condition evolving into less than standard separation between aircraft.
  - d. Extract assigned altitude, requested altitude, route information (departure point), and flight identification from flight progress strip.
  - e. Extract route information, estimated ground speed, true airspeed, remarks, and aircraft type from flight progress strip.
  - f. Extract strip marking from flight progress strip.
  - g. Extract previous posted fix, posted fix, and next posted fix from flight progress strip.
  - h. Extract time over previous posted fix and calculated time of arrival over posted fix from flight progress strip.
  - i. Synthesize traffic picture with altitude, speed, and route information into a complete mental traffic picture (with regard to potential aircraft conflict situations).
  - j. Recognize potential aircraft conflict situation.
7. Receive pilot notice of traffic in sight.
  - a. Transmit air-to-ground (pilot reports traffic in sight).
8. Formulate safety alert content.
  - a. Synthesize traffic picture, weather information, altitude, route of flight, geographic map data, and capabilities of pilot, to create an overall mental picture of an unsafe condition.
  - b. Decide to issue a safety alert based on information available.
  - c. Formulate contents of safety alert (information which is of critical nature to assist the pilot in safely conducting the flight).
9. Issue safety alert in regard to traffic proximity.
  - a. Transmit air-to-ground (safety alert).

## II. Resolve aircraft conflicts.

10. Detect aircraft maneuver in response to safety alert.
    - a. Search full data block, limited data block, and track history on radar display for information pertaining to aircraft maneuvering in response to safety alert.
    - b. Detect changes in lateral movement of the target symbol, track history, and full data block on radar display.
    - c. Detect a change of altitude in full data block.
    - d. Compare movement change to contents of safety alert.
  11. Inform pilot when clear of traffic.
    - a. Transmit air-to-ground (notice to pilot when aircraft is clear of traffic).
  12. Formulate advisory content.
    - a. Synthesize a traffic picture, weather information, altitude, route of flight, geographic map data, and an overall mental picture of the unsafe condition.
    - b. Decide to issue advisory service based on the information available.
    - c. Formulate contents of advisory service (device and information to assist pilot in safe conduct of flight).
  13. Issue a traffic advisory in regard to traffic proximity.
    - a. Transmit air-to-ground (notice to pilot when aircraft is clear of traffic).
  14. Detect aircraft maneuver in response to advisory.
    - a. Search full data block, limited data block and track history on radar display for information pertaining to aircraft maneuvering in response to advisory.
    - b. Detect changes in lateral movement of the target symbol, track history, and full data block on radar display.
    - c. Detect a change in altitude and altitude qualifier in full data block.
    - d. Compare movement change to contents of advisory.
  15. Forward notice of aircraft conflict to supervisor.
    - a. Initiate ground-to-ground communications (aircraft conflict).
  16. Detect aircraft conflict/Mode C intruder (MCI) alert indication.
    - a. Search the radar display for presence of a conflict alert indication.
    - b. Detect conflict data block or conflict alert list on radar display.
    - c. Detect special condition indicator (aircraft pair in conflict) in full data block on radar display.
- B. Perform minimum safe altitude processing.
1. Detect MSAW indication or alarm.
    - a. Scan full data block on radar display for presence of MSAW alerts.
    - b. Detect special condition indicator (E-MSAW alert) in full data block.
    - c. Detect E-MSAW penetration alert on radar display.
    - d. Extract E-MSAW penetration alert from full data block on radar display.
    - e. Detect E-MSAW alert (data block attention indicator, projected alert vector, and vector altitude alert) in full data block.

## II. Resolve aircraft conflicts.

2. Receive notice of a potential low altitude situation/MSAW in sector.
  - a. Receive ground-to-ground communications (notice of potential low altitude situation or MSAW).
3. Inform controller of potential low altitude situation/MSAW in his sector.
  - a. Receive ground-to-ground communications; potential low altitude situation or MSAW in sector.
4. Perceive potential low altitude situation.
  - a. Acquire target symbol, full data block, and geographic map data on radar display for potential low altitude situation.
  - b. Extract aircraft identification, altitude or altitude qualifier from full data block.
  - c. Detect coast track and free track in full data block (loss of radar coverage due to altitude).
  - d. Extract obstruction, route, other map features, or overhead map from radar display.
  - e. Search flight progress strip in flight strip bay for information indicating conditions developing into a low altitude situation.
  - f. Extract flight identification, assigned altitude, and requested altitude from the flight progress strip.
  - g. Extract route information, estimated ground speed, true airspeed, and remarks (celestial navigation) from the flight progress strip.
  - h. Extract previous posted fix, posted fix, calculated time of arrival over posted fix, and time over previous posted fix from the flight progress strip.
  - i. Integrate traffic picture, altitude, route, and obstruction/terrain information into a complete mental traffic picture (with regard to potential low altitude situation).
  - j. Recognize potential low altitude situation.
5. Determine validity of MSAW/altitude notice or MSAW indication.
  - a. Search target symbol, E-MSAW alert, full data block (of aircraft involved), and geographic map data on radar display for information to validate the MSAW.
  - b. Extract location of aircraft involved in MSAW or altitude situation from target symbol and full data block on radar display.
  - c. Extract aircraft identification and altitude from full data block.
  - d. Extract obstruction, minimum vector altitude, route, and other features from radar display or overhead map.
  - e. Search flight progress strip in flight strip bay for information pertaining to the validity of the MSAW.
  - f. Extract flight identification and assigned altitude from flight progress strip (of the aircraft involved).
  - g. Extract route information, estimated ground speed, and true airspeed from flight progress strip (of the aircraft involved).
  - h. Extract previous posted fix, time over previous posted fix, posted fix, and calculated time of arrival over posted fix from flight progress strip (of the aircraft involved).
  - i. Synthesize the extracted information with various non-system information into a mental picture with regard to the current/projected proximity of the aircraft to obstructions/terrain.
  - j. Assess the validity of the MSAW in consideration of the mental traffic picture and other factors such as known pilot intentions.

## II. Resolve aircraft conflicts.

- k. Assess the validity of the relayed notice of a potential low altitude situation in consideration of the mental traffic picture and other factors.
- 6. Determine appropriate action to resolve a low altitude/MSAW situation.
  - a. Extract aircraft routes and altitudes from the flight progress strip, radar display, and pilot reports.
  - b. Extract full data block altitude, route of flight display, and geographic map data from radar display.
  - c. Extract minimum vector altitude and obstruction from the overhead map.
  - d. Decide on the action needed to resolve E-MSAW or low altitude situation considering the mental traffic picture and available options.
- 7. Observe radar display for fixed obstructions/ terrain that may interfere with aircraft flight.
  - a. Acquire target symbol, data block, and geographic map data on radar display for potential violation of aircraft separation standards.
  - b. Extract aircraft identification, altitude, and the altitude qualifier (VFR or OTP) from full data block.
  - c. Extract obstruction (and other map features) in geographic map data from radar display for comparison to the traffic picture.
  - d. Search flight progress strip in flight strip bay for information pertinent to aircraft/obstruction separation.
  - e. Extract aircraft identification, assigned altitude, requested altitude, remarks, and aircraft type from flight progress strip.
  - f. Extract route information, estimated ground speed, and true airspeed from flight progress strip (for comparison to geographic map data).
  - g. Extract previous posted fix, calculated time of arrival over posted fix, and next posted fix from flight progress strip.
  - h. Synthesize mental traffic picture, altitude, route, and obstruction/terrain information into a complete mental traffic picture with regard to aircraft obstruction/terrain clearance.
  - i. Recognize potential aircraft-to-obstruction/ terrain separation violation.
- 8. Issue safety alert in regard to low altitude situation.
  - a. Transmit air-to-ground (safety alert in regard to minimum en route/obstruction clearance altitude).
- 9. Forward notice of valid MSAW or flight assist to supervisor.
  - a. Initiate ground-to-ground communications (MSAW or flight assist).
- C. Perform airspace conflict processing.
  - 1. Perceive potential airspace conflict situation.
    - a. Acquire target symbol, full data block, and geographic map data on radar display for potential violations of airspace separation standards.
    - b. Extract aircraft identification, altitude, and altitude qualifier from full data block.
    - c. Extract airspace area (airspace information) from radar display for comparison to the traffic situation.
    - d. Search status information area for information on airspace status.

## II. Resolve aircraft conflicts.

- e. Extract airspace status (airspace ID, controlling agency, activation periods, and altitude limits) from status information area.
  - f. Search flight progress strip in flight strip bay for information pertaining to a possible violation of airspace separation standards.
  - g. Extract flight identification, assigned altitude, and requested altitude from flight progress strip.
  - h. Extract route information, posted fix, next posted fix, and calculated time of arrival over posted fix from flight progress strip.
  - i. Extract route information (departure point), estimated ground speed, true airspeed, and remarks from flight progress strip.
  - j. Synthesize traffic picture, altitude, route, weather, aircraft special condition, and airspace information into complete picture regarding violation of airspace separation standards.
  - k. Recognize potential aircraft to airspace conflict.
2. Determine appropriate action to resolve airspace conflict situation.
    - a. Extract aircraft route from flight progress strip and route on radar display.
    - b. Extract assigned altitude, requested altitude, aircraft type, and remarks from flight progress strip.
    - c. Extract special condition indicator from full data block.
    - d. Decide on action needed to resolve aircraft to airspace conflict situation considering a mental traffic picture and available conflict resolution options.
  3. Forward notice of potential/actual airspace conflict to supervisor.
    - a. Initiate ground-to-ground communications (airspace conflict notice).
  4. Issue advisory in regard to special use airspace proximity.
    - a. Transmit air-to-ground (advisory to pilot regarding proximity to restricted airspace).
  5. Request release of special use airspace.
    - a. Initiate ground-to-ground communications (request for release of special use airspace).
  6. Receive denial of use of special use airspace.
    - a. Receive ground-to-ground communications (denial of use of special use airspace).
  7. Receive approval for use of special use airspace.
    - a. Receive ground-to-ground communications (approval of use of special use airspace).
  8. Determine validity of airspace conflict notice.
    - a. Acquire position symbol, data block, and airspace area on radar display for potential violations of airspace.
    - b. Extract the airspace area of concern from radar display or overhead map.
    - c. Search status information area for airspace status on airspace.
    - d. Cross-reference stationary data block representing airspace area.
    - e. Acquire flight progress strip on radar display for information pertaining to the validity of the airspace conflict notice.
    - f. Extract aircraft identification, route, altitude, and altitude qualifier from radar display and flight progress strip.

## II. Resolve aircraft conflicts.

- g. Synthesize acquired information into a mental picture with regard to the current/projected proximity of the aircraft to special use airspace and any known pilot intentions.
  - h. Assess the validity of the airspace conflict notice in consideration of the mental traffic picture and known pilot intentions.
9. Inform controller of potential airspace conflict in his sector.
- a. Initiate ground-to-ground communications (notice of potential airspace conflict in other sector).
10. Receive notice of potential airspace conflict in sector.
- a. Receive ground-to-ground communications (notice of potential aircraft-airspace conflict affecting this sector).

### D. Suppress/restore alerts.

- 1. Suppress conflict alert for paired aircraft.
  - a. Initiate suppressed conflict alert pair message.
  - b. Execute suppressed conflict alert pair message.
  - c. Detect system acceptance of the suppressed conflict alert pair message in CA status display on radar display.
- 2. Suppress conflict alert for group suppression.
  - a. Initiate group suppression message for suppression of conflict alert for a group of aircraft or airspace or altitude range.
  - b. Execute group suppression message.
  - c. Detect system acceptance of group suppression message in a group suppression list on list display of radar display.
- 3. Suppress MSAW function for an aircraft.
  - a. Initiate suppression of indefinite/specific E-MSAW alert message.
  - b. Execute suppression of indefinite/specific E-MSAW alert message.
  - c. Initiate deletion of E-MSAW VFR processing.
  - d. Execute deletion of E-MSAW VFR processing.
  - e. Detect system acceptance of suppressed indefinite/specific E-MSAW alert message in E-MSAW alert status display in full data block.
  - f. Detect system acceptance of suppressed indefinite/specific E-MSAW alert message in full data block on radar display.
  - g. Detect absence of projected alert vectors.
- 4. Determine validity/appropriateness of display of an alert.
  - a. Acquire target symbol, data block, and geographic map data on radar display for potential violation of aircraft separation standards.
  - b. Extract aircraft identification, altitude qualifier, altitude, and ground speed from full data block on radar display.
  - c. Search flight progress strip in flight strip bay for information pertaining to unsafe condition advisory.



## II. Resolve aircraft conflicts.

- d. Extract flight identification, computer identification, and aircraft type from flight progress strip in the flight strip bay.
  - e. Extract assigned altitude, estimated ground speed from flight progress strip in the flight strip bay.
  - f. Extract route information and remarks from flight progress strip.
  - g. Extract previous posted fix, posted fix, and next posted fix from flight progress strip in the flight strip bay.
  - h. Search radar display when aircraft is deviating from hazardous weather.
  - i. Extract precipitation (geographic weather areas from ATC radar) from radar display.
  - j. Search weather sequence on computer readout device for hazardous weather information.
  - k. Extract weather sequence from computer readout device.
  - l. Search meteorological data record for hazardous weather affecting traffic.
  - m. Extract hazardous weather from center weather advisory report.
  - n. Extract PIREP and aviation weather forecast from meteorological data record.
  - o. Synthesize a mental traffic picture, altitude, route, speed, weather, and pilot capabilities into a complete mental traffic picture.
  - p. Decide if alert display is inappropriate in consideration of the mental traffic picture for an anticipated situation.
5. Restore specific alert function to normal.
- a. Initiate request for conflict alert pair message to restore to normal the conflict alert functionality.
  - b. Execute request for conflict alert pair message to restore alert functionality.
  - c. Detect system acceptance of restored conflict alert message in CA status display on radar display.
  - d. Detect FDB special condition indicator (blinking full data block) on radar display.
  - e. Initiate group suppression message to restore normal functioning of conflict alert functionality.
  - f. Execute group suppression message (deletion of aircraft or group from group suppression).
  - g. Detect system acceptance of group suppression message in group suppression list on list display of radar display.
  - h. Detect system acceptance of group suppression message via FDB special condition indicator (flashing full data block) on radar display.
  - i. Initiate restoration of indefinite/specific E-MSAW alert message.
  - j. Execute restoration of indefinite/specific E-MSAW alert message.
  - k. Detect system acceptance of restored E-MSAW alert message in E-MSAW alert status display on radar display.
  - l. Detect presence of E-MSAW penetration vector on radar display for pertinent aircraft.

### III. Manage air traffic sequences.

#### A. Respond to traffic management constraints/flow conflicts.

1. Evaluate traffic management constraints for effect on traffic flow.
  - a. Acquire target symbol, data block, and geographic map data on radar display for information pertaining to traffic management restrictions.
  - b. Extract aircraft identification, ground speed, altitude, and altitude qualifier from full data block.
  - c. Search flight progress strip in flight strip bay for information pertaining to a potential violation of flow restrictions.
  - d. Extract flight identification, aircraft type, computer identification, and strip marking (clearance limit/holding instructions) from flight progress strip.
  - e. Extract assigned altitude or requested altitude from flight progress strip.
  - f. Extract route information, posted fix, next posted fix, and remarks from flight progress strip.
  - g. Extract route information (destination, departure point), true airspeed, and estimated ground speed from the flight progress strip.
  - h. Extract calculated time of arrival over previous fix and calculated time of arrival over posted fix from the flight progress strip.
  - i. Search traffic management record for traffic management constraints.
  - j. Extract traffic management constraints (speed, altitude, spacing, etc.) from traffic management record.
  - k. Search sector metering list on inbound list for metering information.
  - l. Extract fix and metering constraints from sector metering list on inbound list.
  - m. Synthesize mental traffic picture, route, altitude, speed, and traffic management into a complete mental traffic picture with regard to the impact of the restrictions.
  - n. Evaluate traffic management and metering information for the effect on traffic flow.
2. Review options to bring aircraft into conformance with traffic management restrictions.
  - a. Acquire target symbol, data block, and geographic map data on radar display to reestablish aircraft within traffic management conformance.
  - b. Extract aircraft identification (to determine priority handling and conformance requirement) from full data block.
  - c. Extract altitude and altitude qualifier from the appropriate full data block.
  - d. Search flight progress strip in flight strip bay for information to help decide how to bring individual aircraft into conformance with flow parameters.
  - e. Extract assigned altitude from appropriate flight progress strip.
  - f. Extract route information, expect further clearance time, and remarks from appropriate flight progress strip.
  - g. Synthesize extracted information with a mental traffic flow picture in order to decide the most appropriate action to bring an aircraft into conformance with flow parameters.
  - h. Evaluate the appropriateness of vectoring/rerouting to bring aircraft into conformance with flow parameters.
  - i. Evaluate the appropriateness of changing altitude to bring aircraft into conformance with flow parameters.
  - j. Evaluate the appropriateness of changing speed to bring aircraft into conformance with flow parameters.

### III. Manage air traffic sequences.

- k. Evaluate the appropriateness of holding aircraft to bring aircraft into conformance with flow parameters.
3. Choose option to bring aircraft into conformance with traffic management restrictions.
  - a. Decide to vector/reroute aircraft to bring aircraft into conformance with flow parameters.
  - b. Decide to change altitude of aircraft to bring aircraft into conformance with flow parameters.
  - c. Decide to change speed of aircraft to bring aircraft into conformance with flow parameters.
  - d. Decide to hold aircraft to bring aircraft into conformance with flow parameters.
4. Negotiate traffic management action with pilot.
  - a. Transmit air-to-ground (option e.g., vectoring/reroute, speed adjustment, altitude adjustment, and holding to conform to traffic management restrictions).
5. Receive traffic management restriction.
  - a. Receive ground-to-ground communications (traffic management restrictions).
  - b. Receive G.I. message (traffic management restrictions).
  - c. Detect appearance of a traffic management record.
6. Discuss discontinuance of traffic management restriction/traffic to reroute with others.
  - a. Initiate ground-to-ground communications (discuss whether flow parameters are necessary based on current or expected traffic conditions).
  - b. Receive ground-to-ground communications (discuss whether flow restrictions are necessary based upon current or expected traffic conditions).
7. Receive metering data.
  - a. Receive ground-to-ground communications.
  - b. Receive G.I. message (metering data).
8. Receive supervisor briefing on what traffic conditions to expect.
  - a. Receive ground-to-ground communications (amount of traffic, upper winds, weather, and special events during specific shift or time period).
  - b. Synthesize information relating to expected traffic conditions.
9. Request metering list.
  - a. Initiate selection of inbound list message (display filter key) for display of inbound list and sector metering list.
  - b. Detect appearance of inbound list and sector metering list on radar display.
  - c. Extract sector metering list information.
10. Receive notice to hold/reroute traffic clear of contingency.
  - a. Receive ground-to-ground communications (notice from supervisor or others to hold or reroute traffic).
11. Receive notice to implement traffic management restrictions.
  - a. Receive ground-to-ground communications (notice of implemented traffic management restriction).

### III. Manage air traffic sequences.

- b. Receive G.I. message (notice of implemented traffic management restriction be imposed).
    - c. Receive communications from supervisor or others.
  - 12. Request traffic management restriction.
    - a. Initiate via land line or from supervisor communications (request traffic management restriction).
  - 13. Request exception to traffic management restriction.
    - a. Initiate via land line or from supervisor communications (request exception to traffic management restriction).
  - 14. Review traffic demands and traffic management restrictions with others.
    - a. Receive ground-to-ground communications (review traffic conditions and traffic management parameters).
    - b. Initiate ground-to-ground communications (review traffic conditions and traffic management parameters).
    - c. Cross-reference radar display, flight strip bay, traffic management record, and list display for traffic information.
  - 15. Receive approval of request for exception to flow restriction.
    - a. Receive via land line or from supervisor communications (approval for exception to traffic management parameter).
  - 16. Receive denial of request for exception to flow restriction.
    - a. Receive via land line or from supervisor communications (denial of exception to traffic management parameter).
- B. Process deviations.
- 1. Perceive an altitude or route deviation.
    - a. Acquire target symbol, data block, and geographic map data on radar display for potential violation of altitude/lateral/speed conformance.
    - b. Extract aircraft identification and ground speed from full data block.
    - c. Extract altitude, free track, coast track and altitude qualifier from full data block.
    - d. Extract route, fix, and airspace area from radar display.
    - e. Search flight progress strip in flight strip bay for information pertaining to potential violation of altitude, speed, or route conformance criteria.
    - f. Extract requested altitude and assigned altitude from flight progress strip in the flight strip bay.
    - g. Extract flight ID, route information, posted fix, next posted fix, and remarks from flight progress strip in the flight strip bay.
    - h. Extract airspeed, altitude, and other flight plan information from response message on computer readout device.
    - i. Synthesize route, altitude, speed, time, and aircraft data information into a mental traffic picture with regard to potential violation of altitude, speed, or route conformance criteria.
    - j. Recognize a potential violation of altitude, speed, or route conformance criteria.

### III. Manage air traffic sequences.

2. Observe aircraft resuming conformance to clearance.
  - a. Detect target symbol, position symbol, and data block on radar display to monitor aircraft's return to previously cleared course.
  - b. Extract relative location and movement of aircraft in question from position symbol (flat or free) target symbol, and track history on radar display.
  - c. Extract aircraft identification, altitude, and ground speed from full data block (of aircraft in question) on radar display.
  - d. Extract fix, airway, and route segment from geographic map data.
  - e. Compare target position/movement with geographic map data.
  - f. Recognize aircraft responding to clearance or resuming conformance with clearance.
3. Determine maneuver to establish/restore flight plan conformance.
  - a. Integrate a mental traffic picture with full data block, target symbol, position symbol, and flight progress strip to determine type of maneuver necessary to correct deviation.
  - b. Formulate clearance and appropriate instructions to place an aircraft within conformance limits of previously issued clearance.
4. Detect lateral/altitude nonconformance indication.
  - a. Search target symbol, data block, position symbol, altitude, altitude qualifier (conformance/nonconformance indication) and radar display for aircraft clearance deviation.
  - b. Detect free track and coast track symbol on radar display.
  - c. Detect altitude qualifier (conformance/nonconformance indication) in full data block on radar display.
5. Evaluate flight data to determine future course of action.
  - a. Search flight progress strip in flight strip bay for information pertaining to nonconformance situation.
  - b. Extract flight identification and route information from flight progress strip in flight strip bay.
  - c. Extract assigned altitude from flight progress strip in flight strip bay.
  - d. Extract departure/arrival position time.
  - e. Extract airspeed, altitude, route, and time from response message on computer readout device.
  - f. Integrate extracted route and altitude information with enhanced mental picture.
  - g. Decide on action needed to resolve nonconformance situation.
6. Evaluate lateral nonconformance indication for action needed.
  - a. Search target symbol, data block, position symbol (flat or free) and geographic map data on radar display for nonconformance situation.
  - b. Extract route, fix, and airspace area from radar display.
  - c. Extract position of aircraft in nonconformance situation from full data block, track symbol, velocity vector, track history, and position symbol on radar display.
  - d. Extract aircraft identification from full data block (of aircraft involved).
  - e. Search flight progress strip for flight data.
  - f. Extract route information and next posted fix from flight progress strip.
  - g. Extract aircraft type, remarks, estimated ground speed and true airspeed from flight progress strip.

### III. Manage air traffic sequences.

- h. Synthesize extracted position, route, and geographic map data into a mental picture of the nonconformance situation.
    - i. Assess available courses of reconformance action.
  - 7. Evaluate altitude nonconformance indication for action needed.
    - a. Search full data block of aircraft with altitude qualifier (nonconformance indication) on radar display.
    - b. Extract altitude (Mode C, reported, or assigned) from full data block.
    - c. Extract aircraft type, special equipment, requested altitude, remarks, and strip marking from flight progress strip.
    - d. Evaluate available courses of reconformance action.
  - 8. Evaluate unreasonable Mode C indication for action needed.
    - a. Synthesize the acquired information into a mental picture with regard to the altitude qualifier Mode C unreasonableness indication.
    - b. Decide upon the proper course of action.
  - 9. Detect unreasonable Mode C indication.
    - a. Search full data block on radar display for unreasonable Mode C indications.
    - b. Detect altitude qualifier indicating Mode C variance exceeding conformance limits or loss of Mode C.
    - c. Extract altitude qualifier showing Mode C variance exceeding conformance limits.
  - 10. Verify altimeter setting.
    - a. Transmit air-to-ground (verify altimeter setting).
  - 11. Inform pilot to reset altimeter/stop Mode C squawk.
    - a. Transmit air-to-ground (inform pilot to reset altimeter or to cease Mode C squawk).
  - 12. Request printing of flight progress strip(s) on flight plan.
    - a. Initiate FR message to observe one or more flight plans.
    - b. Execute strip request message.
    - c. Detect receipt of flight progress strip.
  - 13. Receive controller notice of aircraft flight plan deviation.
    - a. Receive communications (notice of aircraft deviation from cleared route or altitude).
  - 14. Inform controller/supervisor of aircraft flight plan deviation.
    - a. Initiate communications (informing supervisor or other controller of aircraft deviation from cleared route or altitude).
- C. Respond to special use airspace events.
  - 1. Inform others of airspace status change.
    - a. Transmit G.I. message (notice to another controller or supervisor of the status of airspace restriction).

### III. Manage air traffic sequences.

- b. Initiate ground-to-ground communications (notice to another controller or supervisor of the status of airspace restriction).
    - c. Transmit air-to-ground (advising pilot of the status of restricted airspace).
  2. Observe record of airspace status change.
    - a. Acquire airspace status from status information area for altitude in use, use times, and controlling agency.
    - b. Compare new airspace restriction information with previous data.
    - c. Recognize the difference between extracted data and previous airspace restriction data.
  3. Receive notice of airspace status change.
    - a. Receive G.I. message (notice of airspace restriction/release).
    - b. Receive ground-to-ground communications (notice of airspace restriction/release).
    - c. Transmit air-to-ground (notice of airspace restriction/release from pilot).
  4. Determine restrictions to users necessary within released airspace.
    - a. Integrate all available data into a mental traffic picture to project the effect of restrictions on all users.
    - b. Decide on necessary restrictions to be applied for users of released airspace.
  5. Inform others on conditions of release of special use airspace.
    - a. Initiate ground-to-ground communications (conditions on special use airspace release).
    - b. Transmit G.I. message (conditions on special use airspace release).
    - c. Transmit air-to-ground (conditions on special use airspace release).
  6. Receive request for use of special use airspace.
    - a. Receive ground-to-ground communications (request from other controller or supervisor for use of special use airspace).
    - b. Transmit air-to-ground (request from pilot for use of special use airspace).
- D. Establish arrival sequences.
  1. Determine descent time or point.
    - a. Acquire target symbol and data block on radar display for information applicable to establishing arrival patterns.
    - b. Extract aircraft identification, altitude, and ground speed from full data block.
    - c. Search meteorological data record for information applicable to establishing arrival patterns.
    - d. Extract center weather report, PIREP, and aviation weather forecast from meteorological data record for turbulence and icing reports.
    - e. Search flight progress strip for information applicable to establishing arrival patterns.
    - f. Extract aircraft type, route information, and remarks from flight progress strip.
    - g. Search inbound list and sector metering list for metering information.
    - h. Extract metering information from sector metering list on inbound list.
    - i. Search traffic management record for traffic management constraints.
    - j. Extract traffic management information from traffic management record.

### III. Manage air traffic sequence.

- k. Synthesize altitude, route, speed, flow restrictions, aircraft capabilities, pilot request and control workload into a complete mental picture for establishing arrival patterns.
- l. Decide descent time or point for each aircraft.
2. Project traffic sequence to establish/modify approach flow to airport or sector.
  - a. Acquire target symbol and full data block on radar display for information pertaining to aircraft landing in or near this sector.
  - b. Search flight progress strip in flight strip bay (for aircraft landing in or near this sector).
  - c. Extract flight identification, route information (destination) from flight progress strip in flight strip bay.
  - d. Extract airspace status from status information area.
  - e. Recognize aircraft landing in this sector based on route information (destination) on the flight progress strip.
  - f. Extract remarks (estimated time of arrival), posted fix, and calculated time of arrival over posted fix from flight progress strip of aircraft landing in this sector.
  - g. Synthesize extracted destination information and pilot request/intentions picture of arrival flow of aircraft in or near the sector.
  - h. Integrate airport acceptance route with arrival flow.
  - i. Project air traffic sequence arriving at airport.
3. Observe sector metering list for metering requirements.
  - a. Search inbound list and sector metering list on radar display for metering information.
  - b. Extract metering information from sector metering list.
  - c. Synthesize extracted information into mental picture of metering requirements.
  - d. Translate metering requirements into delay factor and/or control methods needed for aircraft to arrive over meter fix at desired rate.
4. Project mentally the range/bearing between aircraft.
  - a. Acquire target symbol and full data block on radar display for information pertaining to a mental projection of range/bearing between aircraft.
  - b. Perceive route display of aircraft of concern for proximity of aircraft along the route of flight.
  - c. Extract ground speed from full data block for use in mental projection of range/bearing between aircraft.
  - d. Search flight strip bay for information on flight progress strip regarding route of flight information.
  - e. Extract aircraft type, route from flight progress strip for use in mental projection of aircraft.
  - f. Extrapolate the range and bearing between aircraft from the extracted information.
5. Project mentally the arrival flow for aircraft landing in or near this sector.
  - a. Acquire target symbol and data block on radar display for information pertaining to aircraft landing in or near this sector.
  - b. Extract altitude and ground speed from full data block.
  - c. Search flight progress strip in flight strip bay (for aircraft landing in or near this sector).
  - d. Extract route information (destination), remarks (to determine aircraft priority), posted fix, and calculated time of arrival over posted fix from flight progress strip.



### III. Manage air traffic sequences.

- e. Extract aircraft type and flight identification (to establish priority handling) from flight progress strip.
  - f. Recognize aircraft landing in or near this sector.
  - g. Synthesize extracted destination/traffic information into a mental picture of arrival flow of aircraft in or near the sector.
- 6. Issue current arrival information.
    - a. Cross-reference airport/runway status in status information area.
    - b. Cross-reference terminal forecast and PIREP in meteorological data record.
    - c. Cross-reference altimeter setting readout in computer readout device.
    - d. Transmit air-to-ground (issue arrival information).
  - 7. Observe radar target/data block of arrival aircraft.
    - a. Scan target symbol and full data block on radar display (for arriving aircraft).
    - b. Detect primary target and secondary target in full data block of arrival aircraft.
    - c. Perceive aircraft position/location in reference to other traffic.
  - 8. Determine approach sequence.
    - a. Compare approach aircraft types and flight characteristics in relation to available runways.
    - b. Decide approach aircraft sequence and spacing in regard to altitude requirements.
  - 9. Record necessary flight plan data.
    - a. Record necessary flight plan data on strip or paper record.
  - 10. Forward arrival sequence to tower controller.
    - a. Initiate ground-to-ground communications (inform of arrival sequence).
  - 11. Request that aircraft be rerouted.
    - a. Initiate ground-to-ground communications (request aircraft be rerouted).
- E. Manage departure flows.
- 1. Project traffic sequence to establish/modify departure flow.
    - a. Search airport/runway status in status information area for data pertaining to aircraft departures.
    - b. Extract runway configuration and appropriate departure route from airport/runway status.
    - c. Search departure list in list display for information pertaining to departure volume.
    - d. Extract airport fix sublist header, aircraft identification, and assigned altitude from departure list.
    - e. Search data block on radar display for information affecting aircraft departures in this sector.
    - f. Detect full data block, velocity vector, and track history on radar display.
    - g. Recognize aircraft departing in or through this sector based on aircraft identification in full data block and comparison with aircraft identification on departure list.
    - h. Perceive location of full data block associated with aircraft departing in or through this sector.
    - i. Search flight progress strip in the flight strip bay (for aircraft departing in or through this sector).
    - j. Extract flight identification, proposed departure time or route information (departure point, destination) from flight progress strip in strip bay.
    - k. Extract requested altitude, aircraft type, true airspeed, and remarks from flight progress strip in flight strip bay.

### III. Manage air traffic sequences.

- l. Recognize aircraft departing in or through this sector based on route information, and proposed departure time on flight progress strip.
    - m. Recognize aircraft departing in or through this sector through matching flight identification in the flight progress strip and aircraft identification in the departure list.
    - n. Extract posted fix, calculated time of arrival over posted fix, and next posted fix from flight progress strip of aircraft departing in or through this sector.
    - o. Search meteorological data record for pertinent weather information.
    - p. Cross-reference center weather report, aviation weather forecast, and PIREP from meteorological data record.
    - q. Synthesize extracted information into a mental picture of departure flow in relation to the overall mental traffic picture and airport/runway departure rate.
    - r. Project traffic sequence to establish/modify departure flow based on a mental traffic picture.
  2. Receive notice of missed approach.
    - a. Receive ground-to-ground communications (notice of missed approach).
    - b. Transmit air-to-ground (pilot notice of missed approach).
  3. Receive request for release of departure aircraft from tower.
    - a. Receive ground-to-ground communications (tower request for release of departure aircraft).
  4. Forward departure release.
    - a. Initiate ground-to-ground communications (inform tower of departure release for aircraft).
- F. Monitor non-controlled objects.
1. Observe airspace intrusion by non-controlled object (e.g., balloon, glider).
    - a. Search data block, target symbol (uncorrelated), and limited data block on radar display for possible non-controlled object.
    - b. Detect target symbol not associated with the limited data block (non-controlled object).
  2. Observe (monitor) a non-controlled object.
    - a. Initiate tracking message to start a track/flight follow non-controlled object.
    - b. Execute initiation of tracking message.
    - c. Detect full data block and target symbol on radar display (untracked target becomes tracked data block).
    - d. Assess track movement of tracked target.
  3. Forward notice of airspace intrusion by a non-controlled object.
    - a. Decide upon need to advise others of an airspace intrusion by a non-controlled object.
    - b. Initiate ground-to-ground communications (notice of airspace intrusion by non-controlled object).
    - c. Transmit G.I. message (notice of airspace intrusion by non-controlled object).
  4. Receive notice of airspace intrusion by non-controlled object.

### III. Manage air traffic sequences.

- a. Receive ground-to-ground communications (notice of airspace intrusion by non-controlled object).
  - b. Receive G.I. message (notice of airspace intrusion by non-controlled object).
  - c. Transmit air-to-ground (pilot notice of airspace intrusion by non-controlled object).
5. Issue advisory in regard to non-controlled object.
- a. Transmit air-to-ground (advisory in regard to non-controlled object).
6. Inform pilot when clear of non-controlled object.
- a. Transmit air-to-ground (pilot clear of non-controlled object).
7. Record controller note.
- a. Record/update controller note (reminder note of temporary action or activity).
- G. Respond to temporary release of airspace requests.
1. Suppress map associated with temporary use of airspace.
- a. Initiate inhibition of a special area.
  - b. Detect suppression of an airspace area from geographic map data on radar display.
2. Discuss release of airspace for temporary use.
- a. Initiate ground-to-ground communications (release of airspace for temporary use).
  - b. Receive ground-to-ground communications (release of airspace for temporary use).
  - c. Evaluate merits of equipment release.
3. Select map display of adapted airspace requested for use by another controller.
- a. Initiate selection of the special area.
  - b. Detect appearance of airspace area on radar display.
4. Evaluate feasibility of releasing airspace temporarily.
- a. Acquire target symbol, data block, and geographic map data on radar display for information pertaining to temporarily releasing airspace.
  - b. Extract aircraft identification, altitude, and altitude qualifier from full data block.
  - c. Extract airspace area from radar display.
  - d. Search flight progress strip in flight strip bay for information pertaining to temporary release of airspace.
  - e. Extract flight identification and assigned altitude from flight progress strip.
  - f. Extract route information, calculated time of arrival over posted fix, and remarks from flight progress strip.
  - g. Extract previous posted fix, posted fix, and next posted fix from flight progress strip.
  - h. Extract estimated ground speed, true airspeed, and route information (departure point) from flight progress strip.
  - i. Cross-reference airspace status in status information area.
  - j. Synthesize traffic picture, route, altitude, weather, and airspace boundary information into a complete mental traffic picture regarding approval of temporary use of airspace.
  - k. Decide upon feasibility of temporarily releasing airspace.

### III. Manage air traffic sequences.

5. Receive request for temporary use of airspace.
  - a. Receive ground-to-ground communications (request from controller/supervisor for use of airspace).
6. Forward approval for temporary use of airspace.
  - a. Initiate ground-to-ground communications (notice of airspace release).
7. Forward denial of temporary use of airspace.
  - a. Initiate ground-to-ground communications (notice of denial of request for airspace release).
8. Receive notification of return of released airspace.
  - a. Receive ground-to-ground communications (notification of return of released airspace).

#### H. Request temporary release of airspace.

1. Request temporary use of airspace.
  - a. Search overhead map for identification of airspace needed for temporary use.
  - b. Extract adapted name or location of airspace needed for temporary use from overhead map.
  - c. Initiate ground-to-ground communications (airspace ID, altitude, and duration of use).
2. Receive release/use of airspace.
  - a. Receive ground-to-ground communications (notice of release of airspace).
3. Receive rejection of use of airspace.
  - a. Receive ground-to-ground communications (denial of use of airspace).
4. Forward notice of return of released airspace.
  - a. Initiate ground-to-ground communications (notice of return of released airspace).

#### IV. Route or plan flights.

##### A. Plan clearances.

1. Discuss alternate suggestion for clearance/approval requested of another controller.
  - a. Receive ground-to-ground communications (alternate instructions).
  - b. Initiate ground-to-ground communications (alternate instructions).
2. Review potential impediments for impact on proposed clearance.
  - a. Acquire target symbol, data block, and geographic map data on radar display for information pertaining to impact on proposed clearance.
  - b. Extract aircraft identification and altitude from full data block.
  - c. Extract airspace area from radar display for comparison to the traffic situation on radar display.
  - d. Search status information area for airspace status.
  - e. Extract altitude limit and activation period of airspace area from status information area.
  - f. Search meteorological data record for pertinent weather information.
  - g. Extract center weather report, aviation weather forecast, and PIREP from meteorological data record.
  - h. Search flight strip printer and computer readout device for pertinent weather information.
  - i. Extract surface observation from flight strip printer and computer readout device.
  - j. Search flight progress strip in flight strip bay for information pertaining to factors which will impact proposed clearance.
  - k. Extract flight identification, assigned altitude, requested altitude, and aircraft type from flight progress strip.
  - l. Extract route information, posted fix, next posted fix, calculated time of arrival over posted fix, and remarks from flight progress strip.
  - m. Extract route information (destination), estimated ground speed, and true airspeed from flight progress strip.
  - n. Synthesize traffic picture, altitude, route, weather, and airspace information into a complete mental traffic picture with regard to factors which will impact proposed clearance.
  - o. Recognize factors which will impact proposed clearance.
3. Discuss clearance alternatives with pilot/relayer.
  - a. Transmit air-to-ground (determine the course of action suitable for traffic demands).
  - b. Initiate ground-to-ground communications (determine the course of action suitable for traffic demands).
  - c. Receive ground-to-ground communications (determine the course of action suitable for traffic demands).
4. Evaluate flight progress strip changes for clearance planning or future actions.
  - a. Search flight progress strip in flight strip bay for changes in flight data which could affect controller planning.
  - b. Extract changes in flight data from flight progress strip.
  - c. Assess flight progress strip changes to determine impact on present or future control actions.

#### IV. Route or plan flights.

5. Determine priority of control actions.
  - a. Decide the order in which control actions need to be implemented.
6. Perceive the need for amended clearance.
  - a. Acquire target symbol, data block, geographic map data on radar display for information pertaining to the need for amended clearance.
  - b. Perceive a mental weather picture from precipitation on radar display.
  - c. Extract aircraft identification, altitude, altitude qualifier, and ground speed from full data block.
  - d. Extract airspace area from radar display for comparison to the traffic situation on radar display.
  - e. Search status information area for airspace status.
  - f. Extract altitude limit and activation period of airspace area from status information area.
  - g. Search flight progress strip in flight strip bay for information pertaining to need for amended clearance.
  - h. Extract flight identification, assigned altitude, and requested altitude from the flight progress strip.
  - i. Extract route information, posted fix, next posted fix, calculated time of arrival over posted fix, and remarks from flight progress strip.
  - j. Extract true airspeed from the flight progress strip.
  - k. Recognize special conditions associated with user needs.
  - l. Synthesize traffic picture, altitude, route, weather, and airspace information into a complete mental traffic picture with regard to the need to amend clearance of one or more aircraft.
  - m. Recognize the need to amend clearance of one or more aircraft based on information available.
7. Formulate a plan of action for clearance generation.
  - a. Synthesize traffic picture, altitude, route, speed, weather, and airspace information into a complete mental traffic picture with regard to formulating a controller plan of action.
  - b. Decide the requirements and restrictions necessary for composing clearance based on available information.
8. Evaluate a mental flight plan projection for appropriateness.
  - a. Search target symbol, data block, and geographic map data on radar display for information to evaluate the appropriateness of the flight plan.
  - b. Assess the J ring on radar display for information pertaining to the need for amended clearance.
  - c. Perceive a mental traffic picture from full data block, track history, and velocity vector on radar display.
  - d. Extract aircraft identification, altitude, and altitude qualifier (VFR or OTP) from full data block.
  - e. Extract airspace area from radar display for comparison to the traffic situation on radar display.
  - f. Extract the relative location of aircraft in question from the target symbol on radar display.
  - g. Extract altitude limit and activation period of airspace area from status information area.
  - h. Search the flight progress strip in the flight strip bay for information pertaining to formulation of clearance.
  - i. Extract flight identification, assigned altitude, requested altitude, and estimated ground speed from flight progress strip.
  - j. Extract route information, posted fix, next posted fix, and calculated time of arrival over posted fix from flight progress strip.
  - k. Extract previous posted fix, true airspeed, and remarks from flight progress strip in flight strip bay.

#### IV. Route or plan flights.

- l. Synthesize traffic picture, altitude, route, speed, weather, and airspace information into a complete mental traffic picture with regard to evaluating the appropriateness of the flight plan.
  - m. Evaluate the appropriateness of the flight plan based upon a complete mental traffic picture.
9. Determine appropriate action for aircraft clearance.
    - a. Synthesize a mental traffic picture to determine controller course of action.
    - b. Decide on the appropriate course of action for clearance.
  10. Receive requested flight plan changes.
    - a. Receive ground-to-ground communications (requested flight plan changes).
    - b. Transmit air-to-ground (requested flight plan changes from pilot).
  11. Receive clearance request.
    - a. Receive ground-to-ground communications (relayed clearance request).
    - b. Transmit air-to-ground (clearance request from pilot).
  12. Receive controller request for clearance/approval.
    - a. Receive ground-to-ground communications (clearance/approval request).
  13. Forward clearance request to another controller.
    - a. Initiate ground-to-ground communications (forward clearance/approval request).
  14. Request clearance/approval from another controller.
    - a. Decide on the need to coordinate clearance with another controller.
    - b. Initiate ground-to-ground communications (clearance/approval request).
  15. Receive clearance approval/clearance restrictions from another controller.
    - a. Receive ground-to-ground communications (clearance approval/restrictions).
  16. Receive clearance disapproval/denial from another controller.
    - a. Receive ground-to-ground communications (clearance rejection/denial).
- B. Respond to contingencies/emergencies.
1. Advise supervisor of emergency.
  2. Issue instructions to NORDO aircraft for identification turn/transponder response.
    - a. Transmit air-to-ground (issuing instructions to aircraft with no transmitter).
  3. Detect pilot or aircraft problem (e.g., hypoxia, emergency beacon code).
    - a. Search full data block on radar display for special condition indicator, target symbol, altitude (nonconformance), emergency beacon code, and position symbol (freetrack).
    - b. Detect emergency beacon code or altitude qualifier (nonconformance indication) in full data block.
    - c. Recognize aircraft turns from target symbol, track history, and full data block.
    - d. Transmit air-to-ground (detect erratic pilot communication behavior).

#### IV. Route or plan flights.

- e. Integrate data received to make a decision as to whether a potential emergency or other problem exists.
- 4. Inform designated emergency response personnel of aircraft having flight problems.
  - a. Initiate ground-to-ground communications (sending contingency information).
- 5. Conduct a search for aircraft without radio contact.
  - a. Decide on appropriate course of action for search.
  - b. Initiate ground-to-ground communications (requesting information on overdue aircraft from another controller or facility).
  - c. Transmit G.I. message (requesting information on NORDO aircraft).
  - d. Transmit air-to-ground (attempt to contact NORDO aircraft including backup and emergency frequencies).
- 6. Observe aircraft identification turn.
  - a. Search target symbol (uncorrelated primary or secondary), full data block, and limited data block on radar display for aircraft turn or transponder response to instructions by ATC.
  - b. Extract movement of target symbol, track history, and velocity vector on radar display in response to instructions issued from an ATC facility.
- 7. Conduct radio/radar search for overdue aircraft.
  - a. Decide on appropriate course of action for search.
  - b. Scan target symbol, data block, on radar display.
  - c. Transmit air-to-ground (attempt to contact overdue aircraft or request another aircraft to attempt contact via normal or emergency communications).
  - d. Initiate ground-to-ground communications (instructing flight service station to attempt to contact an overdue aircraft or inquiring with others about the aircraft).
- 8. Receive supervisor notice to conduct communications search for overdue/NORDO aircraft.
  - a. Receive ground-to-ground communications (notice from supervisor to conduct communication search for overdue or NORDO aircraft).
- 9. Receive notice that the supervisor will conduct a communications search for overdue/NORDO aircraft.
  - a. Receive ground-to-ground communications (notice from supervisor that he will conduct communications search for overdue or NORDO aircraft).
- 10. Receive pilot notice of emergency declared.
  - a. Transmit air-to-ground (pilot declares emergency).
  - b. Search full data block, target symbol and limited data block on radar display for emergency beacon code.
  - c. Detect emergency beacon code in full data block or limited block.
- 11. Determine appropriate emergency/contingency actions.
  - a. Decide what control actions are appropriate to the emergency or contingency situation.



12. Receive termination notice/time of emergency/contingency.
  - a. Receive ground-to-ground communications (notice of termination and/or time of termination of an emergency or contingency situation).
  - b. Transmit air-to-ground (notice from pilot of termination and/or time of termination of an emergency or contingency situation).
13. Forward termination notice/time of emergency/contingency.
  - a. Initiate ground-to-ground communications (forward notice of termination and/or time of termination of emergency or contingency situation).
  - b. Transmit air-to-ground (forward notice to pilot of termination and/or time of termination of emergency or contingency situation).
14. Receive notice of emergency declared and contingency plan invoked.
  - a. Receive ground-to-ground communications (information on emergency declaration and contingency plan).
15. Review contingency/emergency checklist on static record.
  - a. Cross-reference checklist for emergency or contingency situation on static information record.
  - b. Cross-reference automated checklist on computer readout device.
16. Declare an emergency.
  - a. Initiate ground-to-ground communications (inform supervisor or other controller of decision).
  - b. Cross-reference checklist in static information record (review checklist).
  - c. Decide on appropriate actions for situation.
17. Receive notice of a pilot or aircraft having problems (e.g., overdue, loss of radio contact).
  - a. Receive ground-to-ground communications (notice of aircraft problems).
  - b. Transmit air-to-ground (receive notice from pilot of aircraft problem).
18. Forward contingency/emergency information to others.
  - a. Initiate ground-to-ground communications (forwarding contingency/emergency information).
  - b. Initiate flight data amendment message (to enter contingency information in remarks section).
19. Request relay of instructions to NORDO aircraft for identification turn/transponder response.
  - a. Initiate ground-to-ground communications (requesting assistance from another controller or facility to attempt to issue instructions to pilot of NORDO aircraft).
  - b. Transmit air-to-ground (requesting pilot to try to contact another pilot of suspected NORDO aircraft).
20. Conduct emergency actions.
  - a. Cross-reference checklist (position, emergency, contingency) for appropriate emergency actions and assistance to pilot.
  - b. Initiate ground-to-ground communications (coordinating emergency actions and informing others).
  - c. Transmit air-to-ground (providing information and assistance to pilot).

#### IV. Route or plan flights.

##### C. Respond to special operations.

1. Perceive presence of special operation.
  - a. Search full data block on radar display for special operations aircraft (special aircraft callsign).
  - b. Detect special aircraft identification from full data block on radar display (special callsign alerts controller to special operation).
  - c. Extract special aircraft identification from full data block on radar display.
  - d. Search flight progress strip in flight strip bay for special operations aircraft.
  - e. Detect remarks (NOPAR, special operation), flight identification pertaining to special operations in the flight progress strip.
  - f. Extract remarks (NOPAR, special operation), flight identification pertaining to special operations from the flight progress strip.
2. Receive review/notice of special operation.
  - a. Receive G.I. message (receiving briefing on special operation).
  - b. Receive ground-to-ground communications (receiving information on special operation).
  - c. Transmit air-to-ground (receiving information on special operations from pilot).
3. Forward notice of special operations to another controller/supervisor.
  - a. Initiate ground-to-ground communications (notice of special operations).
  - b. Transmit G.I. messages (notice of special operations).
4. Conduct special operation actions.
  - a. Cross-reference checklist, standard operating procedures, letter of agreement, and local directed information for appropriation actions.
  - b. Initiate ground-to-ground communications (coordinate special operations actions).
  - c. Transmit air-to-ground (coordinating special operations actions).
5. Receive notice of termination of special operation.
  - a. Receive ground-to-ground communications (special operation termination).
  - b. Receive G.I. message (special operation termination).
  - c. Transmit air-to-ground (pilot notice of special operation termination).
6. Forward notice of termination of special operation.
  - a. Initiate ground-to-ground communications (special operation termination).
  - b. Transmit air-to-ground (special operation termination).

##### D. Review flight plans.

1. Observe new flight progress strip.
  - a. Acquire new flight progress strip printed out on the flight strip printer or from the flight strip bay.
2. Review flight plan for completeness.
  - a. Extract flight progress strip in the flight strip bay to ensure that appropriate fields are complete.
  - b. Assess flight progress strip for completeness.

#### IV. Route or plan flights.

- c. Decide what data are missing from flight progress strip (after scanning each field to determine if necessary information is available).
3. Review flight progress strip for flight plan errors.
  - a. Assess correctness of information on flight progress strip (e.g., bad routing, airspeed).
  - b. Decide what data are incorrect in flight progress strip (after scanning each field to determine correctness of information available).
4. Receive flight plan from pilot.
  - a. Transmit air-to-ground (receive flight plan from pilot).
5. Receive flight plan data verbally/physically forwarded.
  - a. Receive ground-to-ground communications (receiving flight plan information).
  - b. Receive flight plan data physically from another controller.
6. Question pilot about the flight plan.
  - a. Transmit air-to-ground (question pilot regarding filed flight plan).
7. Forward flight plan data verbally/physically.
  - a. Cross-reference flight progress strip in flight strip bay.
  - b. Initiate ground-to-ground communications (forwarding flight plan to another controller).
  - c. Transmit flight plan data physically to another controller.
8. Enter stereo flight plan into the system.
  - a. Initiate entry of stereo flight plan message for input of stereo flight plan.
  - b. Execute entry of stereo flight plan message.
  - c. Detect system acceptance of stereo flight plan.
9. Record new flight plan data on flight progress strip.
  - a. Initiate recording the flight strip entry on a blank flight progress strip.
  - b. Initiate recording the controller note for new flight plan information.
10. Enter flight plan into the system.
  - a. Initiate entry of the flight plan message for input of flight data (IFR or VFR).
  - b. Execute entry of the flight plan message.
  - c. Detect system acceptance of flight plan.
11. Inform pilot/relay of required flight plan changes.
  - a. Transmit air-to-ground (required flight plan changes to pilot).
  - b. Initiate ground-to-ground communications (required flight plan changes conveyed to other controller or to flight service).
12. Question the relay of a flight plan.
  - a. Initiate ground-to-ground communications (information of error or need for validation).
  - b. Receive ground-to-ground communications (flight plan error/validation).

#### IV. Route or plan flights.

##### E. Process flight plan amendments.

1. Enter flight plan amendment into system.
  - a. Initiate flight data amendment message.
  - b. Execute flight data amendment message.
  - c. Detect acceptance of flight plan amendment.
2. Enter pilot's position report into system.
  - a. Initiate entry of the progress report message (for input of flight plan progress report).
  - b. Execute entry of the progress report message.
  - c. Detect system acceptance of the progress report message.
3. Receive flight plan amendment data that was verbally forwarded.
  - a. Receive ground-to-ground communications (flight plan amendment data).
4. Receive pilot's position report.
  - a. Transmit air-to-ground (position report from pilot).
  - b. Receive ground-to-ground communications (pilot's position report relayed by others).
5. Forward flight plan amendment data verbally/physically.
  - a. Initiate ground-to-ground communications (flight plan amendment data to another controller).
6. Determine the need for a flight plan amendment.
  - a. Synthesize a mental traffic picture, weather conditions, routing availability, and other conditions influencing the possible need for amending a flight's flight plan.
  - b. Assess the flight path of the aircraft.
  - c. Assess application of a preferential route.
  - d. Assess traffic management restrictions.
  - e. Decide on the need for a flight plan amendment.
7. Question the pilot/controller on the flight plan amendment.
  - a. Transmit air-to-ground (query pilot on flight plan amendment).
  - b. Initiate ground-to-ground communications (query other controller or facility on flight plan amendment).
  - c. Receive ground-to-ground communications (response to query on flight plan amendment).
8. Forward pilot's position report.
  - a. Initiate ground-to-ground communications (position report from pilot).
9. Receive computer message of flight plan amendment.
  - a. Detect message waiting lamp (with chime) on computer readout device or new strip on flight strip printer.
  - b. Search computer readout device and/or new flight progress strip for flight data revision (new flight progress strip provided for route amendment).
  - c. Detect flight data revision on computer readout device or flight progress strip.
  - d. Extract new flight data on computer readout device or flight progress strip.

IV. Route or plan flights.

10. Record flight plan amendment data on flight progress strip.
    - a. Record flight strip entry.
    - b. Delete original data from flight progress strip by recorded flight strip entry (drawing a line or X through it).
  11. Flag flight progress strip for reminder action.
    - a. Initiate flagging the flight progress strip (for reminder action by setting the holder off to one side).
  12. Unflag the flight progress strip.
    - a. Initiate unflagging the flight progress strip (termination of reminder action).
  13. Forward request for flight plan amendment to other controller.
    - a. Initiate ground-to-ground communications (request for flight plan amendment).
  14. Review aircraft speed/time for amendment.
    - a. Search flight progress strip in flight strip bay for information on calculated time of arrival over posted fix.
    - b. Extract calculated time of arrival over posted fix from flight progress strip.
    - c. Recognize actual time over posted fix from pilot-reported or radar-observed time/speed on radar display.
    - d. Transmit air-to-ground (query pilot regarding aircraft speed verification).
    - e. Compare calculated time of arrival over posted fix against actual time over posted fix.
    - f. Calculate estimated ground speed.
    - g. Decide if true airspeed needs to be amended.
    - h. Decide if calculated time of arrival over posted fix needs to be amended (next posted fix calculated time of arrival).
  15. Inform controller if unable to amend flight plan.
    - a. Initiate ground-to-ground communications (advising controller when unable to accept flight plan amendment).
  16. Receive controller notification if unable to amend flight plan.
    - a. Receive ground-to-ground communications (receive notice from another controller when unable to accept flight plan amendment).
- F. Receive transfer of control/radar identification.
1. Receive handoff request.
    - a. Search full data block for indication of handoff directed to sector.
    - b. Detect special condition indicator (handoff) in full data block on radar display.
    - c. Receive ground-to-ground communications (handoff request).
  2. Accept verbal handoff.
    - a. Receive ground-to-ground communications (accepting verbal handoff).
    - b. Determine if target being handed off is an uncorrelated or correlated target.
    - c. Detect appearance of appropriate full data block on radar display.

#### IV. Route or plan flights.

3. Accept automatic handoff.
  - a. Initiate acceptance of handoff message for acceptance of handoff.
  - b. Execute acceptance of handoff message.
4. Determine that aircraft is entering sector.
  - a. Search geographic map data on radar display for information that may aid in determining if aircraft is entering sector.
  - b. Extract sector boundary, route structure, airport, obstruction, and fix from radar display (fixes likely for position report).
  - c. Search flight progress strip in flight strip bay for flight progress strip of aircraft potentially entering sector.
  - d. Extract flight identification and computer identification from flight progress strip.
  - e. Extract assigned altitude and requested altitude from flight progress strip.
  - f. Extract estimated ground speed and route information from flight progress strip.
  - g. Extract previous posted fix, time over previous posted fix, posted fix, and calculated time of arrival over posted fix from flight progress strip.
  - h. Determine that aircraft is entering sector.
  - i. Extract next posted fix from flight progress strip.
  - j. Extract true airspeed and strip marking from flight progress strip.
  - k. Acquire aeronautical chart from the static information display pertinent to the flight.
  - l. Synthesize last known position, time at last known position, speed, route, and current time and map data into a mental picture of aircraft position.
  - m. Project a mental picture of aircraft position with respect to the location of the sector boundary.
  - n. Recognize aircraft is entering sector airspace.
5. Determine response to handoff request.
  - a. Scan target symbol, data block, and geographic map data on radar display to determine the response to the handoff request.
  - b. Extract aircraft identification, altitude, and altitude qualifier from full data block.
  - c. Search the flight progress strip for information concerning whether or not to accept the handoff.
  - d. Extract flight identification and computer identification from flight progress strip.
  - e. Extract assigned altitude, requested altitude, and route information from flight progress strip.
  - f. Extract estimated ground speed and remarks from flight progress strip.
  - g. Extract previous posted fix, posted fix, and next posted fix from flight progress strip.
  - h. Extract time over previous posted fix, and calculated time of arrival over posted fix, from flight progress strip.
  - i. Extract strip marking from flight progress strip.
  - j. Synthesize a mental traffic picture with altitude, speed, and route information into a complete mental traffic picture (with regard to accepting handoff).
  - k. Decide whether or not to accept a handoff in consideration of the mental traffic picture.
6. Receive handoff retraction.
  - a. Receive ground-to-ground communications (handoff retraction).
  - b. Detect disappearance of blinking full data block on radar display (indicating handoff retraction).

7. Request transfer of control.
  - a. Initiate ground-to-ground communications (action to request control of an aircraft).
8. Receive control of aircraft.
  - a. Receive ground-to-ground communications (release of control from another controller/facility).
9. Deny handoff.
  - a. Initiate ground-to-ground communications (advising of handoff rejection).

G. Initiate transfer of control/radar identification.

1. Initiate handoff.
  - a. Initiate handoff message to initiate handoff action to another sector or facility.
  - b. Execute initiation of handoff message.
  - c. Detect acceptance of the initiated handoff message by observing the special condition indicator (track being handed off) in the full data block.
  - d. Initiate ground-to-ground communications (handoff request).
2. Observe automatic initiation of handoff.
  - a. Search radar display for handoff indication.
  - b. Detect special condition indicator (track being handed off) in full data block.
  - c. Extract special condition indicator (track being handed off) from the full data block.
3. Retract handoff.
  - a. Initiate retraction of handoff message to recall previously initiated handoff.
  - b. Execute retraction of handoff message.
  - c. Detect acceptance of retracted handoff message.
  - d. Initiate ground-to-ground communications (handoff retraction).
4. Receive handoff acceptance.
  - a. Search radar display for acceptance of handoff.
  - b. Recognize special condition indicator (handoff accepted by center/ARTS) of the full data block that handoff was accepted.
  - c. Receive ground-to-ground communications (handoff acceptance).
5. Discuss transfer of control with other controller.
  - a. Initiate ground-to-ground communications (information concerning transfer of control of an aircraft).
  - b. Receive ground-to-ground communications (information on transfer of control).
6. Determine that aircraft is leaving sector.
  - a. Search geographic map data on radar display for information that may aid in determining if aircraft is leaving sector.
  - b. Extract sector boundary from radar display.
  - c. Cross-reference pilot position report.

#### IV. Route or plan flights.

- d. Search flight progress strip in flight strip bay (for flight progress strip of aircraft potentially leaving sector).
  - e. Extract estimated ground speed, true airspeed, and route information from flight progress strip (non-radar).
  - f. Extract previous posted fix, time over previous posted fix, posted fix, and calculated time of arrival over posted fix from flight progress strip (non-radar).
  - g. Extract next posted fix and remarks (estimated time of arrival) from flight progress strip.
  - h. Extract remarks (estimated elapsed time to destination) and calculated time of arrival over previous fix from flight progress strip.
  - i. Extract strip marking from flight progress strip.
  - j. Synthesize last known position (non-radar), radar position, pilot reported position, speed, and route into a mental picture of aircraft position in relation to sector boundary.
  - k. Project a mental picture of aircraft position with respect to location of sector boundary.
  - l. Recognize aircraft is leaving sector airspace.
7. Detect manual handoff mode indication.
    - a. Search full data block on radar display for automatic handoff inhibit indication.
    - b. Extract special condition indicator and accent symbol (automatic handoff inhibited) from full data block.
    - c. Search for acceptance or non-acceptance of handoff.
    - d. Recognize that the automatic handoff status has been inhibited and that manual handoff is necessary.
  8. Initiate transfer of flight data to another controller/facility.
    - a. Initiate ARTS-III transfer request message to transfer flight plan data to another facility.
    - b. Execute ARTS-III transfer request message.
    - c. Detect system acceptance of message.
    - d. Initiate ground-to-ground communications.
  9. Receive handoff rejection.
    - a. Receive ground-to-ground communications (notice of handoff rejection).
  10. Receive request for transfer of control.
    - a. Receive ground-to-ground communications (receive request for transfer of control of aircraft).
  11. Inform controller of any conditions affecting transfer of control.
    - a. Initiate ground-to-ground communications (informing controller of any conditions affecting the transfer of control of an aircraft).
  12. Inform controller of relinquished control of aircraft.
    - a. Initiate ground-to-ground communications (advising controller of release of an aircraft).
- H. Issue point outs.
1. Initiate point out.
    - a. Initiate point out message.



#### IV. Route or plan flights.

- b. Execute initiate point out message.
    - c. Detect system acceptance of initiated point out message.
    - d. Initiate ground-to-ground communications (point out).
  2. Discuss point out with other controller.
    - a. Initiate ground-to-ground communications (discussing point out).
    - b. Receive ground-to-ground communications (discuss point out).
  3. Receive acceptance of point out.
    - a. Receive ground-to-ground communications (notice of point out acceptance).
  4. Receive rejection of point out.
    - a. Receive ground-to-ground communications (rejection of point out).
- I. Respond to point outs.
1. Receive point out request.
    - a. Receive ground-to-ground communications (point out request).
    - b. Detect full data block forced onto radar display.
  2. Suppress full data block after point out.
    - a. Initiate suppression of forced data block message to remove data block from radar display which had previously been forced to the sector on point out.
    - b. Execute suppression of forced data block message.
    - c. Recognize disappearance of data block from radar display.
  3. Determine response to point out.
    - a. Search data block on radar display to determine response to accept/reject point out.
    - b. Extract track history, full data block on radar display.
    - c. Search flight progress strip in flight strip bay to determine action required regarding point out.
    - d. Extract flight identification, aircraft type, true airspeed, and assigned altitude from flight progress strip in flight strip bay.
    - e. Extract requested altitude from flight progress strip in flight strip bay.
    - f. Extract route information, remarks, estimated ground speed, and next posted fix from flight progress strip in flight strip bay.
    - g. Extract PIREP from meteorological data record.
    - h. Integrate special use airspace, special conditions, and special operations.
    - i. Synthesize a mental traffic picture, weather, special events, airspace, altitude, route, and speed information into a mental picture with regard to point out.
    - j. Decide on an appropriate response to point out.
  4. Accept point out.
    - a. Initiate ground-to-ground communications (point out acceptance).
  5. Deny point out.
    - a. Initiate ground-to-ground communications (point out rejection or radar contact).

#### IV. Route or plan flights.

##### J. Issue clearances.

1. Suggest clearance alternatives to pilot.
  - a. Transmit air-to-ground (clearance alternative to pilot).
2. Formulate a clearance with appropriate instructions.
  - a. Search data block and geographic map data on radar display for information pertaining to formulating a clearance.
  - b. Extract full data block, velocity vector, and track history on radar display.
  - c. Synthesize traffic picture, altitude, route, weather, and airspace information into a complete mental traffic picture with regard to formulating clearance.
  - d. Cross-reference controller note record or flight progress strip.
  - e. Translate a mental plan for aircraft clearance into required phraseology and format.
  - f. Formulate a clearance with appropriate instructions to provide required separation.
3. Issue clearance and instructions to pilot.
  - a. Cross-reference flight progress strip for planned actions and instructions
  - b. Transmit air-to-ground (current clearance and instructions).
4. Detect readback of issued clearance.
  - a. Detect whether readback of issued clearance is correct.
  - b. Transmit clearance until readback is correct.
5. Verify aircraft compliance with clearance.
  - a. Search full data block and geographic map data on radar display for compliance with clearance.
  - b. Extract aircraft identification, altitude, and altitude qualifier from full data block on radar display.
  - c. Cross-reference airspace area from radar display.
  - d. Extract altitude limit and activation period from airspace status on status information area.
  - e. Synthesize traffic picture, altitude, route, weather, and airspace information into a complete mental traffic picture with respect to aircraft compliance with clearance instructions.
  - f. Decide if aircraft is in compliance with clearance instructions issued by ATC.
6. Question pilot/relayer regarding conformance with clearance.
  - a. Transmit air-to-ground (clearance non-compliance query).
  - b. Initiate ground-to-ground communications (pilot compliance query).
  - c. Receive ground-to-ground communications (response to query).
7. Issue clearance through others for relay to pilot.
  - a. Cross-reference flight progress strip for planned actions/instructions.
  - b. Initiate ground-to-ground communications (clearance and instructions for relay to pilot).
8. Approve clearance request.
  - a. Initiate ground-to-ground communications (giving approval to clearance request).

9. Deny clearance request.
    - a. Initiate ground-to-ground communications (clearance denial).
    - b. Transmit air-to-ground (clearance denial).
  10. Suggest alternative(s) to clearance request from controller.
    - a. Initiate ground-to-ground communications (clearance alternative).
- K. Establish, maintain, or terminate radio communications.
1. Receive request to cancel air traffic services.
    - a. Transmit air-to-ground (request from pilot to cancel air traffic services).
    - b. Receive ground-to-ground communications (request from relay for cancellation of ATC services).
  2. Terminate radio communications with aircraft.
    - a. Transmit air-to-ground (advising pilot to change to another frequency or that listening watch is no longer required on assigned frequency).
  3. Receive arrival message.
    - a. Receive ground-to-ground communications (notice of arrival time).
    - b. Transmit air-to-ground (notice from pilot of arrival time at destination airport).
  4. Determine frequency in use by receiving sector.
    - a. Search status information area for discrete frequency in use by sector.
    - b. Extract sector radio frequency from status information area.
    - c. Search overhead map in static information record for discrete frequency assigned to sector.
    - d. Extract NAVAID/radio frequency from overhead map.
  5. Issue change of frequency to pilot.
    - a. Transmit air-to-ground (issuing frequency change to an aircraft).
  6. Receive initial radio contact from pilot.
    - a. Transmit air-to-ground (initial call from pilot reporting his presence on frequency).
  7. Issue altimeter setting.
    - a. Search weather sequence or altimeter setting readout on computer readout device.
    - b. Extract altimeter setting from computer readout device.
    - c. Extract altimeter setting from surface observation on meteorological data record.
    - d. Transmit air-to-ground (issuing altimeter to pilot along route or at destination).
  8. Verify aircraft assigned altitude.
    - a. Extract aircraft identification, altitude, and altitude qualifier from full data block on radar display.
    - b. Search flight progress strip in flight strip bay for assigned altitude of aircraft in question.
    - c. Extract flight identification and assigned altitude from flight progress strip.
    - d. Transmit air-to-ground (request for altitude of aircraft and pilot report of altitude).
    - e. Initiate ground-to-ground communications (verify altitude).
    - f. Decide altitude is verified.

#### IV. Route or plan flights.

9. Validate Mode C altitude.
  - a. Search full data block on radar display for information related to aircraft Mode C altitude.
  - b. Extract altitude (Mode C) from the full data block on radar display (aircraft's current altitude).
  - c. Compare altitude information with the pilot reported altitude.
  - d. Decide the validity of (Mode C) altitude displayed for aircraft.
10. Enter reported altitude.
  - a. Initiate entry of reported altitude message.
  - b. Execute entry of reported altitude message.
  - c. Detect appearance of altitude (reported) in full data block on radar display.
  - d. Record flight strip entry to show reported altitude.
- L. Establish radar identification.
  1. Observe target entering radar coverage.
    - a. Search radar display for presence of new radar targets.
    - b. Extract primary target and secondary target and full data block from radar display.
    - c. Detect appearance of a new primary target on radar display.
    - d. Detect appearance of a new secondary target on radar display.
  2. Inform pilot that radar contact is established.
    - a. Transmit air-to-ground (advising pilot that radar contact has been established).
  3. Observe radar target on departing aircraft within one mile of takeoff runway.
    - a. Detect target symbol and full data block on radar display.
    - b. Cross-reference departure airport (runway centerline extension) of geographic map data on radar display.
  4. Observe beacon target change to specified code.
    - a. Acquire full data block on radar display.
    - b. Detect beacon code change in full data block on radar display of aircraft of interest.
  5. Observe radar target associated with handoff/point out.
    - a. Acquire target symbol, full data block, and limited data block on radar display.
    - b. Cross-reference sector boundary of geographic map data on radar display.
    - c. Detect aircraft identification and blinking field (handoff) on full data block of radar display corresponding to aircraft being handed off.
  6. Inform pilot to make identifying turn.
    - a. Transmit air-to-ground (request turn for identification).
  7. Request pilot squawk ident.
    - a. Transmit air-to-ground (request pilot ident).

8. Observe data block ident.
  - a. Detect identifying target turn, aircraft identification, secondary target, and full data block on radar display.
9. Request that pilot change transponder to standby.
  - a. Transmit air-to-ground (request pilot change to beacon standby mode).
10. Observe loss of beacon target.
  - a. Detect loss of secondary target associated with full data block on radar display.
11. Request that pilot return transponder to normal.
  - a. Transmit air-to-ground (request pilot to return to normal beacon code).
12. Observe reappearance of beacon target.
  - a. Detect appearance of secondary target associated with full data block on radar display.
13. Inform pilot of radar position.
  - a. Transmit air-to-ground (inform pilot of radar position).
14. Observe radar target corresponding to pilot report.
  - a. Acquire target symbol, full data block, limited data block, primary target, and secondary target on radar display.
  - b. Extract aircraft identification in full data block or limited data block corresponding to pilot-reported position.
  - c. Extract primary target or secondary target on radar display corresponding to pilot-reported position.
15. Request beacon code for aircraft.
  - a. Initiate discrete code request message.
  - b. Execute discrete code request message.
  - c. Detect beacon code assigned on beacon code message.
  - d. Extract beacon code assigned from computer readout device.
16. Assign beacon code to aircraft.
  - a. Transmit air-to-ground (assign beacon code to pilot and request "ident" if appropriate).
  - b. Initiate ground-to-ground communications (inform other controller of beacon code assignment).
17. Reassociate data block.
  - a. Initiate track message.
  - b. Execute initiation of track message.
  - c. Detect full data block reassociated with target symbol on radar display.

18. Observe data block not associated with target.
  - a. Scan radar display to verify that full data block is associated with target symbol.
  - b. Detect full data block not associated with target symbol.
  - c. Detect coast track in position symbol on radar display.
19. Initiate use of radar separation standards.
  - a. Scan target symbol on radar display in radar coverage area not under radar contact.
  - b. Detect target symbol or full data block on radar display (aircraft entering an area of radar coverage but not under radar contact).
  - c. Initiate track message (to initiate track on aircraft).
  - d. Execute initiation of track message (to begin track on untracked aircraft).

## **V. Assess weather impact.**

### **A. Respond to significant weather information.**

1. Receive weather briefing.
  - a. Receive ground-to-ground communications (weather briefing).
  - b. Receive G.I. message (weather information).
2. Determine whether another controller or pilot needs weather advisory.
  - a. Assess the need to forward weather advisory to another controller.
  - b. Assess the need to forward weather advisory to pilot.
3. Issue weather/advisory/update to others.
  - a. Cross-reference weather sequence on computer readout device.
  - b. Cross-reference PIREP, aviation weather forecast, and center weather report on meteorological data record.
  - c. Initiate ground-to-ground communications (weather advisory information or update).
  - d. Transmit air-to-ground (weather advisory information or update).
  - e. Transmit G.I. message (weather/advisory/update).
4. Receive weather advisory (e.g., SIGMET, AIRMET).
  - a. Receive ground-to-ground communications (weather advisory).
  - b. Receive G.I. message (weather advisory).
  - c. Receive PIREP, aviation weather forecast, or center weather report.
5. Forward weather/PIREP information.
  - a. Initiate ground-to-ground communications (forward weather information).
6. Request weather information.
  - a. Initiate ground-to-ground communications (request weather information).
  - b. Transmit air-to-ground (request weather information).
  - c. Initiate weather request message (to request stored weather data).
  - d. Execute weather request message.
  - e. Detect system acceptance of weather request message.
  - f. Transmit G.I. message (request for weather information).

## V. Assess weather impact.

7. Broadcast weather information.
  - a. Transmit air-to-ground (broadcasting current weather information).
8. Observe radar display of weather line/intensity/movement.
  - a. Synthesize extracted weather information into a mental weather picture.
  - b. Recognize area of light precipitation.
  - c. Assess severity of weather conditions.
  - d. Estimate the dimensions/movement/location of the weather if such data are not available.
9. Determine weather impact on routes/flow.
  - a. Integrate mental weather picture with mental traffic picture.
  - b. Assess the impact of known and forecasted weather on traffic flows and routes.
10. Determine altitude/route change to bypass severe weather.
  - a. Integrate mental weather picture with pilot request to form mental traffic picture.
  - b. Decide altitude/route to bypass severe weather based on a mental traffic and weather picture and routes through area.
11. Evaluate the impact of a new weather condition.
  - a. Synthesize new weather data and the number of pilot requests for altitude change or reroute into a mental weather picture.
  - b. Evaluate new aeronautical and meteorological data for impact on traffic.
12. Receive new routing for weather avoidance.
  - a. Receive ground-to-ground communications (new routing for weather avoidance).
  - b. Receive new routing for controller note record.
  - c. Receive G.I. message (new routing for weather avoidance).
  - d. Extract flight progress strip with new routing for weather avoidance for an aircraft.
  - e. Extract traffic management record noting new routing for weather avoidance.
  - f. Issue appropriate routing change to pilots.
  - g. Input revised routing into computer.
  - h. Observe compliance of routing change.
13. Forward urgent PIREP to others.
  - a. Cross-reference PIREP including turbulence reports on meteorological data record.
  - b. Initiate ground-to-ground communications (transmit PIREP information).
  - c. Transmit air-to-ground (transmit PIREP including turbulence reports to pilot).
14. Record PIREP.
  - a. Record PIREP (handwritten).
15. Review weather information on displays/records.
  - a. Search weather sequence on computer readout device or flight strip printer.
  - b. Extract altimeter setting, temperature and dewpoint, visibility, and remarks from weather sequence on computer readout device.

## V. Assess weather impact.

- c. Extract wind direction, speed, and character (gusts, variable direction, etc.) from weather sequence on computer readout device or flight strip printer.
  - d. Search aviation weather forecast, center weather report from meteorological data record for weather information.
  - e. Search PIREP for weather information including turbulence reports.
  - f. Extract weather information from PIREP, center weather report and aviation weather forecast.
  - g. Extract NOTAM from status information area.
  - h. Synthesize extracted weather information into a mental weather picture.
16. Receive PIREP on weather.
- a. Transmit air-to-ground (PIREP).
  - b. Receive ground-to-ground communications (PIREP).
17. Inform others of weather impact on routes/flow.
- a. Initiate ground-to-ground communications (weather impact on routes and traffic flows).
18. Receive controller request for weather information.
- a. Receive ground-to-ground communications (request for weather).
- B. Process weather reports.
1. Determine whether usable flight level has changed.
- a. Search computer readout device for altimeter setting.
  - b. Extract altimeter setting from the computer readout device.
  - c. Recognize that minimum assignable flight level and altimeter setting have changed.
  - d. Compare minimum assignable flight level with altimeter setting or barometric pressure for concurrence.
2. Determine whether runway conditions have changed.
- a. Extract airport/runway status on status information area.
  - b. Decide whether runway conditions have changed based on available information.
3. Determine weather conditions in control zone for application of separation criteria.
- a. Search weather sequence on computer readout device or flight strip printer for information pertaining to whether control zone is IFR or VFR.
  - b. Extract sky and ceiling, visibility, and remarks (including PIREP) from weather sequence on computer readout device or flight strip printer.
  - c. Extract previously reported sky and ceiling and visibility data from surface observation and terminal forecast of meteorological data record.
  - d. Decide if airport control zone is IFR or VFR (for approach control service to airport with no collocated approach control services).
4. Request PIREP.
- a. Transmit air-to-ground (request PIREP from pilot).
  - b. Initiate ground-to-ground communications (request other controller obtain PIREP).



5. Receive general NOTAM.
  - a. Receive G.I. message (general NOTAM).
  - b. Receive ground-to-ground communications (general NOTAM).
6. Receive airport environmental information.
  - a. Receive ground-to-ground communications (airport environmental information from tower).
7. Receive runway use data.
  - a. Receive ground-to-ground communications (runway in use data).
  - b. Receive G.I. message (runway in use data).
8. Receive airport specific NOTAM.
  - a. Receive ground-to-ground communications (airport specific NOTAM).
  - b. Receive G.I. message (airport-specific NOTAM).
9. Forward runway use data.
  - a. Initiate ground-to-ground communications (runway use data).
  - b. Transmit air-to-ground (runway use data).
10. Receive weather report/update (e.g., hourly surface observation, other reports).
  - a. Search weather sequence on computer readout device or flight strip printer for changes in weather data.
  - b. Extract altimeter setting, temperature and dewpoint, visibility, and remarks from weather sequence on computer readout device or flight strip printer.
  - c. Extract wind direction, speed, and character (gusts, etc.) from weather sequence on computer readout device or flight strip printer.
  - d. Search PIREP, aviation weather forecast, center weather report, and surface observation on meteorological data record.
  - e. Receive ground-to-ground communications (weather report/update).
  - f. Recognize updated weather information in PIREP, center weather report, surface observation and aviation weather forecast.

## VI. Manage sector/position resources.

### A. Brief relieving controllers.

1. Brief relieving controller.
  - a. Cross-reference checklist or automated checklist during relief briefing.
  - b. Cross-reference controller notes during relief briefing.
  - c. Inform relieving controller (mental traffic picture, mental weather picture, mental systems status picture, priority messages, controller notes, display status).
2. Verify completeness of relief briefing.
  - a. Cross-reference checklist to verify completeness of relief briefing.
  - b. Assess completeness of relief briefing.
3. Sign off at position log.
  - a. Initiate record on paper or automated log, sign on/off log.

### B. Assume position responsibility.

1. Review system status to determine currency/update self.
  - a. Search status information area for system status information pertinent to assuming control of position.
  - b. Extract communications status, equipment status, and airspace status from the status information area.
  - c. Search list display on radar display for information pertinent to assuming control of position.
  - d. Extract departure list, inbound list, hold list, and group suppression list from the list display.
  - e. Extract VFR inhibit list and conflict alert list from list display.
  - f. Synthesize extracted information with regard to assuming position responsibility.
2. Verify that all required display parameters are properly set.
  - a. Scan radar display and controller console for lighting levels, geographical range, altitude filter limits, and setting for other adjustable parameters.
  - b. Compare parameters on radar display with procedural requirements.
  - c. Compare parameters on flight strip printer with procedural requirements.
  - d. Compare parameters on computer readout device with procedural requirements.
3. Adjust parameters and displays/equipment to personal preference.
  - a. Initiate adjustment of contrast, dimmer, and other settings to personal preference.
  - b. Detect changes in console settings.
  - c. Initiate adjustments to communications equipment/displays.
  - d. Adjust volume of audio alarm.
  - e. Adjust focus adjustment.
4. Check displays/equipment for proper configuration, usability, and satisfactory status.
  - a. Recognize display configuration, status, and overall workstation usability.
  - b. Evaluate workstation physical displays and equipment.
  - c. Receive communications status (including configurations).

5. Review briefing checklist/notes to assure completeness of briefing coverage.
  - a. Search information on controller notes.
  - b. Search checklist and locally directed information for data pertinent to assuming control of position.
  - c. Extract pertinent data from checklist and locally directed information on computer readout device or status information area.
  - d. Integrate extracted information with regard to assuming position responsibility.
6. Determine if ready to accept control responsibility.
  - a. Decide whether or not to assume position responsibility based on the information available.
7. Receive controller relief briefing.
  - a. Receive traffic, weather, and system status briefing from controller verbally.
  - b. Cross-reference radar display, flight strip bay, status information area, meteorological data record, and traffic management record.
  - c. Synthesize traffic, weather, and system status information into mental picture of situation.
8. Inhibit automatic handoff for all tracks or for designated track.
  - a. Initiate selection of automatic handoff (inhibit) message.
  - b. Execute selection of automatic handoff (inhibit) message.
  - c. Detect inhibited automatic handoff has been activated in special condition indicator (automatic handoff manually inhibited) in full data block on radar display.
9. Restore automatic handoff for all tracks or for designated track.
  - a. Initiate selection of automatic handoff (enable) message.
  - b. Execute selection of automatic handoff (enable) message.
  - c. Detect automatic handoff has been enabled from absence of automatic handoff inhibited indicator in special condition indicator of full data block on radar display.
10. Review flight progress strips and display lists for correlation.
  - a. Search list display (hold, inbound, departure, etc.) for aircraft identification.
  - b. Extract aircraft identification from list display.
  - c. Search flight progress strip for flight identification.
  - d. Extract flight identification from flight progress strip.
  - e. Recognize matching flight/aircraft identification.
11. Sign on position log.
  - a. Initiate record on paper or automated log, sign on/off log.
12. Review current and projected traffic/weather.
  - a. Search full data block, limited data block, geographic map data on radar display to determine current and projected traffic/weather.
  - b. Extract target symbol, full data block, track history, velocity vector, and J ring on radar display.
  - c. Extract limited data block, target symbol, altitude, and altitude qualifier on radar display.
  - d. Extract full data block altitude and altitude qualifier on radar display.
  - e. Extract aircraft identification and ground speed from full data block on radar display.

## VI. Manage sector/position resources.

- f. Extract track symbol and position symbol from data block.
  - g. Search flight progress strips in the flight strip bay for information pertaining to actual and projected traffic load.
  - h. Extract assigned altitude from flight progress strip.
  - i. Extract route information and remarks from flight progress strip.
  - j. Extract flight identification, aircraft type, and estimated ground speed from flight progress strip.
  - k. Extract previous posted fix, time over previous posted fix, posted fix, calculated time of arrival over posted fix, and next posted fix from flight progress strip.
  - l. Search weather sequence on computer readout device or flight strip printer for hazardous weather data.
  - m. Extract updated weather from weather sequence on computer readout device or flight strip printer.
  - n. Extract altimeter setting, temperature and dewpoint, sky and ceiling, and visibility from weather sequence on computer readout device or flight strip printer.
  - o. Search PIREP, aviation weather forecast, surface observation, and center weather report on meteorological data record for actual and predicted weather conditions.
  - p. Extract aviation weather forecast, surface observation, and center weather report on meteorological data record.
  - q. Extract reported weather conditions from PIREP.
  - r. Extract NOTAM (general notices, alerts) from status information area.
  - s. Search traffic management record for traffic management constraints.
  - t. Extract traffic constraints (speed, altitude, route, etc.) from traffic management record.
  - u. Search sector metering list (where available) on the inbound list.
  - v. Extract metering information from inbound list (where available).
  - w. Synthesize extracted information into a mental picture of current and projected traffic and weather status.
- C. Execute backup procedures for processing/peripheral equipment failures.
- 1. Verify computer action during transition stages.
    - a. Search radar display to verify that all targets under sector jurisdiction are properly identified.
    - b. Extract computer identification, aircraft identification, and altitude from full data block on radar display.
    - c. Recognize absence of lost radar data message on lost radar data display of radar display.
    - d. Extract time from current time display and target symbol and full data block from radar display.
    - e. Recognize that full data block is properly associated with target symbol.
    - f. Search flight progress strip in flight strip bay to verify that data are consistent with data on radar display.
    - g. Extract computer identification and flight identification from flight progress strip.
    - h. Compare computer identification and flight identification of flight progress strip with full data block on radar display.
    - i. Evaluate all computer responses during transitions between host and backup modes.
    - j. Initiate communication with supervisor (discuss current system status).
    - k. Receive information from supervisor regarding computer transition status.

2. Receive confirmation of computer action during transition stages.
  - a. Receive ground-to-ground communications (verification of computer actions and data transmission during transition stages).
3. Detect non-acceptance of input data.
  - a. Detect display update alert on radar display.
  - b. Recognize lack of feedback/system response to control and/or data inputs, frozen targets, alert message, system start-over message, and no time update on radar display.
  - c. Scan response message on computer readout device for status of input data and messages.
  - d. Detect rejection message on computer readout device.
  - e. Extract rejection message from computer readout device.
4. Receive notice of adjacent facility automation equipment status.
  - a. Receive ground-to-ground communications (adjacent system status).
  - b. Receive G.I. message (adjacent system status).
  - c. Acquire adjacent system status from computer readout device or status information area.
5. Forward notice of equipment status.
  - a. Initiate ground-to-ground communications (notice of equipment status).
  - b. Transmit G.I. message (notice of equipment status).
6. Detect failure to update flight plan data base.
  - a. Search new flight progress strip on flight strip printer (to verify that flight plan data base is being updated).
  - b. Recognize that flight progress strip is not updated.
  - c. Detect computer readout device rejection message or code overflow message noting failure to accept flight data amendment message.
7. Receive notice of equipment or operational status.
  - a. Receive ground-to-ground communications (equipment status, computer status).
  - b. Receive G.I. message (equipment status, computer status).
8. Revert to host/DARC backup procedures.
  - a. Search checklist on host/E-DARC backup procedures (DARC/FDP or DARC only).
  - b. Extract procedures to conduct host/E-DARC backup operations.
9. Revert to host reduced capability mode procedures.
  - a. Search status information area for standard operating procedures or checklist on host reduced mode procedures.
  - b. Extract procedures to support reduced capability operations.
10. Detect occurrence of radar display failure.
  - a. Perceive failure (display malfunction/computer outage).
  - b. Detect display alert of not receiving radar message, not updating display message, reduced data display message, not receiving time message or not receiving radar and time message.

## VI. Manage sector/position resources.

11. Observe data base restoration on radar display.
  - a. Detect restoration (display operation) of radar display.
12. Detect occurrence of host failure.
  - a. Search radar display for proper system functioning.
  - b. Extract not updating display message, not receiving radar and time message, or not receiving radar message from display update alert on radar display.
  - c. Extract reduced data display message and not receiving time message from display update alert on radar display.
  - d. Detect steady light on clear/parity error key on alphanumeric keyboard.
  - e. Recognize degradation in resolution of displayed data in any or all displays.
  - f. Recognize degradation in accuracy of displayed data in any or all displays.
  - g. Recognize lack of feedback/system response to control and/or data inputs.
13. Select DARC for generation of radar display.
  - a. Execute selection of CDC prime key (host/DARC function, CDC Mode).
  - b. Detect changes in full data block, target symbol and missing vector line on radar display.
  - c. Detect configuration status on radar display.
  - d. Scan radar display for generation of data block via DARC.
  - e. Detect data block on radar display (DARC).
14. Select host for generation of radar display.
  - a. Execute select CDC prime key (host/DARC function, radar mode).
  - b. Detect NAS status on radar display.
  - c. Scan radar display for generation of complete information in data block (no missing fields, vector lines, etc.).
  - d. Detect data block on radar display (host, correlated targets).
15. Observe posted notice of new/changed equipment/operational status.
  - a. Acquire equipment status or computer status from status information area.
  - b. Acquire new or changed equipment status, computer status or other operational status from status information area.
16. Request DARC be enabled.
  - a. Initiate ground-to-ground communications (request supervisor enable DARC).
17. Verify flight plan data base during transition.
  - a. Search full data block on radar display for verification of flight data accuracy during transition.
  - b. Extract aircraft identification and altitude special condition indicator from full data block on radar display.
  - c. Search flight progress strip in flight strip bay for verification of flight data accuracy during transition.
  - d. Extract computer identification, flight identification, and Mode 3/A beacon code from flight progress strip in flight strip bay.
  - e. Extract assigned altitude and true airspeed from flight progress strip in flight strip bay.
  - f. Extract route information, posted fix, next posted fix, calculated time of arrival over posted fix, and remarks from flight progress strip in flight strip bay.

- g. Extract route information (departure point) from flight progress strip in flight strip bay.
- h. Extract proposed departure time from flight progress strip in flight strip bay (ten proposed departures in sector).
- i. Compare information in flight strip bay with information on radar display.
- j. Initiate ground-to-ground communications (flight data).
- k. Receive ground-to-ground communications (flight data).
- l. Compare flight data on radar display and flight progress strip.
- m. Evaluate extracted flight data for accuracy based on assessment with others' sources.

D. Execute backup NAVAID procedures.

- 1. Determine aircraft needing substitute routing.
  - a. Search flight progress strip in flight strip bay (for aircraft needing substitute routing due to NAVAID failure).
  - b. Extract flight identification, route information, previous posted fix, posted fix, and next posted fix from flight progress strip.
  - c. Extract special equipment from flight progress strip.
  - d. Search status information area for status of NAVAID.
  - e. Extract NAVAID outage/status from status information area.
  - f. Search radar display for affected targets.
  - g. Acquire aircraft identification and altitude from full data block.
  - h. Compare extracted route of flight information with NAVAID outage information and any given substitute routing.
  - i. Decide on aircraft that will require substitute routing.
- 2. Receive notice of NAVAID status.
  - a. Receive communications (notice of NAVAID status).
  - b. Receive G.I. message (notice of NAVAID status).
  - c. Transmit air-to-ground (receiving information from pilot regarding status of NAVAID).
- 3. Receive substitute routing.
  - a. Receive communications (substitute routing).
  - b. Receive G.I. message (substitute routing).
- 4. Discuss appropriateness with supervisor of releasing equipment to maintenance.
  - a. Perceive mental traffic picture from target symbol, full data block, track history, and velocity vector on radar display.
  - b. Cross-reference flight progress strip in flight strip bay for information pertaining to actual and projected traffic load.
  - c. Cross-reference pertinent weather information from PIREP, center weather report, aviation weather forecast, and surface observation.
  - d. Cross-reference NOTAM from status information area.
  - e. Cross-reference traffic management record for traffic management constraints.
  - f. Cross-reference metering constraints from sector metering list on inbound list.
  - g. Cross-reference status information area for information pertaining to releasing equipment.

VI. Manage sector/position resources.

- h. Synthesize extracted information into mental picture of current and projected traffic and weather status.
  - i. Assess feasibility and impact of releasing equipment on the basis of current and projected workload demands.
  - j. Initiate ground-to-ground communications (discuss with supervisor appropriateness of releasing equipment to maintenance).
  - k. Receive ground-to-ground communications (discuss with supervisor appropriateness of releasing equipment to maintenance).
5. Review need/cancellation of substitute routing with supervisor.
- a. Evaluate need for substitute routing.
  - b. Initiate ground-to-ground communications (need to implement or cancel substitute routing).
  - c. Receive ground-to-ground communications (need to implement or cancel substitute routing).
6. Receive supervisor notice of equipment released to maintenance.
- a. Receive ground-to-ground communications (notice from supervisor of release status of equipment).
  - b. Receive G.I. message (notice from supervisor of release status of equipment).
7. Record substitute routing on paper record.
- a. Record controller note (substitute routing).
8. Review status of questionable NAVAID.
- a. Scan equipment status on status information area for status of NAVAID equipment.
  - b. Extract NAVAID outage/status and NAVAID repair schedule from status information area.
  - c. Initiate ground-to-ground communications (request for FSS, ATCT, or supervisor confirmation of NAVAID outage or return to service).
  - d. Receive ground-to-ground communications (FSS, ATCT, or supervisor confirmation of NAVAID outage or return to service).
  - e. Transmit air-to-ground (asking pilot for confirmation of NAVAID outage or return to service, and receiving pilot report of status).
9. Observe record of substitute routing.
- a. Detect substitute routing on status information area.
  - b. Extract substitute routing from status information area.
10. Forward substitute routing.
- a. Initiate ground-to-ground communications (substitute routing).
11. Forward deletion of previous substitute routing.
- a. Initiate ground-to-ground communications (delete previous substitute routing).
12. Forward NAVAID status.
- a. Initiate ground-to-ground communications (NAVAID status).
  - b. Transmit air-to-ground (NAVAID status).



13. Record system status data change.
  - a. Record on controller note a system status data change.
14. Receive cancellation of substitute routing.
  - a. Receive ground-to-ground communications (cancel substitute routing).
15. Request report on NAVAID status.
  - a. Initiate ground-to-ground communications (query others on status of particular NAVAID).
  - b. Transmit air-to-ground (request additional pilot report on status of NAVAID).

E. Execute backup procedures for communication failures/ transient operation.

1. Detect communication failure or transient operation.
  - a. Receive communications status/reconfigurations (detect communication failure).
  - b. Initiate ground-to-ground communications (problem in initiating ground-to-ground call).
  - c. Receive ground-to-ground communications (problem receiving or answering ground-to-ground call).
  - d. Transmit air-to-ground (problem initiating or receiving air-to-ground communications).
  - e. Receive ATIS voice recording (intermittent/filed ATIS).
  - f. Recognize malfunction in communication system which degrades or prevents communication capabilities.
2. Forward alternate communication path.
  - a. Initiate ground-to-ground communications (notice of alternate communications path).
  - b. Transmit G.I. message (notice of alternate communications path).
3. Receive new frequency assignment.
  - a. Receive ground-to-ground communications (notice of new frequency).
  - b. Receive new sector radio frequency to/from status information area.
  - c. Receive G.I. message (notice of new frequency).
4. Forward notice of communication status.
  - a. Initiate ground-to-ground communications (communications status).
  - b. Transmit G.I. message (communications status).
5. Receive notice of alternate communication path.
  - a. Receive ground-to-ground communications (alternate communications path).
  - b. Receive G.I. message (alternate communications path).
  - c. Receive communication channel assignment from status information area.
6. Check status of personal/console communications equipment.
  - a. Assess status of personal and console communications equipment.
  - b. Decide adequacy of switch settings and parameter indicators on interphone switching system or FAA radio.

VI. Manage sector/position resources.

7. Receive notice of communication status.
  - a. Receive ground-to-ground communications (communications status).
  - b. Receive G.I. message (communications status).
  - c. Transmit air-to-ground (communications status).
8. Switch to backup air-to-ground equipment/ radio/ frequency/ BUEC.
  - a. Initiate selection of backup radio.
  - b. Execute selection of backup radio.
  - c. Initiate selection of radio frequency.
  - d. Execute selection of radio frequency.
  - e. Execute operation of backup emergency communications (BUEC).
9. Request communication check from others.
  - a. Initiate ground-to-ground communications (request for communications check).
  - b. Transmit air-to-ground (request to pilot for air-to-ground radio communications check).
10. Receive communication check from others.
  - a. Receive ground-to-ground communications (communications check received from other controller, facility, or agency).
  - b. Transmit air-to-ground (radio communications check received from pilot).
11. Select original air-to-ground communications equipment/frequency.
  - a. Suppress BUEC switch selection (original transmitter/receiver site).
  - b. Initiate selection of primary FAA radio option message.
  - c. Execute selection of primary FAA radio option message.
  - d. Initiate selection of radio frequency message.
  - e. Execute selection of radio frequency message.
12. Adjust ground-to-ground communication path to return to normal operation.
  - a. Execute operation of interphone switching system to adjust communication paths to return to normal operations.
13. Adjust ground-to-ground communication path to accommodate failure/overload.
  - a. Execute operation of interphone switching system to mitigate failure/overload.
14. Forward new frequency assignment.
  - a. Initiate ground-to-ground communications (advising of new frequency).
  - b. Transmit air-to-ground (advising of new frequency).
15. Record communications status.
  - a. Initiate recording controller note, a written record of communications status.

F. Manage personal workload.

1. Determine impending controller overload.
  - a. Search data block and geographic map data on radar display to determine current and projected workload levels.
  - b. Extract target symbol, full data block, track history, and velocity vector on radar display.
  - c. Search flight progress strip in flight strip bay for volume of actual and projected workload levels.
  - d. Search meteorological data record for actual and predicted weather conditions to aid in determining current and projected workload levels.
  - e. Recognize radio frequency congestion by communicating air-to-ground.
  - f. Search traffic management record for traffic management constraints.
  - g. Search sector metering list on inbound list for metering requirements.
  - h. Synthesize extracted information into a mental picture of current and projected workload levels.
  - i. Decide on workload acceptability in projected time frame.
2. Request assistance or relief.
  - a. Initiate ground-to-ground communications (request assistance or relief).
3. Request flow control be imposed or altered.
  - a. Initiate ground-to-ground communications (request flow control be imposed or altered).

G. Perform procedures for non-radar/degraded radar environment.

1. Inform pilot of radar contact lost.
  - a. Transmit air-to-ground (radar contact lost).
2. Terminate radar service to aircraft.
  - a. Transmit air-to-ground (termination of radar service).
3. Initiate use of non-radar separation standards.
  - a. Search flight progress strip in flight strip bay for information pertaining to aircraft separation.
  - b. Extract assigned altitude from strip marking on flight progress strip.
  - c. Extract flight identification and aircraft type from flight progress strip.
  - d. Extract route information, previous posted fix, posted fix, next posted fix, and remarks from flight progress strip.
  - e. Extract time over previous posted fix and calculated time of arrival over posted fix from flight progress strip.
  - f. Extract estimated ground speed and true airspeed from flight progress strip.
  - g. Cross-reference air traffic control FAA order 7110.65 as required for separation criteria.
  - h. Synthesize position, route, speed, altitude, and time information into a mental picture of aircraft separation.
  - i. Recognize aircraft paths warranting further close monitoring and evaluation.
  - j. Recognize when operational advantage may be gained by using non-radar procedures.

## VI. Manage sector/position resources.

4. Request pilot position reports.
  - a. Transmit air-to-ground (request pilot position reports).
  - b. Initiate ground-to-ground communications (request flight service station, or company radio to relay request for pilot position reports).
5. Observe return of normal radar environment.
  - a. Scan target symbol, full data block, and limited data block on radar display (to determine if radar presentation has returned to normal).
  - b. Detect precipitation and permanent echo on radar display.
  - c. Recognize that radar capabilities have returned to normal.
6. Observe loss of radar target.
  - a. Acquire position symbol, data block, coast track symbol on radar display (for aircraft in coast mode).
  - b. Recognize loss of speed (ground) indication in full data block.
  - c. Detect presence of unassociated full data block.
  - d. Detect loss of primary target and/or secondary target (target symbol) on radar display.
  - e. Acquire lost radar data message on lost radar data display of radar display.
  - f. Recognize strobe line or ring-around.
7. Receive notice of radar sensor status.
  - a. Receive ground-to-ground communications (radar sensor status).
  - b. Receive G.I. message (radar sensor status).
  - c. Receive new record of radar equipment outage from status information area.
8. Receive procedures to be used to accommodate sensor outage.
  - a. Receive ground-to-ground communications (procedures to be used during sensor outage).
9. Perceive tracking or transponder failure/interference.
  - a. Search target symbol, full data block, and position symbol on radar display (for track disassociation, aircraft in coast mode, false return, transponder failure, track swap).
  - b. Detect coast track, secondary target (uncorrelated), and primary target (uncorrelated) on radar display.
  - c. Detect display alert of lost weather data message.
  - d. Detect lost radar data message on lost radar data display.
  - e. Detect loss of targets.
  - f. Recognize track swap and track disassociation from relationship of target symbol to full data block on radar display.
  - g. Recognize appearance of strobe line on radar display.
  - h. Recognize disappearance of target from radar display.
  - i. Detect appearance of coast track in position symbol of full data block.

10. Forward notice of radar sensor status.
    - a. Initiate ground-to-ground communications (notice of radar sensor status).
    - b. Transmit G.I. message (notice of radar sensor status).
  11. Record pilot position report.
    - a. Record position report to flight progress strip (pilot position report).
- H. Respond to airspace reconfigurations/resectorizations.
1. Receive notice to release airspace.
    - a. Receive ground-to-ground communications (notice to release airspace).
    - b. Receive G.I. message (notice of released airspace).
  2. Receive notice that adjacent facility is open.
    - a. Receive ground-to-ground communications (notice that adjacent facility is operative).
    - b. Receive G.I. message (notice that adjacent facility is operative).
  3. Receive notice that adjacent facility is closed.
    - a. Receive ground-to-ground communications (notice that adjacent facility is inoperative).
    - b. Receive G.I. message (notice that adjacent facility is inoperative).
  4. Request airspace reconfiguration.
    - a. Initiate via land line or from supervisor communications (airspace reconfiguration request to supervisor).
  5. Receive notice to take over airspace.
    - a. Receive land line or supervisor communications (notice to take over airspace).
  6. Receive notice to prepare for sector reconfiguration.
    - a. Receive land line, G.I., or supervisor communications (notice to assume control of another controller's airspace).
  7. Inform others of sector airspace reconfiguration.
    - a. Initiate land line, G.I., or verbal communications (sector airspace reconfiguration notice).