

TRACON

Multi-Player Air Traffic Control Simulator

Wesson
International

IBM 512K Required
Both 5¼" and 3½"
Diskettes Included

Links with Microsoft® Flight Simulator

WILLIAM

TRACON II

***Multi-Player Air Traffic Control Simulator
Version 2.0***

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TRACON II - Version 2.0

Name: _____
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Where did you hear about TRACON? _____

How did you acquire this software? _____

What were your very first impressions of this simulation? _____

How was the manual? Did you read it? Are you a pilot or controller?

Any problems that we should know about? _____

Please tell us your overall impressions after a few hours of use. _____

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Prologue

From the moment he plugged in, Jim Cochran knew he was in trouble.

"...string of pearls now, kiddo," Ronald Sprague, the radar controller whose shift just ended, was saying. "Not much happening on the scope. American 11 on the profile for 25 Left; United 567 and Western 341 right on his tail; gotta get America West 112 in trail so I've got that Clipper at 200 knots to make the hole. Oh, and there's a Lear over here — right there, see him? — who wants to change his destination to Long Beach. All Long Beach has going is a couple of training flights and a few departures scheduled. Got all that?"

"Inbounds?" Jim asked.

"Naw. Nothing much to worry about. Heavier than usual, but shouldn't be too bad."

"What about that Citation that just came off the teletype? How's he gonna fit in?" Jim wondered aloud.

"Time will tell, buddy. I'm outa here." Sprague quickly unplugged, signed out, and sauntered away. The transition had taken less than 30 seconds.

Dammit, thought Jim. Left me with a scope full of targets and no plan again. Ron was a "natural," one of the rare controllers who could somehow "see" the traffic flows in their heads and make the right calls without quite knowing why. Like people who could play a musical instrument "by ear."

Jim, on the other hand, after three years of intensive on-the-job training, was just now full performance qualified for radar duty. Like meticulously playing a piano by reading the notes one by one, he had to think through every call he made.

And now, with the evening rush hour bearing down on him, he had trouble bringing his concentration up to speed. He hadn't gotten much sleep since going home earlier this morning. Working two day shifts, two swings, and one midwatch seven days a week was wearing him down. And chewing out his wife Cindy for leaving the car lights on didn't help much either. Everybody does stuff like that once in a while. He seemed to be demanding perfection in everyone these days.

"Los Angeles Approach, Lear Five Six Hotel. How's that clearance coming?"

"LA, United Five Sixty-seven. Need to start down now if you please."

No time for daydreaming now, he reminded himself. Gotta get those targets lined up.

"Five Six Hotel, stand-by. United Five Sixty-seven, cleared now profile descent runway 24 LAX. What's your speed now?"

"567 is indicating two two zero, sir, and will maintain that during the descent."

"567, roger. 56H, you want to go to...Long Beach, is it?"

"Affirmative. And we need to get started down now, if possible."

"OK, 56H. Descend and maintain five thousand. I'll have a revised clearance in a moment."

"Roger, Approach. Out of twelve to five for Lear 9056H. Thanks."

His hands flying over the keyboard, Jim took less than a second to slew his trackball pointer over the Lear's radar target return and entered the newly-assigned altitude of 5000 feet. A series of interphone conversations and

a few glances at his D-man's updates of the flightstrips later, Cochran cleared the Lear to its new destination — Long Beach airport on the southeastern outskirts of the central Los Angeles area. Getting into the swing of things was becoming easier with each passing day, as the routine of real, and not simulated, radar control was learned and the nuances of procedure became more ingrained.

This TRACON sector, number 2 of the 12 or so in the facility, was where many of the jet routes that fed LAX came together to form a single flow of traffic. It wasn't the hardest sector — nine was worse. But it was difficult, simply because all those in this area were tough, covering as they did the major East-West thoroughfare connecting Los Angeles International airport with the rest of the country. That reputation, in fact, was what prompted Jim to request this facility in the first place. Along with his co-workers here, he enjoyed Los Angeles TRACON and being regarded as one of the best.

The whole problem of handling this sector's congestion consumed Jim's thoughts. Usually you had four things going for you to manage your airspace: time, altitude, vectors (horizontal separation) and speed. Time didn't work, at least as long as the airlines kept sending them into LAX at the same time. Sometimes he thought of getting up a party line and asking Pan American, World, Eastern, United, American and Transworld just how they expected all their flights from New York to land at LAX at exactly 8:31pm anyway? Altitude didn't work, at least during these profile descents during which the pilots were flying according to fuel-efficient profiles. Not enough room for vectors, especially with all the small plane traffic near the approach corridors of the TCA. So that left speed, and there wasn't much of that when everyone was descending.

"Los Angeles Approach, World 17's with

you, twelve thousand."

"World 17, Los Angeles Approach, roger. Pilot's discretion, descend and maintain three thousand, reduce speed now to 200 knots for spacing."

"Los Angeles Approach, Air Canada Twenty-three."

"Los Angeles Approach, Cessna Three Five Bravo."

"Los Angeles, Western 890 is coming up on ten thousand descending, requesting lower. We're in a broken layer and would like to get out of this turbulence if possible."

"Los Angeles, Air Canada 23 is between layers descending through eight thousand. Just thought you'd like to know."

Getting busy now, as the predicted group started checking into his sector, Jim ticked them off on the strips as they arrived. "Make a plan and make it work," they had drilled into him during the countless hours of training leading to this point. Automatically doing so by looking ahead of the automatic conflict alerter which did straight-line extrapolation of flight paths and warned of imminent conflict situations, Jim noticed that all of the new aircraft would overtake the 200-knot Clipper, which appeared to have slowed down ever further.

"Clipper 15, what speed are you indicating now?"

"Ahhh... Los Angeles, Clipper 15 is coming back up to 200 knots. Guess we let it slip off a little, sorry."

"Roger, give me 250 now."

"Los Angeles, company policy to keep it below 220 on the profile."

"Roger Clipper 15. Isay again, make your speed 250 knots. I've got three targets overtaking you."

"250 knots for Clipper 15, roger." The growl was unmistakable.

Early in his apprenticeship, Jim had learned the wild variability of aircraft per-

formance to expect from the different airlines — even from different captains within one airline — and had learned to accommodate it. Continental he loved. They would go supersonic for you if they could. So would America West. Mexicana was also alright, if they understood you. Most of the foreign carriers, in fact were just fine for the routine stuff, but radio-mutilated English took its toll.

"Los Angeles, Delta 1107 is with you at twelve thousand."

"Los Angeles Approach, Baron 8994 Tango with you, level ten thousand."

"Approach, Cessna One Three Three Five Bravo."

"Cessna Three Five Bravo, standby. Delta 1107, Los Angeles, roger. Descend and maintain six thousand; expect lower in ten minutes. Break. Baron 8994T, radar contact, descend and maintain three thousand, turn left heading one seven five."

As the screen filled up, Jim's data man, Mike Samuels, got much busier. He tried to do as much of the data manipulating as possible, freeing Jim to concentrate on planning and making the calls. That the two worked together well was evident in their almost total lack of verbal interchanges. Since Mike knew Jim's patterns of control, he could anticipate and respond to Jim's actions after only the slightest of nonverbal hints. Even the formality with which Jim addressed a pilot mattered — those Jim felt he could count on would be asked for more complex yet more efficient procedures. The others he handled by the book. That was generally less efficient, but when you didn't know whether they could deal with something non-routine, you didn't try unless it was very light. And it was definitely not light tonight.

"Los Angeles Approach, this is Cessna One Three Three Five Bravo. Please answer. We've got a problem up here."

"Three five Bravo, go ahead." *Who is that guy, anyway? No flightstrip on him.*

"This is Three five Bravo. We're about ten miles south of Palos Verdes at two thousand feet just above the clouds. When we left Catalina for Torrance, it was severe clear, but now it's overcast under us and we're, uh, not real sure what to do...haven't had pilot's license all that long..."

"Three Five Bravo, squawk 0467 and ident, please. Are you instrument-qualified?"

"Three Five Bravo, negative, sir. And we're a bit low on fuel. Maybe twenty minutes left."

"One Three Three Five Bravo, radar contact. Fly heading zero seven zero and standby this frequency."

Just what I need, thought Cochran. A newly-minted VFR pilot lost in the marine layer that rolled in every evening about this time! Why don't they ever think ahead? Dammit! I don't need this! Not tonight!

Just then, a computer check for potential separation conflicts happened automatically. It turned up two potentials:

Potential #1: N8994T AC23 @ 1719:48
Potential #2: PSA89 N8994T @ 1731:37

Noticing that both conflicts involved Beechcraft Baron 8994T, Jim noted the cause — an unrestricted descent for 8994T which would take it through the projected flight paths of two other aircraft.

Quickly glancing at the flightstrip for 94T, he keyed his mike.

"Beech 8994T, you still intend to cancel IFR when you break out? Pilot reports east of the basin indicate layers at six and ten thousand with tops at 16,000. A few build-ups to 40,000."

"Los Angeles, Baron 94T. Affirmative. We should be out of this stuff in a couple of minutes if that report is correct."

Jim stared at his console for a moment, reflecting that even with this automated assistance there were still many improvements to be made. Take these two conflicts, for example. Although he expected the Baron to break out of the clouds and cancel IFR at any time now, and long before the predicted conflicts should actually occur, he couldn't tell the machine that. The computer interface simply couldn't handle "fuzzy" information of this sort. It would not even let him override the conflict alert. He circumvented the problem by declaring N8994T a VFR target, so that the conflict recognizer would ignore it for now, and turned his attention back to the lost Cessna.

The Cessna 152's pilot was clearly not qualified to be up in this muck, yet he was clearly making a supreme effort to keep calm. Taking him back into Torrance was out of the question — the peninsula was completely shrouded in clouds. Long Beach, maybe? Weather over there was holding — the fog hadn't reached that far inland yet. With radar vectors and a little luck, he could vector the Cessna over the lowlands there and line him up with the Long Beach active before it, too, got socked in by the converging temperature and dew point.

Coordinating with LGB tower, Jim started to vector the Cessna pilot east to Long Beach when the whooping siren of the conflict alterter went off. His screen blinked urgently:

*****SEPARATION CONFLICT ALERT!*****
N8994T and AC23: Less than 1 mile.

"What the hell..." he wondered aloud. Then he saw it. In fooling his conflict predictor by improperly marking 8994T as VFR, he had disabled the series of routine conflict checks which would have preceded this last-ditch alarm. 94T had apparently not broken out of the cloud layer by the time it reached

the 6000 foot altitude of the descending Air Canada DC-10 after all. If he didn't do something right now, the two rapidly merging targets would become one. His stomach tightening, Jim hoped both pilots had quick reflexes.

"Air Canada 23, maintain six thousand feet now."

"Los Angeles Approach, this is 8994T. We're still in and out of clouds at six thousand. Guess we'll stick with you a little... JEEZZUS!..." Click.

"Baron 94T, Los Angeles Center, descend immediately, maintain 5000.

"November 8994T, Los Angeles Approach. How do you hear?"

"November 8994T, Los Angeles."

As N8994T's reported altitude wound down at a rate greater than 5000 feet per minute and its tracked heading shifted rapidly, the automated conflict predictor ticked off its projections after Jim automatically but belatedly retagged N8994T as IFR:

Conflict #1: N8994TN300HJ @ 1722:03
Conflict #2: MX67 N8994T @ 1722:27
Conflict #3: N8994TN300HJ @ 1722:28
Conflict #4: N8994TWO14 @ 1725:56

He stared unbelieving at the altitude readout. 5600, 4500, 3300. He had never seen changes so rapid. 2800, 2300, 1900, 1800, 1900... Wait! Was it holding? Yes! The last two updates had been 1900 feet.

"Er...uh, this is 94T. We just...some jumbo or somethin'...uh, stand-by, Approach." Jim could hear the confusion in the background while the Baron's mike was keyed.

"November 8994T, Los Angeles. Say your status. You all right?"

"Uh...guess so...what? no, wait...no, go on back and sit down — I'm talking to them now... sorry, Approach. That was a close one. Guess we hit that guy's vortex?"

"Affirmative, 94T. You just passed close behind a DC-10. When feasible, resume your descent and report any changes in your status. And please call this facility after your arrival on the landline, er, telephone."

Jim began small shivers just as he finished briefing the relief man his area supervisor had immediately provided. He broke into uncontrollable whole-body shaking just before he stumbled through the men's room door and threw up.

He had blown it. He had almost killed 500 people. And he had just sat there and watched while it all crumbled in front of him.

Before, they had been *targets*. Little blips on his scope, nothing more than callsigns and destinations, really. You learned how to move them, arrange them in neat patterns that fit all the rules, and hand them off. Sort of like a grown-up video game.

He never thought of them as, well, you know, *people*. Nobody did that. But those "targets" would taunt him in his dreams for nights to come, and he wondered if he would come back to work tomorrow or ever. This was no game — this was his deadly reality!

1 Welcome to TRACON II

TRACON II is the most complete simulation ever of a Terminal Radar Approach Control facility. Using TRACON II, you will enter a world of almost unimaginable authority and responsibility, a world where the lives of thousands of passengers depend on your skill and ability to "look-ahead" in time and anticipate aircraft flight paths in four dimensions.

You have probably listened in on air traffic control conversations using a scanner, at the movies, or through your headset while sitting bored at 35,000 feet. Much of what was said might have been unintelligible to you, yet the verbal exchanges communicated precise command and control information between pilot and controller. With TRACON II, you can enter into this mysterious world and learn what those verbal conventions mean. You can actually experience the problems and solutions that air traffic controllers must deal with every minute they are on duty.

TRACON II's world is the airspace surrounding a major airport and its satellite airports near one of five major metropolitan cities: Los Angeles, San Francisco, Chicago, Miami, or Boston. A sweeping radar beam continuously scans the skies, pin-pointing each aircraft target and reporting its altitude with each scan. Airports, airways, VOR radio beacons, intersection fixes, and ILS instrument landing systems are all depicted faithfully from actual government airspace charts. Significant ground markings such as coastlines are also shown.

Using this radarscope and the automated flightstrip display plus the communications channel shown along the bottom of your screen, you must handle all the aircraft in your sector, keeping them oncourse, vectoring them into and out of the airports there, and handing them off to the adjacent facility controllers.

This job is complicated by pilot errors — sometimes they don't hear you the first time and ask for your commands to be repeated, sometimes they do hear you but still do not comply! — equipment failures that leave you with no datatag information; pilot emergen-

cies requiring immediate attention; and weather cells moving across your sector. Missed approaches are common in bad weather, so even though you think you have finally finished with some turkey, he may pop up announcing a missed approach, which in turn throws all your other careful sequencing off, and generally turns a "good day" into a nightmare. Or severe weather may even close down an airport, requiring you to vector aircraft to an alternate.

You control these factors, though, and can gradually progress through the ranks from controller trainee to seasoned veteran. Helping you in this process are demonstration scenarios in which prerecorded instructions are played back for you to watch. And always the *Communications* section translates each keystroke command to the official controller/pilot vocabulary, using the proper commands and responses that real air traffic controllers and pilots use every day to keep the skies as safe as they are.

You Don't Do Manuals

Yes, we know. You just fire up the program and muddle through from there.

If you have some controller or IFR pilot experience you can probably get away with that here. But the real job of a Tracon controller typically takes many years of training — you are not going to master it in a couple of minutes. We have painstakingly composed this manual to take you step-by-step into this incredibly rich but complex world, and you will be wasting your time if you do not at least scan its high points first.

Besides, there is an on-disk demo at the end of this chapter and interactive lessons later on. So just sit back and enjoy reading, watching, and listening to the fascinating world of air traffic control. You'll get your chance sooner than you think.

Coming Attractions

If you are not an instrument pilot or controller, you should absolutely read through the second chapter which introduces you to this complex arena. And even if you have substantial knowledge of air

traffic control, you should probably skim this chapter and look over the elements of this environment which are simulated here and which are not.

After this brief introduction to the world of ATC, TRACON II's basic display setup and controls are described. By the time you have read through Chapters Three, Four and Five, you will begin to feel comfortable with the environment of TRACON II. Without this "sense" of TRACON II's world, you will probably be powerless to prevent the inevitable mid-air collision.

Chapter Three begins with a description of TRACON II's Graphical User Interface — novice PC users should be especially attentive to this section. Even though this user interface conforms to the emerging standard for DOS, experienced users should review it as well. Chapter Three ends with start-up and shut-down instructions for the simulator.

Chapter Four documents the keypad commands you use to issue aircraft control instructions. Since you cannot actually *say* "American 1198 heavy, turn right heading one seven zero" like real controllers do (at least, not without our optional Voice Recognition Kit!), you must issue such instructions via the keypad.

In addition to controlling aircraft, you may change the simulator configuration, turning on and off the radar sweep, for instance, or displaying the fix names onscreen for a moment. Chapter Five documents the menu commands available for customization of TRACON II to your taste.

Chapter Six is optional but useful for achieving high performance using TRACON II. This chapter distills information from various air traffic control procedures and describes how to best utilize the resources available to you: altitude, speed, and heading. You might call it a "Hints" chapter. It also points out the errors that can occur and what you should do to prevent them.

Chapter Seven will be of special interest if you want to link with one or more Microsoft® Flight Simulators. Using a modem or direct connection from one of your PC's COM ports, you can control up to sixteen Flight Simulators running on other computers. Their aircraft will appear on TRACON II's screen just like any other, while your commands will appear on the Flight Simulator screen.

Chapter Eight discusses how to vary the simulation once you have mastered the initial configuration. For instance, TRACON II comes delivered with the Los Angeles sector standard and a modest level of aircraft generated for each scenario. As your expertise grows, you can edit this initialization file to routinely generate far more aircraft over a shorter period of time and really stretch your abilities. You must also edit this file if you are using any but COM1: and COM2: for your Flight Simulator linkup(s).

After the chapters come charts of each of the control sectors included with the program.

Manual Conventions

In this manual, we will consistently use *italics* to indicate one-word commands you should type at the DOS prompt (ending it with the Enter key, of course), and:

`this tpestyle`

when we break out a multi-word DOS command line. We will boldface the names of keys (like the reference to the Enter key above) when we discuss them.

About The TRACON II Design Team

The original TRACON was designed by Robert B. Wesson, Ph.D. Dr. Wesson's thesis involved applying artificial intelligence techniques to the problems of air traffic control. In 1977, he created a program running on a mainframe (which had little more power than today's '386-based microcomputers!) which not only simulated an Air Route Traffic Control Center's sector, but also solved separation problems in that environment and issued appropriate ATC commands to the aircraft in the sector. This program was judged by professional controllers at Houston Center to perform better than human ATC personnel handling the same traffic in the same sector. TRACON derives from the simulation component of that program.

During the late '70's at the Rand Corporation "think tank" in Santa Monica, California, Dr. Wesson led a research team which produced and evaluated scenarios for the evolution of the present-day en route ATC system to a modern computer-mediated control environment called AERA. This work helped guide the FAA's multi-billion dollar airspace and airway modernization program currently underway, and the Prologue is an excerpt from one of the many publications Dr. Wesson wrote at that time. Dr. Wesson moved back to Austin in 1981 and is currently president of Wesson International.

TRACON's realism prompted some professional controllers to suggest that we incorporate voice recognition, high resolution large screen displays, and local-area network capabilities into a "professional version" which could be used for real-life ATC training. Several universities, NASA, and other R&D organizations are now using our turn-key professional TRACON systems. Moreover, the realism and performance of these systems led to several Air Force and FAA sponsored research and development contracts, the results of which have naturally influenced TRACON II.

TRACON was initially programmed in Microsoft C by Dale Young. Many of its most advanced, realistic features were suggested and tested by George Booth, a Program Manager at the FAA's Advanced Concepts Division in Washington, D.C. and by a number of Air Force and local professional controllers at the Austin Tracon. Robert Green and Mikal Hart wrote the new graphical user interface, while G. Graham Moore and Brett Adams added TRACON II's expertise in pilot behavior and weather generation. Gareth dePutton edited this manual, which was originally composed by Bob Wesson. Finally, David Warner, an ex-Air Force air traffic controller, wrote the online lessons.

System Requirements

TRACON II requires the following computer system:

- *An IBM PC or compatible computer with 512K of random-access memory. Although TRACON II will run on regular IBM PC 8088 class machines, its performance improves significantly with faster processors such as the*

80286 or 80386 — we strongly recommend using this class of machine. A math chip such as the 80x87 and more memory also improve performance. In particular, the radar sweep works more smoothly and continuously on the faster machines and TRACON II will be more responsive during periods of heavy traffic loading and stormy weather.

- Any type of *graphics adapter and monitor*, including Color Graphics Adapter (CGA), Hercules Monochrome (sometimes called “monographics”), enhanced Graphics Adapter (EGA), Personal System/2 graphics system (MCGA or VGA), and some types of Super-VGA systems, including adapter cards from Video 7 and Paradise. The higher the resolution of the graphics system, the better TRACON II will look. In particular, EGA and VGA screens are stunning compared to their monochrome counterparts. EGA and VGA screens are in full color, while CGA, MCGA, and Hercules are monochrome. Monitor configuration occurs automatically within the program, except for the Super-VGA options, which must be edited into the TRACON.INI file — see Chapter Eight for more details.

Note: To achieve highest resolution, TRACON II must run in monochrome on your CGA system even if you have a color RGB monitor. Also, if you only have an original IBM monochrome adapter card, you will not be able to run TRACON II at all!

- At least *two disk drives* (double-sided, low- or high-density), or hard disk. TRACON II is not copy-protected and may be installed on a hard-drive for better performance.
- IBM-DOS or MS-DOS (version 2.00 or later).

Optional equipment includes:

- A Microsoft-compatible *mouse*, although not required, may be used to pull-down menus, click on dialog box settings, and issue commands to the aircraft. It will be detected automatically if present. Whenever you double-click on an aircraft scope target, a mouse command box pops up just under the target and you may

then select one of the items there. Some of the items, such as altitude changes, require another selection from a graphic representation of the parameter, and the mouse continues to be useful here. Overall, using a mouse can substantially improve the speed with which you can use TRACON II and is highly recommended.

Package Contents

When you open this product, you should find enclosed its three basic elements:

- This manual, which you really should look over before using the program;
- The program diskettes (on both 3.5" and 5.25"); and
- An audiocassette for a synchronized demonstration.

There are no hidden files or copy-protection.

Installing and Running TRACON II

As with any new microcomputer product, you should first make a backup of the distribution diskette and then install the program and all its data files onto your system. Do this by copying all the files onto a newly-formatted floppy disk, or use the DISKCOPY program that comes with DOS. Your DOS manual describes how to make copies of standard DOS disks.

Before even installing TRACON II, you should read the file READ.ME from the distribution disk, if one is present. Like all microcomputer products, TRACON II undergoes constant revision, and some things may have changed since this manual was printed, including the installation procedure. The READ.ME file documents these changes.

To see READ.ME on your terminal, simply enter the command

```
type read.me
```

at the DOS prompt (>) and watch the file scroll across your screen. Be sure to end the command by pressing the **Enter** key. Use the **Ctrl+S** and **Ctrl+Q** commands to stop and restart the scrolling if it is too fast to read. (**Ctrl+S** means to hold down the **Ctrl** key and press the 's' key at the same time.) To print the file to your printer, make sure your printer is connected and turned on, then enter

```
copy read.me prn
```

at the DOS prompt (>).

Floppy-Disk Systems

You will find three 5.25" distribution diskettes and two 3.5" diskettes in the TRACON II package. The 5.25" diskette labelled *Program Disk* contains the TRACON II program, a few auxiliary information files, and the Los Angeles sector files. The *Voice* 5.25" diskette contains the aircraft information file and Los Angeles voice files. Finally, the *Sectors* 5.25" diskette contains sector files along with their associated voice files for all sectors included with TRACON II. Users of 3.5" diskettes will find the contents of the first two 5.25" diskettes described above on a single 3.5" *Program* diskette, with the second 3.5" *Sectors* diskette containing the sector file information as the third 5.25" diskette mentioned above.

After backing up the distribution disks, you should make a working copy of the program and its associated data and voice files. There are several alternatives here, depending on what sort of disks you have in your system. Generally speaking, all the sector files cannot fit onto the working disk(s), so you must decide which sectors you want to use and copy just those onto your working disk before running TRACON. Specific instructions follow:

- a) If you are using a 1.2 megabyte 5.25" floppy disk or 1.44 Mb 3.5" disk, all TRACON II files will fit onto a single working diskette — simply copy the contents of the distribution diskettes onto one working diskette. All sectors will be available at once.

- b) If you are running on a 720K 3.5" disk system, copy the 3.5" Program diskette to be your single working diskette. *Optional: If you want to use any sector other than Los Angeles, you must first delete that sector's files from your working diskette (LAX.VOI and LAX.SEC) and replace them with the data files from the Sectors distribution diskette for the sector you wish to use. These two files will have the same primary name with SEC and VOI extensions. For instance, to replace the Los Angeles sector on your working disk with San Francisco, use DOS to delete the two files named LAX.SEC and LAX.VOI and copy SFO.SEC and SFO.VOI from the Sectors disk to your working disk.*
- c) If you are using 360K 5.25" disks, you must use two working floppies — one for the program and your choice of sector files (your Program working disk), the other for the voice files (your Voice working disk). Copy the Program 5.25" distribution diskette as the first working disk and the Voice 5.25" distribution diskette as the second. *Optional: As in option b) above, if you want to use any sector other than Los Angeles, you must first delete the LAX sector files from the working diskettes (LAX.VOI and LAX.SEC) and replace them with the sector files from the Sectors distribution diskette for the sector you wish to use. These two files will have the same primary name with SEC or VOI extensions. The sector data files with SEC extensions must go on the Program working disk, while the sector voice files with VOI extension must go on the Voice working disk. For instance, to replace the Los Angeles sector with the San Francisco sector, use DOS to delete the file named LAX.SEC from your Program working disk and the file named LAX.VOI from your Voice working disk. Then copy SFO.SEC from the Sectors disk to your Program working disk and copy SFO.VOI from the Sectors disk to your Voice working disk.*

To run TRACON II from a single working disk, simply insert this floppy disk into a disk drive and log into that drive by typing the drive letter followed by a colon and press **Enter**. Then type *tracon* to DOS and the program will start. To run a TRACON II demonstration as described below, the general procedure is to enter

`tracon filename`

at the DOS prompt (>), where *filename* is the name of the demonstration file specified in the instructions. You do not have to enter *filename's* extension.

If you have 360K working diskettes, the digitized voice files are too large to fit onto a single working disk and you should have made a working copy of the TRACON II *Voice* disk as well. You will have to do a little more work to configure your system for running TRACON II from these two working diskettes. (Other users may skip the rest of this section.)

Before running TRACON II from two working disks, always create a *path* to your second (B:) floppy drive by typing the DOS command:

```
A>path=b:\
```

This command tells DOS that if it cannot find a file on the default drive/directory (drive A:), then search drive B: before failing.

The best procedure is to insert this command somewhere in your AUTOEXEC.BAT file so that it will be executed once when you startup each day. Then you won't have to type it in everytime you run TRACON II.

An alternative procedure is to put it into a batch file with a TRACON II command and use that command to invoke TRACON instead. For instance, suppose you create the file VTRACON.BAT by typing the following to DOS:

```
A>copy con vtracon.bat   create file from console
path=b:\                 set up the path
a:                        make sure A: is current
tracon %1 %2             execute TRACON II with args
^Z                        hold down Ctrl and press 'z'
```

Then, instead of typing *tracon demo* to DOS, you would type *vtracon demo* and the above commands would be executed. Note, however, that we prefer putting the path statement into your AUTOEXEC.BAT file. It's a "cleaner" solution.

Then, to run TRACON II, insert both working diskettes into your computer — the TRACON II *Program* working diskette into drive A: and the *Voice* working disk into drive B:. Startup TRACON II as stated above, making sure that you do not change the disk in either drive during its operation.

Hard Disk Systems

Follow this procedure to install TRACON II onto your hard disk:

1. Insert the TRACON II *Program* disk into floppy drive A:.
2. Log onto the hard drive on which you want the simulator to reside. For example, to log onto hard drive C:, type *c:* and then press **Enter**.
3. Type *cd * and then press **Enter** to go to the root directory.
4. Type *md tracon* and then press **Enter** to make a directory for TRACON II. *Note: if you already have a previous version of TRACON on your hard disk, this step will fail, since you already have a \tracon subdirectory. Ignore the DOS message and continue normally — the new version of TRACON will simply overwrite the old one in your existing \tracon subdirectory. (Of course, you can also create a completely new subdirectory called, say, \tracon2, and keep both versions around.)*
5. Type *cd tracon* and then press **Enter** to change directories.
6. Type *copy a:*.** and then press **Enter** to copy all TRACON II program files from the floppy disk in drive A: to the hard disk. Then repeat this step once more using the *Sectors* distribution diskette, and, if you are using 5.25" disks, a third time to copy the *Voice* distribution diskette onto your hard drive.

To run TRACON II from your hard disk, do the following:

1. Log onto the hard disk directory set up for TRACON II. For example, to log onto the directory called *\tracon* on hard disk C:, type *cd \tracon* and then press **Enter**.
2. Type *tracon* and then press **Enter** to run TRACON II.
3. To run a TRACON II demonstration as described below, the general procedure is to type

tracon filename

to DOS, where *filename* is the name of the demonstration file specified in the instructions.

In case of difficulty: If TRACON II does not seem to display properly on your system, it may have autodetected your configuration improperly or your system might not be as compatible as hoped. You can probably fix the problem by changing the first line in the TRACON.INI initialization file so that it matches your monitor exactly — see Chapter Eight for more details.

Exiting TRACON II

You can shut down TRACON II at any time and return to DOS via the File menu's Exit command. You may issue this command via the keyboard by holding down the Alt key on your keyboard and pressing the 'f' key at the same time, then selecting the Exit option by pressing just the 'x' key. Or just use your mouse to pulldown the File menu, drag the selection bar down to the Exit option, and release. If you are running a simulation when this command is processed, TRACON II will popup a dialog box showing the results of the scenario. Simply press Enter at that point and your usual DOS prompt should greet you.

Quick-Start Demonstration

Now for the fun part. Let's run a simple demonstration of TRACON II's capabilities. It will take about 15 minutes, and you don't have to do anything but sit back and watch! This demonstration is a good way to become familiar with many of the program functions documented in the rest of this manual.

To run the demonstration, simply activate TRACON II as described above for either a floppy-disk or hard-disk system, except append the word "demo" to the command you type to DOS. Assuming you are in the TRACON II directory or have the TRACON II floppy disk in your default drive, please type now:

```
tracon demo
```


to DOS (ending with the **Enter** key, of course). Don't touch anything. Instead, look at the lower righthand screen area and you will see a small "Post-it"-like notepad which is "talking to you." Simply sit back and watch this notepad area, which will direct your attention around the screen and generally run through a simple scenario in which a couple of arrivals and departures are handled correctly. This little demonstration should give you a flavor of TRACON II. It repeats continuously until you stop it.

End the demonstration at any time using the **File/Exit** command as described above. Then, you should probably read through the next several chapters and begin to control aircraft yourself directly.



Quick Reference Guide

For those of you who, in spite of our admonitions, are about to jump right in and try your hand at controlling aircraft, the next two pages of this manual provide a handy quick reference guide to the screen displays and keyboard controls in TRACON. After you have read through the rest of the manual, you can always return to these two pages and leave the manual open there to provide a handy reminder of the material detailed later on.

Quick Reference: Screen Display

Radarscope (points to the radar display area)

Top Level Menu Bar (points to the menu bar with File, RadarScope, Detail, Simulation, and FI-Help)

Pull-down menu (points to the File menu options: New, Open Flight Plans..., Save Flight Plans..., Close, Exit..., About TRACON...)

Flights which will enter your sector within five minutes (points to the top of the flight list table)

Flightstrips of aircraft now in your sector. The highlighted strip is SQ173, a Boeing 727 cruising at 385 knots at 11000 feet. It entered at SAUGS intersection; destination is LAX. (points to the highlighted SQ173 entry in the flight list)

Active Sector and time (points to the bottom status bar showing Los Angeles 00:05:53)

Your score (points to the score field in the bottom status bar)

Communications between you and the aircraft (points to the text at the bottom: NBSS: With you level at 10000. App/Dep: NBSS, Radar contact. App/Dep: SQ173, move leader to ...)

Flight	Type	Altitude	Speed	Direction
N899X	F320	160k	50'	SAUGS TOR Tur
N570	PA34	170k	80'	L/O TOR LANCE Ctr
N220N	F320	145k	50'	SAUGS ALBAS Ctr
N21	PA24	150k	70'	L/O ONV TANDY Ctr
N152N	U30	150k	40'	L/O SMO LANCE Ctr
NP51R	727	270k	110'	ALB IN LAX Tur
N55H	L24	200k	80'	L/O LCB LANA Ctr
N895	PA44	140k	100'	TANDY LCB Tur
N72B	PA44	160k	100'	TRINE LANA Ctr
N202Y	DC400	235k	100'	BAVST LCB Tur
SQ173	727	385k	110'	SAUGS Lax Tur
N275B	PA40	215k	80'	ALB IN SMO Tur
N16X	PA42	215k	50'	LANCE TOR Tur
N530U	PA20	180k	80'	ALB IN TRINE Ctr
N876R	PA20	205k	50'	SMO Tur

Scenario Settings Dialog Boxes

Welcome to TRACON.

Controller:

Best Score: 0

Handle aircraft over minutes.

Sector:

ORD	↑
LAX	
MIA	
SFO	
BOS	↓

Buttons: OK, Setup >>, Cancel

Settings For This Scenario.

Weather: INC, Minimum, Turbulent, Stormy

Pilots: Perfect, Average, Lousy

Emergencies: None, Maybe, Nightmare

Equipment: Perfect, Unreliable, Off

Wind: Direction (clock icon), Speed

Buttons: OK, Cancel

Enter your name here (points to Controller field)

The geographic sector you wish to control (points to Sector list)

Wind direction and speed (points to Wind settings)

Emergencies: set for none or create a nightmare. (points to Emergencies options)

Equipment: set for perfect or take your chances. (points to Equipment options)

Weather: IMC is simple while Stormy generates moving thunderstorms. (points to Weather options)

Number of aircraft generated over how many minutes. More aircraft in less time is harder. (points to Handle and over fields)

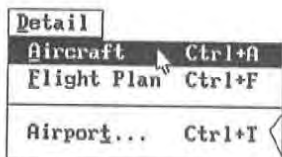
Select to open Settings dialog box to customize simulation. (points to Setup >> button)

Pilot proficiency (points to Pilots options)

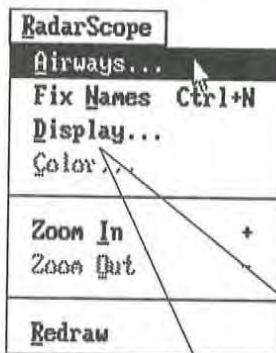
Quick Reference: Menus



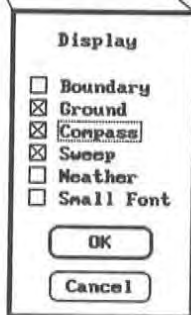
Select **New...** for a new simulation; **Open Flight Plans...** to view/select previously saved simulations; **Save Flight Plans...** to preserve current simulation; or **Exit** to return to DOS.



Select **Aircraft** to popup an information box on any aircraft in your sector; select **Flight Plan** to display the flight plan of a selected aircraft; select **Airport...** to popup a dialog box, then select the airport for which you need information and an information box will popup.

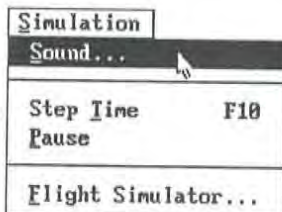


From the **RadarScope** menu, select **Airways...** to toggle actual airways and/or airway names to appear on screen. Select **Fix Names** to display names of all fixes and airports on screen. Select **Display...** to popup dialog box, then check **Boundary**, **Ground**, **Compass**, **Sweep**, **Weather**, or **Small Font**. Select **Color...** to change the color of any part of the screen. Select **Zoom In** or **Zoom Out** to more closely examine a selected portion of the scope.



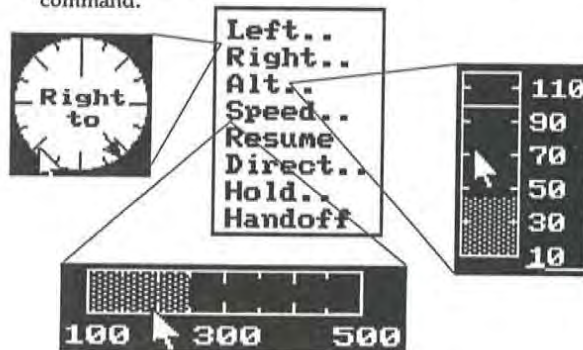
Aircraft Mouse Commands

After double-clicking to select an aircraft, issue the command by choosing from the popup menu. Choose **Left...**, **Right...**, **Alt...**, or **Speed...** to popup dialog boxes for final parameters. **Direct...** and **Hold...** require you to click on the desired fix. Finish command with left button for immediate execution, or right button for stacked command.



Select **Sound...** to popup a dialog box in which you may toggle on/off talking and noise. Select **Step Time** to speed up the action during slow periods. **Pause** is cheating, and will cost you a lot of points. Select **Flight Simulator...** to popup a dialog box for linking with one or more Flight Simulators.

Select **Sound...** to popup a dialog box in which you may toggle on/off talking and noise. Select **Step Time** to speed up the action during slow periods. **Pause** is



2 Air Traffic Control

A Short History of Air Traffic Control

You have undoubtedly heard the expression "flying by the seat of his pants." This characterizes the way early airplanes and their pilots took to the air. They flew by looking ahead at the physical horizon and navigated by looking over the side at landmarks. Seat-of-the-pants flying has a severe drawback, of course, because clouds frequently obscure both the horizon and the ground.

The increasing requirement for reliability in the burgeoning mail and passenger flying services led to the development of *instrument* flying, in which control of the aircraft is achieved using inboard artificial horizons and other instruments coupled with the use of radio navigational beacons along standardized routes of flight. As more and more aircraft began using these routes, however, some method of coordinated control became necessary and the government-based air traffic control service was born.

During these early days, air traffic control was performed using time as the basis for control. Each aircraft was given precise take-off and fix-crossing times. Aircraft flying the same routes were tracked using plastic indicators moved manually across large horizontal maps in the ATC control rooms. These indicators were called "shrimp boats" and continue to be the worst-case backup mechanisms available in many control rooms even today.

The use of ground-based radar to provide more precise position information for this tracking function is really only a few decades old. As frequently happens with government, this concept was a response to a critical catalytic event. In 1956, two airliners, both flying under existing instrument flight rules of the day, crashed over the Grand Canyon. One was climbing and the other descending. Congress mandated that "something has to be done about this!" and so radar-based ATC was created.

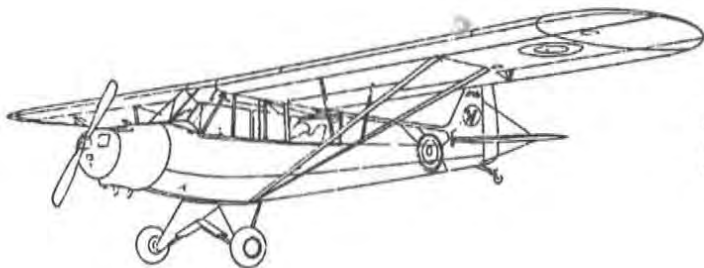
With radar control, ground-based centralized controllers can monitor an aircraft's flight and execute their basic safety mandate: maintain separation between aircraft. In TRACON II, as in real life, that separation requirement is three miles horizontally or one thousand feet vertically. This constraint will form one of your primary goals in TRACON II.

ATC controllers naturally do many other things in the course of their job. Although every airport equipped with an *instrument landing system (ILS)* has a published approach procedure, most pilots never actually fly it. Instead, the air traffic control authority issues guidance commands to position the inbound aircraft at a point from which an abbreviated approach can be successfully completed. In TRACON II, as in real life, you will be required to perform these activities as well.

A Complex System of Interlocking Parts

Air traffic control is not a uniform system — it is comprised of a multitude of overlapping rules, control facilities, and personnel. This section introduces you to that system as a whole, and discusses the part that TRACON II simulates.

Aircraft in this country may fly under two sets of rules and regulations: *visual flight rules (VFR)* or *instrument flight rules (IFR)*. The majority of "Sunday-pilot" flights occur VFR out of uncontrolled fields, where "see-and-be-seen" constitutes the primary traffic control mechanism. But whenever the weather turns cloudy, and



Aircraft like this Piper Cub usually fly VFR, but you will occasionally encounter an IFR one.

1 TYPE		2 AIRCRAFT IDENTIFICATION		3 AIRCRAFT TYPE / SPECIAL EQUIPMENT		4 TRUE AIRSPEED		5 DEPARTURE POINT		6 DEPARTURE TIME		7 CRUISING ALTITUDE
VFR										PROPOSED (Z)		ACTUAL (Z)
IFR												
DVR												
8 ROUTE OF FLIGHT												
9 DESTINATION (Name of airport and code)				10 EST TIME ENROUTE		11 REMARKS						
				HOURS MINUTES								
12 FUEL ON BOARD			13 ALTERNATE AIRPORT(S)			14 PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE				15 NUMBER ABOARD		
HOURS MINUTES												
16 COLOR OF AIRCRAFT						17 CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL						

FAA Form 7233-1 (5-77)

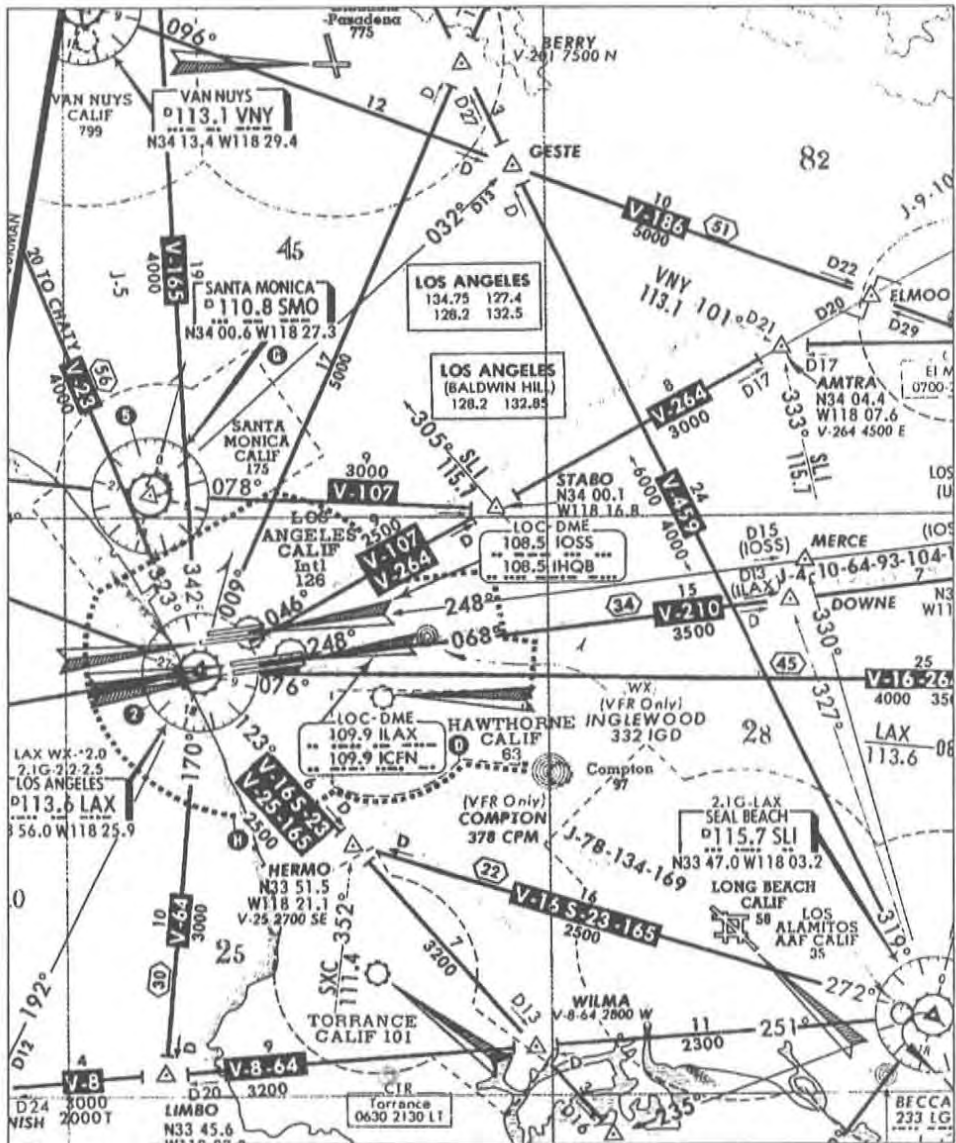
Flightplan Form

always in congested airspace around major commercial airports, aircraft must file flightplans and be guided by ground-based controllers.

In order that these controllers have sufficient information to anticipate the movements of these IFR aircraft, pilots file a *flightplan* before actually taking off. This is filed through a Flight Service Station and entered into a networked nationwide computer system and fed as required to the various control authorities which will oversee the flight.

A flightplan consists of (at least) an aircraft's type (so the controller will have some idea of its performance capabilities), its true airspeed, the altitude it wishes to cruise at, its destination, and its intended route of flight to reach that destination. (Much other information may also be required, depending on the area to be traversed, but for our purposes this is enough.)

Various navigational beacons called fixes have been established over the years, along with Victor (low-altitude) and Jet (high-altitude) airways which form a complex spiderweb connecting these beacons. Aircraft flying IFR carry radio transmitters and receivers which allow them to track along these airways and maintain continuous communication with the ground at all times. In the absence



Los Angeles Area Instrument Flight Chart showing Airways, Fixes, and Instrument Approaches

of a specific instruction from a ground controller, each IFR pilot must maneuver his aircraft according to the flightplan he filed before taking off.

Once an aircraft is airborne, it is continuously monitored by ground-based controllers during each phase of its flight. There are different controllers for each phase of flight.

Before taxiing from the gate, the pilot must call *Clearance Delivery* to get his actual flightplan instructions. Depending on traffic, weather, and delays, the route of flight he is given may or may not be what he requested.

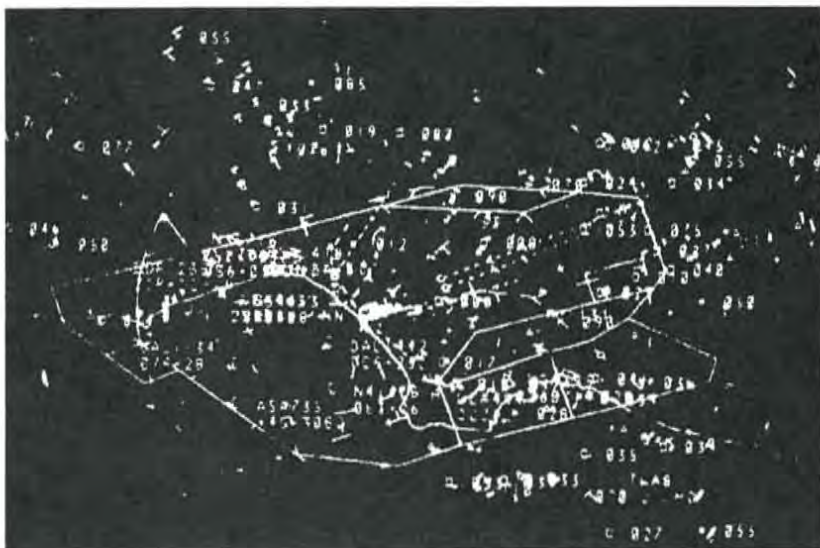
Once he accepts the clearance, he calls *Ground Control* for taxi instructions from the gate to the active runway. Ground Control "owns" all the airport real estate except the active runway(s).

Once positioned in line at the active runway, the *Tower* clears him for takeoff, and after a takeoff roll he lifts off. Once his transponder (a radio beacon device which uniquely identifies him to the radar site) can be seen on the controller's scope, he comes under the control of the local TRACON (Terminal Radar Approach CONTrol), which houses both *Departure* and *Approach* Controls for the surrounding airspace. His transponder reports his altitude as he climbs out, and the TRACON's computer system matches the transponder return with the aircraft's identifier and displays it all onscreen. As you would expect, this program simulates the environment of a TRACON facility.

After climbing to his requested cruising altitude, *Departure control* (that will be you!) hands off to the first of a series of *Enroute* or *Center* Controllers who monitor the more-or-less level flight's progress from an Air Route Traffic Control Center (ARTCC) until it reaches the vicinity of its destination.

For the descent to the airport, the flight is handed off to *Approach Control* (that's you, again), who issues turn and descent commands to line up the aircraft with the instrument approach into its destination. This process is generally called *vectoring* the aircraft, and usually results in maneuvering the aircraft until it is positioned at the correct altitude a few miles outside of the *Final Approach Fix* (FAF) for the destination airport.

The aircraft is then handed off to the destination tower, who clears it to land and finally turns it over to the local ground controller who has responsibility until it is safely parked on the airport ramp.



Photograph of LAX Approach Control Radarscope

Handoffs

Since there are so many sectors in the ATC system, coordination between and among them is critical. Who has control of an aircraft at a particular point in time must always be unique and known to everyone involved with the aircraft. Transitions of control from one sector or facility to another are called *hand-offs*. In TRACON II, since you control no airports directly (their respective Tower controllers do that) and are surrounded by the Center's en route airspace, you will use a handoff procedure for every aircraft you handle.

Inbound aircraft entering your sector will be at their cruising altitude (or level at some intermediate altitude, having been sent there by the Center controller already). Their target on the scope will immediately begin blinking, indicating that the Center control-

ler wishes to hand them off to you. These aircraft may not proceed into your sector until you accept them — that is one of the tenets of the absolute control regime of ATC. If you do not or cannot accept an aircraft, the Center controller has no choice but to hold the aircraft in his airspace until you can accept it. Once you accept the handoff, the aircraft can proceed normally under your control.

Similarly, departing aircraft are not released for takeoff by their tower until you say so. They hold on the ground (easier and more efficient than holding in the air, but burning precious fuel anyway). If the hold becomes protracted, they will start to complain about fuel use, but you have absolute discretion about when to let them depart.

As overflights or departures reach the edge of your airspace, they must be handed off to the adjacent Center controller. Likewise, after you have lined up an arrival so he will arrive at the FAF at the proper altitude and heading, you hand him off to the Tower, who takes him the rest of the way in. If he misses the approach because of pilot error or bad weather, the Tower will send him back to you again once he has attained sufficient altitude to be seen on your radarscope.

Types of Flights

In TRACON II, as in real life, you will deal with three basic types of flights:

1. *Overflights* are the easiest to handle. These aircraft enter your sector at one of its edges at a cruising altitude and wish to exit your sector at another edge straight and level at the same cruising altitude. If there were no other traffic, you would have to do nothing other than accept the handoff from one Center controller and then hand him off to another Center controller. Of course, life is rarely like that, and you might have to change his altitude or vector him around conflicting traffic in your sector. The key constraint in TRACON II is that an overflight must be back at his original altitude when he exits the sector, or you will get an error generated for not adhering to the flightplan that Center expects.

2. *Departures* are still relatively easy. Once you release an aircraft for departure, the tower clears it for takeoff and presumably it starts rolling. You do not immediately see it on your scope — the aircraft must have some altitude before its transponder can be seen by your radar system. That takes time — usually a minute or two. Then, if you do nothing, the aircraft will merely turn to intercept its out-bound course and proceed to climb to its cruising altitude (or the top of your sector control, whichever is higher). Just before it reaches the edge of your sector, you must hand the aircraft off to the Center controller.

Problems arise when an aircraft's requested departure time conflicts with others at the same airport (ever noticed how many airlines schedule 8:13 departures?), when it would conflict with an approach in progress, or when its normal climb-out would conflict with another overflight or climb-out from a nearby field. In this case, you would probably choose to either hold the aircraft or, more probably, release it for takeoff and then vector it or the conflicting one around each other.

3. *Arrivals* are the stickiest, mainly because they take so much of your attention. After accepting the handoff from Center, you must vector the arriving aircraft and also descend it so that it arrives at the destination airport's final approach fix at the correct altitude and heading from which to begin the approach. This usually involves intense concentration and great skill, since you must anticipate when to turn and descend the aircraft and alter the times you give these commands depending on the specific aircraft type. Handling arrivals with finesse requires the most experience of all in TRACON II.

Control Terminology

Each control environment has its own specific vocabulary. Most users will be familiar with the phrase "Cleared to land" — tower terminology which means the subject aircraft will be the next arrival at the target runway and is guaranteed that the runway will be vacant when he arrives. TRACON II has a similar set of phrases that, used properly, guarantee that the target aircraft will perform to your expectations during flight.

Overall, an aircraft's flightplan governs its general operations and route of flight, and its performance capabilities govern the speed with which it accomplishes those operations. The flightplan specifies when it expects to takeoff, what altitude it desires to cruise at, how fast it cruises, the exact route of flight, and the destination airport. In the event of communications failure, in fact, the flightplan (as last modified by a control authority) and standard rules of interpretation are used by both pilot and controller as the sole guidance for the rest of its flight. Pilots file requested flightplans, and then Clearance Delivery, who has been working in conjunction with the other control authorities, either approves it and clears the aircraft "as filed" or modifies it and issues a modified actual flightplan.

Performance capabilities of an aircraft determine much of its behavior. Except for the rule that aircraft may not fly faster than 250 knots below 10,000 feet, an airplane will generally proceed as fast as its normal cruise capabilities allow. Similarly, while small general aviation aircraft might be straining to climb at 500 feet per minute to their cruising altitude, a LearJet might rocket up at over 6000 feet per minute. IFR aircraft generally turn at three degrees per second, so heading changes are easily anticipated.

So overall, then, most of what an aircraft will do once he takes off is predetermined or outside of your control. You really only have three basic tools that you can use to separate aircraft:

1. *Altitude.* "Descend and maintain three thousand feet...Roger, out of ten thousand for three thousand." You have probably heard such interchanges many times when you listened in on ATC frequencies.

Keeping planes apart with altitude seems simple, for it is, after all, a big sky up there. And indeed it is in "en route" airspace, where the traffic is generally boring holes through the sky flying straight and level. In fact, ARTCCs have evolved rules whereby aircraft travelling at certain headings or airways must travel at specified altitudes.

In the TRACON II environment, however, things are not quite so simple, because your aircraft will be continuously descending to land or ascending to their cruising altitudes. Thus, while altitude is always useful in separating aircraft, you will find using it more difficult than you might think in the transitory environment of TRACON II.



Sample vocabulary:

Controller: "November 3275 Tango, climb and maintain eight thousand feet."

Response: "Roger, Swift 75 Tango is out of five thousand for eight thousand feet."

Controller: "American 34 Heavy, descend and maintain three thousand feet."

Response: "Roger, American 34 Heavy is out of ten thousand for three thousand feet."

2. Heading. If two planes are on a collision course, you can always turn one or both of them away. The process of issuing turn or heading commands to an aircraft is called "vectoring" in controller jargon. As a controller, you can command that an aircraft fly any particular compass heading from 001 through 360 degrees. Headings are specified as magnetic compass courses to fly, so magnetic variation (up to 17 degrees from true North on the West coast) affects the courses you specify. You should recall from your geography studies that 090 means East, 180 means South, 270 means West, and 360 (or 000) means North. You can also make fine relative heading changes by asking aircraft to "turn five degrees left."

Again, because of the rapidly-changing nature of the TRACON environment, and because it is poor form to keep an aircraft on a heading significantly away from its destination, this tool is less useful than you might think. Your use of heading in TRACON II will mainly focus on lining up aircraft for their final approaches, just as your most frequent use of altitude might be meeting the FAF altitude requirement (more on that later).



**Directional Gyro with
Magnetic Headings
Shown**

Sample vocabulary:

Controller: "Bonanza 345 Delta Zulu, turn right heading one zero zero degrees."

Response: "Roger, Delta Zulu, right turn to one zero zero."

Controller: "Delta Eleven Eighty-eight, turn left twenty degrees to intercept final approach course."

Response: "Roger, Delta One One Eight Eight turning left twenty degrees."

3. *Speed.* A good controller is able to line up his approaching traffic on the extended centerline of the runway, tightly spaced, and the view from the tower, especially at night, has produced the descriptive jargon for this feat as a "string of pearls." To accomplish this, a controller must carefully adjust each inbound's speed so that the aircraft follows the one in front of it just so. Yet, since airspeed indicators and winds aloft change with altitude, an indicated 200 knots at 10,000 feet might be substantially different than the same speed near the ground. So speed adjustments must be made continuously and regularly. They are also the most imprecise of all the adjustments available to you, for while the human eye can read the reported altitude off the radarscope directly, and can note direction of travel with some certainty, speed of target motion across the scope is particularly difficult to discern.

Sample vocabulary:

Controller: "Eastern Two Nine Two, please make your speed now one seven zero knots."

Response: "Roger, Eastern Two Ninety-Two is coming back to One hundred Seventy."

Controller: "Piper Twenty-three, can you keep your speed at one fifty on final?"
Response: "Roger, Seneca Twenty-three, one fifty all the way in."

This, then, is your charter as a TRACON II controller: Keep 'em apart, but keep 'em on course and on time.

Let's Listen In...

This next demonstration requires any sort of cassette tape recorder. Get one out and put it near your computer. We are going to watch "over the shoulder" of a controller as he performs the above-described tasks in the TRACON environment. Standard terminology is used, but if you read the preceding material and watch the scope carefully, you should be able to easily follow what is going on.

You will need to synchronize the audio tape with the computer. This procedure is quite simple:

1. Set up your cassette recorder where you can hear it near your computer and insert the TRACON cassette. You will not have to operate the recorder once you turn it on during this session, so you may position it across the room or use the cassette deck of a large stereo system.
2. Insert your TRACON working diskette or change directories to your TRACON subdirectory if you are working from a hard disk.
3. Start up TRACON by typing the command *tracon tape* to DOS.
4. Press the Play button on your recorder and return to your computer.
5. Following the dictated instructions on the tape, press the Enter key when you hear a beep tone on the tape. TRACON will synchronize itself with the tape player. Everything is automatic from this point on.

6. Now, sit back listen to the tape, and watch the scope. The controller on the tape should voice all the commands that TRACON is issuing at about the same time as they appear onscreen. If that is not happening, please rewind the tape and start over on this procedure. After the demonstration ends, stop your tape player and rewind the cassette tape. TRACON will stop itself and automatically return to DOS.

Online Lessons

To give you a good idea of what you'll face as a TRACON II controller, you might want to take a few minutes and look at one or more of the disk-based lessons we have provided. To run TRACON II with any lesson, simply type

```
tracon lesson-name
```

to DOS, where *lesson-name* is the name of one of the LESSON?.DMO files. For example, to run the first lesson, type *tracon lesson1* to DOS. As in the demo of the previous chapter, just sit back and watch as TRACON II introduces you to many of the possible variations that you will face as an air traffic controller.

For Further Reference

If you would like more detailed information on how and why the air traffic control system works the way it does, the most recent and comprehensive book on the subject is:

Fundamentals of Air Traffic Control by Michael S. Nolan (Wadsworth Publishing Company, 1990)

Available through most book stores.

3 *Creating Scenarios*

TRACON II provides a simulation of the complex real world of air traffic control. There are many aspects to this world, some you may adjust and many you cannot.

For instance, in real life traffic ebbs and flows according to time of day, geographic sector, and a host of other variables. In TRACON II, you may choose a particular sector to control and set the number of simulated aircraft which will be generated for that sector. The program's built-in rules determine the appropriate traffic mix for each sector. In Los Angeles, for instance, most traffic arrives and departs to the eastern hemisphere of the sector, since the Pacific Ocean lies to the West.

This chapter discusses TRACON II's graphical user interface and other basic methods for moving around, changing parameters and issuing commands within the program. Additionally, an overview of the display screen and its various components is presented, as well as detailed information about the New ... and Exit dialog boxes.

Graphical User Interface

Before using TRACON II, you should learn or review the basics and conventions of our user interface. TRACON II uses pulldown menus and popup dialog boxes similar in structure and operation to Microsoft® Windows. To perform the examples in the following discussion, please activate TRACON II now by typing simply *tracon* at the DOS prompt.

Mouse Techniques

TRACON II may be used with either a single-button or a multiple-button mouse. Always use the *leftmost* button in TRACON II for clicking and dragging. The *rightmost* button is used after choosing

an aircraft command to append the "then" semicolon and link it with the next one — see Chapter Four for more details about using the right mouse button.

The following table defines mouse terminology used in this manual:

<u>To</u>	<u>Do this</u>
Point	Move the mouse until the tip of the pointer rests on what you want to point to.
Click	Quickly press and release the (leftmost) mouse button.
Drag	Press the mouse button and hold it down while moving the mouse.
Double-click	Click the mouse button twice in rapid succession.

Top Menu Bar

File	RadarScope	Detail	Simulation	F1=Help
				Pending
				N98S PA44 155k 70' I/O ONY SAUGS Ctr NM82 728 215k 90' I/O LAX V25 ALBAS KE731 737 225k 90' I/O LAX SAUGS Ctr N4331R PA60 215k 100' I/O TOA MIDDS Ctr NZ42C TB-21 180k 90' ■ AHEIM TOA Tur
				Actives
				N4P C310 175k 50' TOA AHEIM Ctr IB109 737 465k 120' LAX MASSA Ctr DL596 728 250k 90' SAUGS LAX Tur NZES PA60 210k 100' MERMA ONY Tur BA176 725 220k 100' TWINE V23 LAX Tur PA340 727 395k 110' .. V264 LAX Tur
App/Dep: BA176, Turn left heading 090. BA176: Roger. Left to 090. NZ42C: With you level at 9000. App/Dep:				Los Angeles 00:03:16 Scope -40

Selecting Top Level Menu Options

Notice the top level menu bar across the upper part of TRACON II's display. This menu bar will remain constant throughout the simulation, featuring the top-level commands **File**, **Radarscope**, **Detail** and **Simulation** (for more detailed information on these menus, see Chapter Five). There are three ways of selecting from the menu bar and choosing options from the pull-down menus — two keyboard-based and one mouse-based.

With the first keyboard method, simultaneously press the **Alt**-key and the underlined (generally the first) letter of the desired menu bar command, e.g. **Alt+F** (**File**). A menu will drop down under the top level name you have selected with its first option highlighted. You may press the **Left-** or **Right-arrow** keys to pull down menus for each top level option to the left or right of the current one (although generally the **Alt+letter** method is more direct). To choose an option from any pulled down menu, use the **Up** or **Down** arrow keys to highlight the specific option and press **Enter**, or simply press the underlined letter of the option you want. In short, any menu option may be selected by two keystrokes — an **Alt**-key combination to pull down the appropriate menu followed by a typing key to select an option. If you pull down a menu by mistake, press **Esc** to cancel it.

An even faster keyboard method involves the use of a *speedkey*. If an option on a pulldown menu has a speedkey associated with it, that key will be listed to the right of the option name on the pulled down menu. With no menu pulled down, pressing that key will cause the option to be activated directly. Only some menu options will have speedkeys associated with them. Example: For information about a specific aircraft, choose the **Aircraft** option from the **Detail** menu, or press the speedkey **Ctrl+A**.

Naturally, this sort of pulldown menu regime is optimized for use with a mouse. Simply point to the top menu bar name you wish to activate and press (and hold) the left mouse button to pull down the menu. Drag the mouse cursor down so that the menu option you want is highlighted and release the mouse button to select it. Alternatively, as in Microsoft® Windows (but not the Macintosh), you may click on the top menu item you want, release the mouse button, point to the specific option you want on the pulled down menu still showing, then click again to activate it. If you mistakenly

pull down a menu but do not wish to activate any option on it, move the mouse off the pulled down menu and release or click to make the menu disappear.

In general, you may choose any of these methods of choosing menu options. In the rest of this manual, we will say simply to "select the *x* option from the *y* menu" or, even more succinctly, "select *y/x*" and assume that you will use the mouse and/or keyboard as necessary to select the requested option.

Let's see a concrete example of how this menu-based user interface works by selecting the New ... option from the File menu. To do this, first pull down the File menu by either pressing Alt+F or pointing to the word File using your mouse and clicking. Your screen should look like this:



Now, choose the New ... option from the File menu by either of three options: 1) press the 'n' key (the underlined letter of the option), 2) press Enter (since the option is already highlighted), or 3) point to the option New... with your mouse and click on it.

Dialog Boxes

Notice that choosing the New ... option pops up a white rectangular box in the middle of your screen. This is called a *dialog box*. TRACON II uses dialog boxes to give you messages and to ask you for

any additional information needed to carry out a command. This one allows you to enter some initial TRACON II parameters — your name, for instance, and the number of aircraft to generate over how many minutes.

Welcome to TRACON.

Controller:

Best Score: 0

Handle aircraft

over minutes.

Sector

ORD	↑
LAX	
MIA	
SFO	
BOS	↓

OK Setup >> Cancel

You interact with this and all other TRACON II dialog boxes using keystrokes and/or mouse clicks. A dialog box contains various *fields*, each containing some *value* that you can type in, reset, or change. When you are satisfied with the values of all the fields in the box, press **Enter** to accept all those values and unpop the box. Press **Esc**, as usual, to cancel the box without changing anything.

Dialog boxes may contain six different types of fields. The one for **New ...** illustrates three of these types. A *text field* prompts you to type in something. The first field, for example, asks for the controller's (your) name, while just below it is a field asking for the number of aircraft and below that another field asking for the duration of the new scenario. A *list field* allows you to choose from a (possibly large) number of alternatives — you choose the sector from a list field. And finally, you press a *button field* at the bottom of the box to unpop the box and tell TRACON II what to do next — **OK** means to pass all the field values to the program and continue normally; **Cancel** ignores everything you did to the box and leaves the previous values unchanged; and **Setup >>** leads you into another dialog box with more options to set if you wish. Other boxes will have *checkbox fields* which allow you to turn some feature on or off, *radio*

button fields which allows you to choose one of a few specific options, and perhaps some sort of *special field* (such as the wind rose field in the Setup >> box which may follow this one).

Dialog boxes all share the same keystrokes to move among their various fields. **Tab** moves the dotted-line highlight to the next field, while **Shift-Tab** moves it backward. **Backspace** erases characters you have typed into a fill-in field, just as in a word processor or DOS. For radio button and list box fields, such as the Sector list box now showing, use the **Up/down** or **Left/Right arrow** keys to move the selection bar among the alternatives. At a check box field, use the **spacebar** to toggle the check box on and off. When you **Tab** out of an area, a black highlight, check mark, or button dot indicates your final selected choice. Pressing **Enter** will immediately highlight the **OK** button in any box, thereby accepting all the current box settings, while pressing **Esc** will always "press" the **Cancel** button.

Things are considerably simpler with a mouse — simply click on whatever dialog box item you want to select and type in the new value (if necessary). When everything is as you want it, click on the **OK** button to accept the box.

Remember: Pressing Esc whenever a dialog box is showing will unpop the box and return you to TRACON II's radarscope without changing anything. Pressing Enter will always accept the box and continue .

Scenario Settings

The **New ...** dialog box (above) contains the following values which you may change using the above method(s):

Controller

Enter your name (first, last, or both). If more than one person will be training, make sure that each user enters his/her name the same way each time.

Best Score

The highest score for each user will be stored and recalled after the name is entered. You cannot edit this dialog box value.

Handle ___ aircraft over ___ minutes

Fewer aircraft and/or more minutes will simplify; more aircraft over a shorter time will make the simulation more difficult. The maximum value for each of these fields is 99.


Control Sector

The filename of the sector you want to control. Sectors files included in this package are:

LAX . SEC	Los Angeles
SFO . SEC	San Francisco
ORD . SEC	Chicago
MIA . SEC	Miami
BOS . SEC	Boston
SEA . SEC	Seattle

If you feel adventurous enough to customize the simulation's parameters, select "Setup >>" instead of OK to finish the start-up box. The following dialog box will appear:

Settings For This Scenario.

Weather	Wind	
<input type="radio"/> IMC	Direction	Speed
<input type="radio"/> Minimums		<input type="text" value="10"/>
<input type="radio"/> Turbulent		
<input checked="" type="radio"/> Stormy		
Pilots	Emergencies	Equipment
<input checked="" type="radio"/> Perfect	<input type="radio"/> None	<input type="radio"/> Perfect
<input type="radio"/> Average	<input checked="" type="radio"/> Maybe	<input checked="" type="radio"/> Unreliable
<input type="radio"/> Lousy	<input type="radio"/> Nightmare	<input type="radio"/> Off
<input type="button" value="OK"/>		<input type="button" value="Cancel"/>

The Setup dialog box contains the following parameters:

Weather

Use **Up/Down arrow** keys to move the highlight bar to the weather pattern you wish. The further down the list, the harder an approach will be for all pilots and thus the more missed approaches you will encounter. Thunderstorm cells may move across the scope, causing changes in visibility and wind direction and speed, and prompting airports to close or change runways.

- *IMC.* The weather is keeping all the puddle-jumpers at home, but traffic is moving normally. All approaches will terminate in a landing. No thunderstorm cells will be generated or displayed on your screen (useful if you are running on a slow CPU machine such as an 8088-based PC/XT).
- *Minimums.* Occasionally an approach will be missed and an aircraft will popup as though taking off when you think you've finished with him (with the message "aircraft, Missed approach" in the *Communications* box). Initial miss instructions will be to continue on final approach heading, climb to FAF altitude, and contact Approach Control. A few weather buildups can be spotted on your screen moving leisurely with the wind.
- *Turbulent and Stormy.* Approaches are mighty difficult and lots of misses occur. Thunderstorm cells begin to multiply, giving you and your pilots much grief.

Wind

- *Direction.* When you tab into the wind compass rose, the default wind direction (where it's blowing from) will be indicated. Set the wind direction by pressing one of the **Arrow** keys until the desired direction is reached, or by clicking on the desired direction with your mouse.
- *Speed.* You set wind speed by simply typing in a number. Simply tab on to the next parameter.

Pilots

Select as above. *Perfect* pilots never make mistakes (hah!). *Average* pilots might ignore some commands, misinterpret others, execute a command intended for another aircraft, forget to turn at fixes, and do many other things that make life "interesting" for the controller in reality. *Lousy* pilots make it miserable. The most perfect sequencing of approaches can be totally destroyed by one turkey who misses the approach and has to come around again for resequencing, or a pilot who just doesn't understand or hear what you want him to do.

If pilot skill other than *Perfect* is selected, be prepared for the following sorts of pilot errors:

- Pilot does not reply to a command. Normally, every command you give will be at least "roger'ed" by the pilot. A short unobtrusive beep accompanies this reply, simulating the aural feedback of a normal radio transmission. If you do not receive this confirmation that the pilot heard and understood your command, then you must assume that he did not hear it and will not execute the last command unless you issue it again.
- "Please say last command again." He missed the command and needs it repeated in full. He continues his previous actions until you repeat the command. There are many variations of this action, including, "Sorry, approach. Had my head in a map. Please say again..." etc.
- Pilot misinterprets a command. For instance, when given a left turn he might turn right instead, or a turn to heading 080 might be implemented as a climb to 8000 feet. Problems like this are insidious. He might echo the command as he understood it, but then again he might not! It's up to you to spot his mistake and correct it for him!
- The wrong pilot might start executing a command not intended for him. Really tricky to detect, but it happens, especially when callsigns are similar (e.g., N12898 and N21989)!

- An aircraft overshoots a flightplanned turn or doesn't hold where required. For instance, assume an aircraft is tracking an airway heading 100 degrees. The airway veers right to 125 degrees, but the aircraft continues straight ahead after the turning point. Or, when climbing to 6000 feet, the aircraft continues its climb past that assigned altitude. Again, it's up to you to notice this sort of error and gently correct it without damaging the pilot's ego.
- A pilot strays from some assigned value. Told to climb and maintain 10000 feet, he gets there, levels off, then gradually over time descends down through 9000. Or, limited to 160 knots, he lets his speed creep up to 250 knots.

You should expect that pilots of the simpler aircraft will make more mistakes more often than those of the more complex, just as in real life. Airline pilots have probably flown their routes hundreds of times, but a doctor tooling around in his Bonanza probably doesn't get much actual IFR time and is likely to be less familiar with procedures in the area.

Emergencies

The sky is perfectly clear ... no threat of thunderstorms or high winds ... all-in-all an exceptional day for flying. In real-life, however, emergencies happen occasionally — or frequently. A pilot's seemingly standard request for vectors around a weather system may quickly turn into a life-threatening situation if the weather is more severe than he or you thought. Or, more seriously, he may report that he's running low on fuel, that he's lost an engine or that there's a fire on board. Combine one of these with an inexperienced pilot or two, and you can be in for a major headache.

Frequency of emergency situations is selected in the same way as any other dialog box parameter. Depending on how much stress you can stand (enjoy?), choose from:

- *None.* Everything is running perfectly, with all aircraft flying happily along on their way to their final destinations. Non-perfect pilots might miss a command or two, but they won't request vectors and nothing especially bad will happen to you during this scenario.

- *Maybe*. A more realistic scenario: occasional emergencies of varying severity will be announced, along with requests for new vectors or altitude assignments. The severity of the weather will affect the frequency of pilot requests. The wind may shift around enough that the tower controller will announce that he's changing the active runway in five minutes. You might get an engine out or engine fire, but relatively few true emergencies happen at this setting.
- *Nightmare*. All Hell breaks loose! Severe weather might block the path of small aircraft and close down one or more airports indefinitely, requiring you to hold your traffic until the wind shear or thunderstorm cell passes. Disaster strikes LAX, the runways are shut down for an undetermined amount of time, and you've got a 747 inbound with an engine on fire! Not challenging enough? Add lousy pilots, equipment failure, and stormy weather, all at once! And pass the Alka-seltzer...

Equipment

TRACON II comes delivered so that your radar data processing (RDP) equipment is perfectly reliable, always associating a datatag with the radar return of each aircraft. Choosing *Unreliable* will cause your equipment to fail from time to time, just as in real life. When this occurs, the datatags on your radarscope will disappear and the little aircraft icons will be replaced with primary target "blobs" for an indeterminate period of time varying from a few seconds to several minutes. Choosing *Off* will disable RDP permanently so that you can experience the non-RDP equipment that many of the smaller and foreign TRACON facilities must use.

The Screen

In real life, a controller's work area is cluttered with computer-generated icons and hatch marks on his scope, printed strips of paper all over his console, taped-up communications frequencies and notes to himself, and of course, the radar targets of the aircraft in his sector. Your screen is considerably simpler, although your basic control task can be just as complex as his.

File Radarscope Detail Simulation F1=Help

Pending	
N13HZ PA42 215k 100'	T/O ONY BAYST Ctr
N5670 PA42 205k 70'	TRINE UNV Tur
UA092 M89 350k 120'	T/O LAX 0201 SOLED
AL17 728 320k 120'	T/O LAX AHEIM Ctr
N909 86 155k 70'	T/O ONY BAYST Ctr
N402 728 215k 90'	T/O LAX 025 ALBAS
KE731 737 220k 90'	T/O LAX SAUCS Ctr
N4331R PA60 215k 100'	T/O TOR MIDDS Ctr
Active	
N2420 TB-21 100k 90'	AHEIM TOR Tur
N47 C318 175k 50'	TOR AHEIM Ctr
IB109 737 465k 120'	LAX HASSA Ctr
DL596 728 250k 90'	SAUCS LAX Tur
N2ES PA60 210k 100'	MERMA UNV Tur
BA176 728 220k 100'	TRINE 023 LAX Tur
PA340 727 355k 110'	0204 LAX Tur

App/Dep: PA340, Cleared for ILS approach, ...
 PA340: Thanks. Contact tower at FAF.
 App/Dep: Good day.

Los Angeles 09:05:22
 Scope -99

For all examples in this manual, we will use the Los Angeles sector (LAX.SEC). Please refer to the map facing the next page and the flying chart previously shown in Chapter Two for the examples in this section.

Your computer screen is divided into five basic areas for this simulation — the main *Radarscope* itself, which represents these charts electronically; the *Pending* flightstrips, which tell you what aircraft are coming at you; flightstrips of *Active* aircraft; and the *Communications* area where your interactions with the active aircraft and other control personnel are echoed.

Radarscope

Naturally, the largest area of your screen consists of the radarscope. It is black with green lines and icons just like in real life. Imagine it as a bird's-eye view of your sector, with airports marked as circles (their ILS instrument approaches shown as funnels to FAF points, non-precision approaches shown as lines), intersections and radio beacons shown as plus signs. You should pay careful attention to the representation of these elements on the radarscope — after some



practice, you will begin to memorize the locations of the airports, important fixes, and even airways connecting them.

Since an instrument flight does not proceed by reference to ground landmarks, it must use some electronic method of locating its position. Radio beacons have been established for this purpose, and most planes fly from one beacon to the next. Like highways on the ground, these established routes of flight are called *airways* and have been given unique names. Low altitude ones are called Victor airways and usually are denoted by a 'V' followed by a small integer. High altitude ones are called Jet airways and are denoted using a 'J' instead of a 'V'. Scattered among these physical radio beacons are intersections of these airways, created by the intersection of specific radio beams from two beacons. Taken together, these beacons and their intersections form *fixes* which allow planes to determine their precise location in space while flying in clouds. During IFR flying, airplanes generally fly from one fix to another, usually along airways, so flightplan clearances typically are stated as a sequence of fixes and airways.

To approach and land at an airport after flying there in the clouds, pilots and controllers alike consult appropriate handbooks which list the published instrument approaches for the destination airport. Usually only one or two of these are in use at any one time, depending on the wind direction and traffic. On this TRACON II radar-scope, the active instrument approach is shown as an elongated triangle, using a nomenclature similar to that shown in pilots' instrument flying charts. As mentioned before, the controller's job includes vectoring an aircraft so that it can be handed off to the tower at a position from which it can initiate an instrument approach to the airport.

On the scope aircraft will appear and move around. Each aircraft is shown via a small aircraft icon oriented in the direction of travel. Information about that aircraft is shown next to it, offset by a leader line to one of the eight major compass directions (N, NE, E, SE, S, SW, W, or NW). The information shown includes its ID number on the first line and its current altitude (in hundreds of feet) and groundspeed on the second. If it is climbing or descending to a newly-assigned altitude, a small up/down arrow will appear in the middle of the second line.

Notice how the controller has written notes to himself on the real flightstrips shown here. These remind him of commands he has already given to the aircraft, or of commands yet to be given that he must keep in his head.

XXX494J C310/A T180 G150 L4F ³⁴ 03	SALVO 2001 LCH	20 26	80	BTR V70N DAR LCH V70 GLS LCH: V70 V100 HIG	@173
XXX350F PA34/F T160 0179	LCH 1956	20 10	70	HOU. / LCH V20 MICRO LFT VOTC SCR 5211R LFT	@154
XXX134X AC50/U T180 507 ³⁴ 01	LCH 1935 LFT P1935	50/16sw 1935	80 80 A10	LFT 230 LCH T180 LCH LFT V20 LCH V306 DAS DWH V266	@153 D LFT

Pending Flightstrips

About five minutes before an aircraft will be handed off to you from the Center or wishes to takeoff from one of the airports in your airspace, a flightstrip will be posted on the Pending stack (located on the top righthand side of your display, light blue on color displays). A flightstrip gives you information about the aircraft's type, current position (including location, altitude, and speed), and requested flightplan (or route).

A flightstrip looks like this in TRACON:

```
SK234 707 250k 100'
MIDDS V165 SLI DOWNE LAX Twr
```

This particular aircraft, Scandinavian Airlines flight number 234, is a 707 flying at 250 knots (all aircraft, even jets, are required to fly at or below 250 knots at or below 10,000 feet), level at 10,000 feet. Your control sector only extends upward to around 12,000 feet — above that, the Center handles it, so that a nonstop flight from San Diego to San Francisco level at 25,000 feet would never appear on your scope.

This airliner is coming in from MIDDS intersection (one of the fixes that instrument pilots use to locate themselves using radio naviga-



tion when flying in the clouds); will travel via Victor airway number 165 to the Seal Beach radio beacon, then direct to DOWNE intersection, then direct to the LAX airport where the tower there will assume final control for landing.

If you do nothing, the Scandinavian Airliner will proceed blithely along this course and arrive at LAX doing 250 knots at 10,000 feet. Your job, then, is to get SK234 down from 10,000 feet to LAX's 1900 foot FAF altitude without vectoring it too close to any other aircraft under your control.

Recall that you can control an aircraft by either turning (real controllers say "vectoring") it, asking it to climb or descend to a particular altitude, giving it a speed assignment, or holding it at a specified fix. Each simulated aircraft has performance parameters (select from the **Detail** top menu or use speed key **Ctrl+A**) which limit and circumscribe these options.

For instance, aircraft make "standard rate" turns so that their headings will always change at about three degrees per second. A jet will thus use up far more airspace than a piston single during a turn, for example. Each aircraft stalls out below a certain speed and cannot exceed other maximum cruising speeds, and each climbs and descends at various rates typical for its type (generally between 500 feet per minute and 3000 feet per minute). Using the performance envelope for each type of aircraft, TRACON II's simulated aircraft will move through space in a manner consistent with, but not exactly equal to, the performance parameters shown for its type. In other words, an aircraft whose normal cruise speed is 150 knots might enter your airspace actually doing 142 knots, for example.

An aircraft is posted to this stack five minutes before becoming active, giving you the opportunity to look over its intentions before having to do anything about them. You may select an aircraft in the Pending stack and display its intended flight path visually onscreen, but otherwise you cannot control these aircraft.

Active Flightstrips

The flightstrips of all active aircraft are shown in this (light green) area of the screen below the *Pending* stack. Each aircraft occupies two lines and you may use the screen commands to select aircraft here, scroll their flight plan lines, scroll the entire *Active* stack up and down, and otherwise view all the active aircraft. Note that the first line of each flightstrip remains constant, with the speed and altitude shown being the requested altitude of that aircraft rather than the actual values.

Communications

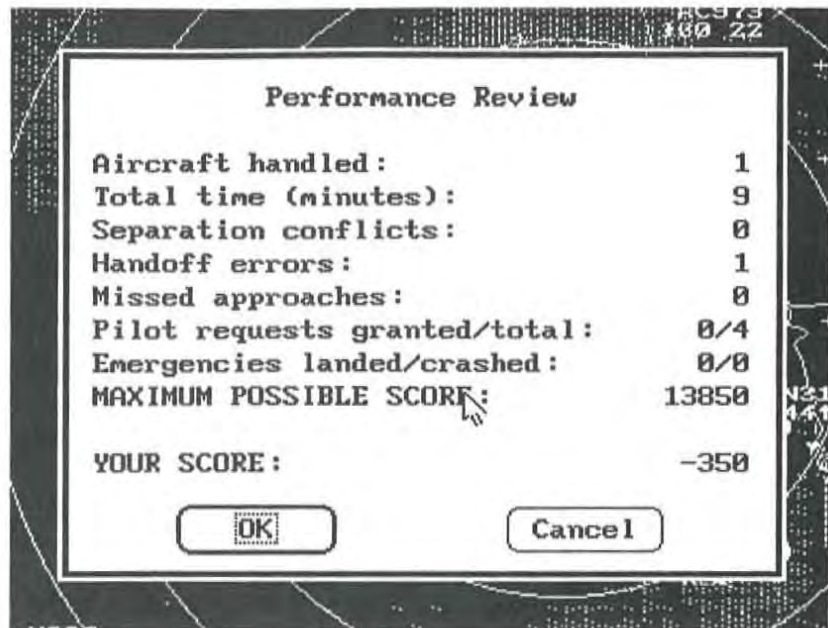
Since the IBM PC does not come with a voice recognizer and synthesizer, just below the radar scope is the (light purple) written Communications area. Consisting of three to six lines, depending on your monitor, it echoes all communications between you, the active aircraft, and the adjacent controllers, as well as other commands you have entered and the simulation's responses to those commands.

You will soon notice that interactions between yourself and the pilots are relatively standardized. Whenever you accept a handoff from Center, the communications box echoes your "*aircraft id*, radar contact" transmission. When you issue a descent and the target aircraft hears it, he responds with "*aircraft id*, descending to *newly-assigned-altitude*" This phraseology has been adapted from current procedures.

Exit Dialog Box

At the end of a successful scenario, an *Exit* dialog box will popup displaying your final score (broken down by error types). Similarly,

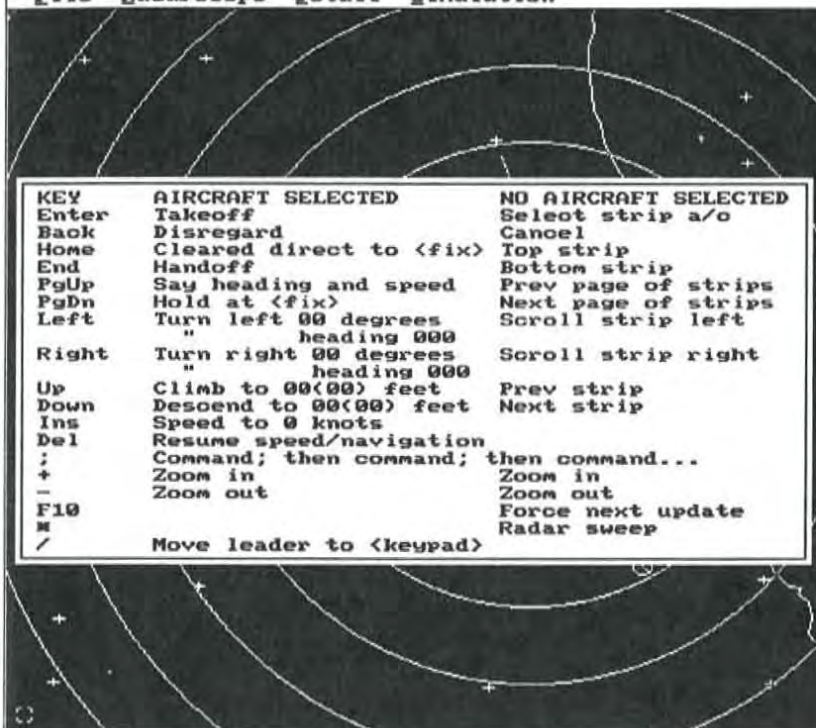
you may popup this box at any time during a scenario by selecting Exit from the File Menu.



Select OK to end the simulation and return to DOS. Select Cancel to return to the current scenario or to start a new one.

OnLine Help

As has become standard with most microcomputer programs today, TRACON II has online help available via the F1 function key. Pressing F1 will give you information about the twin uses of the keypad keys – what commands they issue to selected aircraft, and how they manipulate the flightstrips when no aircraft is selected.



KEY	AIRCRAFT SELECTED	NO AIRCRAFT SELECTED
Enter	Takeoff	Select strip a/o
Back	Disregard	Cancel
Home	Cleared direct to <fix>	Top strip
End	Handoff	Bottom strip
PgUp	Say heading and speed	Prev page of strips
PgDn	Hold at <fix>	Next page of strips
Left	Turn left 00 degrees	Scroll strip left
	heading 000	
Right	Turn right 00 degrees	Scroll strip right
	heading 000	
Up	Climb to 00(00) feet	Prev strip
Down	Descend to 00(00) feet	Next strip
Ins	Speed to 0 knots	
Del	Resume speed/navigation	
:	Command; then command; then command...	
+	Zoom in	Zoom in
-	Zoom out	Zoom out
F10		Force next update
M		Radar sweep
/	Move leader to <keypad>	

Pending

N644V PA34 165k 50'
I/O DPA BOJAR Ctr

N7925Y J-3 65k 90'
COROL DPA Tur

N14H V35 135k 100'
THORR DPA Tur

PI195 727 320k 120'
I/O ORD OBK Ctr

N560 LA250 105k 70'
* OBK PAK Tur

PI902 D10 420k 110'
* PLANO ORD Tur

Actives

No Actives

PI902 heavy: With you level at 11000.
N560: With you level at 7000.
App/Dep:

Chicago 00:00:07
Score 0

4 Controlling Aircraft

This chapter discusses how to issue commands to the aircraft in your sector, for which there are usually several alternative methods available.

Command Syntax

As you have probably noticed by now, the general format of an aircraft command as stated verbally is:

aircraft id followed by
command followed by an optional
parameter

For example, to climb a N123DV to 6000 feet, a controller would say:

N123DV,	<i>aircraft id</i>
Climb and maintain	<i>command</i>
6000 feet	<i>parameter</i>

Or to clear the same aircraft directly to the Torrance airport, he would say:

N123DV	<i>aircraft id</i>
Cleared direct to	<i>command</i>
Torrance airport.	<i>parameter</i>

Some commands have no parameter slot:

N123DV	<i>aircraft id</i>
Resume normal navigation	<i>command</i>

So the general syntax for an air traffic control command is:

1. The aircraft you want to maneuver;
2. What you want that aircraft to do (turn, climb, etc.); and

3. The value you want the aircraft to achieve when it finishes the command (heading to turn to, altitude to climb to, etc.)

Every command must begin when only the *App/Dep:* prompt is showing on the last line of the *Communications* section; if something else is showing after that prompt, you are midway through some other command and should cancel it before continuing by pressing the **Esc** key.

Selecting Aircraft

The first part of each command requires that you “select an aircraft,” which can be done in a multitude of ways.

1. Click once on the aircraft icon or its flightstrip, or
2. Type in enough of the aircraft ID to uniquely identify it. This involves the end of the aircraft identifier, not the beginning — “N3953T” would normally be called “Cherokee Five Three Tango” on the radio and abbreviated here using its trailing “53T”, not the leading “39” as you might otherwise expect. Terminate with any whitespace character (space, **Enter**, comma, etc.); or
3. Use the **arrow** keys to highlight the aircraft’s flightstrip and press **Enter**.

To reselect a just-previously-selected aircraft, simply press **Enter** again. This is especially useful for issuing a rapid-fire sequence of commands to the same aircraft.

To cancel a selected aircraft, either click on the next aircraft, press **Enter** again, or press **Esc**. An aircraft is selected when you see its full ID echoed just after the *App/Dep:* prompt, and the next command you issue will affect that aircraft as though you had keyed your microphone and said, “Southwest Two Three Four, please ...”

If the aircraft you selected is awaiting takeoff, pressing **Enter** again will immediately clear it for takeoff and you should see it on your screen within a minute or two once it gains some altitude. If you are

using a mouse, double-click on the flightstrip. Unless you intervene, the aircraft will automatically turn on course and climb to its flightplanned altitude. A second **Enter** like this will similarly accept inbound handoffs. With a mouse, double-click on either the flightstrip or the aircraft's icon.

Issuing Commands

For all other aircraft maneuvers, you may then complete the command with a keypad key followed by a typed-in parameter followed by **Enter**, or you may double-click on the aircraft icon/flightstrip. With both methods, the commands are echoed in the *Communications* area of the screen, followed by the pilots responses.

Keypad Control Commands

<u>Command</u>	<u>Keypad</u>	<u>Parameter</u>
Turn right (heading) ...	Right arrow	000 or 00 degrees
Turn left (heading) ...	Left arrow	000 or 00 degrees
Climb and maintain ...	Up arrow	hundreds of feet
Descend and maintain ...	Down arrow	hundreds of feet
Change speed to ...	Insert	knots
Resume normal speed/nav.	Delete	
Cleared direct to ...	Home	fix name
Handoff to Tower or Center	End	
Hold at	PgDn	fix name
Say heading and airspeed	PgUp	

If you press the wrong keypad key, the **Backspace** key will undo it and you can then repress the correct one.

Turn (to a Heading of) ___ Degrees...

For the first two vectoring commands, if the last parameter is a two-digit number, the turn is a relative turn; if a three-digit number, it is a turn to an absolute heading. For example, "53T, right-arrow 20" is

echoed as "N3953T, turn right 20 degrees," but "53T, right-arrow 020" will read "N3953T, turn right heading 020 degrees" (that's a North-northeast heading).

Climb/Descend and Maintain ...

Altitude changes are accomplished with the **up-** and **down-arrow** keypad keys. Pressing **up-arrow** after an aircraft has been selected will issue a "Climb and maintain..." command, while pressing **down-arrow** issues its inverse: "Descend and maintain...". Since controllers almost never assign altitudes in other than hundred foot intervals, the altitude parameter is entered in hundreds of feet. Typing in "19" will assign an altitude of nineteen hundred feet, while typing in "100" will assign ten thousand feet. A pilot will complain if you type in something like "6000" for the altitude assignment, since you are really asking him to climb to six hundred thousand feet (which would be in low earth orbit!).

Reduce/Increase Speed to ...

The **Ins** key is the speed assignment key. Use this to slow down or speed up an aircraft. Your assignment must be within the performance capabilities of the target aircraft or its pilot will complain. For instance, asking a Boeing 727 to slow down to 100 knots will just not work, since that aircraft stalls at around 120 knots. And asking a Cherokee to speed up to 250 knots is similarly futile.

Resume Normal Navigation

Speed restrictions are tremendously useful, but you should remove them as soon as possible, since pilots hate them and your score will therefore suffer. The **Del** key accomplishes this and simultaneously gives the aircraft authority to proceed directly to the next fix in its flightplan and from there along its previously-planned route of flight. It basically means "Cancel any restrictions I have placed on you and continue normally along your flightplan." The assigned altitude remains unchanged, however.

Cleared Direct to ...

The **Home** key clears an aircraft directly to a fix. After pressing it, you must type in a fix (intersection or radio beacon) name or just the **Enter** key. If you just press **Enter**, the aircraft will proceed directly to the next fix in its flightplan. If you actually type in a fix name, the aircraft will then proceed direct from its present position to the fix you typed.

An alternative way to indicate the destination fix for a "Cleared direct to..." command is to click on it using the left mouse button. That way you do not even have to remember its name!

Cleared for the Approach/Handoff to Center

The **End** key is used to handoff an aircraft to the appropriate tower or center controller specified as the last item in the aircraft's route on the flightstrip. When you clear an aircraft for an approach, it will turn and intercept the approach course for its destination airport. You still have control of the aircraft until it reaches the FAF, whereupon it will switch over to the tower frequency and you will be unable to contact the aircraft unless it misses the approach and the tower hands it back to you for another try.

If the aircraft reaches the FAF without being at the required final approach altitude for the airport or is more than 30 degrees off the final approach heading, the aircraft will automatically execute a missed approach and fly outbound on the approach heading at its last assigned altitude. You must then bring the aircraft around again for another try, losing points in the process for inefficient fuel use and loss of time.

Similarly, if you attempt to handoff an aircraft to the center before it is within five miles of the handoff fix, the center controller will tell you that because it cannot yet see the aircraft on its radarscope it is unable to accept the handoff. If the aircraft is not at its requested altitude when it reaches the handoff fix, an error will still occur but the handoff will be accepted and the center controller will try to sort out the mess you created for him. Finally, if an aircraft has requested vectors around weather, you may hand him off at a nearby fix other than the one he filed for.

Hold at ...

Pressing the **PgDn** key will command an aircraft to proceed directly to a fix and hold there until you release it. Aircraft cannot really just stop in space like helicopters can. Holding an aircraft requires that aircraft to fly in a circular pattern based upon the fix location until you tell it to "resume normal navigation" or clear it directly to another fix. This maneuver is aviation's equivalent of "just a moment" but deducts points since the aircraft is burning fuel while waiting in place. Pilots hate holding more than almost anything you can do to them!

Say Heading and Speed

The **PgUp** key asks the selected aircraft to say its current heading and airspeed. Its real life counterpart is frequently used when a controller needs more precise information than he can deduce from his display to space aircraft properly for landing or intercept the glide slope.

Ending Keypad Control Commands

When you've finished entering the complete aircraft command, pressing **Enter** will automatically issue that command to the selected aircraft. If the pilot heard it and makes no mistakes, the aircraft will execute the command as issued and you are free to issue the next one. Of course, average and especially lousy pilots make mistakes, and so you will sometimes have to repeat commands or correct a pilot's interpretation of the command you issued to him.

If you end a command with a **Semicolon** instead of the **Enter** key, the command becomes part of a multiple-part, stacked command that can guide the aircraft's movement in complex ways. Pressing **';** echoes **" ; ... then ..."** and you are expected to begin another command for the same aircraft as though you kept your microphone button depressed and just continued speaking.

For instance, a nice SOP (standard operating procedure) for taking inbounds from the Southeast into LAX is:

<i>aircraft id,</i>	Cleared direct to DOWNE;
then	Turn left heading 245;
then	Speed 180 knots.

An aircraft executing this stacked command will turn immediately and head straight for DOWNE intersection. Upon reaching DOWNE, it will then turn left heading 245 degrees (which will intercept the final approach course for LAX nicely). When the turn is completed, it will then begin slowing down to 180 knots.

Stacked commands are executed in sequence, with each subcommand beginning immediately after the previous subcommand completely finishes. This means that an aircraft must reach a cleared-to fix or the newly-assigned altitude, speed, or heading before the next subcommand will be executed. (To have multiple changes going on at once, you can use the traditional commands terminated by **Enter** — the aircraft will execute all such commands immediately upon receipt.) Also, please note: you may NOT include a handoff instruction (End key) in a stacked command. Handoffs, which necessarily involve coordination with adjacent sector controllers and frequency switching by the pilot, must occur in real time.

If, during execution of a stacked command, you issue a real time command to the same aircraft, the type of the commands determine the resulting actions. Speed, altitude, and heading commands are regarded as separate types. A newly-issued command of one type will erase all stacked subcommands of the same type, but not those of different types. Thus, using the above example, if the flight is heading for DOWNE and you issue the real time command,

"aircraft id, Turn right heading 340"

then the stacked commands to head for DOWNE and then turn left to 245 will be ignored. The speed command in the list will continue in effect, however, and will become the active command from the stacked command list, so *aircraft id* will begin slowing to 180 knots immediately. If an aircraft is executing a stacked command to proceed directly to a fix then descend to a new altitude, and you clear it to another altitude before it reaches that fix, then the stacked conditional descent will be ignored.

Pressing the Del key will cancel all stacked commands for an aircraft, of course, and force it to resume normal speed and navigation.

Note that communication stops during your construction of stacked commands, just as it does when your microphone button is depressed in real life. If you take too long in constructing such a command, you might end it and have several take-off requests and other backed-up communications quickly scroll by.

The best way to understand stacked commands is to practice using them in "don't-care" simulations.

Mouse Control Commands

As previously mentioned, you may select an aircraft using the mouse by clicking on its icon or its flightstrip. This simulates your pressing the microphone button and stating the aircraft's call sign. A command would normally be issued next from the keyboard.

The screenshot shows a flight simulator interface with a radar scope and a list of aircraft. The radar scope displays several aircraft icons and their flight paths. A mouse control menu is overlaid on the radar, listing commands like Left, Right, Alt, Speed, Resume, Direct, Hold, and Handoff. The aircraft list on the right shows call signs, altitudes, and destinations.

File RadarScope Detail Simulation		F1-Help																												
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Left.. Right.. Alt.. Speed.. Resume.. Direct.. Hold.. Handoff </div>																														
<table border="1"> <thead> <tr> <th colspan="2">Chicago</th> </tr> </thead> <tbody> <tr> <td>KI558 737 230k 100'</td> <td>T/O ORD COROL Ctr</td> </tr> <tr> <td>N839C L24 425k 110'</td> <td>T/O MDW PAPPY Ctr</td> </tr> <tr> <td>A123 AB2 210k 100'</td> <td>T/O ORD BOJAK Ctr</td> </tr> <tr> <td>N4796 737 220k 100'</td> <td>T/O ORD YEARN Ctr</td> </tr> <tr> <td>UA158 737 420k 110'</td> <td>T/O ORD BEBEE Ctr</td> </tr> <tr> <td>N624 PA42 210k 70'</td> <td>FLAND MEC Tur</td> </tr> <tr> <td>N67C PA42 200k 50'</td> <td>T/O DPA FARMH Ctr</td> </tr> <tr> <th colspan="2">BOSTON</th> </tr> <tr> <td>N390J LA250 195k 50'</td> <td>YEARN DPA Tur</td> </tr> <tr> <td>LH186 737 200k 100'</td> <td>ORD BOJAK Ctr</td> </tr> <tr> <td>N17X C402 220k 50'</td> <td>BOJAK DPA Tur</td> </tr> <tr> <td>N255N TB-21 175k 30'</td> <td>FARMH MEC Tur</td> </tr> <tr> <td>N25T PA24 135k 90'</td> <td>LAIRD MEC Tur</td> </tr> </tbody> </table>			Chicago		KI558 737 230k 100'	T/O ORD COROL Ctr	N839C L24 425k 110'	T/O MDW PAPPY Ctr	A123 AB2 210k 100'	T/O ORD BOJAK Ctr	N4796 737 220k 100'	T/O ORD YEARN Ctr	UA158 737 420k 110'	T/O ORD BEBEE Ctr	N624 PA42 210k 70'	FLAND MEC Tur	N67C PA42 200k 50'	T/O DPA FARMH Ctr	BOSTON		N390J LA250 195k 50'	YEARN DPA Tur	LH186 737 200k 100'	ORD BOJAK Ctr	N17X C402 220k 50'	BOJAK DPA Tur	N255N TB-21 175k 30'	FARMH MEC Tur	N25T PA24 135k 90'	LAIRD MEC Tur
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N25T PA24 135k 90'	LAIRD MEC Tur																													
App/Dep: LH186 heavy, Released. N390J: With you level at 5000. App/Dep: N390J, Radar contact. App/Dep: LH186 heavy.		Chicago 00:02:55 Bravo 0																												

If you double-click on an aircraft's icon, however, a command box pops up near the aircraft and you will be able to complete the command with at most two more clicks.

All mouse commands may be issued by at most four button presses — a double-click to popup the command box, a click on the command, and (possibly) a click on a parameter box or fix to complete the command. The following options are available on the popup mouse command menu:

Mouse menu	Command
Left ..	Turn left to a heading of ..
Right ..	Turn right to a heading of ..
Alt ..	Climb or descend to .. feet
Speed ..	Make your speed .. knots
Resume	Resume normal navigation/speed
Direct ..	Cleared direct to ..
Hold ..	Hold at ..
Handoff	Handoff to center or tower

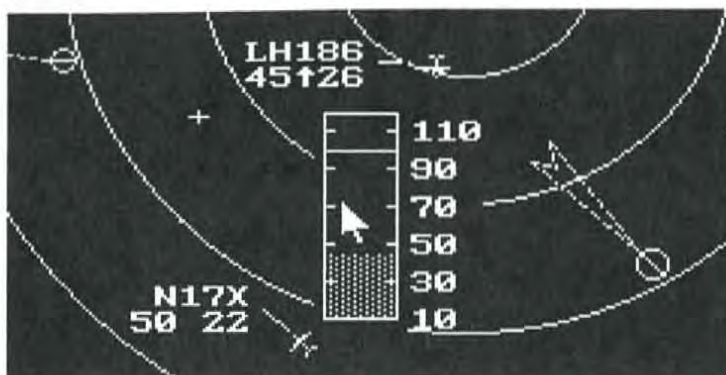
As you move the mouse pointer down the list of options, each one will highlight as the mouse passes over it, and you may select it with a simple click. The options which are followed by two dots require one more click to complete the command:

Left .. or Right ..



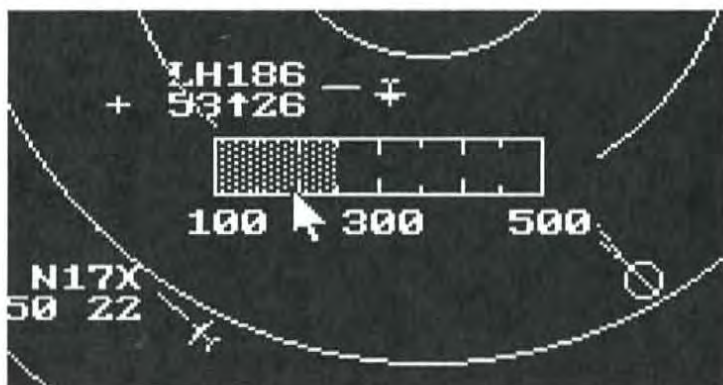
A compass rose replaces the mouse menu. Click anywhere on the circle to complete a heading command to the nearest 5 degree increment.

Alt ..



An altitude "thermometer" replaces the mouse menu. The filled-in part of the thermometer shows the current altitude, while the assigned altitude (if different from the current) is shown as a white bar. Click on the thermometer at the new altitude assignment.

Speed ..



Like altitude, but a horizontal tape appears. It runs from 50-250 knots with 25-knot increments. Click on the new speed assignment.

Direct ..

The mouse menu disappears. Click on a fix and the aircraft will be cleared directly to that fix, whose name will echo in the communications area.

Hold ..

Similar to the "Direct .." mouse command, but the aircraft will proceed to the indicated fix and hold there.

Handoff

The aircraft is handed off to either a tower or Center controller in the same fashion as if the End key were pressed.

Mouse-issued commands are echoed in the *Communications* area the same as keypad-issued commands, and at any time during a mouse-issued command, you may complete it using its keyboard equivalent. To cancel a partially-constructed mouse command, simply click outside the popup mouse box.

To issue a stacked command using the mouse, press the *rightmost* mouse button after the final parameter portion of a mouse-issued command. The mouse command box will repop and you may stack another command after the one you just issued completes. See the above keyboard section for more details about stacked commands.

5 Controlling The Simulator

In Chapter 3, you were introduced to TRACON II's user interface, methods and terminology for issuing commands, setting parameters via dialog boxes, and the main elements of the screen. Chapter 4 taught you how to control the aircraft in your sector using keypad or mouse commands. This chapter details how to use the top level menu bar to access and activate information boxes, display or suppress features on the radarscope, and to customize the simulator to your taste.

The File Menu



The File menu is used to create a New simulation, Open a previously saved scenario of flight plans, Save a set of flight plans as a scenario, Close a running simulation, or Exit the program to DOS.

New ...

In Chapter 3, we presented the New ... command for creating a new simulation. Recall that the first dialog box that pops up after selecting this option asks for your name, the sector in which you wish to control traffic, and the difficulty of the scenario as measured by the number of aircraft the simulator introduces over how many minutes. If you select the Setup >> button after setting these parameters, you are taken to a secondary dialog box that enables you to change such items as the weather, wind speed and direction, pilot capabilities, and type and frequency of emergencies and equipment failures.

Save Flight Plans ...

You may save any scenario of flight plans by choosing the Save Flight Plans ... option during an active scenario. It will pop up a

dialog box asking for a filename for saving the scenario — just type in any legal DOS eight-character or less main filename. TRACON II will save the flight plans of the current scenario under that filename with a SIM extension for reuse later on.

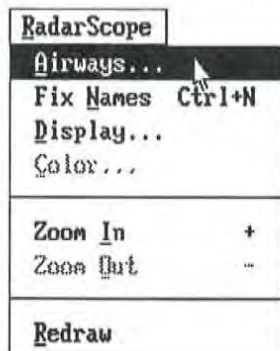
Open Flight Plans ...

The **Open Flight Plans ...** command pops up a dialog box containing all previously saved simulations, including TRACON II's demo and lesson scenarios as well as the scenarios you have saved yourself. Select a scenario from the list box (using the up/down arrow keys on the keyboard or in the scroll bar to see all possibilities) and choose **OK** to activate that scenario using the current setup. If you want to change the setup before starting this saved scenario, choose the **Setup >>** option and the same Setup dialog box as with the **New ...** command will popup.

Close ...

Close ... pops up the performance box, displaying a breakdown of your score. See Chapters Three and Six for more information about the contents of this box. Selecting its **OK** button will finish the close operation, leaving the radarscope blank to begin a new or previously-saved scenario, while selecting the **Cancel** button will cancel the close operation and return to the previously-active scenario.

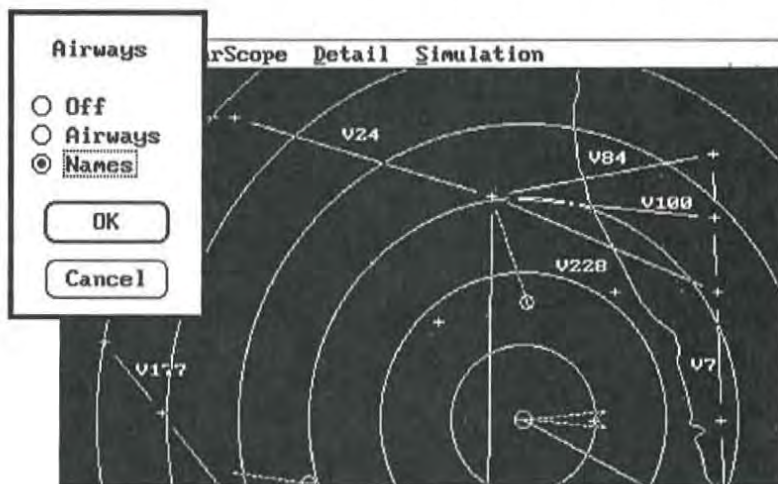
The Radarscope Menu



The Radarscope menu allows you to display the airways (including names) and fix names onscreen, as well as toggle various elements of the display such as your sector's boundary, the ground terrain, a compass rose, and the like. It also enables you to change colors and zoom in/out on your map. Generally speaking, the items that affect the radarscope area of the screen occupy this menu.

Airways ...

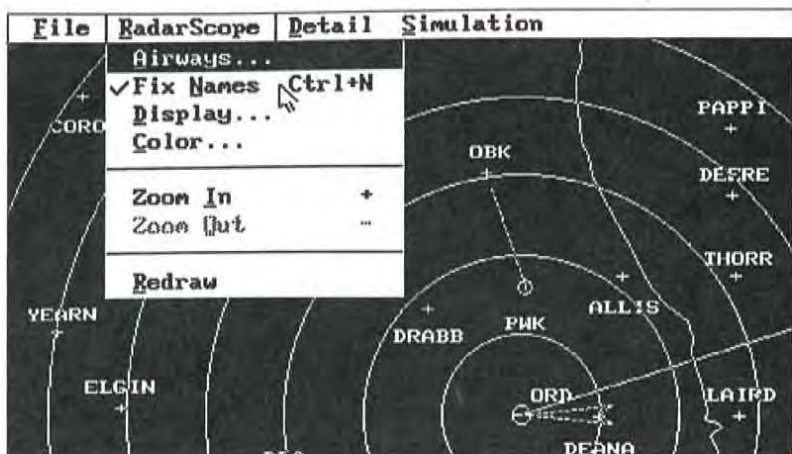
Choosing Airways ... pops up a dialog box containing check box fields from which you may choose to display no airways, the airway connecting lines between fixes, or both the airways and their names on the radarscope. In the latter case, the aircraft targets will disappear for one revolution of the radar sweep while the airway names are displayed, after which the scope will revert to its previous status. If you turn on just the airways themselves (i.e., no names), however, they will remain displayed until you turn them off again.



Note that TRACON II defaults to no airway display just as in the typical real TRACON facility. However, since ARTCCs (Centers) routinely display airways, we have included this option so that TRACON II can function as a rudimentary Center simulation as well.

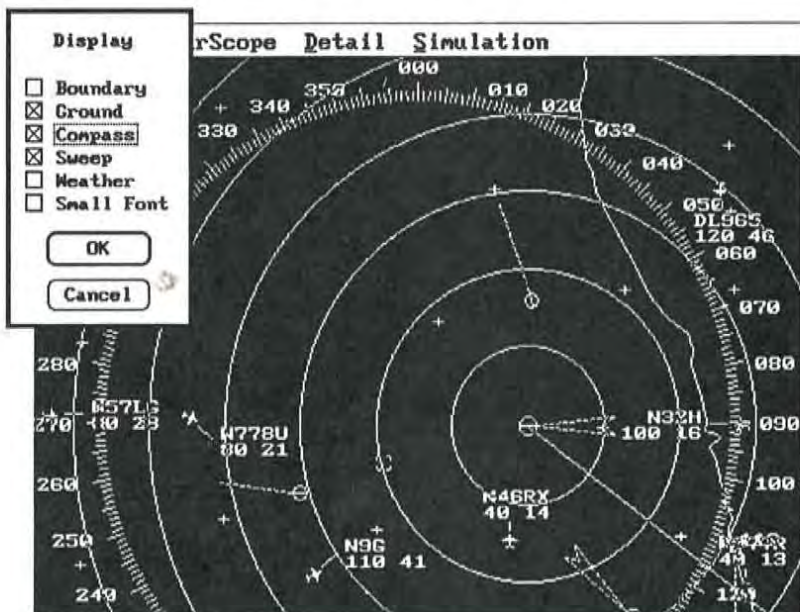
Fix Names Ctrl+N

Choosing the **Fix Names** option will display the names of all airports and fixes on the radarscope for one complete revolution of the sweep, after which they will automatically disappear and the targets will return.



Display

Display ... pops up a dialog box containing check box fields, enabling you to toggle on/off your sector's Boundary, Ground features, a reference Compass, radar Sweep, and Weather cells, as well as for changing the size of the datatag lettering by using a Small font. Each of these settings affect the scope permanently, at least while TRACON II is running.



Check or toggle **Boundary** to display the edges of your sector. Fixes along the boundary determine where aircraft will enter or exit your control, so displaying this boundary will give you a good visual indication of entry/exit points. TRACON II comes delivered with the boundary turned off.

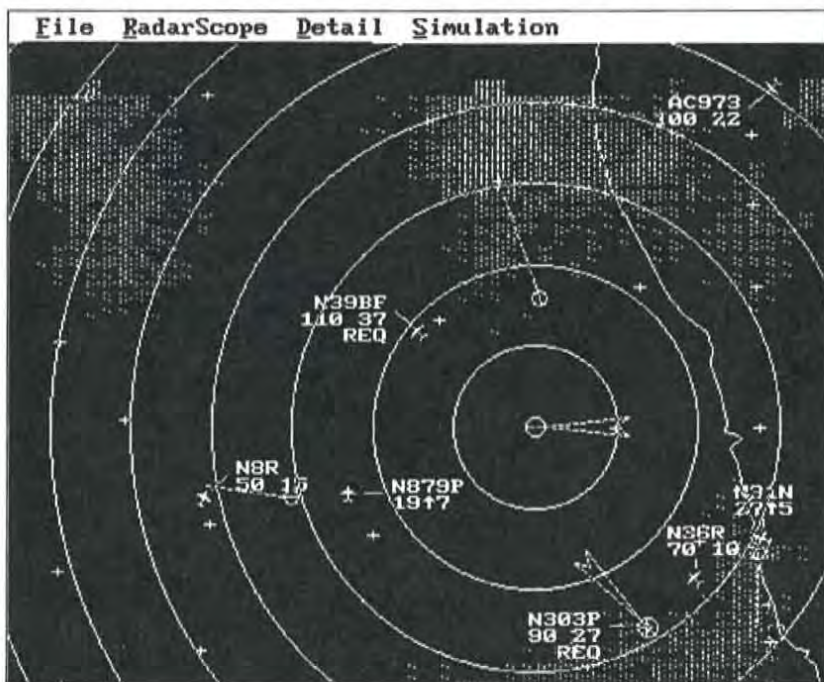
Toggle **Ground** to display coastlines and other geographical features within your sector. This starts out turned on.

The **Compass** command will display a red compass rose on the radarscope, allowing you to more accurately select headings for aircraft in your sector. Normally turned off.

Sweep toggles the radar sweep on/off. Delivered turned on.

Monochrome (especially CGA) users note: You can probably achieve superior performance by turning the sweep off, because it interferes with the aircraft datatags on monochrome displays far more than on color displays.

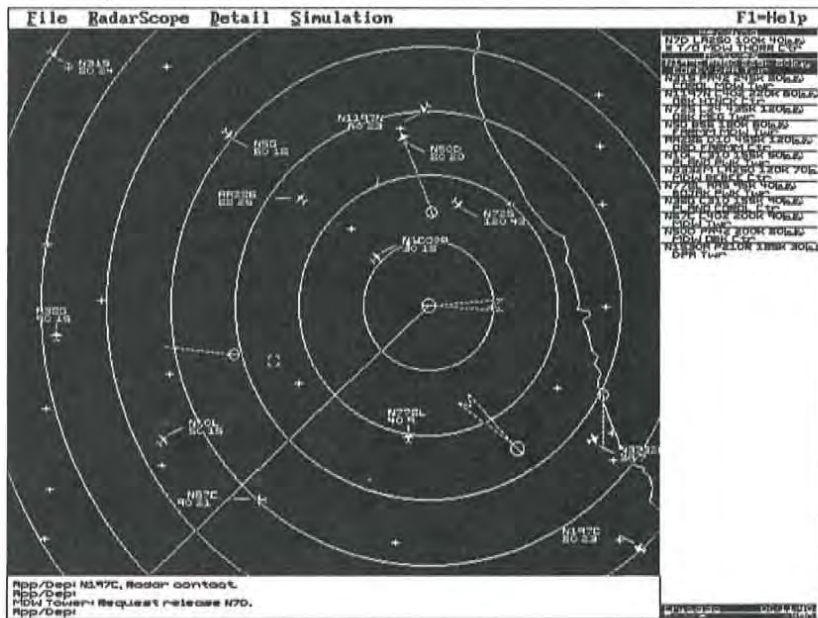
Weather allows you to see weather cells moving through your sector. The presence of weather is controlled via the Setup >>



dialog box extensions to the New ... and Open Flight Plans ... menu selections, but this option controls whether or not to display it. In other words, if you have selected any Weather/Setup >> option besides IMC, weather will be generated and affect aircraft behavior, but you can choose to not display it using this toggle. TRACON II comes so that what weather there is shows on the radarscope.

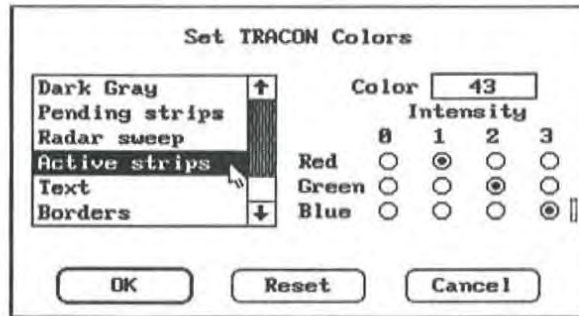
Monochrome (especially CGA) users note: You can probably achieve superior performance by turning the weather display off, for the same reason as you would turn off the sweep.

Small font allows you to make all letters on your screen smaller, thereby increasing the relative size of the radarscope. The small font on a VGA display gives you a 1:96 ratio of font:screen height — the same ratio as on an expensive high-resolution 1024x768 monitor. Although the small font is harder to read, it is especially useful when you are handling a large number of aircraft and need to decrease the size of their datatags. *Note: the small font is always activated on CGA screens to achieve acceptable resolution — it cannot be turned off.*



Color ...

This dialog box allows you to change the color and intensity in any portion of the screen using both list fields and radio button fields. You may customize any or all of the following portions of your screen:



Background	Radar map
Communications	Targets
Inbound targets	Top menu bar
Caution box	Error box
Flight path	Button
Button shadow	Pending strips
Radar sweep	Active strips
Text	Borders

Select **Color ...**, then highlight the feature that you want to change. The current color and intensity will appear as a bar in the upper right portion of the box. This color is composed of the three screen colors red, green, and blue. Each of these colors may take on one of four intensities, giving you 64 possibilities for each color ($4 \times 4 \times 4$). When you select the individual color component (red, green, blue) and set its intensity (0-3), the new color will appear in the dialog box color bar (and on the corresponding screen element, if it is showing behind the dialog box). Click the **Reset** box to reset the colors to the defaults specified in the TRACON.INI file (see Chapter Eight for more information).

Zoom In +

Choosing this command (easiest by pressing the '+' key) will zoom the radarscope on the selected or last-selected aircraft. Each press will increase the zoom by a factor of two, so that after you press it once, the scope is shown at 2x magnification, and after the next press it is shown at 4x. You can thus look more closely at a congested area, but be careful — events might be occurring offscreen that could demand your attention.

Zoom Out -

This command performs the inverse function — it zooms back out after you have zoomed in on a particular area of the screen. If you are displaying the radarscope at 4x, select **Zoom Out** once to zoom back to 2x magnification, and again to return to the original 1x.

The Detail Menu

Detail	
Aircraft	Ctrl+A
Flight Plan	Ctrl+F
Airport...	Ctrl+I

Aircraft ... Ctrl+A

If you would like to see detailed information on a particular aircraft, select the aircraft's icon or flightstrip, then choose the **Aircraft ...** option.

Callsign: N9G
Type: L23 (Learjet)
Class: CorpJet
Crew: 64

Top speed: 473 kt
Cruise speed: 425 kt
Approach speed: 160 kt
Stall speed: 120 kt
Rate of climb: 3000 fpm

Weight: 7025 lb
Wingspan: 35.6 ft
Length: 43.2 ft
Ceiling: 51000 ft
Range: 1323 miles

Armament:
None, civilian



An information box will popup showing that aircraft's silhouette and performance parameters, including its full name and type, climb, cruise, and approach speeds, climb rate in feet per minute, etc. The information box will disappear with the next radar update.

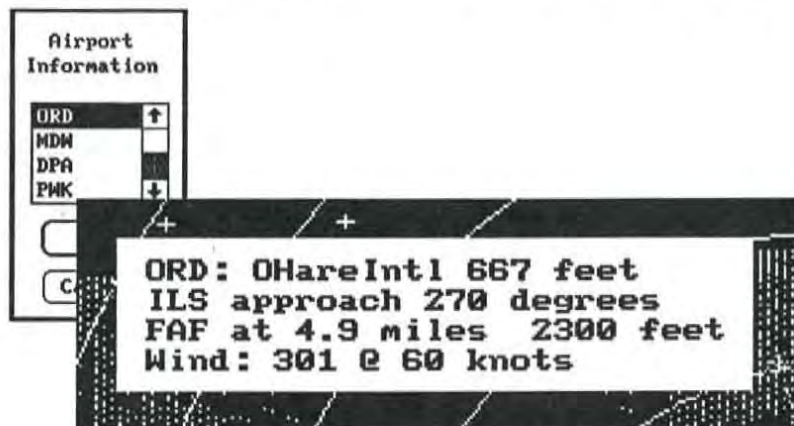
Flightplan **Ctrl+F**



Select an aircraft icon and choose **Flightplan** to draw a line that traverses the aircraft's flightplan on the radarscope. (It will disappear with the next radar update.) This command is incredibly useful to see just where an aircraft will go once it becomes active, or where the rest of its nominal flightplan would take it. Expert TRACON II controllers use it frequently.

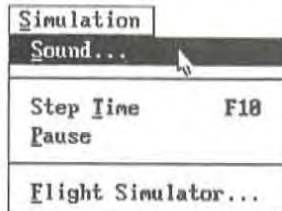
Airports ... **Ctrl+T**

If you need information on an airport in your sector, select **Airports ...**, then choose the one you need from the list field in the dialog box.



An information box will pop up showing details for the desired airport and the airport name will appear next to the airport icon on the radarscope. This is especially useful when you forget the FAF altitude for an airport in your sector. Current wind direction and speed for that field is also shown — something that you may want to know to anticipate when the tower might have to switch runways on you. (Note that, as in real life, the wind in TRACON II may veer from the direction you originally set in the **Setup >>** dialog box. Its speed may change over the course of the scenario, too!)

The Simulation Menu



Sound ...

TRACON II provides realistic sound in each simulation, including pilot and ATC voices and background noise.



Choosing **Sound ...** lets you toggle on/off any or all voices (via radio buttons) and noise (e.g., telephone rings from the tower, the conflict alert beeper, etc.).

Step Time

F10

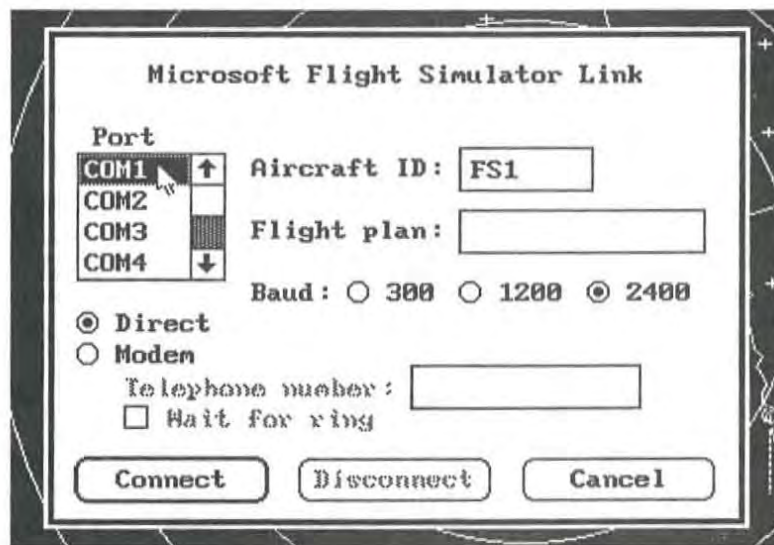
This command jumps the simulator's clock forward one cycle. Held down or repeated, it forces the computer to zip the aircraft across the screen as fast as its processor can go. Since a real controller's life is hours of boredom punctuated by moments of sheer terror, do not use this command if you want to experience what a controller really does, but it does save time when simply finishing out a scenario and also allows you to skip over boring periods when nothing interesting is happening.

Pause

You may **Pause** the simulation at any time, but this is cheating and will automatically result in the loss of 10,000 points. Choose **Pause** again to return to normal mode.

Flight Simulator ...

This command pops up the Flight Simulator dialog box, allowing you a direct link with another computer running Microsoft Flight Simulator. For detailed information on the TRACON II - Flight



Simulator link, see Chapter 7. This dialog box uses both text fields and check box fields for entering parameters. When the link is activated, Flight Simulator aircraft will appear on TRACON II's radarscope in the same way as any other aircraft.

Flightstrip Commands

Another set of simulator commands does not require an aircraft to be selected — they generally manipulate the flightstrips and the display in general. Issue these commands by clicking with the mouse, or with the keypad. If an aircraft is selected (and showing on the *App/Dep:* command line), then the keypad issues the middle phrase of a three-part aircraft control command. If no aircraft is selected, the keypad controls the flightstrip display.

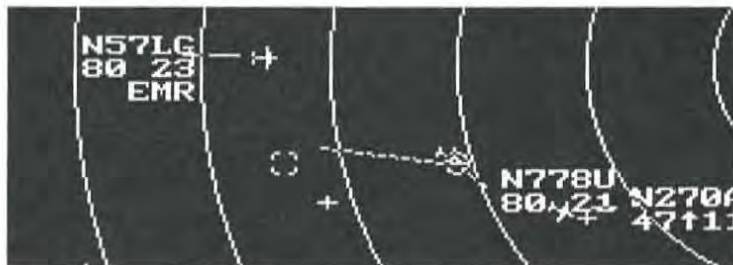
Keypad	Meaning
Down arrow	Highlight the next flightstrip, scrolling down as necessary
Up arrow	Highlight the previous flightstrip, scrolling up as necessary
Right arrow	Scroll the highlighted flightstrip's route right one column
Left arrow	Scroll the highlighted flightstrip's route left one column
PgDn	Next page of currently-selected flightstrips (either Pending or Active)
PgUp	Previous page of currently-selected flightstrips
Home	To first flightstrip in current area (either Pending or Active)
End	To last flightstrip in current area

Remember: If an aircraft is selected (and showing on the *App/Dep:* command line), then the keypad issues the middle phrase of a three-part aircraft control command. If no aircraft is selected, the keypad controls the flightstrip display.

Annotating Datatags and Flightstrips

In TRACON II, as with a real TRACON's radar data processing equipment, an optional third line may be appended to each aircraft's datatag. The information in this line is also shown after the final fix on the second line of the aircraft's flightstrip. Normally, a controller will use this feature to post little reminders to himself, such as the target's destination, temporary altitude assignments, and the like.

To exploit this feature, first select an aircraft using any of the methods described above. Then, instead of pressing a keypad command key, simply type at the main keyboard and press **Enter**. You may enter up to fifteen characters (letters, numbers, spaces, etc.), all of which will be shown at the end of the second flightstrip line. To see such reminders in their entirety, you must scroll the flightstrip left or right one word at a time by pressing the **left/right arrow** keys with that flightstrip selected — see Chapter Five for more information.



Only the first eight characters of this reminder will be shown on the datatag on the radarscope. To erase a reminder line, select the aircraft and press **Spacebar** followed by **Enter**.

Whenever a pilot request or emergency occurs, this third datatag line will automatically be given a small notation — **REQ** for pilot requests and **EMR** when an aircraft declares an emergency. See Chapter Six for more information.

Moving Leaderlines

At some point during any simulation, the screen will become cluttered with inbound and outbound aircraft and their accompanying leader lines. The more aircraft you're handling, the more crowded the screen. This will inevitably lead to overlapping, and therefore unreadable, datatags, but you may change the position of as many leaderlines as necessary. You may select from any of eight positions.

With the mouse, point to the aircraft icon; then, while holding the button down, drag the leaderline to the desired quadrant. Release the button when you have the leaderline in position. With the keypad, highlight the aircraft, then press / (slash) followed by the (white) keypad key that matches the quadrant you want the leader to move the datatag to (clockwise from the top): **Up-arrow** = N; **PgUp** = NE; **Right arrow** = E; **PgDn** = SE; **Down-arrow** = S; **End** = SW; **Left arrow** = W; **Home** = NW.

6 Make a Plan and Make It Work!

The title of this chapter is an old saw in ATC circles. It means that you have to think ahead and commit yourself to a plan of action and then follow through decisively. Bad control emerges from making tentative calls and then constantly revising them. In this chapter, we will discuss how to make that plan, how to make it work, and what to do when it falls apart!

Elements of Good Control

A good air traffic controller handles traffic at several mental levels at once. The basic FAA manual of Air Traffic Control requires that a controller "Give first priority to the separation of aircraft ... and to the issuance of safety advisories." What this means operationally is that your first priority is to insure that aircraft never be permitted to come within a prescribed distance of each other. In TRACON, as is generally true throughout the system nationwide, this means three miles or a thousand feet.

If they do, you have caused what is called a "separation conflict." In today's safety-oriented ATC environment, even one such separation conflict is cause for disciplinary action. You should never tolerate a separation conflict, even in this simulation. A real air traffic controller's life is spent in a zero-tolerance environment where no mistakes are allowed. Your goal should be the same: separation restrictions must always take precedence over your other activities.

Once you have separation achieved, there are other requirements you face:

Arrivals

Arrivals must be set up for their approach via a series of vector and descent commands. Typically, Center will have descended an arrival from its cruising altitude to somewhere near the top of your

control sector, ten to twelve thousand feet or so. When you first see the aircraft on your radarscope, its blinking will indicate that Center has offered you the handoff. After selecting the aircraft and pressing Enter, you have accepted it and can now issue control commands. Usually, you must continue its descent down to the FAF altitude for its destination airport. This altitude is listed in the airport information at the back of this manual and is available online by choosing **Detail/Airports ...**, then selecting the desired airport from the dialog box.

Then, while the aircraft is descending, you must vector it into alignment with the approach course. If you have multiple aircraft inbound for the same airport, you may also want to use speed adjustments to set up all the aircraft on extended final approaches with minimal separation. Although vectors are usually given in absolute magnetic headings (e.g., "...turn left heading 170 degrees"), a handy shortcut is to turn aircraft relative to their current heading (e.g., "...turn left 20 degrees"). This latter command syntax allows you to make small adjustments to an aircraft's course without having to remember its current heading.

Once you get an aircraft within the vicinity of the approach course, you can use the End key to clear it for the approach into the airport. The aircraft will immediately turn to a heading that will intercept the final approach course, fly that heading until it is lined up for the approach, then continue inbound to the final approach fix where its pilot will switch to tower frequency and begin a descent to the field. Unless the aircraft misses this approach, it becomes the tower's responsibility at that point and you are finished with it.

Departures

Although an airport's control tower "owns" the runway and clears all departures for take-off, they must have your permission to release an IFR departure. You therefore can determine when to take an aircraft off after the tower informs you that the aircraft is ready. Bear in mind that the aircraft is sitting at the end of the runway with its engines running, so you should try to release a departure as soon as possible after you receive that request.

Once you release a departure, the tower clears it for take-off and the pilot begins to rev-up his engine. After a few moments, he starts his

roll down the runway and before long is airborne. Since your radar cannot pick up targets until they reach a few hundred feet in the air, you will typically not see a departure on your radarscope until a minute or so after you release it.

Once airborne, a departure will begin turning to its on-course heading and climb to its flightplanned altitude unless you direct him otherwise. It will climb out at a normal rate of climb for that aircraft until it reaches its flightplanned cruising altitude, then level off and continue flying on course. You may, at any time, alter these initial instructions with vector, altitude, or speed commands of your own, but the aircraft must be at its requested altitude, speed, and outbound fix when it reaches the edge of your sector for handoff. If you do not issue any instructions to the aircraft before it reaches that outbound fix, and the aircraft has not climbed enough to reach its requested cruising altitude, you may still hand it off to Center normally there. If you have countermanded its normal procedures with instructions of your own, however, you must hand it off at the flightplanned altitude and speed.

Overflights

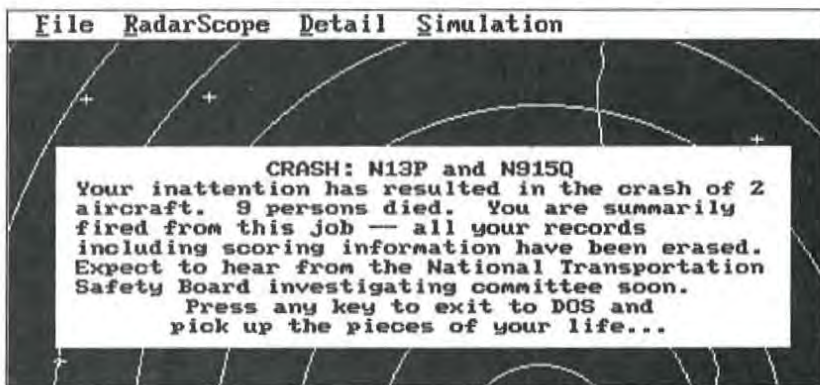
Many aircraft will merely transit your sector, flying from an entry fix to an exit fix straight-and-level. These are typically the easiest aircraft to handle, since all you really have to do is accept the entry handoff and then hand them off to Center when they reach the exit fix.

They do tend to complicate your control problem, however, since they tend to remain on your scope for long periods of time. Remember also that airline overflights tend to cruise at flight level altitudes (e.g., above 18,000 feet) so the overflights you get will usually be general aviation aircraft with relatively slow cruise speeds. A Piper Cub cruising at 50 knots will remain on your scope for a long time, cluttering it and making coordination with the faster traffic more complicated.

Keep 'Em Apart!

TRACON II, like its real-life counterpart, has many constraints placed on your ability to accomplish the above procedures. Violating the primary constraint, so that aircraft do indeed come too close together, can cause three different types of errors.

The most critical of these is not to *Crash* two (or more!) aircraft together. A Crash is defined as a separation of less than 1/2 mile horizontally and 500 feet vertically. If that occurs, the simulation ends immediately: you lose your job, all your employment records (i.e., previous high scores) will be erased, and you will be unceremoniously dumped back to the DOS prompt after an unpleasant message about the number of people you have killed (computed based upon the number of passengers in the aircraft involved) and about your probable future. The program may recommend that you enter psychological counseling for killing those poor unsuspecting passengers, for instance. Causing an airplane crash is not something to be taken lightly, even in TRACON II!



A less serious error is a *Near Miss*, defined as separation of less than one mile and 1000 feet vertically. This and all other errors subtract from your point score, depending on their severity. This one subtracts a lot — it is the worst thing you can do and not be immediately dismissed. It is accompanied by a high-pitched lengthy wail that should awaken you to your error and keep you from ever wanting to do that again.

The least serious separation error — a simple *Separation Conflict* — will occur when you break the 3 mile/1000 foot rule mentioned before. While not as severe as a near miss, you still receive a reprimand and a long series of beeps. As in real life, the computer continuously monitors for these separation errors and automatically notes them in your performance review.

The above errors are substantial. The latter two are cumulative, in that every sweep of the radar will announce the error anew and deduct points from your score. Thus, the longer you have a separation conflict in progress, the more it counts against you.

Handoff Errors

Interfacing with adjacent controllers, you must accept and handoff aircraft properly, too. When an aircraft first appears on your radarscope, it will blink and announce itself in the *Communications* section. You will first see the aircraft at the edges of your scope and it will be traveling directly to the inbound fix shown on its flight-strip. If you do not accept the handoff by selecting the aircraft and pressing **Enter** (or by double-clicking on the aircraft with a mouse), it will reach the end of its Center clearance and go into a holding pattern at the inbound fix and stay there until you accept the aircraft. This, of course, will ultimately deduct from your score, since it stops the aircraft's forward motion through your sector and hence increases its delay.

Landing aircraft must be cleared for the approach before reaching the FAF for their destination airports. If you have successfully vectored them so that they arrive at that FAF within 200 feet of the required altitude for the approach and heading within 30 degrees of the final approach course, then the Tower for that airport will accept the aircraft and they will disappear off your scope normally as they descend on the instrument approach. If an aircraft is not within this envelope when you attempt a Tower handoff, it must declare a missed approach and continue on the approach heading at its last assigned altitude until you bring it around again for another try.

Handoffs to Center for aircraft leaving your airspace must be handled properly, too. If you have vectored (or allowed its own internal navigation to get it there) an aircraft to within five miles of

its flightplanned outbound fix at its requested altitude, then the Center will usually accept your handoff. Of course, during bad weather, the Center controller may have his hands full with the aircraft already in his airspace, so you will occasionally "hear" him reply to your handoff request that he is too busy to accept an aircraft just then. You will simply have to hold the aircraft or vector it around for a couple of minutes and try again later. Eventually, Center should accept your handoff.

Coordinating with Center is sometimes touchy. If you attempt to hand an aircraft off to Center when the aircraft is more than five miles from its outbound fix, the Center controller will report that he cannot yet see the aircraft on his scope and to call again later. Also, if you do not have the aircraft at its flightplanned altitude and speed at the handoff point, a yellow *Caution* message box will popup and points will be deducted from your score. This is not a severe error, but it does increase the workload for the Center controller and cause him to question your abilities.

If you forget to make the handoff altogether and allow the aircraft to reach its outbound fix or the edge of the radar without a handoff, a yellow box will popup reminding you that you let the aircraft fly out of your sector without coordinating with the adjacent controller. Losing an aircraft like that from your scope is really bad form.

Occasionally, as these sorts of errors occur or other information needs to be shown, a small box will temporarily popup on the main radar screen. The color of this box will mirror its contents:

- | | |
|---------------|--|
| Red | Bad error. Near Misses, Separation Conflicts, and losing an aircraft off your scope produce this color box. |
| Yellow | Not-so-severe error. Missed approaches or letting an aircraft exit your radarscope without a handoff will generate a yellow box error. |
| White | This sort of box displays routine information such as aircraft performance or airport parameters (only when you request it). |

Keep 'Em Happy

Pilot-initiated actions — requests and emergencies — are normal parts of an air traffic controller's daily routine. Requests are usually for simple things like vectors around weather cells, a different altitude, or a destination change. If you ignore such a pilot request, that pilot may continue to announce his request until you acknowledge it or he has been cleared through your sector. If you can comply with his request, you get bonus points for doing so; but you don't lose any if you can't, although it's still a hassle listening to him gripe at you.

Some requests, however, result from your lack of attention. If you forget to descend an arrival, for instance, he may "request" a lower altitude as he closes in on his destination. In these sorts of cases, the pilot is really doing your job for you. You will lose points for these types of oversights.

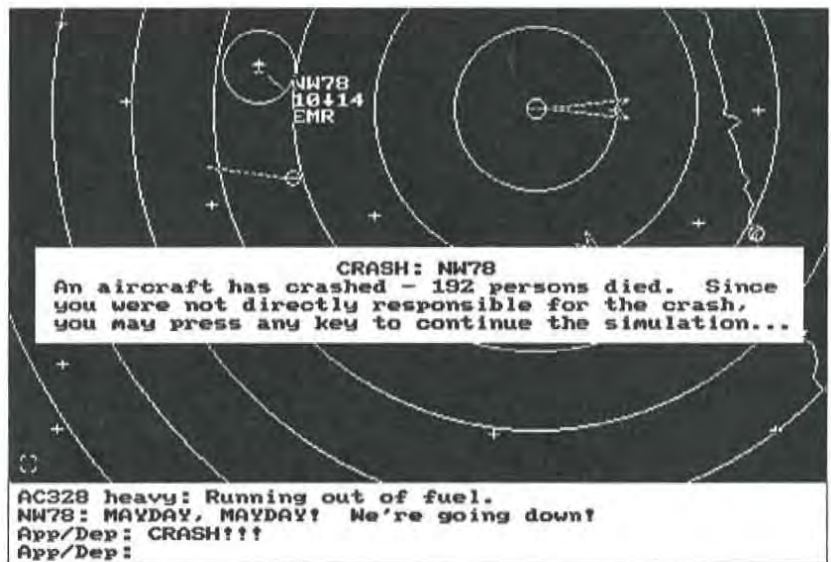
In even the most uneventful flights, pilots are always making the above types of requests, such as *Request destination change to ...* or *Request descent for approach to airport..* But severe weather conditions along an aircraft's flightpath or an on-board emergency situation can increase the urgency of these requests. Pilot requests under these conditions include *Request vector around weather*, *Request lower/higher altitude*, and *Request vector back to airport.* (if you have let him fly past his destination without an approach clearance).

Pilot requests result in the reminder REQ being posted in the aircraft's third datatag line.

Bring 'Em Down Safely

Pilots are notorious for keeping cool under threatening situations. Often the simplest sounding request may, if ignored or handled incorrectly, result in an emergency situation. Allow an aircraft to fly into heavy weather and it may wind up inside a thunderstorm cell, lose control, and crash. At the very least, the pilot might declare an emergency. Whenever that happens, your life gets really interesting!

All emergencies will eventually result in a crash unless you vector and land the aircraft first. If a crash does occur as the result of an inflight emergency, TRACON II will not simply terminate like it will if you caused the crash by vectoring two aircraft together. It will, however, pop up the crash box and deduct a substantial number of points, depending on the situation. If you ignored the emergency, the deduction will be even larger, so you had best pay attention whenever someone announces that he's "got a little problem up here."



Most emergencies can be handled by vectoring the aircraft declaring the emergency to the nearest airport for landing. However, if an aircraft has engine trouble, runs out of fuel or loses control, it cannot gain altitude or increase speed, and the pilot will inform you of this if you ask him to do so. The aircraft will, instead, slow down and start losing altitude. Commanding it to descend to a lower altitude may stop its decline temporarily, allowing you a little time to decide on the best course of action for handling the situation.

There are several levels of severity for emergencies. For instance, the first you hear about an onboard fire might be the pilot announcing *Uh, we've got a little problem up here...Smoke in the cockpit.* The third datatag line of the affected aircraft will have the reminder EMR posted. Should you fail to respond quickly enough, this will

be followed by *Emergency! Emergency! Smoke in the cockpit!* Continued failure to respond will result in a Mayday declaration, for which there are three levels. You should continue trying to get him down safely until you hear the fateful *Mayday! Mayday! Mayday! We're going down!* which is the last thing you'll ever hear from him.

Typical Emergency and Mayday situations include at least the following:

Emergency/Mayday! Low on fuel!
Emergency/Mayday! Lost an engine!
Emergency/Mayday! Engine running rough!
Emergency/Mayday! Fire on board!
Emergency/Mayday! Hydraulic failure — losing control!
Emergency/Mayday! Severe turbulence — losing control!

Airport Closures

Emergency situations don't always occur in the air. Weather, natural disasters, and terrorist threats will sometimes require an airport to close for an undetermined and varying amount of time. Whenever an airport is reported closed, you may instruct incoming aircraft to hold position, or vector them to alternate destinations. And aircraft awaiting release will have to wait, leaving you with a large number to clear through your sector when that airport reopens.

The tower may report *Runway closed due to disabled aircraft ... bomb threat ... terminal fire ... earthquake damage ... inclement weather.* Or it may simply report *Runway unsafe, wind shear detected.* Later, the tower will report *Runway now open,* but you as the controller have no way of knowing how long it will be and must issue commands to aircraft in your sector accordingly.

Scoring

As you successfully handle an aircraft, your score will rise according to how well you did with it. You get points each time you make a successful handoff (to either Tower or Center), but those points are adjusted downward by the distance you required the aircraft to travel beyond its requested flight path. Points are also subtracted according to how long you held the aircraft on the ground or at its inbound fix before accepting it. Finally, points are deducted for every control command you gave to the aircraft (except when you're responding to pilot requests). Remember — your job is to be unobtrusive. The more you "interfere" with an aircraft's planned route of flight, the worse you are doing (at least from his individual perspective).

Since different types of aircraft use fuel differently, the actual number of points awarded after handling an aircraft depend on its type. Military jets gulp fuel at an astounding rate and generally merit the most such fuel-related point adjustments. In descending order of importance, airline jets, corporate jets, twins, and then piston singles also get you points when they are finished.

These adjustments are relatively minor compared to the sorts of negative deductions that occur with errors, emergencies, and crashes. Points (far more, generally) are deducted whenever you make any mistake mentioned above during the simulation. In sum, then, the more aircraft you successfully handle per unit of time, the higher your performance review at the end.

See Chapter Eight for more information on point values for the various aircraft operations.

7 *Linking With Flight Simulator*

TRACON II can link with other computers running Microsoft Flight Simulator (versions 3 and above only) for realtime controller-to-pilot interactions. This chapter describes the procedures for setting up and using this link. The TRACON II menu option **Flight Simulator ...** under the **Simulation** menu pops up a dialog box containing everything you need to set it up.

What You Need to Know Before Linking

You need to know something about how your hardware is set up before you try connecting TRACON II with another computer. Please refer to your computer owners manual if you don't understand the serial port concepts presented below.

What is a Serial Port?

TRACON II links with one or more Flight Simulator computers via *serial ports*. A serial port is a set of hardware components (either an add-in adapter card or part of your computer's motherboard). It allows your computer to send and receive information to an outside device such as a modem, mouse, or specialized piece of equipment. It can send binary information at various *baud rates* such as 300, 1200, 2400 or even higher. These baud rates roughly correspond to the number of bits per second that information are being transferred out of, or into, a serial port.

One Port = One Flight Simulator

Serial ports synchronize with your computer's central processing unit (CPU) via an *interrupt*. On most typical PCs, only two inter-

rupts are available for serial ports, so a maximum of two ports has been defined as the IBM standard. These ports are always referred to as *COM1* and *COM2*. However, by “stealing” interrupts intended for other parts of your computer’s architecture, such as the parallel printer port interrupt, you can install one or even two more serial ports. These are referred to as *COM3* and *COM4*. (Sometimes *COM3* or *COM4* is installed to share an interrupt from *COM1* and *COM2* — this works, but you can still have only two serial ports simultaneously active.) By using multiplexing cards that enable up to eight serial ports to share the same interrupt, such as those made by DigiBoard, Inc., sixteen or more serial ports may be installed on a single PC.

Microsoft Flight Simulator, versions 3 and above, can send flight data (e.g., position, airspeed, etc.) through its computer’s serial port. This capability was originally designed so that two Flight Simulators could communicate with each other. TRACON II can accept and interpret such incoming data and display the Flight Simulator aircraft on its radarscope, as well as send data back over the serial port to the Flight Simulator computer. To link both types of programs, the Flight Simulator computer’s serial port that is transmitting its flight data must be connected to its own incoming serial port on the TRACON II computer. Thus, your TRACON II computer must have as many serial ports available as Flight Simulators that you wish to control.

Where Are the Ports?

Each input/output device on a PC is referenced by an *address*. The standard serial ports *COM1* and *COM2* are always installed at the same standard address, but beyond that, things suddenly get non-standard. TRACON II can support non-standard serial port addresses, as well as (non-standard) DigiBoard products, but you must edit the *TRACON.INI* file so that those ports’ addresses are correct. See Chapter Eight for more information about editing *TRACON.INI* and the specific layout of the serial port information there.

The key item to remember here is that if you are using *COM1* and *COM2*, you need not worry about serial port addresses.

Direct Connection or Modem?

You can connect serial ports either via a direct, hard-wired connection or over the phone lines using a modem. A *null-modem* cable must be used in the former case, which will directly connect the transmit pin of each serial port to the receive pin of the other, and vice-versa.

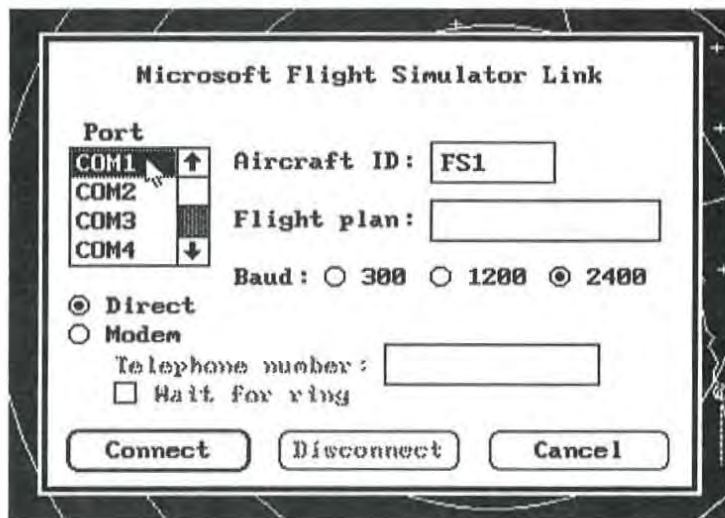
If you are communicating over a modem, one modem will originate the telephone connection while the other will answer it. If you choose to dial the call, TRACON II needs to know the number to call. If not, it may need to wait until your modem autoanswers the incoming call before trying to connect. All this information is entered via the **Flight Simulator ...** dialog box. TRACON II performs all communication with modems via Hayes protocols, (i.e., the "AT" command set) which have become standard.

Activating a Link

To link with another Flight Simulator computer, each of you sets up communication parameters and activates the link with dialog boxes. Your "pilots" should do this from their Flight Simulators — instructions are contained in that manual. Each pilot needs to do it only once. You set up a link to each of them via the **Flight Simulator ...** dialog box from the **Simulation** pulldown menu.

Each time you pop up this box, fill in the appropriate fields, and press the **Connect** button, a new Flight Simulator will be connected. Fill out each field according to the following instructions:

1. **Port.** Select the port that is connected to the Flight Simulator via either a null-modem cable or a modem. When you select the port, the other information in the dialog box may change to reflect the current port settings.
2. **Callsign.** Each Flight Simulator needs its own callsign for TRACON II's and your use. Default callsigns are FS1, FS2, and so forth, but you may enter any callsign up to seven characters in length.



3. **Flight Plan.** You may leave this field blank, but filling it in causes this information to appear as the second line of the Flight Simulator's flightstrip. Usually, you would list a sequence of fixes and airways just as in any real flight plan.

4. **Baud rate.** Match the baud rate set here with that of the Flight Simulator on this port. Since relatively little data needs to be passed, and Flight Simulator apparently has a bug that can cause data loss at high baud rates, only 300, 1200, and 2400 baud are allowed.

5. **Direct.** Push this radio button to select a direct, null-modem connection.

6. **Modem.** Push this radio button if you are using a modem to communicate with this pilot. Additionally, if you are originating the call, type in the telephone number that TRACON II should dial when you press the Connect button. As with most modem protocols, you may use hyphens and commas to separate number groups and pause for a second during the dial. If TRACON II is to wait for your modem to automatically answer the incoming call from the Flight Simulator's computer, check the "Wait for answer" box. If you are establishing connection manually, do not fill in this box and press the Connect button only after you have established the modem connections.

As you select various serial ports, you will see the values in each field change, depending on the status of that serial port. After you have everything set up correctly, push the **Connect** button. TRACON II will dial the modem, wait for it to answer, or just start accepting incoming data, depending on what you requested. In all cases, once the connection is established successfully, you should see a Flight Simulator target appear on your screen.

Working Flight Simulator Traffic

If your Flight Simulator pilots are nearby or you have a telephone line available, you can simply speak your commands to them just as any real controller would. In the Wesson International trade show booth, we use a little wireless headset from Radio Shack that provides voice-actuated or push-to-talk communication over a common channel. A pair of such units sell for about \$70 and might be a good investment if you're interested in communication realism.

However, you and your pilots can also communicate digitally (a capability planned for ATC in the future but not currently available). Your commands that echo in the *Communications* area of your TRACON II screen will automatically pop up just above the instrument panel of the target Flight Simulator. They will appear in full English, even though you just pressed a keypad key. If the Flight Simulator pilot chooses to respond, he can type back to you just the way he would to another Flight Simulator aircraft (see the Flight Simulator manual for details).

Moreover, since TRACON II is also transmitting the coordinates of the nearest target to the Flight Simulator aircraft (either its own phantom aircraft or another Flight Simulator), you can call traffic and the Flight Simulator pilot might be able to see it out his windshield. For instance, if another aircraft is dead ahead, you might call "Flight Simulator one, traffic twelve o'clock, two miles, passing left to right, altitude indicates five thousand three hundred and climbing." The pilot of the Flight Simulator aircraft, depending on his wind crab angle, should be able to look out his windshield (if he has good weather selected) and see the right side of another aircraft in a climb configuration ahead of him. If he passes very close to his traffic, he will see either a Cessna 182RG or a Learjet, whichever of

these Flight Simulator types is closest in performance to the actual TRACON II target.

After you have finished working the Flight Simulator traffic, bring up the **Flight Simulator ...** dialog box again, select the appropriate serial port, and press the **Disconnect** button.

Known bug note: Apparently, Flight Simulator may just stop sending its data. This almost never occurs at the baud rates we are using. But if it does, have the affected pilot turn off and then back on again data communications at his Flight Simulator. Things should revert back to normal.

And that's it! You and your pilots can use your imagination to dream up many interesting scenarios where your computers mediate a simulated reality that otherwise would cost a huge amount of time and money to duplicate in real life. Have fun!

8 *Varying the Simulation*

This chapter describes all the ways you can vary the simulation. You have probably noticed that you can enter your name on the New ... dialog box, as well as change the number of aircraft generated and the time span over which they enter your sector. You can also change the sector itself, as well as weather and pilot capabilities.

These are temporary settings, valid only for the current session. In this chapter you will learn how to permanently change the defaults presented to you in that startup box. You can even permanently change scoring parameters, screen colors, and error probabilities. All this can be done by editing the TRACON.INI initialization file.

TRACON II comes to you configured for an "average" beginning user. Ten aircraft are generated over a twenty-minute period in the Los Angeles sector (the example sector used throughout this manual), resulting in about four aircraft onscreen at once and a total scenario run time of about forty minutes to an hour. This results in scenarios which, although still difficult to handle without any practice, are nonetheless not too slow and boring.

You should be able to reasonably handle these beginner scenarios without too much trouble before attempting to change anything about the simulation. The only exception to this rule might be if TRACON II is not interpreting your graphics card properly in its automatic mode, forcing you to edit the first line of TRACON.INI to fix that problem. See the Video section below for more information.

TRACON Files and What They Do

The distribution diskettes should contain at least the following files. A READ.ME file (if present) will document any discrepancies from this list.

TRACON.EXE The main program. You cannot change anything in this file.

TRACON.INI Initialization file. See the special section below for information on this file's internal structure and how to customize it to meet your particular needs. This is the only TRACON II file that you should try to edit or customize.

TRACON.SMS The small font file. Absolutely essential for CGA systems. Not necessary on non-CGA systems, but must be present if you choose **Small Font** on the **Radarscope/Display ...** dialog box.

***.SEC** Sector data files. Each control sector has one of these files. In the standard distribution version, the following files should be present:

LAX.SEC	Los Angeles
SFO.SEC	San Francisco
ORD.SEC	Chicago
MIA.SEC	Miami
BOS.SEC	Boston
SEA.SEC	Seattle

***.SIM** pre-recorded scenarios. In particular, the following files should be present:

DEMO.SIM	Continuously-running demonstration scenario.
TAPE.SIM	Cassette tape demonstration scenario.
LESSON?.SIM	The prerecorded lesson files. <i>Note: ? = 1, 2, and so forth.</i>

***.DMO** Annotated solution files to the similarly-named *.SIM scenario files:

DEMO.DMO	Annotations and commands to be issued for the DEMO.SIM scenario.
TAPE.DMO	Cassette tape commands for the TAPE.SIM scenario.
LESSON?.DMO	Annotations and commands for the LESSON?.SIM scenarios.

LOGO* . * This set of related files stores the entry screen's logo in different formats for the various graphics cards supported.

*** .VOI** TRACON II's voice comes from highly compressed digitized speech stored in these files.

AIRCRAFT . * Information and parameter files for the various aircraft that TRACON II "knows about."

Other Sectors

If you tire of handling traffic around Los Angeles, if you live in another part of the country and would rather train on a sector closer to home, or would like Flight Simulator's Chicago sector as the default, you can make any sector the default for the New ... dialog box by editing the "Sector" entry in TRACON.INI. See below for more information.

Traffic Loads

After a few hours of sampling TRACON II, you will notice that minutes go by without your issuing any command in the delivered configuration. To make life more interesting, and to continue learning control techniques, shortcuts, and develop standard operating procedures through experience, you should always try to handle the most aircraft per unit time as possible.

You can vary the number of aircraft handled and the time period over which they enter the sector in the startup dialog box. Once you progress well beyond the 10 aircraft over 20 minutes delivered default, you should probably edit the appropriate items in TRACON.INI to automatically default to more appropriate values for your skill level. Notice that the time period for aircraft entry into the sector is always shorter than that taken to complete a scenario, since the last-generated aircraft will take some time to transit your sector.

Just what those values should be depends on your personality. If you like going for high scores, then you should keep the time period relatively long and substantially increase the number of aircraft generated. The score for any particular scenario is increased mainly by the number of aircraft handled and decreased by the number of mistakes and inefficiencies you introduce. For a maximum score, you should therefore handle many aircraft, and that means long scenarios. The maximum number of aircraft you may enter for a single simulation is 99, while the maximum time over which they enter is 99 minutes. Such a scenario will typically require over two hours to complete.

On the other hand, if you like intense but short periods to tune up your skills, you should keep the time period short and continuously increase the number of aircraft generated in that fixed time period. Increasing your scores this way demonstrates more capability than simply lengthening the scenario time to handle more aircraft. You will get better quicker.

A quick note about "average" values for these parameters: After a few hours of concentrated practice, you will probably be able to handle about 20 aircraft over a period of 15 minutes. Decreasing that period to ten minutes and getting through without a conflict of any type is the mark of an intermediate TRACON II user. Once you have generated and handled 20 aircraft that entered your sector within a period of 5 minutes, you will truly know what ATC stress is all about and can consider yourself an expert, at least within the context of this simulator!

The mixture of aircraft categories, routes of flights, and destinations which is randomly generated for a simulation is controlled by the data in *.SEC, which also stores the sector geographical information such as fix and airport locations.

Repeating Scenarios

In Chapter Five we mentioned that you can save the flight plans of a running scenario anytime using the **Save Flight Plans ...** option on the **File** menu. If you do not use this command, the last scenario generated is always saved to a file called LAST.SIM as well. This feature is intended to allow you to rerun selected scenarios, ones

that you had particularly difficulty on or would just like to keep around for later use.

To rerun a particular scenario, you should open it using the **Open Flight Plans ...** dialog box from the **File** top menu bar option. Whenever you **Restart** a scenario from the **Exit ...** dialog box, the current simulation, which has been saved as **LAST.SIM**, becomes the default scenario in that position. Thus, by restarting a scenario, you can handle the same aircraft again, possibly to investigate alternate control procedures or simply try again without making that hideous mistake you just made!

You can also rerun a particular scenario by typing a SIM file's name after *tracon* at the DOS prompt. For instance, you can always rerun the last scenario generated by typing:

```
tracon last
```

to DOS. If you have saved a scenario to disk under the name **FABULOUS.SIM**, you can rerun that one by typing *tracon fabulous* to DOS instead.

TRACON.INI

As mentioned before, you may edit the **TRACON.INI** initialization file with any DOS-file-compatible text editor such as **EDLIN.COM** that comes with DOS or even your word processor. You should make a backup of the distributed version of the file for insurance against errors on your part, and should set up your word processor in "non-document", "program editing", or "DOS" mode. The file has various sections, each of which is composed of individual lines which usually have a key word followed by one or more parameters. The amount of white space is not significant, so you may put as many spaces or tabs between the key word and its parameter(s) as you wish, but the basic format and sequence of the lines in **TRACON.INI** is important and should not be changed.

In this section, we list each line in **TRACON.INI** followed by a short discussion of its meaning and the possible values you can use for its parameter(s).

Monitor**Auto**

The first line in TRACON.INI determines the monitor used. If that line shows "Auto" (the delivered default), then TRACON II auto-detects the monitor you are using and adjusts accordingly. Other monitors can be forced by editing the line so that the desired monitor is specified from the following list of supported monitors:

<u>Monitor</u>	<u>Description</u>
Auto	Automatically query the hardware and adjust to the highest-resolution graphics output achievable
CGA	Color graphics — 640 x 200 black-and-white
MCGA	PS/2 model 25 and 30 — 640 x 480 black-and-white
Hercules	720 x 348 black-and-white
EGA	More than 64K EGA — 640 x 350 16 colors
EGA64	Older EGA with 64K on board — 640 x 350 4 colors
EGAROM	EGA systems such as on the Zenith Z-248 which do not contain the normal EGA font — this option substitutes the regular IBM ROM font instead.
VGA	PS/2 models 50+ or VGA — 640 x 480 16 colors
V800	SuperVGA mode for Video Seven FastWrite, v1024i, and VRAM cards — 800x600 16 colors
V1024	1024x768 mode for Video Seven FastWrite, v1024i, and VRAM cards (requires high-frequency monitor and 512K memory on video card)
P800	Paradise Professional VGA card in 800x600 mode 16 colors
8514	IBM 8514 Graphics card — 1024x768 mode 16 colors

We have observed that some clone EGA/VGA cards may give erroneous responses when our software queries them, perhaps indicating limited 64K EGA capabilities when they can actually emulate the full 256K 16-color IBM EGA or even VGA standard. Or perhaps you have an EGA card driving an RGB (CGA resolution) monitor.

You can try out TRACON II's various monitor options using a command-line switch first and then edit this line in TRACON.INI once you discover the appropriate setting for your system. The syntax of the command-line switch is:

```
tracon /m monitor
```

where *monitor* is one of the above monitor designations. Many Z-248

the Startup dialog box or through the command line. It may have any value from 1-99 minutes.

Weather

IMC

The Setup >> dialog box weather setting occurs next. Allowable values mirror those in the startup dialog box — IMC (Instrument Meteorological Conditions), for the easiest weather; Minimums, for difficult but likely-to-be-completed approaches; Turbulent, for more missed approaches; and Stormy, for the worst weather possible. More thunderstorm cells are generated with the latter weather conditions, too.

WindFrom

60

Initial wind direction. Note that wind direction means the direction the wind is blowing from, not to, so that planes will tend to be swept towards a direction of 180 degrees from the wind direction when you vector them.

Windspeed

0

Initial wind speed. This initial speed will increase with weather conditions — see below.

Pilots

Perfect

This parameter sets up the "Pilot" value in the Setup >> dialog box. There are three possible values: Perfect, where everyone does what you tell them immediately; Average, where they generally execute your commands but might not hear some of them; and Lousy, where they frequently miss commands and some pilots actually execute commands intended for other pilots altogether!

Emergencies

None

Although initially no emergencies and pilot requests will be generated (to let you get used to controlling aircraft before they start

misbehaving on you!), you may change this parameter from "None" to "Maybe" to "Nightmare" and really make things interesting!

Equipment Perfect

This parameter determines whether or not your radar data processing (RDP) equipment fails during use. In real life, the backroom computers which associate datatags with raw radar returns fail from time to time, resulting in a controller seeing only primary radar targets with no tags on the scope for periods varying from a few seconds to several minutes. You may choose to set this parameter from "Perfect," where the equipment never fails, to "Unreliable," in which your equipment might fail perhaps once or twice during a scenario, or to "Off," which never shows datatags at all thereby allowing you to experience the control regime of smaller TRACONs and in-the-field installations which have no RDP capability at all.

Airways OFF

Turning this parameter ON will display all airways that link the nav aids on your scope. Most TRACONs leave airway display off, while ARTCCs leave them on.

Talking Both

This parameter determines how TRACON II starts talking. "On" or "Both" will cause both pilots and controllers to talk through your PC's speaker. "Pilots" will cause pilots to talk to you, but your commands will not be repeated verbally — useful with our voice recognition kit. And "Off" will turn off talking altogether.

Noise ON

You have probably heard the various bleeps, burps, ringing, and warbles that TRACON II makes as pilots and other controllers call you or you make mistakes. Setting this parameter to OFF will cause TRACON II to run silently. Useful with sleeping wives and coworkers.

Boundary **OFF**

Turn this parameter on to display your sector's boundary.

Ground **ON**

Turn OFF to disable the shoreline and other ground features display.

Compass **OFF**

Turn ON to start up with the compass rose displayed.

Sweep **ON**

Initially, the radar sweep and range rings are ON, simulating the full-impact radarscope in a true TRACON II. Many users — especially those on monochrome systems — may find that these display items detract from their primary control task, and so to save the need for pressing '*' to toggle them off when you start, you can simply edit this parameter to OFF and no range rings or sweep will show. You can always turn them on again using the asterisk key at any time during the simulation.

WeatherRadar **ON**

In any but IMC weather, thunderstorm cells will be generated, move around, and disrupt aircraft behavior. You can choose to have TRACON II not display these cells, although their effect will still be felt.

SmallFont **OFF**

Setting this parameter ON will cause TRACON II to start up using its small font instead of its larger normal one. This will improve display congestion at the expense of readability of individual aircraft datatags and flightstrips.

The next section of TRACON.INI determines screen colors. Recall from Chapter Five that you can set the colors of individual screen items using the Colors ... dialog box under the Radarscope menu if you are using an EGA or VGA graphics system. Those color settings are in effect for only that particular execution of TRACON II; to make them permanent, their corresponding color line in TRACON.INI must be edited. Color numbers can vary from 0-63 — the number of any particular red/green/blue combination is shown within the color bar in the Color ... dialog box.

EGA/VGA 16Colors	
0Background	0
1RadarMap	2
2Communication	47
3Targets	58
4InboundTargets	58
5TopMenuBar	59
6CautionBox	54
7ErrorBox	44
8FlightPath	47
9Button	7
10ButtonShadow	56
11PendingStrips	11
12RadarSweep	16
13ActiveStrips	19
14Text	0
15Borders	63

The first color section in TRACON.INI sets colors for EGA and VGA systems. You should only change the color number parameters, not the order or naming of the color items themselves.

EGA 4Colors	
0Background	0
1Targets	58
4RadarMap	2
7Other	55

The second color section in TRACON.INI sets colors for EGA 64K systems. Older, less expensive EGA cards might have only 64K instead of the more typical 256K that virtually all modern ones do. You will know whether or not your EGA system is a 64K one by

observing that only four colors are shown onscreen in the high resolution mode we use, and one of those is black! We have chosen other colors that will permit your system to function yet differentiate between the data and radar background items.

```
CGA Color
0Foreground 2
```

CGA Color sets the foreground color in CGA mode. Color 2 is green (default). The value may be changed from 0-15.

```
Scoring Parameters
add_enroute      500
add_depart      600
add_arrive      800
add_actype      100
sub_command      10
sub_delay        20
sub_pause       10000
sub_enrwrongspeed 100
sub_enrwrongalt  250
sub_enrhandoff   500
sub_missedapp   250
sub_offradar    1500
sub_3mile       1000
sub_1mile       5000
sub_crash        0
sub_wthr         5
val_request     30
val_emerg       500
```

The above section sets up scoring parameters for TRACON II. You may change them, but if you do, your scores cannot then be compared to others training with you using another copy of TRACON II with its original TRACON.INI file.

Each scoring item begins with the word "add" or "sub", which indicates whether that item is added or subtracted from the accruing score. After the underscore comes the description of the item and then the number of points associated with it.

The first few items determine the basic point value of an aircraft which you handle. Each time you successfully handoff an aircraft to either an airport Tower or to Center, points will be awarded. Overflights start with 500 points, departures 600, and arrivals 800 points. To that is added 100 points for each increasing aircraft type: 0 points for a single; 100 points for a twin; 200 points for a turbo-prop; and so forth until an additional 500 points is added for handling a military flight. (We did this because the more sophisticated aircraft tend to burn more fuel faster and carry more passengers.) From this basic aircraft score, then, is subtracted 10 points for each command that you issue to it, and 20 points for every minute you delay it from its optimal time of passage through your sector.

For example, suppose you handle N66DZ, a Learjet taking off from Van Nuys. Suppose you hold him on the ground for two minutes after he requests takeoff clearance, and because of a sequencing requirement you issue four commands which result in another three minutes being lost in vectors for traffic. You would get 760 points for handling this aircraft: 600 to start with, plus 300 because he is a corporate jet, minus 40 points for the commands you issued, minus 100 points for the delay you imposed on his flight.

The other points to be subtracted are associated with the various types of errors that TRACON II detects: handoff errors to the en route Center, approach altitude errors, missed handoff errors, vectored-off-radar errors, and the various classes of separation conflict errors. There are no points associated with a crash — the simulation merely terminates and erases you from its records forever.

Com	Ports	4	
COM1	3F8	4	D0
COM2	2F8	3	D0
COM3	3E8	4	D0
COM4	2E8	3	D0

Serial port information comes next. You may have to edit this portion if you are using non-standard communication port assignments or a multiplexer board from DigiBoard, Inc. to control up to sixteen Flight Simulators at once. The first line tells TRACON II how many lines will follow, with each line describing one serial port connection. Each subsequent line contains four values: 1) the port name, from COM1 through COM16; 2) the hexadecimal port address; 3) the port's interrupt (IRQ) line; and 4) a code for the

Digiboard type: *D0* means it is a regular, not multiplexed, serial port; *D4* means it is a four-port DigiBoard; and *D8* indicates an eight-port DigiBoard.

We have set up this section so that COM1 and COM2 are at the standard locations and interrupt lines, while COM3 and COM4 match the second-port defaults on most common two-port AT I/O cards. Note that even if you have COM3 and/or COM4 available, because of interrupt collisions, no more than two Flight Simulators may be active at once in this configuration.

Pilot Proficiency

Type	Perfect	Average	Lousy
Single	100	70	50
Twin	100	80	60
Turboprop	100	85	70
CorpJet	100	90	80
Airline	100	90	85
Heavy	100	85	65
Turbine	100	85	65
Trainer	100	85	65
Transport	100	85	65
Bomber	100	85	65
Fighter	100	85	65
Experimental	100	85	65
Helicopter	100	85	65

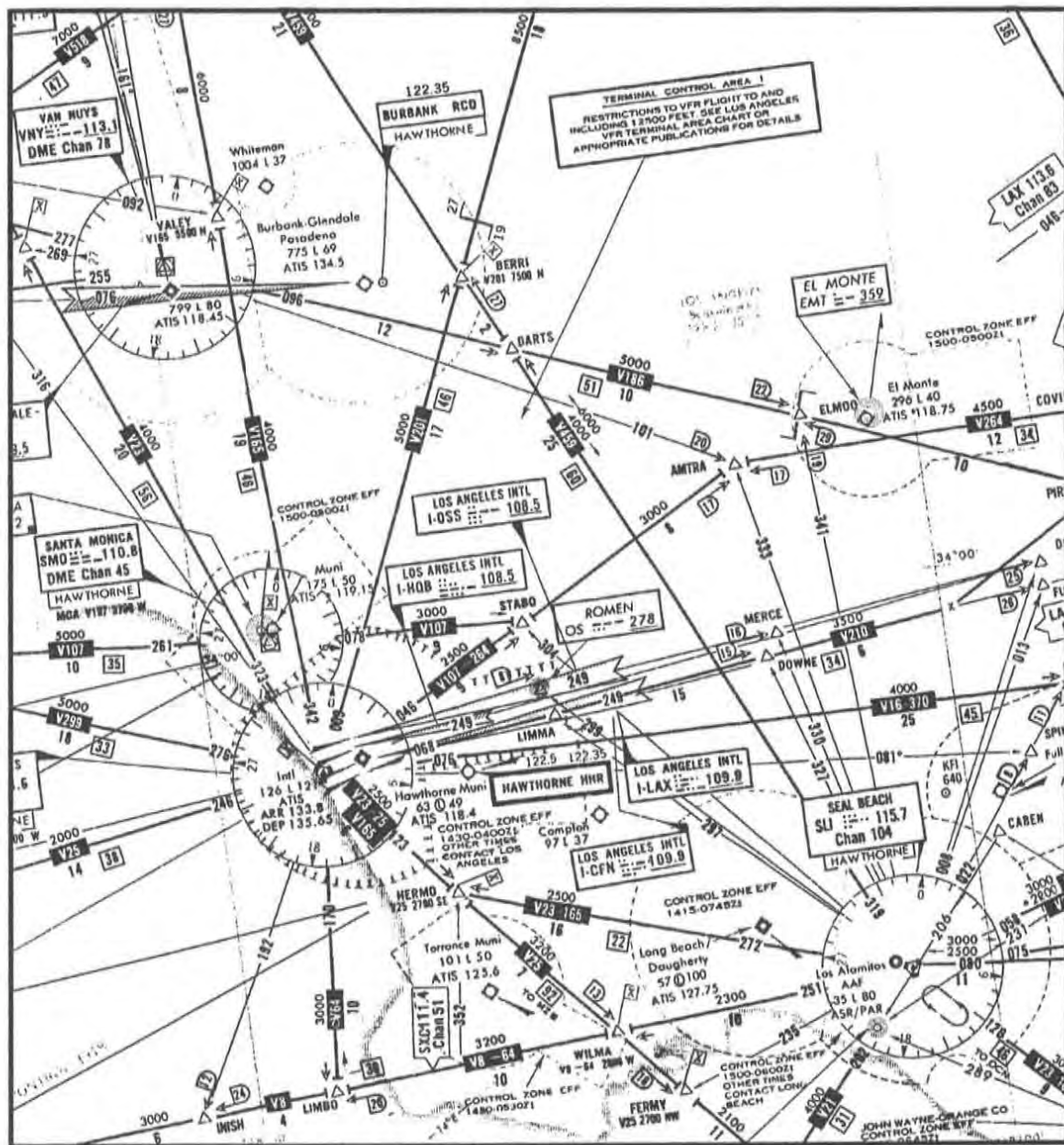
This section determines the probability that the different pilots of the different types of aircraft will make mistakes. One hundred percent means that no mistakes will be made, while 50% indicates that half the time, a pilot will mistake your command, ignore it, execute a command for another aircraft, etc. Notice that pilots of singles and twins are assumed to be generally less proficient than pilots of corporate jets and airliners. If you fly a single, you might want to change this situation, and you can.

Weather Factors

Type	IMC	Minimums	Turbulent	Stormy
Landing	100	80	60	40
CenterAccept	100	90	80	70

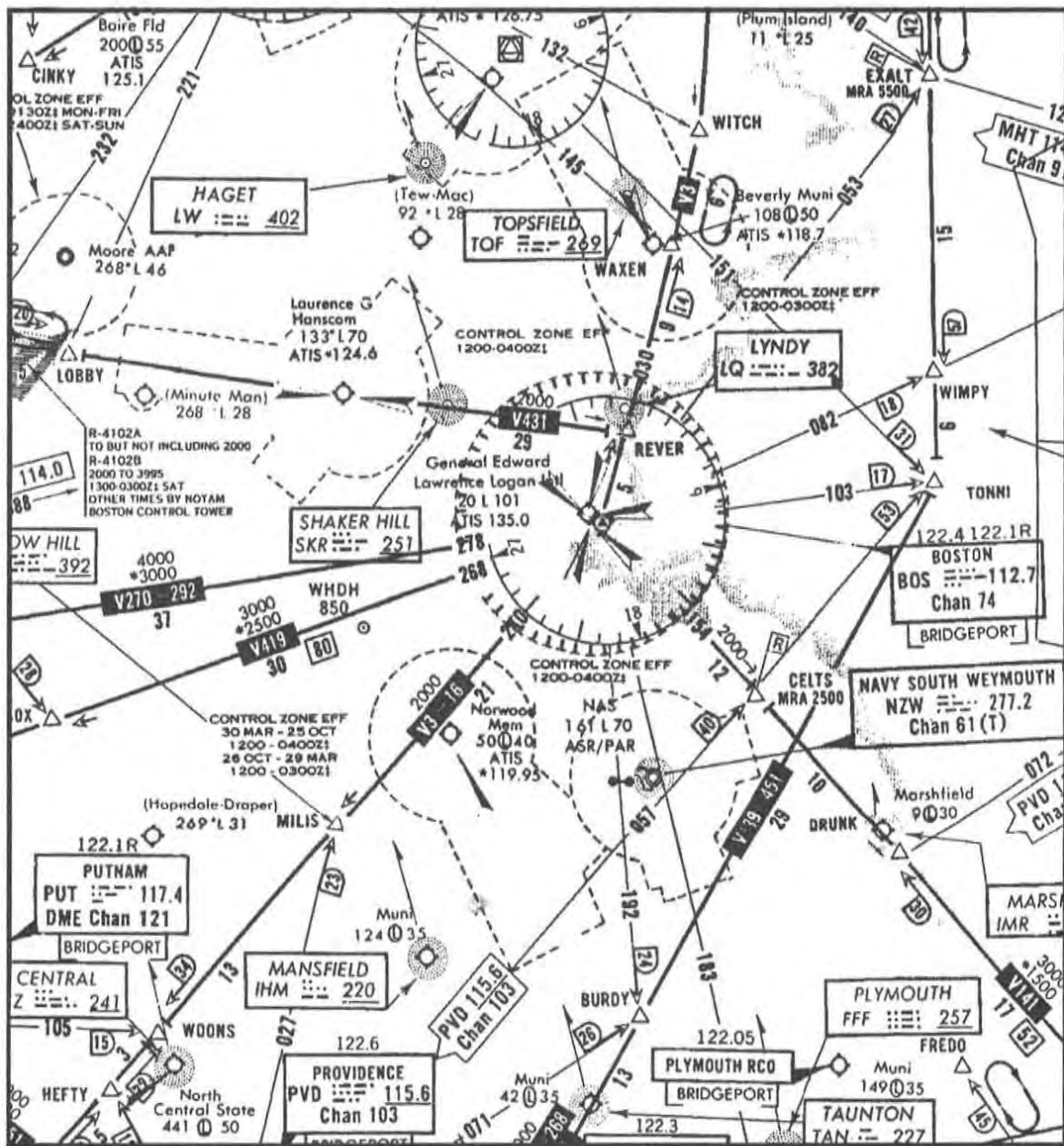
Like the above pilot "goodness" probabilities, these weather-related numbers set up the probability of missing an approach in the various types of weather TRACON II simulates. They also set the probability that Center is too busy to accept your handoffs for each weather type. Stormy weather, for example, means missed approaches 60% of the time and Center controllers with their own headaches who reject your handoffs 30% of the time.

Los Angeles (LAX.SEC)



Not for Navigation -- For Use with TRACON II Only!

Boston (BOS.SEC)



Not for Navigation -- For Use with TRACON II Only!

Appendix B: Airport List

This appendix lists the important characteristics of the various airports under your control in the different control sectors. Each sector's table lists the airport three-letter designator, its name, the distance in miles from the airport to its final approach point (FAF), the FAF altitude (arrivals must be at this altitude when they reach the FAF to begin an approach), the airport elevation in feet, and the inbound heading to the airport from the FAF.

<u>ID</u>	<u>Name</u>	<u>Elev</u>	<u>Run</u>	<u>Head</u>	<u>Dist</u>	<u>Alt</u>
<i>Los Angeles (LAX.SEC)</i>						
LAX	Los Angeles	126	* 7	069	4.9	1800
			25	249	5.4	1900
VNY	Van Nuys	799	16	161	8.1	4300
LGB	Long Beach	58	30	301	4.6	1600
TOA	Torrance	101	29	294	4.8	2000
SMO	Santa Monica	175	21	214	6.6	3000
<i>San Francisco (SFO.SEC)</i>						
SFO	San Francisco	11	* 19	191	4.5	1800
			28	281	5.3	1800
OAK	Oakland	6	11	113	5.7	1800
			27	275	4.2	1500
			29	293	4.6	1600
SJC	San Jose	56	12	123	5.3	1900
			30	303	5.1	1800
HWD	Hayward	47	29	294	4.5	2600

Boston (BOS.SEC)

BOS	Logan Intl.	20	*	4	36	5.1	1800
				33	331	4.4	1500
				27	273	5.0	1700
				22	216	5.0	1700
BED	Bedford	133		15	150	4.9	1900
				11	112	4.0	1700
				29	293	4.3	1800
OWD	Norwood	50	35	350	4.4	1400	
BVY	Beverly	108	16	157	5.0	1800	

Miami (MIA.SEC)

MIA	Miami Intl.	11	*	9	90	4.4	1500
				12	122	5.7	2000
				27	270	4.0	1500
				30	302	4.1	1500
FLL	Ft. Lauderdale	11		9	93	5.4	2000
				27	273	5.0	2000
OPF	Opa Locka	9	9	89	5.4	1900	
TMB	Tamiami	10	9	90	3.6	1400	
FXE	Ft. Executive	14	8	87	6.4	2200	

Chicago (ORD.SEC)

ORD	O'Hare Intl.	667	*	4	42	4.4	2200
				14	140	5.2	2400
				9	90	4.7	2300
				27	270	4.2	2100
				32	320	5.3	2500
MDW	Midway	619		13	135	5.1	2400
				31	315	3.4	1800
				4	44	5.1	2600
DPA	DuPage	758	10	97	5.3	2600	
PWK	PalWaukee	647	16	157	6.0	2700	
MEG	Meigs	647	36	360	4.4	2300	

Seattle (SEA.SEC)

SEA	TacomaIntl	429	* 16	158	4.1	1800
			34	338	4.0	1600
TIW	Industrial	292	17	170	5.0	2000
BFI	Boeing	18	13	128	6.3	2200
			31	308	3.7	1600
S42	Silverdale	525	29	290	4.3	1700

* Note: These airports have parallel runways where an arriving aircraft and a departing aircraft can be within the separation conflict boundaries without generating an error. The following rules apply:

1. One aircraft must be arriving and the other one departing at the same airport.
2. Both aircraft must be below the FAF altitude + 300 feet. If the FAF altitude is 1900 feet then they must be at or below 2200 feet.
3. Both aircraft must be within 5 miles of the airport.

Appendix C: Creating New Sectors

Note: This entire appendix is for advanced TRACON II users only. It documents how to create your own scenario (SIM) and sector (SEC) files using any normal text editor, your flying charts, and a little common sense.

Scenario File Format

Using any text editor, you can create your own scenarios composed of a sequence of flightstrips. If you name your scenario file with a SIM extension, you should be able to run it using the **Open Flight Plans ...** dialog box from the **File** top level menu.

Using the file DEMO.SIM as our example, the structure is relatively simple to follow:

```
Sector                LAX . SEC
```

The name of the sector file comes on the first line.

```
Aircraft             7
```

The number of aircraft in the scenario comes next.

```
Minutes              5
```

The number of minutes over which these aircraft will enter comes next.

Enter '1' here for your scenario. It primes the random number generator. When TRACON generates its own scenarios, this number must be saved so that the replay with the specified weather and pilot proficiency will be correct.

```
N16FG TB-20 IFR a 0.5 146 8000 8000
  LANGE LGB Twr (optional data tag)
```

This aircraft — N16FG — is a type TB-20. It is an arrival (a) entering the scenario 0.5 minutes after it starts. Its groundspeed is 146 knots; and its assigned altitude is the same as its current altitude: 8000 feet. It enters at LANGE intersection will fly direct to Long Beach airport where it will be handed off to the tower there. Up to 15 characters of optional information to be displayed on its flightstrip (eight characters of which will also appear as the third datatag line) may also be included in parentheses after the hand-off point.

```
N1EQ L24 IFR a 0.7 250 5000 5000
  TWINE V23 LAX Twr
```

N1EQ is a Learjet type 24, another arrival. It enters 0.7 minutes into the scenario traveling at 250 knots and 5000 feet. It will enter at TWINE intersection, traverse Victor airway 23 to LAX, whereupon it should be handed off to the tower there.

```
N9565G C402 IFR e 2.8 209 12000 12000
  HASSA TANDY Ctr
```

```
SK190 747 IFR d 2.1 250 9000 126
  LAX AHEIM Ctr
```

```
N841K M20K IFR d 3.6 170 6000 175
  SMO HASSA Ctr
```

```
N8W PA34 IFR a 4.7 250 10000 10000
  HASSA VNY Twr
```

```
N39F L23 IFR a 4.6 250 8000 8000
  COVIN V264 LAX Twr
```


The other flightstrips are similar, except that some are enroute overflights ('e'), some are departures ('d'), and some are practice flights ("p"). Although not shown in this example, a flightplan can link various airways together:

COVIN V264 DOWNE V123 LAX Twr

You may choose from the following aircraft types and airline designators in constructing your flightstrips:

Codes for the following columns:

1. type
2. description
3. engine type
4. approach speed
5. climb speed
6. cruise speed
7. stall speed
8. rate of climb
9. "XX" if should have an airline callsign; 'N' otherwise

1	2	3	4	5	6	7	8	9
AircraftTypes 47								
AA5	Traveler	single	70	80	115	51	600	N
C-23	Sundowner	single	80	85	110	60	750	N
C150	Cessna_150	single	60	65	106	40	600	N
C172	Skyhawk	single	70	75	114	55	600	N
M-5	Maule	single	70	70	125	50	900	N
J-3	Piper_Cub	single	40	45	65	35	400	N
PA28	Cherokee	single	70	75	113	55	600	N
PA28R	Arrow	single	90	80	140	60	500	N
V35	Bonanza	single	100	90	150	60	500	N
M20J	Mooney_201	single	100	100	160	65	800	N
M20K	Mooney_231	single	105	100	180	65	1000	N
PA24	Comanche	single	85	85	140	60	900	N
PA32	Saratoga	single	100	100	148	60	1000	N
PA32R	SaratogaSP	single	110	100	157	65	1000	N
PA46	Malibu	single	120	120	220	70	1000	N
TB-20	Trinidad	single	85	85	164	65	1200	N

TB-10	Tobago	single	90	90	187	70	1090	N
F33A	Bonanza	single	85	90	170	64	1167	N
V1730	Viking	single	90	90	172	66	1200	N
C182	Skylane	single	80	85	156	41	1140	N
P210R	Centurion	single	90	95	185	65	1150	N
LA250	Lake	single	75	80	125	55	600	N
C208	Caravan	single	95	100	170	60	1200	N
C210	Cessna_210	single	110	100	160	60	1000	N
PA31	Navajo	twin	130	120	220	80	1000	N
C310	Cessna_310	twin	125	120	180	70	1000	N
C402	Cessna_402	twin	125	130	225	80	1000	N
B56	Baron	twin	110	115	190	85	1700	N
C425	Conquest	twin	120	120	205	90	1800	N
PA60	Aerostar	twin	110	110	217	75	1600	N
PA34	Seneca	twin	110	110	191	67	1250	N
PA44	Seminole	twin	90	95	165	57	1000	N
PA42	Cheyenne	turboprop	135	150	300	100	2300	N
BE400	Beechjet	corpjet	150	165	454	111	3000	N
L23	Learjet	corpjet	160	170	425	120	3000	N
L24	Learjet	corpjet	160	170	440	120	3000	N
Cit	Citation	corpjet	140	140	350	95	2500	N
M80	Douglas	airline	135	250	480	105	2500	XX
72S	Boeing	airline	136	250	520	106	2500	XX
727	Boeing	airline	136	250	520	106	2500	XX
737	Boeing	airline	134	250	440	102	2500	XX
D10	Douglas	heavy	145	250	490	105	2500	XX
L10	Lockheed	heavy	139	250	480	109	2500	XX
AB3	Airbus	heavy	134	250	470	113	2500	XX
747	Boeing	heavy	150	250	500	120	2500	XX
757	Boeing	heavy	132	250	480	102	2500	XX
767	Boeing	heavy	140	250	480	104	2500	XX

Airline Names

1. id
2. mask
3. name

1 2 3

Airlines 40

AirlinesUSA 14

DL	31	Delta
UA	31	United
AA	31	American
CO	31	Continental
HP	28	AmericaWest
NW	28	Northwest
PA	31	PanAmerican
TW	31	Trans_World
EA	7	Eastern
PI	7	Piedmont
ML	6	Midway
WN	28	Southwest
AS	24	Alaska_Air
AL	24	USAir
NH	24	Nippon_Air
JL	24	Japan_Air
MH	24	Malaysian
SQ	24	Singapore
KE	24	Korean_Air
AF	31	Air_France
UP	1	Bahamasair
SK	30	Skandinavia
QF	24	Qantas
LH	31	Lufthansa
SR	6	Swissair
BA	31	British_Air
MX	25	Mexicana
AM	25	Aeromexico
AI	28	Air_India
KU	6	Kuwait_Air
MS	6	Egyptair

AC	31	Air_Canada
IB	31	Iberia
KL	31	KLM
BR	31	Caledonian
CI	24	China_Air
LY	7	El_Al
PL	1	Aeroperu
SN	7	Sabena
SU	6	Saudi_Air

Sector File Format

With the proper instrument charts and a few tedious hours, you can create your own sector file(s). Only advanced users should try to do this – the data in a sector file is not error-checked very extensively. (We have created 24 more sector files in-house and are offering them as an option, eight per sector disk — use the enclosed order form if you want one or more.)

Nevertheless, if you want to “roll your own” sector files, the following information documents the file format of the SEC files. One caveat: if you try this, PLEASE DO NOT CALL OUR TECHNICAL SUPPORT LINES FOR HELP. They are busy enough helping out new users with the basics.

A final note about sector files: you will not be able to create a VOI file for your sector without adding digitizing hardware, a microphone, and some of our maintenance software to your system. The only time you will miss the sector-specific VOI file is when you clear an aircraft to a fix. The fix name will not be spoken during the voiced command and pilot’s response.

Coordinate System Used

A sector file necessarily contains numerous ground references. These points are entered using an x,y coordinate system measured in nautical miles from an origin located at the lower lefthand corner of the radarscope. The LAX scope, for instance, measures about 45 nautical miles across. Its lower lefthand corner is at approximate coordinates

0,0, while its upper righthand corner is at about 45,45. All ground references should be input using this sort of coordinate system.

The best way to get these coordinates seems to be finding a piece of graph paper with a suitable grid that matches the scale of your Jepp or NOS area/low altitude chart and xeroxing that grid onto a sheet of clear plastic overlay. Then, you can simply tape the grid over your chart and pick off points, composing your SEC file using your favorite text editor.

Line Structure Within the File

The following discussion will mimic the structure of the TRACON manual's Chapter 8 — using the LAX.SEC file as an example, each line or group of lines will be shown and then discussed in sequence.

```
Version 2.00  
Los Angeles
```

The first line of a sector file contains the version number of the program required to run this sector (although old sector files from TRACON versions 1.x are accepted, while the second line contains the name of the TRACON that the file represents. This name may be up to 13 characters in length and will appear at the top of the screen during a scenario.

```
RadarMin  -1.3 -1.5  
RadarMax  44.9 47.7
```

These lines represent the coordinates of the lower lefthand and upper righthand corner of the radarscopes for each sector. Since you should allow a couple of miles around the boundary fixes, the easiest way of getting a first cut at these x,y coordinates is to subtract two or three from the lowest x-coordinate and y-coordinate for the *RadarMin* value, and to add the same amount to the highest x- and y-coordinates for *RadarMax*.

Since the radarscope is roughly square (actually slightly wider than it is tall on most monitors), these diagonal endpoints of the radarscope should match this shape, even if the above calculation yielded some-

thing a little different. For instance, in the LAX example above, the radarscope is 46.2 miles wide by 49.2 miles tall. These values for LAX seem to look OK on all monitor types.

If the values you wind up with have the proper aspect ratio for your monitor, the onscreen map will "look right" when compared to a paper chart. After a little experimenting, you should be able to establish a reasonable value for *RadarMin* and *RadarMax* that works for your sector. Just be sure to give yourself a little room at the edges for inbounds, so that when they hold they're still on the scope, and make sure all fixes can be drawn well within these limits.

31

SOLED	b	25.3	44.5	26.0	44.0
SAUGS	b	14.0	45.2	14.7	44.6
LANGE	b	11.8	43.5	7.6	44.3
TWINE	b	3.8	39.3	1.7	40.3
BAYST	b	1.4	22.2	0.1	23.2
MERMA	b	1.2	14.5	-0.1	12.2
TANDY	b	1.8	5.1	-0.2	2.7
ALBAS	b	27.2	1.0	25.3	-1.3
MIDDS	b	38.8	1.0	36.8	-1.3
TUSTI	b	42.0	7.0	40.2	4.6
AHEIM	b	39.0	9.7	39.7	9.1
LAHAB	b	38.7	16.2	39.4	15.6
PIRRO	b	41.6	22.5	37.0	21.7
COVIN	b	40.0	25.4	38.1	26.4
HASSA	b	42.4	33.0	40.4	33.9

After an integer indicating the total number of fixes (boundary, interior, and airports) to come, each boundary fix is entered in the following format:

FIXNAME	an FAA-standard 5-character fix name from your chart
'b'	a boundary fix
x-loc, y-loc	the location of the fix itself
x-name, y-name	the location of the lower lefthand corner of the fix name when it is shown using the Alt-M command.
Boundary fixes	should be entered counter-clockwise starting with the upper lefthand fix.

LIMBO	i	12.2	6.0	10.2	3.6
WILMA	i	22.0	6.7	22.6	6.0
SLI	i	32.2	7.5	32.8	6.9
HERMO	i	17.2	12.0	17.9	11.2
DOWNE	i	28.5	18.3	26.4	15.9
BASET	i	35.9	19.2	36.5	18.5
STABO	i	21.0	20.8	19.0	21.8
AMTRA	i	28.4	25.2	26.3	22.8
VALEY	i	12.2	35.5	13.0	35.0
BERRY	i	20.0	32.5	18.2	33.4
GESTE	i	21.4	30.0	19.7	27.7

Then enter each interior fix just like you did the boundary fixes, except use the 'i' for interior instead of 'b' for boundary.

LAX	=	13.2	16.5	10.5	14.2
VNY	+	10.3	34.0	7.3	32.5
LGB	+	27.0	10.0	27.8	10.2
TOA	+	17.8	7.5	16.7	4.6
SMO	-	12.0	21.2	9.2	22.1

Then enter each airport as a fix, using a similar format. The type indicators for airports include '=' for an airport with parallel runways accomodating simultaneous approaches and departures, '+' for airports with an ILS approach, and '-' for airports with a VOR approach.

The total of all lines entered in this format should equal the integer at the start of this grouping.

```

14
V8 a 5.1 6.2 35.4 9.6
    TANDY LIMBO 0
V64 a 9.9 10.4 37.7 5.1
    LAX LIMBO WILMA SLI TUSTI 0
V25 a 4.1 13.2 22.9 1.3
    MERMA LAX HERMO WILMA ALBAS 0
V21 a 29.3 1.7 0.0 0.0
    ALBAS SLI AHEIM 0
V210 a 21.8 18.4 39.1 19.1
    LAX DOWNE BASET PIRRO 0

```

```

V264 a 35.9 26.1 0.0 0.0
      LAX STABO AMTRA COVIN 0
V107 a 5.1 22.5 0.0 0.0
      BAYST SMO STABO 0
V201 a 23.2 37.3 0.0 0.0
      LAX BERRY SOLED 0
V186 a 27.5 28.4 0.0 0.0
      VNY GESTE PIRRO 0
V459 a 30.5 11.6 16.0 41.6
      SAUGS BERRY GESTE SLI 0
V23 a 4.2 31.0 34.2 1.6
      TWINE LAX HERMO SLI MIDDS 0
V165 a 12.9 27.7 0.0 0.0
      LANGE VALEY LAX HERMO 0
V16 a 35.3 14.5 0.0 0.0
      LAX LAHAB 0
V299 a 3.0 18.2 0.0 0.0
      LAX BAYST 0

```

The next grouping consists of the airways that connect the fixes you entered. After a count of the number of airways to follow, each airway is entered using two lines per airway. The first line is the airway name followed by the character 'a' followed by two x,y locations where the airway name should appear via the Alt-A command. If you only want the airway name to appear once, use 0.0, 0.0 for the second set of coordinates.

The second line of an airway consists of the fixes that the airway connects in order. Indent the first fix name. The line should end with a '0' character.

```

6
LAX LosAngeles 2 126 40 0 0 5 5 45 45 0 0 0 0 0 0 0
    7 069 4.9 1800
    25 249 5.4 1900
VNY VanNuys 1 799 15 30 40 15 15 0 0 0 0 0 0 0 0 0
    16 161 8.1 4300
LGB LongBeach 1 58 10 35 35 10 20 0 0 0 0 0 0 0 0 0
    30 301 4.6 1600
TOA Torrance 1 101 13 50 50 0 0 0 0 0 0 0 0 0 0 0
    29 294 4.8 2000
SMO SantaMonica 1 175 5 35 45 10 10 0 0 0 0 0 0 0 0 0
    21 214 6.6 3000
Ctr Enroute 0 0 17 40 40 20 0 0 0 0 0 0 0 0 0 0

```

The next grouping consists of airport information. After an integer showing how many airports (including a "Ctr" designator for the Enroute Center) will follow, each line consists of general information about one airport, while one or more succeeding lines contain information about each instrument approach to that airport. The information on the first "general airport information" line is ordered as follows:

LAX	Three-letter ID of the airport
LosAngeles	Name of the airport (no spaces)
2	Number of lines (instrument approaches) to follow
126	Airport elevation in feet
40	Percentage of flights in a scenario that will involve this airport. The total of this column for all airports (including Ctr) should equal 100. Notice now LAX gets most of the traffic here, while Santa Monica doesn't get much at all.
0	Of the aircraft in a scenario that involve this airport, this percentage will be piston singles (Cherokees, Cessnas, Bonanzas, etc.)
0	This percentage will be piston twins (Navajos, Barons, etc.)
5	This percentage will be turboprops (Cheyennes, etc.)
5	Percentage of corporate jets (LearJets, etc.)
45	Percentage of "normal" scheduled airliners (American, United, KLM, etc.).
45	Percentage of "heavy" airliners.
Seven 0's	Percentages of different types of military aircraft (not currently used).

Note: the sum of the preceding percentages of aircraft types should equal 100, adding across for each airport. These percentages will determine the traffic mix at the airport. Note how LAX mainly services the larger aircraft, while Torrance handles the puddle-jumpers.

The "Ctr" line in the airports grouping determines overflight percentages and aircraft mix in a similar manner.

Each airport must be followed by the number of lines indicated which contain information for each instrument approach for that airport:

6	The runway or approach name (this approach is to runway 06).
069	The precise approach heading.

5.0 Distance of FAF from airport.
1800 FAF altitude.

13		
SOLED	7	7
HASSA	10	10
COVIN	15	15
LAHAB	10	10
AHEIM	10	10
MIDDS	5	5
ALBAS	3	3
TANDY	5	5
MERMA	3	3
BAYST	4	4
TWINE	5	5
LANGE	8	8
SAUGS	7	7

Of the flights that enter and/or exit boundary fixes, the next grouping determines the distribution of flights around these fixes. The total of these percentages must add up to 100. In the LAX.SEC data above, for example, you can see that most traffic involves the Eastern fixes and to a lesser extent the fixes in the North. Fixes to the West over the water such as MERMA have much lower percentages than fixes such as COVIN to the East.

MagneticNorth 0

In a TRACON, the video map is oriented with magnetic North aligned straight up. However, in a Center environment, the videp map is aligned with true North. This parameter tells TRACON how the magnetic variation to use if a Center-type display is desired.

Compass Position 0.0 0.0

Not currently used.

RadarPosition 13.2 16.5

This is the location of the radar site — the centerpoint of the sweep.

```
MinAltitude      1000
```

The minimum vectoring altitude for the sector comes next.

```
MaxAltitude      12000
```

This is the altitude of the top of the sector.

```
Mask             16
```

This line determines which airlines fly into this sector. For instance, while Quantas might fly into LAX, it doesn't fly into Miami. But BahamasAir does. Geography determines what to do here, and the safest procedure is to pick a distribution sector closest geographically to the sector you're creating and use its Mask value in yours.

```
Shoreline or Border  
x1, y1  
x2, y2...
```

Finally, as many "Shoreline" or "Border" groupings may be used as you wish. The LAX sector has a single shoreline, while others might have more (islands have their own disconnected shoreline, for instance). Each "Shoreline" grouping consists of *x,y* pairs, one per line, up to a maximum of 290 points in all. End each list with a 0.0, 0.0 pair. These points will be connected with blue lines via the Ground dialog box setting. Borders are the same as Shorelines, except that they are drawn using dashed-lines between vertices in the radar background color.

```
flight_simulator  LAX  15374 5805  
flight_simulator  SMO  15402 5799  
fsim_angle 31
```

The final three lines of each sector file contain the Flight Simulator north and east coordinates of any two points within the sector. The coordinates of airports are easiest to retrieve from Flight Simulator, so those are the simplest points to include. These two points allow TRACON II to scale its coordinate system to that of Flight Simulator.

Glossary of ATC Terminology

Air Route Traffic Control Center (ARTCC) — A centralized location where numerous enroute controllers have jurisdiction over a large airspace subdivided into sectors. It is frequently referred to by pilots as the "Center."

Air Traffic Control (ATC) — Ground-based coordination of aircraft utilizing radar and pilot/controller radio telephony intended to prevent midair collisions and expedite the safe and orderly flow of air traffic.

Airway — A path consisting of line segments joining geographic points specified by radio beacons or intersections formed by two or more such beacons.

Approach — (see Instrument Approach)

Approach Control — The ATC facility responsible for radar separation and coordination of aircraft in the vicinity of an airport. Approach Control's jurisdiction extends about 20-40 miles from the airport horizontally and 10-12 thousand feet vertically.

Approach Speed — The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration.

ARTCC — (See Air Route Traffic Control Center)

ATC Clearance — (See Clearance)

Automated Radar Terminal Systems (ARTS) — The generic term for computer-mediated radar data processing facilities located in most TRACONS. ARTS II systems are used at low to medium density facilities, while ARTS III systems are available for high density situations.

Automatic Altitude Reporting — That function of a transponder which responds to Mode C interrogations by transmitting the aircraft's altitude in 100-foot increments.

Autopilot — A mechanical device which steers the aircraft automatically. The more sophisticated — often called flight directors — allow the pilot to preprogram complex functions and give him almost "button-pushing" command of the aircraft.

Beacon — (see Fix)

Below Minimums — Weather conditions below the minimums prescribed by regulation for the particular action involved; e.g., landing minimums, takeoff minimums.

Ceiling — The heights above the earth's surface of the lowest layer of clouds or obscuring phenomena.

Center — The ATC facility, also called Enroute Control, responsible for aircraft separation and coordination while in cruising flight between departure and destination airports.

Chart — Aviation term for map.

Clearance — A set of flightpath parameters, generated by an ATC facility and similar to if not identical to a pilot's requested flightplan, which specifies how the IFR aircraft will proceed to its destination. It consists of assigned altitudes, airways, radio frequencies, and the like, and must be obeyed until superceded by a newer clearance.

Cleared as filed — Means the aircraft is cleared to proceed in accordance with the route of flight filed in the flightplan.

Cleared for (type of) Approach — ATC authorization for an aircraft to execute a specific instrument procedure to an airport.

Cleared for Takeoff — ATC authorization for an aircraft to depart.

Codes/Transponder codes — The number assigned to a aircraft's transponder.

Collision Avoidance System (CAS) — A method of automatically warning pilots of impending midair collisions. Some are ground-

based, relying on radar returns and controller-relayed commands; others are based on airborne transponders which use cockpit displays to directly warn pilots of the proximity of other aircraft.

Conflict — A situation in which one or more aircraft, through controller inaction, has been allowed to violate a governmental directive such as radar separation minima. A controller is charged with the prevention of conflicts as his primary job task.

Conflict Alert — A function of certain air traffic control automated systems designed to alert radar controllers to existing or pending situations that require his immediate attention/action.

Contact (facility) — Establish communication with a certain ATC facility.

Control Tower — The ATC facility responsible for the visual separation and coordination of aircraft in the immediate vicinity of an airport. The Tower's airspace extends about five miles from the airport.

Controller — Person who mans the radar scopes and performs the functions of air traffic control.

Cruise/Cruising Altitude — Aircraft is straight-and-level flight proceeding towards its destination.

Departure Control — The ATC facility which complements Approach control, coordinating departing aircraft via radar near a major air terminal. It is colocated with Approach control in the TRACON.

Direct Clearance — A set of instructions which clear an aircraft directly from its present position to a specified point such as a radio beacon.

Enroute — see Center.

Final Approach Fix (FAF) — The geographical point at which a pilot, referring solely to a published approach procedure and his instruments, begins a final descent to an airport. This point is generally specified by a fix location and an altitude from which the approach must begin.

Fix — A specified geographical location used in air navigation. Usually, fixes are easy-to-locate points formed by radio beacons.

Flight Service Station (FSS) — The governmental service interface with all pilots, both VFR and IFR. The FSS provides preflight and enroute weather briefings, receives and processes flightplans, and issues initial clearances.

Flightplan — A description of an aircraft's proposed flight, including departure time, route, altitude, etc. An IFR flightplan is a request for ATC service, subject to controllers' commands; a VFR flightplan merely records a proposed flight and aids in searching for overdue aircraft.

Flightstrip — As an aircraft transits the various sectors and receives clearances, the current flightplan parameters are continually printed out by the computer on strips of paper. These strips are then used by each controller responsible for that aircraft as a memory aid.

Fly Heading (degrees) — Informs the pilot of the magnetic heading (0-360 degrees) that he should fly.

General Aviation — That portion of civil aviation which encompasses all facets of aviation except the airlines.

Glideslope/Glidepath — Radio beacon which provides vertical guidance for aircraft during approach and landing.

Go Around — Instructions for a pilot to abandon his approach to landing. Additional instructions follow.

Ground Control — The ATC facility responsible for coordinating movement across and airport's surface, exclusive of the active runway(s).

Ground Controlled Approach (GCA) — A radar approach system operated from the ground by air traffic control personnel transmitting instructions to the pilot by radio.

Handoff — To release control of an aircraft and give it to another ATC facility as the flight proceeds past the airspace limits of the control jurisdiction.

Hold — A command which directs the aircraft to fly in a tight oval pattern (called a holding pattern) thereby effectively stopping its forward progress for a specified period of time.

Instrument Approach — A procedure, standardized and published by the Federal Aviation Administration (FAA), whereby an aircraft can descend to an airport solely by reference to its flight instruments and navigational aids.

Instrument Flight Rules (IFR) — A set of guidelines and regulations created by the FAA which define standardized requirements and procedures for flight without visual reference to the ground.

Instrument Meteorological Conditions (IMC) — Correct terminology for weather conditions under which a pilot must observe IFR (see above).

Leader line — Connects an aircraft's identification and altitude information with the target on a controller's radar scope.

Maintain (altitude) — To remain at the altitude specified. The phrase "climb and .." or "descend and .." normally precedes "maintain" and the altitude assignment.

Missed Approach — When conditions prevent a pilot from completing an instrument approach to a landing, a missed approach is declared and the pilot may elect to try again or proceed to an alternate destination airport.

Negative — "No," or "permission not granted," or "that is not correct."

On Course — Indicates that an aircraft is established on the route centerline.

Outer Marker — The radio fix from which a particular kind of instrument approach — called a precision approach — is begun. Only the larger airports have precision approaches.

Pilot Request — A request to the controller, initiated by the pilot, for some change in the current clearance, such as another altitude or route of flight. The controller has the option of granting or denying the request, depending on the traffic situation at the time.

Profile Descent — An uninterrupted descent from cruising altitude to interception of a glide slope.

Radar — Acronym for Radio Detection and Ranging. A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

Resolution — A command sequence given to the aircraft involved in a conflict which prevents or destroys the conflicting situation.

“Resume Normal Navigation” — A command which directs an aircraft to fly back to the track and speed from which it had been vectored and proceed as specified in its clearance.

Runway — A defined rectangular area on an airport prepared for the landing and takeoff run of aircraft.

Say Again — Repeat.

Say Altitude/Heading — Used by ATC to request an aircraft altitude or heading.

Sector — A subset of an ARTCC’s or TRACON’s airspace over which a single controller team has jurisdiction.

Separation Conflict — The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures have been violated. In a TRACON, this is generally three miles horizontally and one thousand feet vertically.

Shrimp Boat — A slip of paper containing an aircraft’s identification, altitude, etc. manually placed next to its radar return on a controller’s horizontal scope. These have been phased out with the advent of radar data processing facilities.

Squawk — Controller instruction to activate specific modes/codes/functions on the aircraft’s transponder; e.g., “Squawk code zero two five six.” (See Transponder)

Taxi — The movement of an aircraft under its own power on the surface of an airport.

Terminal Area — A general term used to describe airspace in which approach control service is provided.

Tower — A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport.

Track — The airway segment along which an aircraft would ideally fly. Pilot inattention and controller vectors both cause the aircraft to become "off-track."

TRACON — Acronym for "Terminal Radar Approach Control".

Transponder — An airborne receiver/transmitter combination which replies to the ground-based radar interrogation pulse with a coded signal uniquely identifying the aircraft.

Vector — To issue a specific heading change command to an aircraft, usually as a collision-avoidance technique. The aircraft is said to be "on a vector" until another command, such as "resume normal navigation," cancels it.

Visual Flight Rules (VFR) — A set of governmental regulations and guidelines for aircraft not under continual control of an ATC facility and flying by visual reference to the ground.

VORTAC — Also called VOR or omni, a VORTAC is a navigational radio beacon broadcasting in the VHF frequency band.

Waypoint — A radio fix along the route of flight. An aircraft flies from waypoint to waypoint until it reaches its destination.

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