COMANCHE CD™

USERS MANUAL

Note: For easier navigation, this on-line electronic manual has **hypertext links.** Clicking on red-colored text will take you to a page with a related subject or section. Clicking on ◀◀ on the menu bar will return you to the previous page viewed. The red **T.O.C.** icon, at the lower left corner of most pages, brings up the first page of the 3-page *Table of Contents*. Each topic in the *Table of Contents* and the *Index* is hypertext linked.

NOVA LOGIC™

INTRODUCTION

Simulating the RAH-66 Comanche

When it comes to any of today's computer flight simulations, one must realize that they are approximations of reality. General purpose PCs cannot provide the kinesthetic cues, tactile feedback or the contiguous view that you get in a real combat situation. It is our belief at NovaLogic™ that we must accept the limitations of the emulating hardware and adapt the design to take advantage of the computer's interactive strengths. A properly executed simulation can create the level of suspension of disbelief which can make you break out in a sweat. This has been our goal in bringing you **Comanche™**.

Rather than burdening the player with all the trivialities of managing a complex machine, we have concentrated on re-creating the "combat envelope" of the **RAH-66**. For example, the simulator's flight ceiling is set at about 500 ft. On today's battlefield, if you are flying above 150 ft., you are flying too high. We eliminated missions that require auto-deployment. Anyone who has taken a long flight in a helicopter for the sole purpose of getting from point A to B knows that this is one of the most uncomfortable modes of modern transportation.

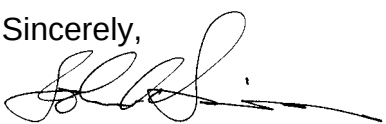
What we have added is a quantum leap in terrain representation and visual awareness. For the first time, you are able to use terrain masking in the same way combat helicopters do. This is the essence of modern helicopter warfare.

This simulation is designed to have a very fast learning curve and be easy to fly. Like the **Comanche RAH-66** with its fly-by-wire controls and management by exception approach, both systems are optimized to lessen the work load. Pilots ready the **Comanche** by plugging in an optical disk–containing mission information and maps–and fly away on image intensifiers in just 3 minutes. You do the same with our combat simulator.

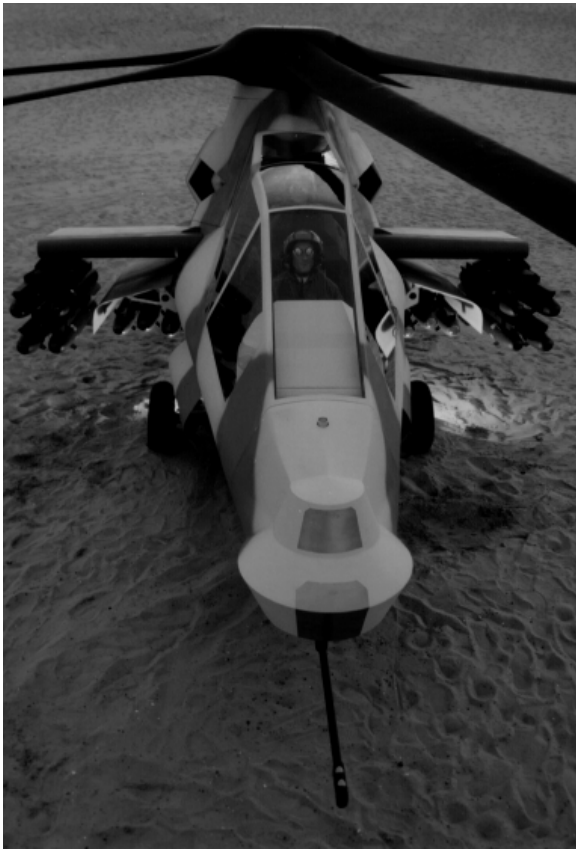
The fact that **Comanche** is easy to fly is only one of the reasons that it's a great simulation. Colonel Marvin Leibstone, Editor of *Military Training & Simulation,* said "NovaLogic's **Comanche** rivals dedicated multi-million dollar military simulators — on your PC."

We are very excited about the product we have created. We hope that you'd enjoy it as much as we do.

Sincerely,



John A. Garcia
President, NovaLogic, Inc.



COMANCHE™ MAXIMUM OVERKILL™

Helicopter Combat Simulator

NovaLogic™ is committed to bringing you software that is on the cutting edge of design and technology. As with our entire line of innovative products, **Comanche** aims to provide you the finest in software entertainment while pushing the technological envelope of computer hardware to the limit.

If you have any questions or comments about this program or any of our other exciting products, feel free to contact us at our Technical Support Line by calling (818) 878-0325 between 9 A.M. and 5 P.M. Pacific Coast Time. You may also call the 24-hour NovaLogic BBS – which contains answers to many technical questions as well the latest program updates – by calling (818) 880-3444.

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INSIDE THE COMANCHE

by David R. Holmes

As you ease into the cockpit seat of your RAH-66 **Comanche**, you realize you're sweating. You crank up the air conditioning but it doesn't help. You can still feel the heat rising off the instrument panel from the beating it's taken from the late afternoon sun here in the Far East.

You'd think with an advanced bird like the **Comanche**, they'd be able to beat small problems like that, but some things never change. Like war. For centuries, it's brought out the best and the worst in people. Especially now, in 1999. Man still seems determined to find some way to destroy himself. But, that's why you're here. If anything can stop this deadly tactical war between Pakistan and India from developing into a nuclear holocaust, it's you and the Boeing Sikorsky RAH-66 **Comanche**.

Your thoughts return to the present as the hatch seals beside you. The onboard computer activates. Its multiple processors start the massive systems check the **Comanche** demands before you leave the ground. In seconds, green lights begin to appear on your digital instrument panel.

As the sun finally starts to disappear behind the Pakistani horizon, you switch on your *Night Vision Pilotage Subsystem*. Immediately, your helmet's visor lights up

with data from the passive sensors that encircle the light attack helicopter. It's a dizzying amount of information — but you'll need it to survive the coming mission.

You signal your co-pilot. He signals immediately back. His onboard *Target Acquisition System* is ready to go. As the **Comanche** rises into the night, your troop levels off at 150 feet. Within your sound-proofed cabin, you can barely hear the main rotor as it strains to unleash the power of the twin T-800 turbine engines. You shift in your seat and with a twist of your hand, your **Comanche** is suddenly hurtling forward at over 190 miles per hour.

Even though you've flown this bird hundreds of times, its speed and maneuverability still give you an adrenaline rush! A smile breaks over your face as the artificially illuminated landscape whirls beneath you in a blaze of light. You look through your "Wide Eyes" visor display and turn for a nearby gorge that will provide protective cover for your troop.

The rubble-strewn sides of the canyon close in on your airship like the hands of a gigantic ghost, but you're in no real danger. The **Comanche's** night vision capabilities are second to none. The RAH-66 was developed to handle high-speed maneuvers just like this. To test your timing, you accelerate your **Comanche** even faster. As the walls become a blur, your smile gets even wider.

As the dry, arid hilltops below you turn into mountains, you keep right on course and out of enemy sensor range. This is only a reconnaissance mission, you remind yourself. All you have to do is avoid any detection gear the enemy might have set up. You glance at the Radar Altimeter. Still

150 feet. Even flying at these speeds, the **Comanche** hugs the ground as if it were attached to it by a string.

An alarm sounds -- there's an incoming FM micro-burst message from TAC-OPS. That's unusual. The message is anything but reassuring. Your orders have been changed.

A terrorist base has been located somewhere within the Nagar-Parkar gorge. Positioned right on the cusp of the India-Pakistani border, this base has been wreaking havoc throughout the territory with its mobile and stationary SAM launchers and its troop of Werewolf airships. You're about to go up against one of the most deadly fighting machines the enemy has in its arsenal - the Kamov KA-50 Werewolf, formerly code-named "HOKUM." Developed in the early years of the Commonwealth of Independent States, the Werewolf's two contra-rotating main rotors make it fast, maneuverable and just plain nasty.

But so is the **Comanche**! Your co-pilot signals. There's not much left to say. You issue a few final commands and wish your men luck. You take a long breath and with a twist of your wrist the Comanche turns its nose east and heads at top cruising speed for the Nagar-Parkar gorge.

Within minutes you are hovering at 75 feet above a ravine leading to the access route to the base. Your co-pilot signals to you. Your chopper is at maximum sensor standoff distance from the base. Data streams into your onboard CPUs. You activate your visor's VCASS system. The entire gorge is synthetically generated within your field of view on your "Wide Eyes" visors.

Every stationary or moving hostile that

your sensors detect is highlighted in a brilliant luminescence. In micro-seconds, graphic symbology designates the “bogeys.” Those moving targets are definitely Werewolves. This is it. You tighten your flight restraints for the high G-force maneuvers you know are coming.

As you knead your hands to work out the tension, one of the other pilots signals, “Any last orders, sir?” There’s a coldness in your voice that surprises you as you recall the unprovoked attacks against defenseless villages. Their massacre of hundreds of innocent victims. “Yeah. Don’t leave anything standing.” “Sir?” queries the other pilot.

Your voice is as cold as an Arctic blast. “Maximum overkill, kid. Let’s press it!”

At a touch of your cyclic control stick, the **Comanche** leaps forward like an avenging angel. The die is cast. The outcome of the battle is now in your hands.

HOW TO FLY THE RAH-66 COMANCHE

Traditionally, all helicopters have been complicated flying machines. It takes a special kind of pilot to handle such a complicated aircraft that depends on flawless integration of so many different controls and functions just to get it off the ground, much less to use it in battle.

The designers who have worked on the RAH-66 have recognized these stress factors and have devised a user-friendly flight environment for future pilots to use when they fly the **Comanche**. The **Comanche** systems are designed for management by exception. If things are working properly, the aircraft keeps it to itself and lets you get on with the flying and the fighting.

Our efforts in achieving a state-of-the-art helicopter flight simulator were motivated by the functional architecture of the **Comanche**. Since the real aircraft is so highly integrated with the various computer systems, it easily adapts itself to an electronic representation of both its capabilities and characteristics. This combat simulator is both realistic and easy to fly.

Even so, there are some basic flying tips to go over before you take the RAH-66 out on your first mission.

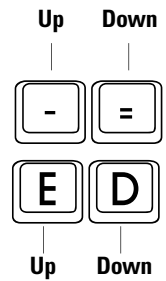
BASIC FLIGHT TRAINING

When you choose a mission, you should read the on-screen mission description to determine your goals and possible strategies. Once you have accepted the mission, your **Comanche** is checked out by the on-board diagnostics. If your PC is set up for speech you will get a corresponding audio message. Your chopper is now fully powered and all systems are on-line and ready to be accessed. Check your weapons and fuel load, since these may change from mission to mission.

To actually fly the **Comanche**, you must become proficient in operating two separate controls.

COLLECTIVE CONTROL

The first control you should learn is the COLLECTIVE PITCH CONTROL. This function simultaneously controls the degree of pitch for each of the five main rotor blades. The higher the degree of pitch, the more air the blades are able to "bite" into and the higher your helicopter goes. The more collective you use, the higher you go. A decrease in the collective pitch of your **Comanche** rotor blades will decrease the altitude, ultimately landing the bird on the ground.



The Collective can be controlled in several different ways depending on your preference and the control system that you are using with your computer.

From your keyboard or your numerical keypad, you can control the Collective by pressing the **"E"** key for more Collective (higher altitude) and the **"D"** for less Collective (lower altitude). Alternately the **"-"** or keypad **"-"** and the **"="** or keypad **"+"** can be used with the same effect. These Collective Controls are active with the use of the keyboard, normal joystick or the ThrustMaster FCS control stick.

NOTE: *If you are using a joystick with an integrated throttle control (e.g. CH FlightStick) the joystick's throttle is used to control the Collective setting; the "**E**" and "**D**" keys will then be disabled.*

TURNING: THE CYCLIC CONTROL

To turn your **Comanche**, use the CYCLIC CONTROL. The direction you point the stick to is the direction the **Comanche** will head. Pulling back or pushing forward moves the nose up or down in pitch; pushing left and right provides **roll**, and twisting left or right gives you **yaw**.

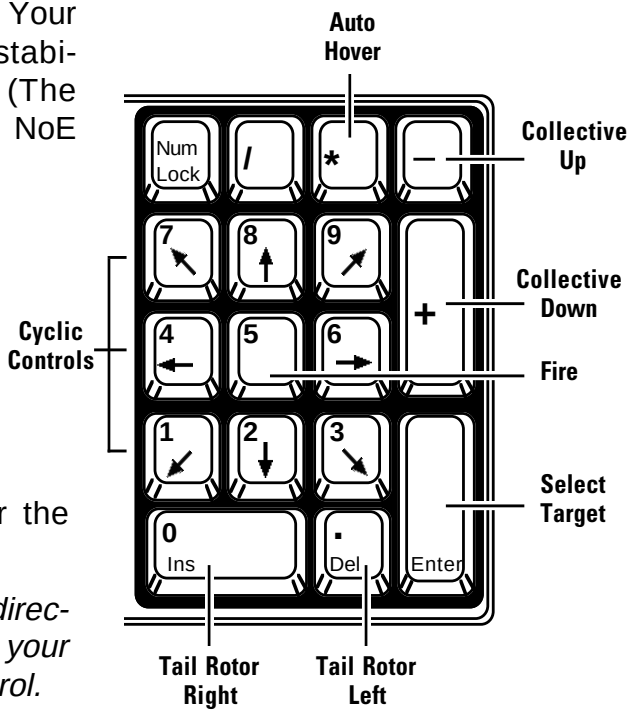
If, in mid-flight, you wish to set your bird to a hover at a low altitude,

press the **"✶"** key on your numerical keypad. Your **Comanche** will respond to the command by stabilizing into a hover position at low altitude. (The hover position sets you at an ideal height for NoE flying.)

While hovering, the helicopter can quickly be turned by altering the setting of the Fantail rotor. By pressing the **"Insert"** and **"Delete"** keys, you will turn to the left and right while simultaneously pointing your craft in that direction. *(See section on Rudder Control System.)*

To turn left or right while hovering or at low speeds, press the **"Insert"** key to turn left or the **"Delete"** key to turn right.

NOTE: *While the Cyclic control changes your direction, it will not change your altitude. Changing your airship's altitude is done with the Collective control.*



GROUND EFFECT

When flying close to the ground, the air forced down by your main

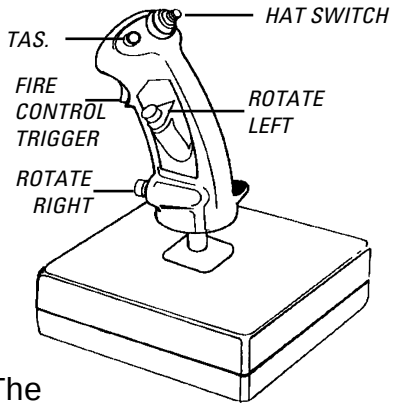
rotor blades provides an additional cushion similar to that of a hovercraft. This cushion is called “Ground Effect”. This effect combined with the fly-by-wire system monitoring your distance to the ground, makes flying low very easy. If you set your collective low or press the numeric keypad **“✶”** you can then for the most part track the ground without any further collective adjustment. A sudden upward change in the terrain, such as a mountain or a cliff, will force you to make adjustments. If you want to go over a steep hill you should increase the collective.

The ThrustMaster Flight Control Stick (FCS)

If you have an FCS connected to your system, **Comanche** can be set-up to interface with this control system.

The ThrustMaster FCS becomes the Cyclic control stick for your airship. The “Hat” switch located at the top controls the first four (4) Cockpit viewing options.

The button directly to the left of the “Hat” switch activates the Target Acquisition System’s laser controlled target lock. The trigger on the front of the control stick fires your selected weapon. The two other buttons rotate the **Comanche** when it is hovering or moving at slow speeds. The center button on the left side of the stick



The ThrustMaster FCS becomes the Cyclic control stick for your airship.

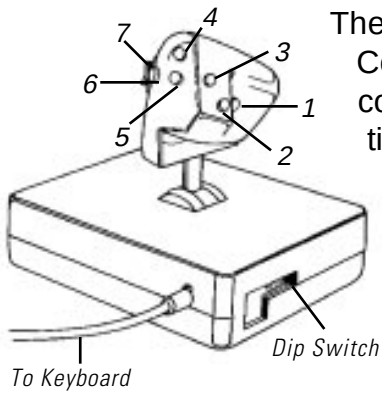
rotates your **Comanche** to the left. The button on the bottom of the control stick will rotate your airship to the right.

The ThrustMaster Weapons Control System (WCS)

If you use a ThrustMaster WCS with your CPU, **Comanche** also utilizes its specific control functions for more realistic gameplay. You must use the **default** Dip Switch setting for the **Comanche** combat simulator. This Setting means your WCS's Dip Switch Position 1 is ON (towards the numbers or towards the top of the box) with all of the other Dip Switches OFF. Refer to your WCS manual for more information on dip switch configuration.

DIP SWITCH SETTING

*The correct Dip Switch Setting to enable the WCS for **Comanche** is "Dip Switch Position 1 as per the WCS Owner's Manual." **This setting is the Default Dip Switch Setting that is set on the WCS when you take it out of the box.***



The WCS handle acts as your Collective Control for the **Comanche**. Pushing the control stick forward **de**creases the collective pitch to lower the airship. Pulling the stick back, **in**creases the collective pitch to raise your **Comanche's** altitude.

The three (3) position rocker switch, #7, controls the magnification of your Digital Map Display. This switch allows

***NOTE:** The ThrustMaster Weapons Control System is a programmable keyboard device. Because it generates keyboard characters, your keyboard weapon selection buttons are **not** active when you use the ThrustMaster Weapon Control System. However, they **are** active if you are using **only** the ThrustMaster joystick.*

you “Zoom In” and “Zoom Out” from the closest maximum magnification to a medium setting to the farthest allowable view of the Digital Map. Weapon Control buttons #1 through #6 control access to your six (6) different weapon choices.

Button #6: Selects 20MM CANNON

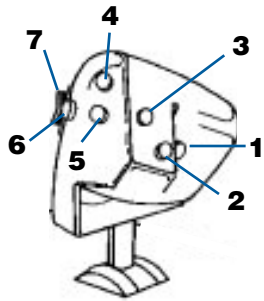
Button #5: Selects 70MM ROCKETS

Button #4: Selects HELLFIRE MISSILES

Button #3: Selects STINGER MISSILES

Button #2: Selects ARTILLERY SUPPORT

Button #1: Selects WINGMAN



USING THE MARK II WCS: *When using the ThrustMaster* ***Mark II WCS****, you* ***should not*** *select WCS or the FCS from the menu. Instead, you should select FlightStick with Throttle. To program the Mark II for Comanche, type* ***MARK II*** *from the* \COMANCHE *directory and select FlightStick from the menu.*

The ThrustMaster Rudder Control System (RCS)

Comanche also has full rudder capability if you are using the ThrustMaster Rudder Control System (RCS) with your computer system. Simply follow the instructions in your RCS manual and use this Rudder Control Device to rotate your airship during hover and low speed flight.

The CH FlightStick

Collective Control

Comanche has also been designed to work with the CH Flight-Stick and its built-in throttle control.

Use the FlightStick joystick as your Cyclic Control. Its Button #2 can be used to activate your TAS laser sight and its Trigger Button (#1) can be used to fire your weapons. On the base of the control, you will find the Throttle Control which you can use as your Collective Control.

NIGHT MISSIONS

The Army likes to brag, “We Own The Night.” That’s not far from the truth. With the help of your Image Intensifiers that amplify moon and starlight over 30,000 times and *Forward Looking Infrared* (FLIR) that looks for temperature differences, your **Comanche** was built to embrace the darkness in many of its missions.

During all of your night missions on-board the **Comanche**, the Cockpit Main Screen Display will appear in tones of green and black. This means that your Image Intensifiers and Thermal Imagers are on-line and operating for nighttime duty. Your two Tactical Monitor Displays will also be operating in this mode while used during night missions.

CHOOSING YOUR MISSION

Comanche is a finely detailed *combat simulator* representing the next generation of the military light-attack helicopter – the Boeing-Sikorsky RAH-66 **Comanche**. Every effort has been made to maximize your experience as a pilot in one of the most advanced military systems ever designed for combat duty.

In each one of your missions, you and your RAH-66 **Comanche** will be tested in a series of possible, even probable, military scenarios around a world-wide theater of operations.

To begin, move the Highlight Bar with your Cursor Keys to the **Begin Mission** Option. Press the "**Enter**" Key. You will be presented with another screen where you will be asked to **Select a Campaign**. This screen lets you choose from the following campaigns:

1. COMANCHE TRAINING MISSIONS

These missions are designed to let you enjoy and get familiar with the **Comanche**. If you play them in order, they will work as a tutorial, familiarizing you with the control and weapons systems in a sequence that will build in a progressive manner. All navigational and sensor systems will be fully active during these

training missions; however, armament loads will differ so that you can concentrate on learning the proper use of the individual weapons. Your objectives in each training mission will vary depending upon the assignment you actually choose. These Mission Objectives will be described on a secondary screen once you have made your choice. You will then have the choice to either “Accept The Mission” or “Reject The Mission.” If you decide to “Reject The Mission,” you will then be given the choice of selecting a new one.

You should take the opportunity at this Training Level to try to gather experience and enjoy flying your **Comanche** . Completing these simpler missions will allow you to move to the next level with confidence and skill.

2. OPERATION MAXIMUM OVERKILL

This is the big one. Operation Maximum Overkill is a theater-wide campaign that will span the globe. Each mission will have specific objectives and goals that you must complete in order to move onto the more difficult levels.

Unlike the training level, your **Comanche** may not be operating at peak efficiency for every mission. Like a real military operation, weapon loads will vary or your fuel may be low. Each of these missions holds a different danger for you and your **Comanche**. The missions in this campaign are staged according to difficulty. You will not be able to access some missions until you have completed earlier ones.

3. OPERATION OVERLOAD

Operation "OVERLOAD" consists of generally easy missions. Damage and weapon characteristics are heavily biased in favor of your **Comanche**. Play these missions to familiarize yourself with flying, or when you just want to relax and enjoy the program.

In this campaign, you and your **Comanche** airship are on general assignment for military duty throughout the world. The divergent sorties that you will be sent out on will be as far-ranging as a simple Antarctic search-and-destroy mission on an abandoned base to a deadly hunt for a new stealth device that's being tested for use by your enemies either on land or in the air.

Many times within these scenarios your **Comanche** will be packed to the limit with defensive and offensive weapons for maximum overkill. This will allow you to experiment with new strategies and battle tactics in many of the adverse battle-grounds that will await you in the other campaigns.

All of these missions will be accessible to you to fly if you select this campaign. You **do not** have to successfully complete other missions to switch to any of the other scenarios that are included in this campaign.

4. OPERATION RESTORE PEACE

This series of campaigns brings you and your **Comanche** into conflict with smaller, but very lethal, military opponents across the globe. Your **Comanche** will battle drug lords in South America, Middle East anarchists who want to launch a bloody Jihad with SCUD missiles and even terrorists who have stolen Comanche airships for their own treacherous deeds. As the title of the operation indicates, you will be assigned to take on the terrorist enemies of the free world to restore order in deadly scenarios ripped from the headlines of today's newspapers.

Each mission will have very specific goals and objectives that you must accomplish before you can claim victory at the end of your sorties. As in real military operations, your offensive and defensive capabilities will vary. It is imperative that you utilize the resources that are available to you to complete each mission. All but the most difficult missions in this campaign are available to you at any level when you select this campaign. The advanced scenarios are not accessible until you have successfully completed some earlier ones.

5. OPERATION CLEAN SWEEP

Similar to the original "MAXIMUM OVERKILL" campaign. The action is fast and furious and you better be an ace pilot to survive this one.

Every other mission has led to this theater-wide campaign. Here, you must take on sometimes nearly impossible odds to successfully complete your assigned objective. One minor miscalculation at the beginning of a sortie can mean disaster in the last few moments of your mission.

In these difficult scenarios, the planning and execution of your battle strategy is going to be just as important as your firepower. In many of these missions, you will have to overcome an enemy's superior position and firepower before you can go on the offensive and accomplish your mission objective. Some of the missions on this level are accessible only if you have successfully completed previous missions in this campaign. All of these missions demand the utmost utilization of your skills and talent.

6. OPERATION SILVER DOVE

Operation "SILVER DOVE" is designed to be the least challenging of the four new campaigns. It is an excellent starting point to familiarize yourself with the new enemies, terrains, and Comanche capabilities.

7. OPERATION WHIRLWIND

Operation "WHIRLWIND" provides a well-rounded and varied group of 10 missions that require both speed and skill. A little caution and strategy will help you survive.

8. OPERATION OVER THE EDGE

Operation "OVER THE EDGE" is collection of wild, fast-paced missions. You'll need to shoot first and ask questions later if you are going to make it through all 10 missions. Take a deep breath, and always check six.

9. OPERATION TERMINAL VELOCITY

Operation "TERMINAL VELOCITY" is the most difficult set of missions yet devised for Comanche pilots. Only the best and most experienced flight veterans need enter this battle arena. You'll need to use nearly every bullet, every drop of fuel, and every last bit of nerve to succeed. But you can make it through if you have what it takes.

10. OPERATION ZEPHYR

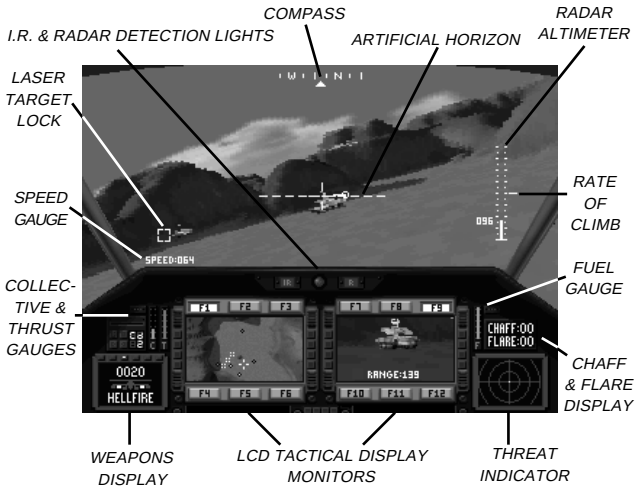
Operation "ZEPHYR" makes use of all the skills you have developed as a **Comanche** pilot. This globe-spanning campaign uses every feature and terrain introduced in previous missions. Let's see what you've learned, hot shot. Happy hunting!

THE COMANCHE'S COCKPIT

MAIN DISPLAY SCREENS

When you settle yourself into the **Comanche's** pilot seat, you will notice three display screens in your cockpit that will help guide you through the difficult missions ahead.

Like the advanced tactical and display systems onboard the real **Comanche**, your simulator allows you to select which visual, navigational and control displays will be shown on the cockpit display screens at any time through simple keyboard commands.



Comanche Cockpit Main Display Screen

THE WINDOW DISPLAY SCREEN

Comanche's simulator offers a number of different views while flying. You can access these views by selecting the appropriate key directly above the QWERTY layout on your keyboard.

USE THESE KEYS:

1 2 3 4 5 6 7 8

to change your view in the cockpit.

FORWARD COCKPIT VIEW – "1"

This is the normal pilot's view from the cockpit of the RAH-66 through your front cockpit window. When you first enter the cockpit, this is what you will see. In this viewing mode, you will be able to see all of the Heads Down Gauges and the Tactical Display Monitors on the instrument panel below you and the Helmet Integrated Display information projected on the lenses of your helmet directly in front of your eyes.

In the midst of battle, this forward view is the most advantageous viewing mode to be in to maintain complete control of your navigational, targeting, weapon and flight control systems.

LEFT COCKPIT VIEW – "2"

This allows you to see out of the Left side of your cockpit window.

RIGHT COCKPIT VIEW – "3"

This lets you to see out of the Right side of the cockpit window.

REAR COCKPIT VIEW – "4"

By choosing this selection, you can look behind your seat towards the rear of your aircraft to see your co-pilot/gunner and any hostile aircraft attacking from behind your **Comanche** airship. Pilots like to call this the "Check Six" position.

PANORAMIC FRONT VIEW –"5"

This is a full front display without any of the cockpit struts or your Heads Down Gauges and Displays to distract your attention. ALL navigational, weapon and control systems are active in this mode. All the HID displays are still active in this mode for use in targeting or navigation.

CHASE VIEW – "6"

This viewing mode places you a short distance directly behind your chopper while the **Comanche** remains under your control. This view will rotate and pan with your copter to keep the **Comanche** in view.

This *Chase View* has a cinematic perspective and can let you analyze your different fighting techniques and their effectiveness. NONE of your HID displays will be visible. However, this view affords the player an interesting view of your **Comanche** firing weapons, chaff and flares.

DROP CAMERA - Remote Ground View – "7"

This viewing mode monitors your **Comanche's** progress from the

STATUS CHECK:
During each mission, you need to stay aware of your fuel, weapon and damage status. Since not all navigational, weapon and control systems are active in this mode, you should make it a point to return to the MAIN COCKPIT VIEW "1" so you can check the status of each system through the Heads Down gauges and displays.

ground level as if you have dropped off a remote camera pod onto the terrain below you. When you reach an area where you wish to drop the camera, press the “7” button and the viewing pod will drop to the surface at that designated location. Once on the ground, the camera will automatically rotate to follow your **Comanche's** progress from this lower visual perspective.

Repeat this as many times as you want during your mission. Only the most recently activated camera can be accessed by you and your monitor screens. To activate a new drop camera on a different location, simply move your **Comanche** to that new location and press “7.” The new camera will start, interrupting the former view of your flight and continue to follow your movements until you drop a new camera.

REACTIVATE LAST DROP CAMERA - Ground View – “8”

This viewing mode allows you to reactivate the last *Drop Camera* you released. You can use this function to re-access the broadcast signal from this ground viewing device while in any of the viewing options without having to drop a new camera.

MAIN DISPLAY SCREEN VIEWS

Keyboard or Keypad Commands

“1” – Forward Cockpit View
“2” – Left Cockpit View
“3” – Right Cockpit View
“4” – Rear Cockpit View
“5” – Panoramic Front View (with HID & Targeting)
“6” – Chase View
“7” – Drop Camera and Activate - Remote Ground View
“8” – Reactivate Last Camera Drop - Remote Ground View

Move the "hat" in these directions to change the cockpit view:


Forward Cockpit View


Left Cockpit View


Right Cockpit View


Rear Cockpit View

Note to ThrustMaster Joystick Users

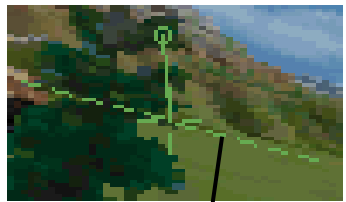
The first four of these viewing options are accessible to the ThrustMaster Flight Control Stick through the keyboard controls as well as the Hat switch on the top of your flight stick. While in flight, simply push the Hat switch towards the direction you want to view. Experiment with this option during the training missions until you get the feel of how to change your Main Cockpit Viewing Display at the touch of this button.

HELMET INTEGRATED DISPLAY (HID)

The RAH-66 **Comanche** utilizes a ***Helmet Integrated Display* (HID)** system for the pilot to manage the navigation and weapon systems. These displays are projected onto the optics of his helmet display so that the pilot can watch them without having to avert his eyes from guiding the airship. This can account for the targeting box sometimes traveling over the interior of the cockpit. Unlike traditional Heads Up Displays (HUD), the HID is not limited to the view directly in front of the windshield. In fact, you can target some weapons out the side and rear views.

ARTIFICIAL HORIZON (Center of Screen)

This *Artificial Horizontal Line* shows you where the true horizon is even if it is obscured by darkness or objects such as mountains. It displays the present “pitch” (whether your bird's nose is up or down) and your copter's “roll” (left or right). This horizontal line shifts and changes when you adjust your Cyclic or Collective controls to direct your aircraft across the field of battle.



Artificial Horizon

RADAR ALTIMETER DISPLAY (Right Side of Screen)

This display tells you the **Comanche's** *actual distance from the ground sensed by radar*. This is very different from a standard altimeter that tells your airship's altitude above sea level, but does not tell you how far you are from the actual terrain below.

In this simulation the **Comanche's** ceiling is limited to about 500 ft. above sea level. For this reason, even when flying at maximum altitude, if you go over a mountain, your altimeter may register only a few feet above the ground.

NOTE: *Keep an eye on this Radar Altimeter display in mountainous terrain. It could save your* ***Comanche****.*

Rate of Climb Indicator

Radar Altimeter

RATE OF CLIMB INDICATOR (Right of Screen)

Placed to the right of the Radar Altimeter, this HID indicator gives you an indication on the rate of speed at which you are climbing or descending relative to sea level.

HEADING VELOCITY DISPLAY (Center of Screen)

This HID uses an onboard computer system to calculate your **Comanche's** speed and direction and displays them in an easy to read gauge.

Imagine that you were looking at an overhead map, not at the front of the windshield. Your **Comanche's** present position is shown by the

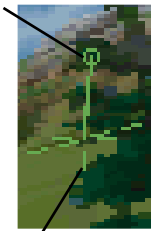
cross in the middle of your view. The position that your helicopter will be at one second from now is marked by the center of the circle connected to the cross by the vector line.

When you change direction, the line shifts towards that direction. As you pick up speed, the line increases in length since you are now traveling further on your map. This indicator changes with every adjustment of your Cyclic control. The angle of the line tells you in what direction you are heading and the length of the line indicates your speed.

Relax! It sounds complicated but after a while you'll instinctively know how to read and use it.

NOTE: *This is your copter's current and future position as though you were looking down at it from straight above the aircraft.*

Position 1 Second From Now



Current Position

DIGITAL SPEED INDICATOR DISPLAY (lower left of screen)

This digital display tells you the true airspeed of your **Comanche** in knots. Top speed for a **Comanche** is about 177 kts. or about 200 m.p.h. (1 kt. = 1.15 m.p.h.).

COMPASS DISPLAY (top center of screen)

This HID shows the aircraft's heading via a projected compass displayed at the top of your field of view.

TACTICAL DISPLAY MONITOR SCREENS

Directly below the *Main Cockpit Display* are two very important sources of information for the pilot. They are your two identical and redundant ***Tactical (TAC) Display Monitors***. Both of these monitors have direct access to the *Digital Map*, *TAS*, *Threat Indicator*, *Damage Display* and *Help Function*. Access to these TAC Displays is INDEPENDENTLY AVAILABLE on either Tactical Monitor. Each TAC Display is controlled by the Function Keys on the keyboard.

*Liquid Crystal Display Monitors can be switched to display a number of TACTICAL DISPLAYS. Each monitor can independently summon **ANY** of the TAC displays at **ANY** time. In case either of the monitors is damaged, you can always use the other monitor display for back-up. (The sixth display for each monitor is reserved for future expansion.)*

DIGITAL MAP DISPLAY (Left TAC – F1; Right TAC – F7)

This *Digital Map Display* contains a wealth of information for any pilot on a dangerous mission. It combines a downward-looking contoured Terrain Map loaded in from your Optical Mission Disk, while superimposing ground threats and mission targets acquired through AWACS, surveillance satellites and other information gathering resources.

Downloaded into your computers from the Optical Mission Disk, this precise *Geologically-Contoured Terrain Map* will show the terrain that you are overflying and the location of all vehicles and structures that have been detected by the above listed means.

You can also magnify your view of these maps. To "Zoom In" and "Zoom Out" within the Digital Map display on either the Right or Left TAC Monitor, press the "**<**" key to **Zoom Out** and the "**>**" key to **Zoom In** on the ride hand side of your keyboard.

If you are using a **ThrustMaster Weapon Control Stick**, you may also "Zoom In" and "Zoom Out" by using the 3 position #7 switch on the control. By clicking the switch all the way down in its lowest position you will be at maximum magnification. The middle position puts you at a medium magnification. The top setting shows you the widest view of the Digital Map.

If both of your TAC monitors are set to show this display, then pressing these two keys will affect both monitors at the same time.

Combining a *Ring Laser Gyro-based Inertial Navigation System* with the *Global Positioning Satellite System*, this TAC view selection shows your **Comanche's** precise location in this map within a few meters at all times during your mission. This naviga-

F1 *through* **F6** *keys control the Left TAC.*

F7 *through* **F12** *keys control the Right TAC.*

Zoom Out

Zoom In

tional position information is overlaid with an overhead view of the terrain and information obtained from your mission disc as well as friendly and enemy vehicles detected by surveillance satellites, AWACS airplanes and other means.

This enhanced Digital Map display is one of the best resources you can utilize to complete your missions. But be careful! Not all of your threats can be picked up by your automated systems. Your direct view through the HID will be the only way to see some hidden ones. Remember, keep your “Wide Eyes” open.

When accessed through either monitor, the Digital Map display relays its sensor information by assigning known threats and targets to the monitor as color coded blips or markers superimposed on the currently visible map.

Red “markers” refer to air threats. Yellow “markers” refer to ground hostiles such as Soviet T-80 tanks or SAM Mobile Missile Platforms (Geckos). White “markers” represent neutral objects such as fuel tanks. Green “markers” refer to friendly aircraft and Blue “markers” designate friendly ground vehicles.

MAP MARKERS:

RED *– Air Threats*

YELLOW *– Ground Threats*

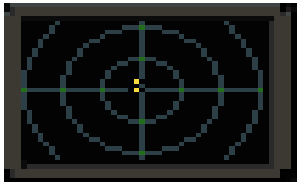
WHITE *– Neutral*

GREEN *– Friendly Aircraft*

BLUE *– Friendly Ground Vehicles*

NOTE: *Mission completion goals are designated by markers with* ***FLASHING BORDERS****.*

THREAT INDICATOR (Left TAC – F2; Right TAC – F8)



Your **Comanche** is equipped with several sensors to let you know if you are being targeted by an incoming missile or rocket. This display is so important that it is duplicated as a full-time display on the right side of your instrument panel and is connected to a voice warning system.

In general, you will get advance warning of missiles and rockets that have been targeted towards you. The display is very effective in spotting radar-guided missiles and somewhat less effective in spotting laser- and IR-guided threats. Rockets also produce an IR signature, so you may also get a warning if one is fired.

Should you get an incoming threat, you should perform an immediate evasive maneuver. Dropping behind an outcropping might be effective. Making abrupt attitude changes, such as dropping and turning (*jinking*) will also reduce your chances of being hit.

Flying low and always keeping a safe terrain formation nearby to hide behind is one of your best defenses against enemy fire.

TAS CAMERA DISPLAY/TARGET DISPLAY (Left TAC – F3; Right TAC – F9)

When you lock on a target, an image derived from your *Target Acqui-*

sition System (TAS) is shown in this display.

In this mode, it displays a forward-looking gyro-stabilized image of whatever item has been locked on by your TAS.

When you lock onto a land or air target via your TAS, this sensor display will then visually lock into a stabilized Close-Up Shot of your intended target until you either destroy the target, lose lock, manually re-target or manually change to a different TAC Display.

The TAS displays a view of the targeted object once you have obtained weapons lock.

MISSION STATUS DISPLAY (Left TAC – F4; Right TAC – F10)

By opting for this TAC display, you will be able to get an update on your progress for your assigned mission.

As specified by the parameters given to you before you accepted this mission, this status screen will show you how close you are to accomplishing your task.

On the screen display, you will see two indicators. One is the number of assigned goals you need to destroy in order to complete your

NOTE: *Each mission has different goals and targets. Not all enemies are mission goals. Only those with flashing markers count towards mission completion.*

mission. The second is the actual count remaining to be destroyed verified by your onboard computer.

DAMAGE STATUS DISPLAY

(Left TAC – F5; Right TAC – F11)

Using an icon representing your RAH-66 **Comanche**, this display will keep an active status report for you of all major operational systems onboard your airship during a mission.

If you are unable to avoid an attack by hostiles, and your ship is behaving peculiarly, refer to this Damage Status Display to analyze which systems may have been damaged or destroyed by your enemies.

*See **DAMAGE** section on page 57 for details.*

FUTURE EXPANSION (Left TAC – F6; Right TAC – F12)

These key functions are reserved for future sensor expansion on additional **Comanche** mission disks.

TAC MONITORS HELP DISPLAY (“?”)

Pressing the “**?**” key on your keyboard temporarily throws a ***Help Screen*** up on both of your TAC monitors that lists the Six TAC Display Options that you have to choose from.

By using this screen, you don't have to interrupt your game by constantly referring to the manual for the correct key to pick the Tactical Display you want on each monitor.

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TAC KEYBOARD COMMAND SUMMARY

LEFT TAC DISPLAY MONITOR SCREEN

F1 Digital Map
F2 Threat Indicator
F3 Target Acquisition System (TAS)
F4 Mission Status Display
F5 Damage Status Display
F6 Future Expansion

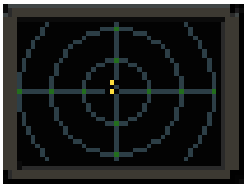
RIGHT TAC DISPLAY MONITOR SCREEN

F7 Digital Map
F8 Threat Indicator
F9 Target Acquisition System (TAS)
F10 Mission Status Display
F11 Damage Status Display
F12 Future Expansion

? TAC HELP MENU

Q Last TAC left (w/o ThrustMaster WCS)
W Next TAC left (w/o ThrustMaster WCS)
A Last TAC right (w/o ThrustMaster WCS)
S Next TAC right (w/o ThrustMaster WCS)
< Zoom Out (DIGITAL MAP)
> Zoom In (DIGITAL MAP)

DEDICATED THREAT INDICATOR



Because of the importance of this display, it has been allocated as a dedicated full-time output screen to give you information on incoming threats. Similar to the TAC Threat Indicator, the display uses several sensors to let you know if you are being targeted by a hostile weapons system.

In general, you will get advance warning of missiles and rockets that have been targeted towards you. The display is very effective in spotting radar-guided missiles and somewhat less effective in spotting laser- and IR-guided threats.

Rockets will also produce an IR signature so you may get a warning if one is fired.

WEAPON SELECT DISPLAY

Another important display in the **Comanche's** cockpit is the ***Weapon Select Display Screen*** located at the far left of your Heads Down Instrument Panel. As the name suggests, this will tell you which weapon system is selected for you to use with your Fire Control buttons.

These selection screens are easy to access. To choose your weapon, you must press the appropriate key on the keyboard to activate that selection. It will then appear on the Weapon Select Display Screen with the remaining number of units left in your armament to fire.

Remember: Your **Comanche** has a limited amount of arms that it is able to carry into battle. Therefore, you will **not** be carrying an unlimited amount of rockets and missiles on your sorties. In each mission, you will be carrying a different weapons payload comprised of varying amounts of Hellfires, Stingers, 70mm rockets and 20mm cannon rounds. Make sure that you are aware of these limitations **BEFORE** you go into battle so you don't use the weapons inappropriately.

The Keyboard Weapon Keys are on the lower left side of the key row directly above the space bar.

"**Z**"	CANNON
"**X**"	ROCKETS
"**C**"	HELLFIRES
"**V**"	STINGERS
"**B**"	ARTILLERY
"**N**"	WINGMAN

There is also a keyboard shortcut to access the weapons. To access the Previous Weapon on the Weapon Select Display, press the "[" button. The Next Weapon in your arsenal can be called up by Pressing the "]" button.

COMANCHE ARMAMENT AND WEAPONS

The weapon systems below can be selected by using the direct access keys noted (or the WCS). Once selected, the weapon should be locked on to the target with your TAS. To do this, either press the **ENTER** key on the keyboard or button #2 on your joystick. Once the weapon is locked, a green rectangle will mark your target and, if a TAC is in the TAS mode, a close-up of the target will appear. You can then fire the weapon by pressing the **Spacebar** or button #1 on your joystick.

20mm Gatling Vulcan II Cannon ("Z" key)

(unless using ThrustMaster WCS)

The three-barreled 20 mm cannon hides in a LO fairing to minimize **Comanche's** radar signature, but swings out to engage ground or air targets. The 20 mm Vulcan II cannon is tied to your helmet sight and can go to its full 1,500 rounds-per-minute rate of fire. *(At this continuous rate of fire, your ammunition will last less than 1 minute.)* The cannon will fire as long as your firing button is held down and there is still ammunition left.

The Vulcan Cannon is auto-aimed by your Target Acquisition System if a target is selected in your sight. It is accurate at short and medium ranges.

70mm Rockets ("X" key)

(unless using ThrustMaster WCS)

Your **Comanche** fires these powerful weapons in spreads of 1 or 2 rockets. Small but lethal up to 2 km, their Flechette warheads can fill the sky with nails out to 1 km vaporizing any nearby airborne hostile from the sky.

Your TAS can only aim at their azimuth (up/down). Once fired, they do not have guidance systems to seek the target. The rockets only fire in the direction that the **Comanche** is headed.

NOTE: *Your "**M**" key is always a "Live" firing control to your 70mm rockets. Even if you are set in another Weapon Select mode, you can press the "**M**" button to Fire a 2 rocket salvo in an emergency if you still have any rockets left in your mounts.*

AGM 114 Hellfire Laser-guided Missiles ("C" key)

(unless using ThrustMaster WCS)

Guided to its target by your TAS laser sight, the supersonic Hellfire has a standoff range greater than 8 km. Heavier than the Stingers, the Hellfire also carries a larger warhead. It is your most powerful weapon against armored ground targets.

Unlike Stingers, you must maintain TAS lock on your target until the Hellfire strikes. Conversely, if the Hellfire is still in flight, you can sometimes re-target and hit a different target than the one you first locked onto.

Don't waste Hellfires on minor targets. Never forget the Hellfire missile is also a devastating weapon against a flying target.

AIM-92 Stinger Missiles ("V" key)
(unless using ThrustMaster WCS)

The RAH-66 ordinarily carries Stinger air-to-air missiles. The IR-seeking Stinger should be used at short ranges from 1–2 km. Once it has been locked onto a target by your Target Acquisition System it will try to keep its lock on the target even if you lock on a different target. While less powerful than your Hellfire missiles, it is a deadly "fire-and-forget" weapon against air targets.

The Stinger is a superb fire-and-forget weapon that enables you to go on with your fighting and flying while it seeks its target.

HAND-OFF WEAPONS

The following are two other weapon selection options for you to choose from. These weapons are not carried aboard the **Comanche** airship, but can be designated and fired as if they were.

Artillery Fire 155mm & MLRS ("B" key)
(unless using ThrustMaster WCS)

The **Comanche's** computers know at all times its precise location. By locking on to a target with its TAS, the computers can derive the precise coordinates of

the target and transmit them to the Command and Control network. This will call up fire from conventional artillery or ground-based *Multiple Launch Rocket Systems* (MLRS), sometimes called "Steel Rain."

NOTE: *The amount of Artillery Support varies with each mission's parameters.*

If available in a mission, this is the most destructive weapon at your disposal. This is a fire-and-forget system. The main disadvantage is that since it takes time for the shells to reach their destination, they are less effective against fast moving targets.

Wingman/Hellfire Missile Support ("N" key)

(unless using ThrustMaster WCS)

In some missions your **Comanche** will have another **Comanche** flying with you as your wingman. If he is there, you can usually see him on your Digital Map, as a GREEN marker flying close to you.

If you can't see your Wingman, try shifting your Cockpit Main Display View off to one of the Side Views where your WINGMAN may be flying along with you on the mission.

In general, your wingman will fly conservatively and stay in ground cover. However, when you select the WINGMAN Weapon Option, your wingman will assume a targeting position so that he/she can effectively fire a Hellfire missile that will seek on the enemy you currently have targeted with your TAS laser sights. When heavily

outnumbered, careful coordination with your wingman may be the only way to win a mission.

Be careful not to keep your wingman in a precarious position for too long. The enemy could concentrate their fire on him and destroy his ship. If this happens, this weapon option will become deactivated as will he.

WEAPON SELECT DISPLAY SUMMARY

KEYBOARD COMMANDS

"["	Previous Weapon Selection
"]"	Next Weapon Selection
"M"	Fire Salvo (2 x 70mm Rockets) (w/o WCS)
"Z"	Select 20MM Cannon (w/o WCS)
"X"	Select 70MM Rockets (w/o WCS)
"C"	Select Hellfire Missiles (w/o WCS)
"V"	Select Stinger Missiles (w/o WCS)
"B"	Select Artillery Support (w/o WCS)
"N"	Select Wingman (w/o WCS)

NOTE: *The only time your Keyboard Weapon Commands will not be available for your use is when you are using a ThrustMaster Weapons Control System. If you are using any other joystick or control device, these Keyboard Commands will remain active for your use.*

ThrustMaster WEAPON CONTROL SYSTEM COMMANDS

Button #6 - Select 20mm CANNON
Button #5 - Select 70mm ROCKETS
Button #4 - Select HELLFIRE MISSILES
Button #3 - Select STINGER MISSILES
Button #2 - Select ARTILLERY SUPPORT
Button #1 - Select WINGMAN

OTHER COCKPIT DISPLAYS

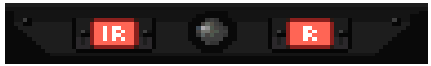
COLLECTIVE CONTROL and THROTTLE GAUGES

Simply stated, your collective control changes the pitch of all your main rotor blades which in turn makes your **Comanche** go up or down. In conventional helicopters changing your collective setting also means that the pilot must adjust the throttle and the tail rotor to compensate for the new input.

Since the **Comanche** is a fly-by-wire helicopter, changing the setting of the collective control tells the computer to automatically adjust all the other settings so as to maintain stable flight. The two bar type gauges located in the top left side of your cockpit indicate the settings that the on-board computer has chosen for pitch and throttle to make the **Comanche** do what you want it to do. Keeping the gauge marked “C” near the bottom of its range will allow for easy Nap-of-the Earth (NoE) flying.

NOTE: *Keeping the gauge marked* ***“C”*** *near the bottom of its range will allow for easy Nap-of-the-Earth (NoE) flying.*

RADAR and IR SENSORS

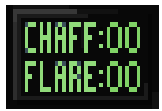


Your **Comanche** depends on a low detection profile to get in and out of tricky situations without alerting the enemy. Sometimes this is impossible when your objective is in the middle of a net of radar and laser detection gear. These two sensor lights will FLASH RED to warn you if your **Comanche** is being "painted" by radar or the heat signature of a rocket being launched at your helicopter is detected.

If either of these sensors activate, it's a sure bet that a weapon has been targeted or is about to be launched to blast you from the sky. Take evasive action immediately!

The Left Detection Light activates when your ship's **Infrared (IR)** sensors have picked up a tell-tale heat signature approaching the **Comanche**. The Right Detection Light activates when your RAH-66 passive sensor gear has picked up a nearby radar (very similar to a radar detector in your car.)

CHAFF and FLARE RELEASE DISPLAY



If you are detected and locked onto by hostile forces, don't lose hope. Your **Comanche** has two **automatic** defense mechanisms that will come to your aid.

Press  *for* ***Chaff***

Press  *for* ***Flares***

If the onboard detection systems sense that your airship is being

tracked by a missile or rocket with a detectable infrared-guided signature, your **Comanche** will automatically release **Magnesium Flares** to trick the heat-seeking missile into following the hotter heat source away from your own engine exhaust.

If your onboard defense system senses that radar is being used to track you, it will automatically release a load of **Reflective Chaff** to disperse the radar signal and confuse the tracking of the on-coming missile.

If you would like to activate these counter measures manually, press the **";"** (semicolon) key to release the chaff and the **"'"** (apostrophe) key to release a flare. You can see either of these being ejected if you choose the **"6"** Cockpit Viewing option.

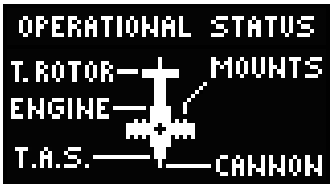
NOTE: *The **Comanche's** onboard defense system has only a limited supply of Chaff and Flares that it can either automatically or manually release. Once these supplies are gone, you have no defenses left except your speed and maneuverability.*

FUEL GAUGE

The Fuel Gauge indicates the amount of fuel remaining. Since missions sometimes start with limited amounts of fuel, it is wise to keep your eye on this gauge.

Keep an eye on the Fuel Gauge to see how much fuel remains in your tanks.

DAMAGE



During your mission, your ship may start to react abnormally if you are struck in a crucial area. There are potentially grave consequences to your **Comanche's** integrity if you take a hit in an essential system. The damage indicator lets you see which system (if any) has been damaged.

DAMAGE CAN OCCUR IN SIX DIFFERENT AREAS:

- *TAIL ROTOR*
- *ENGINE*
- *TAS*
- *WEAPON/MOUNT*
- *20mm CANNON*
- *TAC DISPLAY*

Here's what can happen:

Tail Rotor Damage -- A damaged tail rotor will cause the **Comanche** to want to spin, making the airship difficult to control.

NOTE: *To avoid damaging your tail rotor, you should avoid flying backwards.*

Engine -- Damaged engines will limit altitude and speed.

TAS Damage -- If the *Target Acquisition System* becomes damaged, holding a target lock becomes difficult. This may eliminate some of your weapon choices. For instance, the Hellfires require a laser locked on the intended target until impact. Further damage can keep it from working altogether.

Weapon Mount Damage -- The external weapon mounts can be damaged which prevents your long range weapons, such as the Hellfires, Stingers or rockets, from being fired.

Fly carefully; your Comanche isn't built to be a battering ram.

20mm Cannon Damage -- If the cannon becomes damaged, no firing will occur. To prevent further damage to the copter by a misfire, the onboard computer will automatically disable the cannon.

Slamming into objects nose first will usually result in Cannon or TAS damage.

Tactical Monitor Display Damage -- Should one computer be damaged, that monitor will no longer function. Luckily, the TAC Displays have redundant systems and if one of them becomes damaged, the other can still display all the TAC functions, although now you can only monitor one at a time.

PILOT SELECT SCREEN

During the title or demo sequences, press any key. You'll then find yourself at the *Pilot Select Screen.*

Here you'll be able to choose from a list of a few brave pilots who have flown the **Comanche** on the several training missions included with your program. Or, you can insert your own name into one of the blank spaces which are included in the ranks of **Comanche** pilots and volunteer for upcoming missions.

NOTE: *Once the list is filled, you must delete another pilot's name and his records to insert a new name.*

Number of Campaigns: Next to the names of the pilots, there is a number that tells you how many missions that particular pilot has flown. As you complete campaigns, medals will be added to your name.

NOTE: *If your helicopter is destroyed during any campaign, you will have to re-start the campaign from the first available mission of that campaign.*

Each time a pilot goes out on a mission, his/her status and

consequently, his/her numerical rank increases. Advanced missions will be denied to pilots who have not completed earlier missions.

If all the pilot slots have been used up, you can add your name by selecting a pilot and pressing the "**Delete**" key. A box will appear at the bottom of the screen. Fill in whatever pilot's name you feel is appropriate to your degree of aggression. Then press "**Enter**". Your name will be entered onto the list and ranked against that of the other pilots.

ADDING YOUR NAME
You can add your name by selecting an empty line or another pilot's "handle" with the highlight bar, and pressing the ***DELETE*** *key.*

Relax, everybody has to start somewhere and rookies always start at the bottom of the heap. But don't worry, as you start accumulating missions as a **Comanche** pilot you'll climb quickly up the list of ace pilots.

After you enter your name into the active ranks of the **Comanche** pilots, you're ready to move on. Use the cursor keys to make sure your name is highlighted and press the "**Enter**" key.

MAIN OPERATIONS MENU

You'll now find yourself at the *Main Operations Menu* of our

Comanche combat simulator. From here you'll be able to:

Begin Mission - Enter the SELECT CAMPAIGN menu and begin your next mission.

Your Stats - Examine your latest statistics and cumulative score as you proceed through each campaign and mission.

Choose Another Pilot - Choose another pilot (in case you feel a little worn-out).

RAH-66 Overview - Scan a technical and armaments overview of the **Comanche** as a quick review before your next mission.

Demo - Let the computer run a demo of the **Comanche** program showing the RAH-66 in action.

Credits - Check out the list of talented people that made this game possible.

Exit to DOS - Exit the game and return to DOS.

Feel free to access any of the functions on this selection menu.

If you feel that you have gone a little too prematurely into one of the areas, press the "**Esc**" key. This will immediately return you to the previous selection or menu level you were just working from.

*The "**Esc**" key is one of the most powerful keys that controls the operation of the game.*

In fact, the "**Esc**" key is one of the most powerful keys that controls the operation of the game. Even in the midst of battle, you can pause in mid-mission by using the "**Esc**" key, make adjustments to the program's operating parameters and re-enter the simulation at another press of the "**Esc**" key. A simple, yet very powerful control system - just like the RAH-66 **Comanche**.

Menu Bar (Esc)

Before you take off on your first mission, let's make sure that the combat simulator is precisely configured to your computer's hardware.

To access the Menu Bar from the *Main Operation Menu* press the "**Esc**" key.

At the top of the screen, above the shot of the RAH-66 in flight,

you will see the Menu Bar appear with four menu titles and their respective options.

Next to some of these menu options are keyboard alternatives that you may use without having to use the "**Esc**" key to access the Menu Bar. You may use these keyboard shortcuts even while in the midst of your missions. From the Menu Bar use the cursor keys to move to the furthest left of the menu choices - "Game."

USING SHORTCUT KEYS
You may use these Keyboard Shortcuts even while in the midst of your missions.

Game Menu

About Comanche — Pressing this selection will display the game credits and the serial number of the game package you have purchased. Don't forget to include this serial number when you send in your registration card or call in for customer support.

Return to Game — When you access this menu during the middle of a mission, choosing this menu selection will return you to the midst of battle.

Save Menu Settings — Choosing this option will allow you to

save whatever configuration menu settings you have chosen, including joystick centering. These same settings will be used whenever you re-start the game or until you use this option again.

Abort Mission — This option allows you to pull out of your present mission and go back to the *Main Operations Selection Screen* for reassignment. You can access this option through the Game Configuration Menu or at anytime during game play by pressing the keyboard shortcut "**Alt-A**".

Exit to DOS — Selecting this option takes you directly out of the game and leaves you in DOS. You may access this option from this menu, or in the midst of a game, via the keyboard shortcut "**Alt-Q**".

ENDING THE MISSION
*You can end the game through the Game Configuration Menu **or** at any time during game play by pressing the keyboard shortcut **Alt-A**.*

Detail Menu

These Menu selections allow you to configure the highest resolution of our Voxel Space graphic technology that your CPU can handle. The higher your CPU's speed, the faster the game will play, and the more detail it will be able to show per frame. As a rule, the lower the detail you select, the faster the simulation will run.

Experiment with all five Detail settings until you find the setting best suited to your computer's configuration. Use the cursor keys to highlight your selection and press "**Enter**" to activate that Detail Option.

Detail High — This option allows the greatest 3-D detail within the flight mission areas.

Detail Medium — Choosing this option maintains high graphic detail, with somewhat faster frame rates for your simulator.

Detail Low — This detail selection uses lower graphic detail in the mission scenarios and allows the fastest simulator operation of all three settings.

Clouds — This Detail Option allows you to turn the cloud backgrounds on or off. On some computers this is the best way to maintain a high frame rate with no loss in play quality. When this option is switched "on" (the Option Box on the left of the setting is filled), the sky is filled with cloud cover for greater detail.

Small Pixels — This option chooses the pixel size for your 3-D landscape rendering.

Setting at Restart
When you save your configuration settings, these same detail settings will be used whenever you re-start the game or until you save the settings again.

Detail Versus Speed:
If your computer runs slowly, you should select the DETAIL LOW option and turn off the CLOUDS and SMALL PIXELS Detail options.

For even more speed, you might want to switch off the Artificial Horizon, HID Indicators and HID Compass located under the OPTIONS menu.

When the Small Pixel function is turned off (Option Box is empty), the larger pixels reduce the detail in the landscape rendering, but the speed of the simulator will cause the greatest speed increase of any of the options. The “Small Pixels Off” setting is recommended for slower computers, particularly 386SX machines.

SETTING CHANGE: *To change the setting, move the highlight bar to the correct setting and press* ***Enter****.*

HAZE — This option shows haze in the distance. It takes time to compute the haze so use it only on faster computers.

The Option Box is ON ▣

REFLECTIONS — Reflections over the water on some missions are turned on with this feature, but as above, this is best on fast computers.

The Option Box is OFF ☐

Control Menu

This menu allows you to change and choose the *Sound* and *Voice Effects Volume*, the *Music Volume*, and what *Control* Device you will use to fly the RAH-66 simulator.

The ***Sound Loud***, ***Sound Soft***, and ***Sound Off*** options control the volume of the Sound Effects and Voice within **Comanche**. Use the cursor keys to choose the selection you want and press “**Enter**” to activate. A small arrow will indicate your selection.

The ***Music Loud***, ***Music Soft***, and ***Music Off*** options control the volume of the Music in the **Comanche** program.

As in the previous option, use your cursor keys to choose the selection you want and press "**Enter**" to activate. A small arrow will appear on the left side of the selection you have made.

These next menu options allow you to specify what control device you want to use to fly your RAH-66. **Comanche** will support either a keyboard with joystick or the keyboard alone for **ALL** of the combat simulator functions.

Use the cursor keys to make a selection and press "Enter" to activate. A small arrow will appear on the left side of the selection you have made.

Shortcuts Active Except for WCS: *Whatever Flight Control Option you use to fly the* ***Comanche****, the keyboard shortcuts will always remain active for your use* ***UNLESS*** *you use the ThrustMaster Weapon Control Stick. This particular unit* ***disables*** *some shortcuts on the left hand side of the keyboard.*

ThrustMaster FCS Joystick — Select this option to use the ThrustMaster Flight Control System joystick to fly your bird.

CH Flightstick Pro — Activates the Flightstick Pro.

Flightstick w/ Throttle — Choose this option if you are using a FlightStick with an independent throttle control. This option will work with some other joysticks that have built in throttle control.

Normal Joystick — Please choose this option if you are planning on using a regular joystick as your flight controller. In this mode, the joystick will act as your Cyclic control, button #1 as your fire control, and button #2 as your TAS lock.

Keyboard — Select this option if you want to use the keyboard to control your copter. This control option is set by the program as the default control. The keyboard can control all functions of the simulator.

ThrustMaster WCS Mark I (Weapons Control System) — Please select this option if you are planning to use this Weapons Control System with your ThrustMaster Control System (see WCS section.)

Rotor Control — This selection can be used if you have a device that will use the X-axis of the second joystick port as a control for

IMPORTANT NOTE ON USING MARK II WCS: *When using the ThrustMaster* ***Mark II WCS*** *you* ***should not*** *select WCS or the FCS from the menu. Instead, you should select* ***Flight-Stick with Throttle****. To program the Mark II for* ***Comanche****, type MARK II from the* \COMANCHE *directory.*

your tail rotor. This allows you to make more precise turns. Choose this option if you have either ThrustMaster foot pedals and other similar systems.

Calibrate Joystick "J" — If, while playing **Comanche Maximum Overkill** , your joystick seems to be "drifting," use this menu option to re-center it. You may also press "**J**" while in the middle of playing a game to re-calibrate your joystick without having to access this menu.

To calibrate your joystick from the menu, select "**Calibrate Joystick**". You will then be prompted to make sure that your control stick is at its center position along with your foot pedals (if you have any) and press any key. Next, you will be prompted to swirl your joystick in a circular motion around the outer perimeter of the joystick's furthest range of travel and push each pedal to its limit. You're ready to go!

You can also, during game play, re-calibrate your controls by centering your joystick and foot pedals (if any) and press the "**J**" key. Immediately after pressing the "**J**" key, you should swirl your joystick and push each pedal to its limit to finish calibrating the device.

*To calibrate your joystick, press the "**J**" key.*

*During game play, you can also re-calibrate your controls by centering your joystick and foot pedals (if any) and pressing the "**J**" key.*

If you are using a ThrustMaster FCS control stick, the procedure is a little bit different. When you activate the calibration program by pressing "**J**" or selecting the menu function and move the ThrustMaster joystick around in a circle to calibrate its maximum "X" and "Y" axis, you must **also** press the "Hat" switch up (forward) for proper calibration of the pilot's four possible views using this switch. Once this is done you're ready to go.

Save Menu Setting: *Use the "Save Menu Setting" Option to save the joystick settings so that every time you play* ***Comanche****, you don't lose your calibration.*

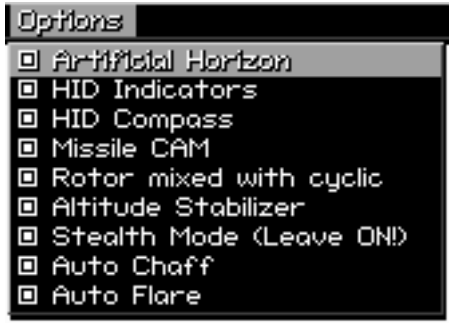
If you are using a combination throttle control/joystick like the CH FlightStick, similar products or the ThrustMaster Weapons Control System , you must also calibrate the throttle by first setting your throttle control device to its **maximum** position, then immediately moving the control to its **minimum** setting. This will calibrate your throttle control.

Options Menu

This Menu sets the clutter control of the *Helmet Integrated Display* (HID).

The RAH-66 **Comanche** utilizes a HID system for the pilot to manage the navigation and weapon systems. These HID Dis-

play Options control the amount of information visible through your Helmet Integrated Display.



Artificial Horizon (Center of Screen) — This option controls the display that shows your present "pitch" (whether your bird's nose is up or down) and your copter's roll (left or right bank).

HID Indicators — This option controls the Helmet Integrated Displays that report your **Comanche's** present physical position and status. This setting will turn "On" or "Off" the following HID indicators together: *Radar Altimeter Display, Rate of Climb Indicator, Velocity Display* and *Speed Indicator Display.*

The HID Indicators Option turns these four (4) Helmet Integrated Displays "On" or "Off" together:

- *Radar Altimeter Display*
- *Rate of Climb Indicator*
- *Velocity Vector Display*
- *Speed Indicator Display*

Missile Cam — Changes your view while in TAS Camera Display. When this tactical display monitor is engaged, your Stinger or Hellfire missiles will relay closing views of the target.

Rotor Mixed with Cyclic — When disengaged, the rotor and cyclic can now function independently via the joystick and the rudder

pedals (or keyboard), providing for more precise and realistic movement.

Altitude Stabilizer — When disengaged, the **Comanche's** pitch is no longer held stable by the computer, requir-ing greater emphasis on altitude control.

Stealth Mode — Maintains all of the **Comanche's** stealth systems. If turned off, enemies will be able to detect your presence from much farther. Turn it off if you think the missions are too easy.

Auto Chaff — Lets the onboard computer dispense chaff as needed.

Auto Flare — Lets the onboard computer dispense flares as needed.

Radar Altimeter Display (on the right side of your screen) — This bar graph and associated digital display will tell you the **Comanche's** actual distance (in feet) over the ground. The instrument works by bouncing a very low-strength, pencil-thin radar beam off the ground below you. Therefore, the relative altitude can change either by changing your *Collective* setting or

by flying over mountains or ground depressions.

Rate of Climb Indicator (to the right of your *Radar Altimeter Display*) — This instrument lets you know, relative to sea level, whether you are going up or down. This instrument is very important in setting your *Collective* control.

Heading Velocity Display (in the center of the screen) — A 'Top-Down' course projection of the **Comanche's** movement combining both your speed and direction. The length of the line gives an indication of your speed, while the angle of the line shows in what direction you are traveling. Imagine that the direction pointer is superimposed on a map rather than on your windshield.

Speed Indicator Display (on the lower left hand side of screen) — This digital display tells you the true airspeed of your **Comanche** in knots.

1 knot = 1.15 mile/hr

HID Compass (center top of screen) — This analog compass tells you what direction your airship is flying.

All of these HID displays are active within the program when it is first run. To change this default status, move the highlight bar to the appropriate selection and press the "**Enter**" key. When

MENU BAR ACCESS: *You may access the Menu Bar anytime during* ***Comanche*** *gameplay by pressing the "****Esc****" key.*

turned on, the box to the left is filled. When deactivated, the box is blank.

Congratulations! You've finished the setup. Press the "**Esc**" button and you're back at the *Main Operations Menu* again and ready to head out on your first mission. Buckle in! You're about to enter into the 21st century aboard the ultimate helicopter combat simulator:

Comanche™ Maximum Overkill™ !

ABOUT THE COMANCHE

by Frank Collucci

THE ORIGINS OF THE COMANCHE

Born To Fly - and Fight

The world has changed a lot since a U.S. Army the need for a new Light Attack Helicopter two decades ago. The threat of a massive Warsaw Pact armored assault on NATO is gone, but whatever the conflict, the U.S. Army still needs a survivable scout-attack helicopter that flies and fights at night.

The Boeing-Sikorsky RAH-66 Comanche will achieve Initial Operational Capability at Fort Rucker in Dec. 1998.

After years of research and testing, the Comanche impressively combines advanced technologies with an array of modern armament in a powerful fighting machine for what the Army calls the nonlinear battlefield.

Instead of large armies massed behind discrete lines, the nonlinear battlefield disperses small forces for their own protection, then concentrates them for decisive action. It demands timely reconnaissance

and accurate long-range firepower to strike deep and shape the situation before the decisive battle. The Comanche flies armed reconnaissance, light attack and air combat missions in a fast-moving war.

Within U.S. Army Aviation, the Air Cavalry finds the enemy for a combined arms team. Attack helicopter battalions strike fast and deep. The RAH-66 is a stealthy Reconnaissance/Attack Helicopter with the sensors, communications systems, and precision navigation aids to be the perfect scout. It also flies and fights like no other helicopter before.

Shaping The LHX

LHX -the Light Helicopter Experimental

How did the RAH-66 come about? Back in 1982, the Mission Area Analysis listed shortcomings in U.S. Army Aviation, mostly tied to the 7,000 Vietnam-vintage Cobras, Kiowas, Cayuses, and Hueys in use at that time. A new development, LHX–the Light Helicopter Experimental, was originally two helicopters with about 70% commonality in dynamics and subsystems.

The armed scout-attack version (SCAT) would find the enemy with advanced sensors and attack with missiles, rockets, and guns while

the larger Utility LHX would haul a six-man tactical team or about 2,000 lb of cargo. At 8,000 lb gross weight, LHX SCAT or Utility was to do small jobs more efficiently than the 14,000 lb Apache and 17,000 lb Black Hawk.

The one other major consideration was speed. This airship had to fly at least 185 knots per hour. A small, fast LHX would also be harder to see and hit on the high-intensity European battlefield. Faced with modern Soviet air defenses, the U.S. Army's underpowered light helicopters proved to be slow and vulnerable. They had no air combat capability to fend off Hinds and later attack helicopters.

Whatever the shape of LHX was going to be, fiber-reinforced composite materials promised lightweight, crashworthy structures free of metallic corrosion and more tolerant of battle damage. Bell and Sikorsky built flying demonstrators for the Army's Advanced Composite Airframe Program in 1984 to verify the advantages and explore tooling and production using composites instead of metal.

Low Observable technology could give combat aircraft reduced radar, infrared and acoustic signatures. Passive or self- contained navigation systems could reduce electronic emissions; and nap-of-the-earth (NoE) flying at night negated most air defense threats. Army and industry

planners briefly considered a single-engined LHX to cut weight and cost, but two engines obviously enhanced wartime survivability and peacetime safety, particularly during long flights over water. Strategic airlift is always scarce and Sealift is always slow, so the U.S. Army wanted an air vehicle that could self-deploy over 1,260 nautical mile stages to reach Europe by southerly routes.

The Bell D292 and Sikorsky S- 75 incorporated blow-out panels and crushable floors, and the first hints of Stealth shapes for helicopters.

Less clear was how many crew members would fly the LHX, since a trained co-pilot was an expensive “processor” for a flood of cockpit information. Bell, Boeing, Hughes, IBM and Sikorsky all did simulation studies and flight tests in the Advanced Rotorcraft Technology Integration Effort in 1984. Their measures of workload indicated a solo pilot in an automated cockpit might fly, but probably couldn’t fight nap-of-the-earth at night. The scout Battle Captain was even busier managing his own situation and that of his team.

NoE: Nap-of-the-Earth flying

As ambitious technologies and diverse requirements made LHX bigger, heavier and more expensive, the Army had to come to terms with the U.S. budget crisis. In 1985, an LHX fleet of 4,545 aircraft was expected to replace a larger fleet of less reliable and less available light helicopters. In August , 1990, the Secretary of Defense reduced the LHX fleet to 1,292 new light attack helicop-

It was calculated that a second crewman added around 1,000 lb to the light attack helicopter.

ters, or 1,610 if the Army Reserve and National Guard units had to become fully modernized.

LHX Realities

Today's Comanche is a compromise of capability, cost and risk. The Army declared its Light Helicopter would be a conventional, two-seat scout-attack helicopter that would weigh no more than 7,500 pounds empty and cost no more than $7.5 million in 1988 dollars based on production of 2,096 aircraft. When the Department of Defense cut the number to 1,292 helicopters, the average flyaway cost went up to $8.5 million each. Half of the total program cost was tied to avionics. The First Team, Superteam and their subcontractors approached the LHX air vehicle and its mission equipment package with their different technologies hanging from the same advanced engines.

Average Estimated Cost Per Airship: $8.5 million each

Allison Gas Turbine joined Garrett Turbine Engine Company to compete against a team from Avco Lycoming and Pratt and Whitney. In October 1988, the Allison-Garrett Light Helicopter Turbine Engine Company - LHTEC - was named supplier of the LHX power plant. The T800-LHT-800 engine for the Light Helicopter had to generate 1,200 shp intermediate rated power and spool up from idle to IRP in just two seconds for NoE agility and air-to-air combat. It was expected to burn 10 to 30% less fuel than older engines.

The original T800 requirement called for an engine that could grow 50% more powerful in the same physical envelope. And before the first prototype flew, the picture of a Comanche loaded with mast-mounted radar, infrared jammers and other add-on equipment led the Army to specify the T800-LHT-801 with 12% more power to preserve the performance of a heavier helicopter. The T800 has a Full Authority Digital Electronic Control for fast power response and to reduce pilot workload. FADEC also provides important diagnostic functions that can isolate faults down to the module.

FADEC: Full Authority Digital Electronic Control for fast power response and to reduce pilot workload.

From the outset, the Army wanted a reliable, durable engine that was easy to maintain. LHTEC chose a dual-centrifugal compressor specifically for its resistance to sand and particle erosion and, unlike its competition, avoided complex variable inlet guide vanes. The T800 in-

corporates an integral inlet particle separator. A suction fuel pump reduces risk of fire from ruptured lines and a self-contained emergency oil system keeps the engine running should external lubrication be lost. The engine is effectively an on-condition maintenance item without fixed overhaul intervals.

The four engine modules are replaceable in the field, and the T800 tool kit consists of just six dedicated tools.

Without the funds heaped on the Advanced Tactical Fighter for the U.S. Air Force, the Army's Light Helicopter Demonstration- Validation had no flying prototypes, but a wealth of computer simulations on the ground and systems demonstrations in laboratories and on surrogate aircraft instead. In April, 1991, the Boeing-Sikorsky First Team won the right to build DemVal prototypes and pursue a full-scale development contract for the RAH-66 Comanche. The first prototype is to fly in 1995.

A DIFFERENT KIND OF HELICOPTER

Point and Shoot

The Army wanted a fast, agile, stealthy scout with a protected anti-torque system in place of dangerous tail rotors. Bell and McDonnell Douglas based their LH proposal on a four-bladed

Black Hawks, Apaches, and most other helicopters designed before the 1980s have articulated rotor heads with feathering, flapping, and lead-lag hinges to maintain.

main rotor and the NOTAR no-tail rotor system. Boeing and Sikorsky chose a five-bladed main rotor and a shrouded tail fan with eight broad-chord blades.

The five-bladed Pentaflex main rotor pushed vibration into higher frequencies more easily damped with less weight. It also increased main rotor disk density to improve agility and reduce noise. The amount of hinge offset is a good indicator of the aircraft's roll agility, so important in air-to-air-combat. The all-composite bearingless main rotor designed for LH has elastomeric elements instead of hinges, and it is tailored with 9.5% equivalent hinge offset for crisp, fighter-like control response.

Conventional tail rotors are readily damaged by trees or terrain and too often mangle people on the ground. The Fantail shroud protects the composite blades and enhances the performance of the fan. The canted tail rotor gives the Comanche a measure of super-maneuverability, enabling it to point its nose quickly and fire on a target off the flight path.

The optoelectronic interfaces and actuators in fly-by-light controls never proved reliable enough for the First Team's Comanche proposal. But fly-by-wire flight controls still save weight compared to old

mechanical rods and cranks, and their redundant control paths improve survivability. The Comanche flight control computer reduces pilot workload and opens new firing possibilities.

With some allowances, the Comanche ultimately met the Army's 7,500 lb empty weight requirement, but armed reconnaissance mission weight is 10,630 lb with four Hellfires, two Stingers, 320 rounds of 20 mm ammunition, and 2.5 hours of fuel. The clean RAH-66A has a dash speed of 177 knots and a never-exceed speed of 190 kt. Rate of climb is 1,182 feet per minute at 95% maximum power, and a 180-degree hover turn to target takes just 4.6 seconds. A 90-degree constant altitude turn requires 5.5 seconds. Negative G maneuvering is a distinct possibility in air combat or evading air defenses, and the Comanche flight envelope spans +3.5 to -1.0 G.

The clean RAH-66A has a dash speed of 177 knots and a never-exceed speed of 190 kt. Rate of climb is 1,182 feet per minute at 95% maximum power, and a 180-degree hover turn to target takes just 4.6 seconds.

The Comanche is flown by two rated pilots in identical cockpits, both wearing helmet displays and helmet-mounted image intensifiers. Multifunction head-down displays show infrared and television sensor imagery, systems data, and the three-dimensional digital map. NoE tactics call for the

Comanche to pop up from terrain mask, sweep the battlefield with its target acquisition system, and return to cover so the crew can review the stored imagery in safety.

Thinking Machine

The Comanche Mission Equipment Package is built around a Core Computer Cluster with data and signal processor, memory, and data bus control elements in SEM-E standard electronic modules. VHSIC (Very High Speed Integrated Circuit) processors are tied to sensors and displays by an 800-megabit per second per channel data network. Other communications are carried by a MIL-STD 1553B data bus.

The power of the processors and the speed of the data buses open new possibilities for a scout-attack helicopter. The Target Acquisition Subsystem combines a high resolution focal plane array, infrared imager and digitized television. The combined picture of the battlefield is processed with Assisted Target Detection/ Classification algorithms, and hidden targets are exposed and identified on cockpit and helmet displays.

The Comanche's TAS (Target Acquisition Subsystem) combines a high resolution focal plane array, infrared imager and digitized television.

Integrated Communication, Navigation, and Identification Avionics

(ICNIA) include a radio and navigation package made of SEM-E modules that are able to assume the functions of burnt-out or battle-damaged components. The comm and navigation systems reconfigure themselves automatically to provide accurate position fixes or secure communications for the scout on deep strikes. The automatic hand-over target function within the ICNIA suite ties the battlefield scout into a combined arms team, sending target positions to artillery or fixed-wing attack aircraft.

ATDC: *Assisted Target Detection/Classification*

ICNIA: *Integrated Communication, Navigation, and Identification Avionics. Helps send target positions to artillery or fixed-wing attack aircraft.*

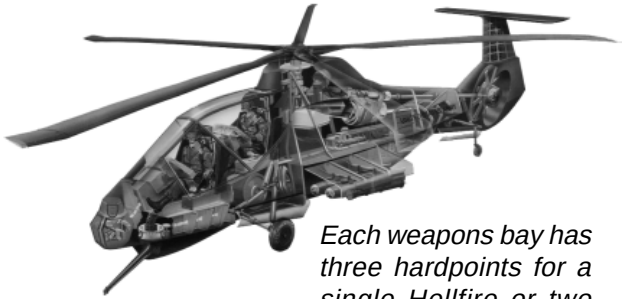
The two-level maintenance schedule for the Comanche has only unit maintainers and distant depots, eliminating big intermediate maintenance facilities in the theater. Built-in test functions isolate faults down to the module and eliminate the enormous electronic test facility trailers that still accompany Apache battalions. Redundant, fault-tolerant avionics are housed in three bays, slightly pressurized like the cockpit for chemical warfare protection with cool, filtered air from the environmental control system.

The cockpit of the RAH-66 Comanche is pressurized for chemical warfare protection.

Stealthy and Lethal

But all of this technology would be useless if the Comanche couldn't

protect itself. The designers were well aware that advanced air defense weapons now protect the armies of many nations, and the classified annexes of the LH Request For Proposals included specific signature reduction goals to make the Comanche less vulnerable to those threats. The RAH-66 has radar and infrared jammers, but Comanche design philosophy emphasized passive protection.



Each weapons bay has three hardpoints for a single Hellfire or two Stingers, and the doors swing up when the aircraft is on the ground to speed re-loading. The doors can also double as work platforms.

Flat plate canopies are a common way to prevent telltale glint, and the dull black-olive infrared-suppressing paint protects all Army helicopters. Stealth styling however, gives the RAH-66 a faceted nose turret for its target acquisition and night vision pilotage systems. Low Observable design rules flared the fuselage sides, and put an inverted shelf under the tail to reflect radar returns away from threat emitters. Radar-absorbing material is applied sparingly to “hot spots.” The radar flicker of main and tail rotor systems has long been a dead giveaway for helicopters. The composite rotor and fan blades on the Comanche are treated to minimize return, and the main and tail rotor hubs are neatly covered.

The Comanche infrared suppression system mixes hot exhaust with ambient air and ducts it down through two long slits under the tail shelves. The swirling double mix effectively dissipates the exhaust plume, and hot metal engine parts are buried within the airframe. An infrared jammer is available for the latest, most sensitive IR threats.

The Comanche RFP also includes acoustic signature requirements, and the RAH-66 is quieted by both the five-bladed main rotor and shrouded tail fan. The flight control system gives the pilot a "whisper mode" that reduces tail rotor speed 10% for stealthy surveillance situations. With weapons bays closed and gun retracted, the Comanche is a very low-observable scout.

The flight control system gives the pilot a whisper mode that reduces tail rotor speed 10% for stealthy surveillance situations.

The Army did not want to tie development of its new helicopter to the development of new weapons, and the internal weapons bays of the Comanche are sized for proven Hellfire anti-tank and Stinger air-to-air missiles. Each bay has three hardpoints for a single Hellfire or two Stingers, and the doors swing up when the aircraft is on the ground to speed re-loading. The doors can also double as work platforms. The three-barrelled General Electric Vulcan II 20 mm cannon fires 750 rounds per minute at ground targets or 1,500 rounds per minute in air-to-air combat, and swings in and out of its protective fairing in 2 seconds.

The three-barrelled General Electric Gatling Vulcan II 20 mm cannon can swing in and out of its "Low Observable" protective fairing in 2 seconds.

Outfitted with the External Fuel and Armament Management System (EFAMS), the RAH-66 is the attack helicopter of the U.S. Army's Light Divisions. The non-lifting EFAMS "wings" are attached or removed in 15 minutes and increase the Comanche weapons load to 14 Hellfires, 62 70 mm rockets or 14 Stinger missiles. The EFAMS also carry two 430-gallon tanks for long-range self-deployment or crashworthy 230 gal tanks for extended combat endurance. Maximum weapons load for an RAH-66 would be 13 Hellfires, two Stingers, and 500 rounds of 20 mm ammunition.

EFAMS: *External Fuel and Armament Management System.*

For all its firepower and intelligence, the Comanche is supposed to be easy and inexpensive to operate. On-board automatic boresighting functions keep gun, sensors, and EFAMS aligned. A *Portable Intelligence Maintenance Aid* (**PIMA**) that diagnoses aircraft system saves troubleshooting time and eliminates heavy, expensive support equipment.

The RAH-66 is fielded with an Integrated Training System for pilots and maintainers. Its Combat Mission Simulators are designed around Fiber Optic Helmet Mounted Displays to eliminate big simulator domes, and allow mobile Team/Combined Arms Trainers to enable

Comanche crews to rehearse their missions in the field, before they fly.

The political landscape has indeed changed from Cold War days, but today's battlefields are no less dangerous for those in combat. The Comanche is supposed to be the world's most survivable and lethal combat helicopter. Given its job, it had better be.

FLYING THE COMANCHE

The first training helicopter you, another student, and an instructor pilot suffered in at Fort Rucker had no automatic flight control system, and you quickly learned why helicopters are harder to fly than fixed-wing airplanes. Pulling the collective up with your left hand got you up in the air, but staying there called for many power changes and a lot of stick and pedal movements.

The cyclic in your right hand worked like an airplane stick -- sort of. Pushing forward put the nose down and got you moving. Pulling back flared the nose up and slowed you down. Pushing left or right put you in a bank. But for every simple action, there were several collective and pedal reactions. Eventually, the reactions became habit, but they could never be forgotten, and they always kept you busy.

But now it's 1999 and the Comanche is smarter than earlier rotorcraft,

and the fly- by-wire flight controls put every command through computers that understand what you want to do and figure out how to do it. Control laws within the computers provide a velocity stabilization mode to simplify hovering; a normal automatic flight control stabilization mode for routine handling; and an integrated fire and flight control mode to help track targets. Which set of laws the Comanche obeys depends on the flight environment, but the result is a responsive weapons platform that is easy to point where you want to go or where you want to shoot.

Most helicopters are controlled entirely by changing the pitch of rotor blades cutting through the air. Coarse pitch or a higher blade leading edge increases lift. Increase the pitch or angle of all the main rotor blades at once and you go up. Increase the pitch on one side more than the other, and you roll left and right or pitch the nose up or down.

The Comanche collective stick in your left hand works just like any other helicopter collective, although it is connected to wires instead of control rods. Pull the collective up and you increase pitch to go up in the air. Push it down, and you decrease pitch to descend.

Normally, movements of the collective are matched by movements of foot pedals. A tail rotor counteracts the torque of the big main

rotor, and regular helicopter foot pedals vary the pitch of tail rotor blades to push or pull the tail left or right.

The Comanche has a very powerful fantail with a protective shroud that keeps the blades from being mangled by tree limbs, wires or buildings, and from mangling people on the ground. The flight control system, however, automates the routine tail rotor control, so flying is much simpler. The Comanche has fixed footrests instead of moving tail rotor pedals.

The Comanche has fixed footrests instead of moving tail rotor pedals.

The cyclic stick between your knees on most helicopters has been replaced by a sidearm longitudinal stick in your right hand on the Comanche. Pulling back or pushing forward moves the nose up or down in pitch; pushing left and right provides roll, and twisting left or right gives you yaw. The sidestick has only limited travel, but the flight control computers turn them into smooth aircraft response and do away with the constant corrections needed by earlier helicopters.

Full Authority Digital Electronic Control (FADEC) takes care of the engines. Once you hit the startup switch, power management is automatic. You decide where you want to go and how fast with cyclic and collective. Once you're flying, if you put the nose down,

you go forward. If you want to go faster, just pull more collective. The engines will generate more power to apply more main rotor torque automatically. The flight control computer will increase tail rotor pitch to counter the extra torque.

The Comanche in Battle

The Big Picture

You fly and fight mostly at night to catch the enemy unaware and to enhance your own survivability. You stay low and slow to get in under air defenses and pick your shots. You thrive on an electronic battlefield rich with targets and threats, and you tie into a combined arms team that puts enormous firepower right where you tell them to. You're the cutting edge of U.S. Army Aviation. You fly the RAH-66 Comanche.

Eight out of ten Comanches in the U.S. Army are allocated to the scouting mission in either Cavalry squadrons or attack battalions. Cav squadrons generally have two troops of eight Comanches apiece. The attack battalions in light infantry divisions have up to 25 RAH-66s, and their Comanches play scout with internal weapons alone or attack with up to 14 Hellfire missiles. Attack battalions in "heavy" divi-

sions use their 10 Comanches as scouts and escorts for their 15 AH-64 Apaches. Whatever the organization, the Comanche exists to support the Army ground commander, and it has to survive, see and shoot in a unique environment.

Compared to flashy tactical jets, helicopters are slow and short of range. Main rotor aerodynamics make helicopter speeds greater than 200 kt an expensive struggle. With a dash speed of 177 kt at 4,000 ft on a hot day, your Comanche is about 100 kt slower than the propeller driven Mustang of World War II. The Mustang could get up to 40,000 ft. The Comanche often fights less than 50 ft above the battlefield. A half-century of helicopter experience has taught the U.S. Army how to master that environment, and a thin slice of that experience was passed along to you at the Army Aviation Center at Fort Rucker, Alabama.

Cockpit Consciousness

In order to run all of its systems, the RAH-66 is powered by three engines. The Secondary Power Unit that provides the electrical power to your systems on the ground and starts the engines, keeps working in the air. The Startup Sequence starts the SPU, which enables you to do a systems checkout and allows you to

An optical disk can hold 640 megabytes of mission specific information for the Comanche computer systems to access.

load the optical disk with your mission plan.

The optical mission disk will carry your route, navigation waypoints, communications frequencies and the location of known air defense threats. The navigation information is superimposed on the color digital map display on your liquid crystal displays. An inertial navigation system with ring laser gyro, and a receiver to take fixes from the Global Positioning System satellites, gives you your precise location within a few meters at all times.

Flying, navigating, communicating, and shooting generates a high cockpit workload, and because of this, the Comanche needs two pilots to do its job. Cobras and Apaches put the pilot in back so the co-pilot/gunner could have a sighting system with direct-view optics. High-resolution television and thermal imagers did away with DVO, so the Comanche pilot sits up front with a better all-around view. Everything in the RAH-66, from the step up to your climate-controlled cockpit, to your crewchief's hand-held maintenance computer is designed with MANPRINT -- Manpower Integration -- in mind.

Cobras and Apaches put the pilot in back so the co-pilot/gunner could have a sighting system with direct-view optics (DVO).

The Comanche systems are designed for management by exception. If things are working properly, the aircraft keeps to itself and lets you get on with flying and fighting. Malfunctions bring up systems

warnings and menus on the head-down display. The Comanche avionics and flight controls have built-in test capability, and can reconfigure themselves to preserve functions should modules or data buses burn out or be shot out. When your diagnostic routines are completed, you're ready to fly.

Rucker taught you how to fly and how to work the Comanche systems. Field units and experience will teach you how to use this marvelous fighting machine — and come back alive. Your primary access to the aircraft and the outside world comes through the helmet-mounted display.

At night, your helmet display shows you either image-intensified scenes from the tubes on either side of your head, or thermal imagery from the FLIR turret on the nose of the helicopter. In daytime, you look through the display to see the real world. At any time, the picture you see will be covered with symbology to help you find your way and manage your aircraft.

The Apache had a display over the pilot's right eye that showed essential flight and targeting data. The Comanche's Helmet Integrated Display (HID) shows you airspeed, altitude, heading, rate of climb, and

The Comanche's Helmet Integrated Display (HID) shows you airspeed, altitude, heading, rate of climb, and much more.

much more. It can show you where your sensors are in relation to the aircraft; the time of flight of your missiles heading to their target; and the number of rounds of ammunition you have left. The helmet display can give you quick warnings of malfunctions and air defense threats that you can identify by looking down in the cockpit.

The Comanche sensors and gun move with your helmet as followed by a magnetic head tracker. The display has a field of view 52 degrees wide by 35 degrees high, and the resulting scene is a virtual display, moving through its field of regard as you turn your head. Most of the controls you need to fly and fight are on the sidestick and collective, and you can page through system menus without taking your hands from the controls.

The display has a field of view 52 degrees wide by 35 degrees high.

Stealthy and Dangerous

The Army likes to say “We Own The Night.” In fact, you lease it with the help of Image Intensifiers (Night Vision Goggles - NVGs) and thermal imagers (Forward Looking Infrared - FLIR). The Image Intensifiers amplify moonlight, starlight, and cultural lighting like that from towns and cities up to 30,000 times. FLIR looks for the temperature differences between objects. The Comanche is designed to use them together.

On a clear night with a full moon, the RAH-66's third generation Image Intensifiers are a miracle. But on an overcast night with no moon they're almost completely blind. In summer or winter, over desert or ocean, second generation FLIRs detect subtle temperature contrast and paint a picture in the darkest night and see through fog and smoke. But after a couple of cold, rainy days or in a humid jungle people, trees, and the air itself are all the same temperature. To survive, you need both the Image Intensifiers on your helmet and the thermal imagers in the nose of the Comanche to fly and fight at night.

The Night Vision Pilotage Subsystem (NVPS) in the nose of your Comanche is a FLIR for you, the pilot. The Target Acquisition Subsystem (TAS) below it shows your "backseater" the targets through magnified FLIR at night or TV by day, and it includes a laser to guide Hellfire missiles and other "smart" munitions to targets. The laser also gives you precise range information for your gun and rockets.

NVPS allows you to not only see but automatically track targets in near total darkness.

The Comanche gets its position from the network of GPS satellites and its laser gyro.

You fly from your squadron or battalion base area with its Tactical Operations Center (TOC) to forward arming and refueling points (FARPS) to get fuel, weapons, and target and threat updates. The digital map is a wealth of information with navigation waypoints, air defense threats, targets, and other information. The Comanche

navigation system benefits from the Global Positioning System and can use the constellation of satellites to find its own position, and pinpoint the location of targets within feet.

If you know your own position within feet, the laser range data and turret azimuth from the TAS turret and the precision elevation data from the digital map also tell you the position of the enemy within feet. The Automatic Target Handover System (ATHS) used in the Apache and OH-58D has been refined on the Comanche and interconnected to an advanced data modem that uses any of your radios.

With ATHS, Comanche can hand over the position of targets to remotely emplaced artillery or rocket based systems by merely adding its own position to the range and position information acquired through its TAS.

Airborne with your wingman, and with all lights off, you stay at an altitude of 100 ft or less, just hugging the hills and treetops to keep under enemy radar. At night and at your speed, individual soldiers can't see you to aim guns much less IR sensors or laser-guided missiles. Even if you are spotted by an enemy with night vision goggles, the targeting opportunity is brief, and the chances of you being identified and engaged are small. Of course, radio transmissions are kept to a minimum to keep from drawing attention to yourself.

Jamming air defense radars, and shooting flares and chaff lets

the enemy know you are around. The Comanche relies on stealth to avoid detection and resorts to active countermeasures only when trapped. Your digital map display shows the detection area of known air defense sites. But mobile guns, SAMs, and radars are surprises to be countered with tactics and countermeasures, in that order. The objective is to avoid detection, and if detected, to hide in terrain mask. Radar and IR jammers, chaff, and flares are automated and tied to your radar warning receiver and missile launch detectors.

The Comanche relies on stealth to avoid detection and resorts to active countermeasures only when trapped.

As you approach the target area, you slow down to a near-hover at treetop level. The navigation system shows the possible target area on the digital map, and you close for a pop-up with weapons bays still shut and gun covered to minimize your radar signature. The **Comanche** tail rotor can slow down in Whisper Mode to reduce noise and let you get even closer without being detected.

Pull the collective and climb over the terrain. Your targeting system automatically sweeps across its field of regard. You drop back to terrain mask, and the stored image of the target area appears on the heads-down display. The **Comanche** computer cluster contains aided target detection/classification (ATD/C) algorithms to recognize stored target signatures, and it shows you tanks, command-and-

ATD/C algorithms recognize stored target signatures, and show you tanks, command-and-control vehicles, trucks, and air defense vehicles hidden beneath the trees.

control vehicles, trucks, and air defense vehicles hidden beneath the trees. Your wingman does his own pop-up and scan off to the side, then returns to safe cover.

As your helmet and cockpit displays point out the targets, you and your co-pilot/gunner decide what to do. A secure data burst to your TOC feeds the type of target and its location to the Command and Control network. The network enables Division commanders to call up fire from conventional artillery or Multiple Launch Rocket Systems 30 km away to blanket entire map grids with shear firepower, or bring in tactical jets with their own cluster munitions. They can also bring in Apaches or Comanches to strike with Hellfires.

TOC: *Tactical Operations Center*

The TOC decides you can have these few targets, and you pop open the weapons bays to swing your Hellfires and rockets into the night. An encrypted message to your wingman on FM radio sends him further out to one side, and you shift your position lat-

erally so you won't emerge from cover in the same spot again. You begin the pop-up, unmask, and your backseater laser designates the air defense vehicle first.

A Hellfire leaves the rail and follows its characteristic lob to the laser spot more than 8 km away. The air defense threat disappears in a bright blob. Another shot from your wingman still hiding behind the hill hits the first tank you designate, and another kills the next. You drop back into cover, and your wingman pops up to shoot. Another lateral remask maneuver, and you shoot again. Rockets leave both helicopters and climb high to rain submunitions on the armored personnel carriers.

You withdraw and go on to another possible target site. An air defense vehicle with an unknown radar surprises you with a blast of gunfire. You snap off a burst of cannon fire and break away from the threat, noting the location in your navigation system. At the end of your mission, you return to base. The recorded target imagery is downloaded for further analysis, and the brief encounter with an unidentified air defense threat adds a new signature to the threat library.

Survive to Shoot

Scout missions call for the RAH-66 to use its Low Observable design

to get in close to the enemy undetected, and report enemy strength and position to the ground commander. Comanche Scouts in Cavalry Squadrons or Heavy Division attack battalions are lightly armed and operate in pairs; each helicopter with up to six Hellfire anti-tank missiles or a mix of Hellfires, 70 mm rockets, and Stinger air-to-air missiles neatly covered in internal bays. The three-barrelled 20 mm cannon hides in a LO fairing to minimize the Comanche's radar signature, but swings out to engage ground or air targets.

The Light Infantry Division fields battalions of 25 Comanches, some playing stealthy scout with only internal weapons, others fitted with the External Fuel and Munitions System (EFAMS) which carry another four Hellfires on each side. EFAMS can also take rockets, Stingers, or extra fuel, and the deep strike configuration puts four Hellfires on one side and a 230 gallon drop tank on the other. If your unit can't wait for C-5s or C- 17s to carry its Comanches to war, EFAMS are loaded with a big 430 gallon ferry tank on each side for the long overwater legs.

How your Comanche is configured depends on your mission and the air defense threat, and the threat has grown more complicated since the end of the Cold War.

The Soviet Union pressed on with “double-digit” SAMs up through the SA-19 with infrared or laser guidance and a range of 10 km. The Soviets packaged 30 mm guns and SA-19s on a fearsome helicopter killer, the ZSU-30-4 anti-aircraft vehicle. They developed a single-seat “fighter” helicopter, the Ka-50 Werewolf (NATO called the Ka-50 the Hokum, but there’s nothing phoney about an agile 190-kt. helicopter with laser-guided missiles, 80 mm rockets, and a 30 mm cannon). The Soviets built and stole air defense technology, and they developed integrated air defense tactics to protect their field armies. The Soviet Union equipped and trained armies around the world to protect themselves from helicopters. Then the Soviet Union disappeared.

The Ka-50 Werewolf

The sudden disintegration of the Warsaw Pact early in the last decade made the High Intensity European battlefield unlikely. Falling defense budgets generally made armies smaller everywhere. But the technology of the high intensity battlefield survived and propagated. A hungry Russia without political stigma could

sell its best weapons to former Soviet allies and countries who would not deal with the old Moscow. Smaller domestic markets put added pressures on U.S. and European arms manufacturers to find export markets to survive. The Red threat of Soviet air defense technology and the “Blue threat” of French, British, and even American technology became a mixed “Purple threat”. Your mission and your life depend on defeating the mixed air defense threat.

The U.S. Army stresses a mix of tactics, reduced signatures, and active countermeasures to help helicopters survive on the modern battlefield. NoE tactics hide helicopters behind terrain and foliage. It takes them below the line of sight of radar and optically directed air defense threats. Night flying hides helicopters from optically directed weapons, including the heat-seeking SAMs initially aimed by unaided eyes. Low Observable technology addresses radar, infrared, optical, electronic, and audible signatures. Flares and IR jammers confuse infrared threats, and chaff and radar jammers blind air defense emitters. The Comanche is the first fighting machine designed to blend all three survivability elements in an integrated package.

COMANCHE BATTLE STRATEGIES

Modern wars do not end at sunrise any more than they do at sunset, and you can be called upon to scout and attack by day as well as at night. Daylight operations add risk, and they increase the chance of air-to-air combat with enemy helicopters. The Comanche is the first Western helicopter designed for air-to-air combat, but it is not your job to seek out dogfights. Unlike jet fighters, helicopters cannot run from the fight. Once the fight is on, somebody is going to die; and the more close-in fights you join, the greater your chances of not coming back.

The Comanche is the first fighting machine designed to blend all three survivability elements in one integrated package.

The Kamov Ka-50 Werewolf, with its contrarotating main rotors, has extremely high yaw and roll rates. Likewise, the more conventional Mil Mi-28 and Eurocopter Tiger or Gerfaut have high-agility rotor systems and ample power margins to be flung around the sky. Even

the little MD500s spread all over the world are truly deadly opponents. The only way you can beat these challengers in the long run is by fighting smart.

U.S. Army doctrine says helicopters will engage in air combat only when air combat fits the ground commander's scheme of battle or in self defense. The RAH-66 can lay in ambush for enemy airmobile forces, and it can be deployed as an escort for our own Apaches, Black Hawks, and Chinooks. It can be used to protect friendly armored forces from air attack, or to feed data to ground-based air defenders.

Hidden in ground clutter, helicopters are difficult and deadly targets for tactical jets. In the current air defense environment, the fighter or ground attack pilot who hangs around in blue sky trying to get a firing solution on a helicopter in the weeds is likely to become an early casualty. Properly armed, helicopters are lethal in air combat. They are extraordinarily agile at low speed, and they can use terrain to their advantage. Unless you are deployed to strike from ambush as part of the ground commander's scheme, odds are your contest with enemy helicopters will be a chance encounter.

The RAH-66 can lay in ambush for enemy airmobile forces, and it can be deployed as an escort for our own Apaches, Black Hawks, and Chinooks.

The Comanche pilot chasing enemy helicopters to become an ace is

not doing his job. But supporting the ground battle plan, the same pilot surprised by an enemy helicopter had better be ready to hide or fight. Compared to jet fighters, a dash speed of 177 kt, vertical rate of climb of 1,200 fpm, and a maneuvering envelope from -1 to +3.5 G seems puny, but in the low altitude world of helicopter air-to-air combat, your Comanche is the most agile and powerful fighter ever fielded.

The RAH-66 ordinarily carries two or four Stinger air-to-air missiles. The IR-seeking Stinger is more or less effective at 1 to 2 km. It is a fire-and-forget weapon. Flechette warheads on your 70 mm rockets fill the sky with nails out to 1 km. They are a shotgun weapon good for surprise encounters. The 20 mm Vulcan II cannon is tied to your helmet sight and can go to its full 1,500 rounds-per-minute rate of fire for the close-in shootout. It is accurate enough for air-to-air engagements out to perhaps 1,500 m. Never forget the Hellfire missile is a devastating weapon at 8 km or more against a hovering or slow- flying target.

The three-barrelled 20 mm cannon hides in a LO fairing and takes just 2 seconds to swing out into firing position.

Tactically, you try to avoid the close-in turning fight, especially if facing multiple bogeys - the odds of winning are no better than 50-50. You try to engage targets from the safety of terrain at the full

standoff range of your weapons. If caught in a surprise encounter, turn into the attack, both to bring your own weapons to bear, and to increase your closure rate and minimize the enemy's aiming time. In a maneuvering fight, the one who gets behind wins, and the safest place for you to be is perched above and behind the enemy's rotor system. From there, his weapons are blocked and yours can be aimed effectively.

Never forget you are a member of a combined arms team, and to use the firepower behind you when appropriate. An enemy airmobile advance can be decimated by MLRS submunitions or artillery fire, or fast movers with cluster bombs. You can report oncoming enemy aircraft to your own air defenders and let them engage with SAMs and gunfire.

Never forget you are a member of a combined arms team, and to use the firepower behind you when appropriate.

The Comanche is what engineers like to call an integrated system. Airframe, engines, avionics, and weapons were all taken into account at each design step to achieve the greatest effect. Likewise, the modern Army has to be an integrated system with aviation, artillery, armor, and infantry tied together for maximum effect. The Comanche is the best Army Aviation has to offer; it's up to you to make the most of it.

TECHNICAL SPECS

Boeing Sikorsky RAH-66 Comanche

Engines

Manufacturer:	Allison - Garrett
Model:	Two T800-LHT-801
SHP:	925

Transmission

Max, shp:	2,054

Bearingless main rotor system

Blades:	5
Construction:	composite
Diameter, m (ft):	11.90 (39.04)

FANTAIL anti-torque rotor system

Blades:	8
Length, cm (in):	11.43 (4.50)
Construction:	Composite
Chord, cm (In):	17.0 (6.69)
Diameter, m (ft):	1.37 (4.50)

Performance

Dash speed, km/h: above 328
Vert. rate of climb-m/m (fpm): 360 (1182)
Load factor: +3 g
Range- self-deploy, km: 2,335

Accommodation

Cockpit crew: 2

External Dimensions

Length-fuselage, m (ft):	13.22 (43.37)
Length-rotors turn, m (ft):	14.28 (46.85)
Width-landing gear, m (ft):	2.31 (7.58)
Width-fuselage, m (ft):	2.29 (7.51)
Height, top of horiz. stabilizer, m:	3.39

Weights

Self-deploy-kg (lbs):	7,790 (17,174)
Primary mission-gross, kg (lbs):	4,587 (10,112)
Empty:	1,185 (7,500)

Fuel capacity

Internal-liters (gals):	984 (260)
Self-deploy-liters (gals):	4,542 (1,200)

WEAPONS

Missile armament

AGM-114 Hellfires
AIM-92 Stingers

Turreted 20-mm Gatling gun

Basic ammunition load: 500 rounds
Rates of fire: 1,500 rounds/min

Targeting system

Focal-plane-array FLIR
Low-light-level Image Intensified TV
Helmet-mounted sight & inst. displays
Laser range-finder/designator
Aided Target Detection System

Night Vision/adverse-weather pilotage system

2nd generation focal-plane-array FLIR
Image intensifiers
Wide-field-of-view helmet-mounted display

Low observable characteristics

Reduced radar cross-section
Integrated infrared suppression
Low acoustic/visual signatures

Possible Missions

Armed reconnaissance
Military Escort
Light attack
Air combat

KA-50 Kamov "Hokum" WEREWOLF

Developed by the Soviets in the late 1980's, the Werewolf (NATO code-named "Hokum") is a single-seat "fighter" light attack helicopter. The Kamov KA-50 Werewolf with its contra-rotating main rotors has extremely high yaw and roll rates and is capable of speeds of over 190-kts. Armed with laser-guided missiles, 80 mm rockets, and a 30 mm cannon with selective explosive or anti-tank rounds, it was developed to protect their field armies from other helicopters.

Engines

Manufacturer	Klimov Corporation
Model	(2) TV3-117K engines
SHP	2,220

Transmission

Max, shp	5,500

Co-axial, contrarotating blade rotor

Blades (2 axials); 3 blades per mount	
Construction	Composite
Diameter, m (ft)	14.5 (47.5)

NO rear rotor system

Performance

Dash speed, km/h (kts):	above 350 (above 189)
Vert. rate of climb, m/m (fpm):	600 (1,968)
Load factor:	+3 g
Range, self-deploy, km (m):	2,335 (1,260)

Accommodation

Cockpit crew:	1

External Dimensions

Length, fuselage, m (ft):	16 (52.8)
Length, rotors turn, m (ft):	14 (47.85)
Width, stub wings w/ landing gear, m (ft):	7.3 (24)
Width, fuselage, m (ft):	1.47 (4.82)
Height, top of horiz. stabilizer, m (ft):	4.51 (14.8)

Weights

Self-deploy, kg (lbs):	10,800 (23,760)
Primary mission-gross, kg (lbs) :	9,800 (21,560)

Fuel capacity

Internal, liters (gals):	450 (1,710)
Self-deploy, liters (gals):	950 (3,610)

WEAPONS

Missile armament

Vikhr air to ground missiles
or Spiral air to ground missiles
SA-19 air to air missile

Turreted 30-mm cannon (selective)

Can fire either anti-armor or high explosive rounds.
Basic ammunition load: 500 rounds
Rates of fire: 1,000 rds./min

Targeting system
FLIR
Helmet mounted sight
Laser range-finder/designator
Target Detection System

Night vision/adverse-weather pilotage system
FLIR
Image intensifiers

Low observable characteristics
Reduced radar cross-section
Integrated infrared suppression
Low acoustic/visual signatures

Possible Missions
Armed reconnaissance
Military Escort
Light attack
Air combat

MI-24 HIND-E GUNSHIP

A deadly example of Soviet air technology at its best, the U.S.S.R. regarded the development of this helicopter to be so important that it was designed from the ground up. It is based on a completely new design. No other helicopter in your enemy's arsenal combines the weapons, sensors, armor and flight performance of the MI-24 Hind-E airship. It is generally considered to be one of the world's deadliest helicopters - before the introduction of the Comanche.

Engines

Manufacturer	Mil
Model	(2) TV3-117 Turboshafts
SHP	2,220

Main rotor blade system

Diameter, m (ft)	17 (55.9)

Performance

Dash speed, km/h (kts)	320+ (199+)
Cruising Speed (full weapon load)	295 (183)
Vert. Rate of Climb, m/m (fpm)	900 (2,935)
Load factor	+3g
Range, self-deploy, km (m)	160 (99)

Accommodation

Cockpit crew	2
Cabin	up to 8

External Dimensions

Length, fuselage, m (ft)	21 (68.86)
Length, rotors turn, m (ft)	18.5 (60.66)
Height, top of horizontal stabilizer, m (ft)	6.5 (14.8)

Weights

Loaded, kg (lbs)	11,000 (24,250)
Empty kg (lbs)	7,500 (16,534)

Fuel capacity

Internal, liters (gals)	350 (92.6)

Hughes 500MD

The Hughes 500MD helicopter is a high performance advancement of the OH-6 model, and is used by many countries throughout the world (including potential enemies). The vast improvements to the chopper's power, maneuverability and armaments make it a weapon to be feared.

Engine Alison 250-C20B

Main Rotor
Diameter 8.05 m
Blades 5

Dimensions
Fuselage length 9.3 m
Height 2.7 m

Speed 226 km/h

Armament
2 Missiles
Machine Guns

LAND-BASED FRIENDLIES

M1A1 Abrams
MAIN BATTLE TANK

Developed out of necessity to counter potential Nuclear Biological and Chemical attacks, the M1A1 has a full NBC air filtration system. The A1 version also differs from the original M1 by the incorporation of a smooth bore 120mm cannon.

Dimensions

Length (gun forward)	9.82 m
Width	3.65 m
Turret Height	2.37 m
Ground Clearance	.48 m

Performance

Speed	45 mph (max)
Cruising range	275 miles
0 to 20 mph	7 seconds

Engine

Avco-Lycoming 1500hp Gas Turbine

Armament

Main	Smooth bore 120mm M256
Coaxial weapon	7.62mm
Commander's weapon	50 Cal M2 MG

The Soviet T-80 MAIN BATTLE TANK

The Soviet T-80A entered active military service in 1983. Similar to the T-64 and the T-72, this amphibious MBT is considered to be only an evolutionary design. Improvements over the earlier model include a gas turbine engine capable of speeds up to 46 mph, laser sights and range finder and a modified turret capable of firing both shells and rockets. Fires a very reliable long range anti-helicopter missile code named *Songster*.

Crew 3

Armor Heavy Armor

Weight 42 tons

Guns

125 mm smooth bore – 42 rds
7.62 mm machine gun
12.7 mm anti-aircraft machine gun

Projectiles

AT Songster anti-tank missile
AT Songster anti-helicopter missile
HE-FRAG (FS); HEAT-FRAG
APFSDS

Engine 985 hp gas turbine

Speed 75 kph (46 mph)

The Scud-B (SS-1) MISSILE LAUNCHER

An operational tactical missile, the NATO-designed SS-1 SCUD-B entered active service in the mid-1960s as an improved version of the SCUD-A. Doing away with the earlier model's obsolete tank chassis, the SCUD-B Launcher carries and launches from an 8x8 chassis with good cross-country mobility. Deployed by the Soviet Army at their front lines in brigades of three, the SCUD-B is also in service in all the former Warsaw Pact nations as well as Egypt, Iran, Libya, North Korea, South Korea and of course, Iraq.

Range	80 - 280 km
Weight	860 kg
Missile Size	
Length	11.4 meters
Diameter	0.84 meters

Warhead Options:

HE
Training
Chemical
Tactical Nuclear

THE SA-8 GECKO

This short range, low altitude mobile Surface to Air system entered Soviet service in 1974. This stand alone system replaced many Soviet towed AA guns because of its greater mobility and reliability. Carrying its own Radar array, it can engage a single target with a two missile salvo operating on different frequencies to overcome ECM and avoid guidance problems.

Guidance	Pulse-doppler radar
Warhead	88 lb contact/proximity fragment.
Range	1 to 9.4 miles
Altitude	32 to 42,000 ft
Missile Speed	Mach 2

The Soviet BRDM-3
ARMORED WHEELED VEHICLE

The Soviet BRDM-3 was developed in the early 1960's. First seen in 1966, it is currently in operation in over 45 countries world-wide. Equipped with thermal sights, machine guns and Spandrel guided missiles, this is a small yet formidable opponent.

Crew 4

Armor
Light Armor 14mm (0.55 inches)

Weapons
14.5 mm KPVT machine gun
7.62 mm PKT co-axial machine gun

Missiles
5 Spandrel Anti-tank guided Missiles

Engine GAZ-41 V-8
Water-cooled, 140 hp

Speed 100 kph (62 mph)

Range 750 km (465.8 miles)

WATER-BASED HOSTILES

OSA II MISSILE PATROL BOAT

The Russian-made OSA II Missile Patrol Boat is a larger and more sophisticated version of its predecessor the OSA I. It carries a powerful assortment of guns, missiles, and anti-aircraft armament. Sleek and deadly, the ship provides more than adequate coastline defense against would-be attackers.

Crew	25
Displacement	
Standard tons	168
Full load tons	203
Dimensions	
Length: 128.7 ft	Beam: 25.1 ft
Draught: 5.9 ft	
Performance	
Speed: 34 kts	Range: 800 miles

Engines	
Diesels	3
Total BHP	13,000
Shafts	3
Armament	
30mm guns	4
SSN 2-A missiles	4

LEBED Air-Cushion LANDING CRAFT

These huge Russian hovercraft are the world's largest air-cushion vehicles. They can carry many tons of cargo, troops, and even tanks. Typical payload for the Lebed class include 2 light tanks or 40 tons of cargo or 120 troops,They are quick and agile for their size, and can operate out of the stern well decks of the "Ivan Hogov" class of LPD's.

Displacement 87 tons full load

Dimensions

Length	80 ft
Beam	5.4 ft

Performance

Speed	70 kts

Complement 6

Armament 2 - 14 mm MG's

GLOSSARY

AA: Anti-aircraft. Guns designed to shoot down aircraft.

AAM: Air-to-Air Missile.

ADF: Automatic Direction Finding. A detection sensor used to home in on navigational signals.

AFCS: Automatic Flight Control System.

AGM: Air-to-Ground missile.

AFV: Armored Fighting Vehicle.

APU: Auxiliary Power Unit.

ATGM: Anti-Tank Guided Missile. TOW-2 and Hellfires are ATGMs.

CBU: Cluster Bomb Unit.

CHAFF: Radar decoy. Small metal film strips that produce radar reflections to mask the real target.

CM: Counter-Measures. Includes electronic jammers and decoys like chaff and flares.

CO: Commanding Officer.

COLLECTIVE CONTROL: Helicopter control used to "collectively" change the pitch (angle of the main rotor blades). Controls the height of your airship.

COMM: Communications.

CP/G: Co-Pilot/Gunner. Sits in the rear of the Comanche. Handles sensor and targeting gear for team.

CYCLIC: Helicopter flight control used to selectively change the pitch of the main rotor blades, thereby changing its direction.

DITCH: A term for crash landing.

EFAMS: External Fuel and Armament Management System. Non-lifting 'wings' attached to Comanche to hike the RAH-66's weapon or fuel load for

extended combat sorties.

FADEC: Full Authority Digital Electronic Control.

FARP: Forward Arming & Refueling Point.

FLARE: A cartridge-shaped heat source of intense energy. Used as a defensive weapon. Discharged from Comanche to draw IR missiles away from airship's heat signature.

FLIR: Forward Looking InfraRed. An imaging system that can see in the dark, by detecting the differences in temperature between different objects and surfaces.

GPS: Global Positioning System. Satellite based navigation system connected to Comanche through high speed modem.

HID: Helmet Integrated Display. A display of your chopper's vital statistics along with enhanced night sight systems. The display is projected by a fiber optic bundle directly on to the pilot's and co-pilot's "Wide Eyes" goggles.

ICS: Internal Communication System. Used for communication within the Comanche cockpit.

IFV: Infantry Fighting Vehicle. A tracked vehicle that transports an infantry squad. Usually armed with small caliber cannons.

INS: Inertial navigation system. A device that tracks a helicopter's current position and desired destinations.

IR: Infrared. The low-frequency portion of the electromagnetic spectrum where the intensity of the signal is related to its heat signature. Used to guide missiles.

IITV: Image Intensified Television. Placed in nose array of Comanche's passive sensors.

JAMMER: A source of intense Infrared

or radar energy used to confuse or "fool' weapon targeting systems.

KA-50: The HOKUM Werewolf.

KLICK: Slang for kilometer.

KNOT: A measure of horizontal motion equal to 1.14 miles per hour.

LGB: Laser Glide Bomb. A bomb guided by reflected laser energy.

LHX: Light Helicopter Experimental.

LO: Low Observable. Term used to describe aircraft with reduced radar, infrared and acoustic signatures to avoid detection.

LONGBOW: Long range millimeter wave radar detection gear to be mounted above the main rotors in next generation of Comanches.

LZ: Landing Zone.

MANPRINT: Manpower Integration. Electronic and software system that allows Comanche to maintain itself while pilots are flying and fighting.

MASK: Large, naturally occurring objects like mountains used as sensor and visual cover for your Comanche.

MBT: Main Battle Tank.

MEDEVAC: Medical evacuation of wounded troops.

MFD: Multi-Function Display.

PASSAGE POINT: Safe area for friendly troops to travel through.

PRIMARY: The most important objective or target of a sortie.

PULL PITCH: To quickly add collective control for more altitude.

RAH-66: Military designation for the Boeing-Sikorsky Comanche Reconnaissance Attack Helicopter.

RDF: Rapid Deployment Force. A strike force used for a fast military response around the world in trouble spots.

RETICULE: A small circular “glass window” positioned over one of the eyes of the pilot. Combat and flight information is reflected off the reticule like a HID for the pilot to use while flying.

SAM: Surface-to-Air Missile.

SEAD: Suppression of Enemy Air Defenses. A mission to destroy enemy air defense units.

SECONDARY TARGET: Targets of less importance than the primary target in your mission.

SIGNATURE: Electronic identification of object detected by sensor arrays.

TAS: Target Acquisition Subsystem.

THEATER OF OPERATIONS: Geographic area that defines area of military interaction.

T-80A: The Soviet’s Main Battle Tank with reactive armor.

SOP: Standard Operating Procedure.

SORTIE: A single mission.

SSM: Surface-to-Surface Missile.

TADS: Target Acquisition and Designation System. A device mounted on the nose of the Comanche that's used to lock onto targets and to control the laser designator for your laser-guided or laser-targeted missiles to track with.

TF: Task Force.

TOC or TAC-OPS: Tactical Operations Center or Tactical Operations.

VISIONICS: A collective term to describe sighting and night vision systems devices.

VOR: VHF Omni-directional Range. A radio beacon used for navigation.

WEAPONS FREE: A term to describe full freedom to fire weapons on targets.

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