KA-50-2 ATTACK HELICOPTER:
A MEETING OF EASTERN AND WESTERN TECHNOLOGIES

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Introduction

In August 1999, the Kamov Company and Israel Aircraft Industries (IAI) conducted demonstration flights of the Russian Ka-50-2 Attack helicopter with IAI's Core Avionics. These flights successfully demonstrated the helicopter's day and night flight capabilities with IAI's newly developed "Glass Cockpit". Turkish pilots participated in the demonstration flights, experiencing the helicopter's superior performance and the unique capabilities of its new advanced avionics system. The demonstration flights achieved all the assigned goals set by the engineers and test pilots.

IAI and Kamov teamed together to offer the tandem-seat Ka-50-2, the world's most powerful attack helicopter, in response to the Turkish Land Forces requirement for 145 attack helicopters.

The Ka-50-2 is the product of a joint effort by the Kamov Company, the famous developer of advanced coaxial rotor technology, and IAI's Lahav Division, a leader in avionics modernization. Kamov is responsible for the helicopter airframe, with its various subsystems, while IAI is responsible for the avionics and weapons delivery system. The integration of a state-of-the-art Western avionics suite with a robust Eastern platform offers best value, in terms of both performance and price.

The Ka-50-2 is equipped with IAI's flexible modular avionics suite, which provides extensive growth potential. The avionics suite employs advanced human engineering and operational concepts in order to reduce pilot workload and improve operational efficiency.

Kamov and IAI conducted successful demonstration flights of the Ka-50-2 helicopter with IAI's Core Avionics. These flights demonstrated the helicopter's "Glass Cockpit" with Multi Function Color Displays and CDU driven by centralized Mission and Display computers; flight navigation, which was planned and carried out on a digital map; and operation of the HMOSP targeting system. The flights continued with night mission capability demonstrations utilizing NVG and the day/night targeting system.

Kamov and IAI have complied with the Turkish requirement for a Tandem cockpit by reconfiguring the existing Side-By-Side configuration to a Tandem one. The transition to Tandem configuration affects only the nose section, while the center and the tail sections of the helicopter remain unchanged.

Another Turkish requirement, which was met by Kamov and IAI, is the integration of a Turret Gun in place of the original fixed gun. The KA-50-2 will use a folding turret gun, as an integral part of its armament system.

By combining Eastern and Western technologies, the combat effective Ka-50-2 is able to provide extraordinary value.

Ka-50-2 Missions

The principal missions anticipated for the Ka-50-2 are as follows:

- Destruction of Massed Armored Enemy Forces
- Armed Reconnaissance and Observation
- Close Air Support to Ground Forces
- Air-to-Air Combat
- Escort to Airborne and Air Assault Units
- Offshore and Naval Aerial Fire Support

Avionics Highlights

The Ka-50-2, equipped with IAI's modular, flexible Avionics suite with extensive growth potential, can be tailored to meet the Customer's immediate and future requirements. The highlights of the avionics system are as follows:

- Advanced human engineering and operational concepts to reduce pilot workload and improve operational efficiency:
  - Missionized Avionics operation concept
  - Hands on Collective and Stick (HOCAS) concept
  - Integrated Control & Display
- Enhanced tactical awareness based on advanced communication and data link systems.

- Task oriented crew stations, integrating “glass cockpit and helmet mounted display system.
- Advanced weapons control and aiming capability.
- Full operability under day, night and adverse weather conditions.
- A highly integrated, combat proven, state-of-the-art Electronic Warfare and Self Protection System.
- Two main computers (MDPs) and four Multi Function Color Displays (MFCDs) on board the Ka-50-2 provide the following:
  - Maximal redundancy for minimal performance degradation in the event of a system failure
  - More than 300% spare memory capacity and throughput.

Operational Concept

The evaluation of an attack helicopter requires the examination of its specific missions in the future battlefield. In the early years (Vietnam war), the attack helicopter's main mission was to attack guerilla forces. However, over the years more missions were added, such as anti-armour and air-to-air. Due to these additional missions, more advanced, accurate and versatile avionics and weapons systems were needed. Future requirements are going to be even more demanding, further increasing the need for improved avionics and weapons systems.

The challenges that pilots face today and are likely to face in the future, are much greater than in the past, since the low level and low speed flight regime that was once safe is now threatened by the enemy's surface-to-air missile systems. Therefore, although the attack helicopter's lethality has increased over the years, its vulnerability still remains a problem.

As such, the main goal of today's attack helicopter designers is to increase survivability without causing any degradation to the platform's killing capabilities. The key to achieving this goal is ensuring that the pilot is aware of the surrounding threats. In other words, “know about the enemy before he knows about you and see the enemy before he sees you . All this must be achieved without causing the crew any data overflow.

The Ka-50-2 helicopter, with its new avionics design, achieves this goal. Its modern Western avionics, combined with its superior Russian airframe and unique flight characteristics, make it the world's leading attack helicopter.

Analysis of the mission requirements, taking into consideration increasing battlefield threats, has brought us to emphasize the following criteria in the avionics design of the Ka-50-2:

- The flight crew will be able to operate and control the helicopter with maximum "head out" time.
- The pilot at the controls will not have to remove his hands from the HOCAS (Hands On Collective And Stick) grips, as all control activities will be performed via the HOCAS. The same applies for the gunner operating the targeting system, as well.
- In order to minimize the need for aural exchange of information between the crewmembers, all relevant data will be displayed in front of each pilot on Multi Function Color Displays (MFCDs).
- The number of control panels in the cockpit will be minimized by utilizing MFCDs, a Control and Display Unit (CDU), and stick and collective switches.
- The helicopter will have a complete onboard mission planning capability.

Avionics System Architecture

The Ka-50-2's centralized avionics system architecture addresses the operational criteria described above. The design relies on the use of two identical computers, which are based on an R-4740 family RISC Central Processing Unit (CPU), to provide outstanding graphics and computational capabilities as well as full redundancy.

The computers, which are accurately referred to by IAI/Lahav as Mission and Display Processors (MDPs), centralize system management, general processing, fire control, navigation/guidance, data display and control, communication/identification, integrated BIT and aircraft interface. The MDPs handle all system data display and control functions, including those of the Electronic Warfare and Targeting Systems. The MDPs interface with the avionics subsystems through either the avionics bus or the armament bus. The graphics capabilities provided by the MDPs are utilized to drive the Ka-50-2's displays.

The architecture maximizes the use of Non Development Items to eliminate any requirement for development, apart from the MDP software adaptation. This provides flexibility and growth potential.

The Ka-50-2's MDP has been used by IAI on previous similar programs, enabling the reuse of numerous existing software development tools and significant portions of already developed software. The time and risk associated with software development is thus reduced as only software adaptation is required. The MDP also provides significant growth potential for future applications.

The utilization of two MDPs with the centralized architecture provides complete redundancy in all system management functions. Critical elements such as the MDP, INS/GPS, controls and displays are redundant and no single failure in any unit will cause mission abort or prevent a safe return home under combat conditions.

The avionics system includes numerous features such as Multi Function Color Displays (MFCDs) with integrated controls, Helmet Mounted Display (HMD), and an advanced, all weather, day/night targeting system to assist the pilot and gunner perform their mission tasks. All this equipment has been verified through modeling, simulation, and the scrutiny of Israeli pilots. The proposed approach incorporates real combat experience to address cockpit and weapon system operation.

The centralized architecture is based on two MIL-STD-1553B Mux Bus networks: the Armament Bus and the Avionics Bus. The armament bus links the MDP, Armament Interface Unit (AIU), Targeting System, Pilots Integrated Helmet Systems (IHSs) and the wing weapons stations. The avionics bus links the Communication/Identification, Navigation/Guidance, and Electronic Warfare Subsystems.

The bus architecture provides isolation between the avionics and weapons functions, minimizes inter-network data flow and provides growth potential for future communication capability.

The avionics system maximizes the integration of the aircraft instruments and panels with the avionics controls and displays. This integration enables the elimination of cockpit clutter common in previous generation helicopter cockpits, resulting in simpler operation and reduced pilots' workload. The integrated controls provide the capability to automatically perform functions that on most helicopters are executed manually by the pilots. This includes data entry, display selection, mode initialization, etc.

The Ka-50-2's avionics system components have been selected for optimal performance and man machine interface. The MDP interfaces with the avionics subsystems through either the Avionics Bus or the Armament Bus. The graphics capabilities provided in the MDP are utilized to drive the displays. The MDP is responsible for System Management, General Processing, Fire Control, Navigation/Guidance, Data display and Control, Communication/Identification, Integrated BIT, and aircraft interface. The MDP handles all the system data, control and display functions such as Electronic Warfare, targeting system, etc.

Avionics System Functional Description

Tactical Weapons Avionics (Stores Management)

The integrated stores management system is comprised of the computation component, hardware interface to the stores, and weapons systems components. The computation component is located in the MDP. The Armament Interface Unit (AIU) provides the interface from the MDP to the stores, including the gun, rockets and missiles. The MDP and AIU provide growth capability for the interface of new weapons.

System Management Avionics

The system management function is located in the MDPs. Each MDP is capable of performing all system management functions including avionics bus control, system BIT activation and status monitoring, and system initialization and mode control.

Control and Display

The MDPs provide the system's graphics generation capability. The MDPs generate all formats and symbols for the MFCDs. The human machine input functions are processed by the MDP based on inputs from the MFCD bezel mounted Option Selection Switches (OSS) and HOCAS controls. The control and display task is divided between the two MDPs, so that each backs the other. The MDPs also function as the avionics system's video signal controller.

Navigation, Communication and Identification

The Navigation, Communication and Identification control functions are integrated into both the Control Display Unit (CDU) and Option Selection Switches (OSS) and are displayed on the Multi Function Colored Display (MFCD). These functions are implemented and executed within the MDP software as part of the system management and control task.

Tactical digital communication data is provided to the MDP by the Data Link System (DLS). The MDP uses the information for mission calculations, and displays it upon the pilot's request.

Night piloting is enabled through the use of Night Vision Goggles (NVG).

The avionics system architecture includes dual INS/GPS, dual MDP, dual CDUs and four MFCDs ensuring that no single failure causes a mission abort. The system can handle any single failure without degradation in the navigation/guidance performance.

The Ka-50-2 avionics system provides all the communications capabilities required for mission execution. The advanced subsystems are all off-the-shelf, used in other similar applications and provide secure voice and data communication with land, air and naval forces in EW environments. All communication instruments are monitored by the central computer (MDP) and controlled via the CDUs, MFCDs and HOCAS.

Digital Map

The Ka-50-2 avionics system incorporates an advanced Digital Moving Map (DMM). The DMM's mass storage memory is integrated into the MDP, which generates the map graphics and overlaid symbols.

Targeting System

The Targeting System provides the operator with the capability of detecting, ranging and tracking tactical targets under day, night and adverse weather conditions. The system includes a stabilized electro-optic sensors payload which can be slaved to the pilot/gunner Integrated Helmet System (IHS) and cockpit controls. The Targeting System displays are presented on the MFCD.

The Targeting System performs all the day and night targeting functions. The system provides targets observation, detection and recognition capability using a Forward Looking Infra Red (FLIR), High resolution TV Camera with zoom capability, Target range measurement, Laser pointer and Autotrack capability.

Integrated Helmet System (IHS)

The Ka-50-2 Integrated Helmet System (IHS) is a high performance, light weight, monocular display and sight system, utilizing an electro-optical head tracker system. The IHS's advanced helmet mounted display and sight system projects flight, navigation and weapon data onto the user's visor via a miniature Cathode-Ray Tube (CRT).

Summary

The Ka-50-2 program provided the opportunity to combine combat proven Western mission avionics with a robust and agile Eastern helicopter platform. This meeting of Eastern and Western technologies enabled one of the most combat effective attack helicopters ever designed to be offered at a highly competitive price.