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APPLICATION OF THE POSITION LOCATION REPORTING SYSTEM

(COPA COMPLEX)

TO THE ITALIAN ARMY HELICOPTERS

IN CATRIN

by

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ABSTRACT

In the modern battlefield scenario, the Command and Control functions are evolving toward even more sophisticated characteristics of planning, coordination and management.

The new military needs require high capabilities in term of targets acquisition, data processing and dissemination, prompt reaction, also under hostile conditions due to enemy threat.

With the acquisition of the CATRIN system, Italian Army took an high effort in this directions.

CATRIN system realizes the Communication and Information functions of a C3I system; it performs enemy information acquisition, processing and displaying to the commanders for decision making and reaction.

It is composed by the following subsystems:

- SORAO

- for battlefield surveillance and target information acquisition and processing;

- SOTRIN

- for fast and secure information transmission;

- SOATCC

- for tactical sighting, command and control;

Agusta Sistemi is responsible, within the SOATCC subsystem, for the realization of the systems that process all the information related with Italian Army Light Aviation Activities.

The COPA-PLRS (COMplex for Positioning of Aircraft-Position Location Reporting System), part of the SOATCC, is a military tactical management, guidance and optimization system developed from the Huges PLRS system by Hughes/Agusta Sistemi Companies.

It enables the Italian Army Light Aviation helicopters to meet the full achievement of performances required by changing operational scenarios and to upgrade the efficiency, survivability, security, flexibility and mobility of operation in the battlefield environment.

1. Introduction

For many years, every military tactical commander has needed a body of information he rarely could get: accurate and timely information on where every one of his units was located.

In the past, by the time commanders received position location information, the unit often was somewhere else.

In battle, keeping track of unit movement is hard enough under ideal conditions. When a large number of units is involved and the effort is complicated by distance, bad weather, darkness, rough terrain or interference with communications, the problem becomes more difficult. In particular helicopter navigation coordination and control under combat conditions is extremely difficult; the capability to proceed at low level and high speed directly to a destination is essential.

2. Overall Description

The objective of COPA-PLRS is to supply Italian Army Light Aviation commanders with continuous and global monitoring and control of mission involving helicopters and surface vehicles, as close as possible to the final operative area.

COPA-PLRS also includes the COMIX (Complex for Mission Control) functionally integrated within a position location reporting network; the operative elements of the network are called User Units (UU).

The network utilized for PLRS and COMIX is based on a synchronous time ordered architecture utilizing a common spread spectrum waveform, time-sharing a single UHF frequency band and is managed by a computerized center called Master Station (MS).

The technique employed to locate and track the position of users is multilateration. It is based on determining range to a UU by measuring Time-Of-Arrival (TOA) of signal burst from units at known locations.

COMIX complex can be considered as one of the network Users Units. It is an avionic set able to control and manage missions involving groups of helicopters, as close as possible to the final operative area. The battlefield management and control are performed using the capabilities supplied by the COPA-PLRS network, of which COMIX and every helicopter are users.

A schematic description of the COPA-PLRS network is provided in Figure 2-1.

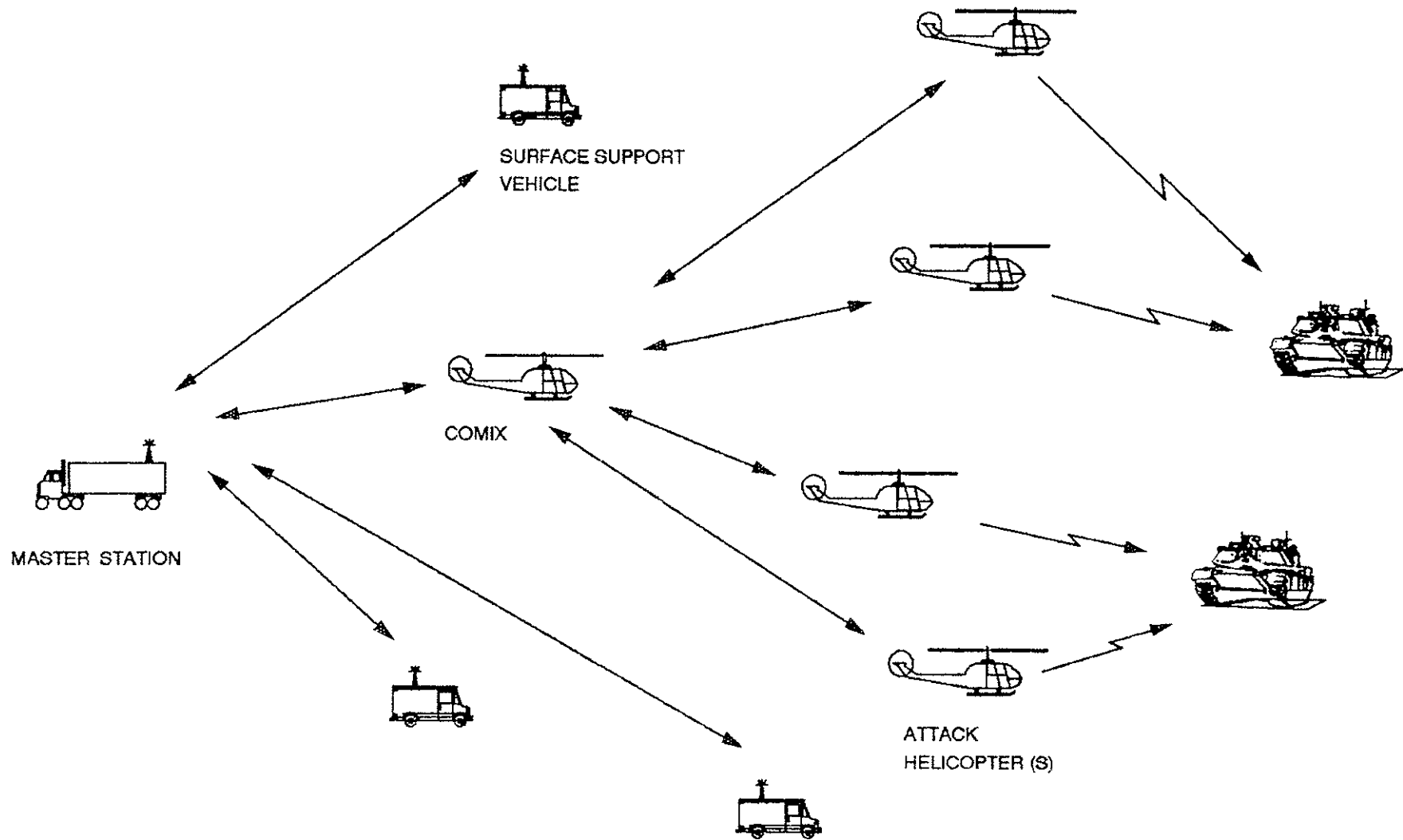


FIG. 2-1 COPA-PLRS NETWORK

When assigned by the MS, each UU in the network reports the TOA of any signal bursts it has received from other specified units. The MS compares the reported time of message received with the known time of transmission, and converts the difference into range between sender and receiver.

When the ranges between a given unit and three or more previously located units are known, the position of the unit in three dimensions can be calculated.

UUs also contain a barometric transducer which provides direct altitude data to complement TOA data in unfavorable geometry situation.

The use of more than three measurements for a unit increases its location accuracy.

Because tactical units are frequently beyond the line-of-sight of the MS, and COPA-PLRS is a line-of-sight system, the COPA-PLRS enables any UU to serve as an automatic relay. When many units are deployed over a broad area, up to four levels of relays are available to establish paths between remote users and MS.

Through this means it is possible to serve many users throughout the operative area.

Each UU can be automatically programmed by the MS, when necessary, to perform as a relay, make TOA measurements, store data and report to the MS - all without any operator action.

The MS monitors continuously the communication reliability, track quality and geometry. If a UU working as a relay moves out of the line-of-sight, is damaged or its performance is otherwise degraded below a programmed limit, the MS computer, without any operator action, selects another suitable UU and instructs it to assure the required function.

To support contemporary hundreds of users in near real-time, COPA-PLRS employs frequency-hopping and a direct sequence pseudo-noise spectrum-spreading techniques, combined with data encryption and interleaving, which provide reliable Electronic Warfare (EW) protection.

A network management algorithm monitors all radio links and maintains real-time information about the connectivity.

In this way COPA-PLRS automatically compensates for the hazards of tactical operations, and maintains the network at an optimum efficiency level.

3. Physical Description

COPA-PLRS is a radio network consisting of a transportable Master Station with computers and a situation display, communicating with up to 400 (370 contemporary active) individual User Units (UUs); COMIX is a special User Unit.

The Master Station (MS) is housed in a standard military UEO-2 air-transportable shelter. It may be deployed by helicopter or carried by any suitable military vehicle.

The MS contains the network communications facilities, rugged Vax computers, data displays and related equipments as required to support a single independent network, or to cooperate with other MSs in a multi COPA-PLRS network; all the functions have been implemented making use of ADA language.

The basic COPA-PLRS UU consists of a multi-function transmitter-receiver and processor, packaged in a 1-ATR short, low case, and equipped with either of two interchangeable input/output (I/O) devices.

In the manpack configuration the hand-held User Readout (URO) module is employed, together with a battery pack. The other I/O unit is the Pilot Display Control Panel (PCDP), for use in a fixed and rotary wing aircraft, tanks, amphibious assault vehicles, armored personnel carriers and similar tactical vehicles.

The PCDP and the URO are functionally identical except for the different types of installation (for aircrafts or vehicles). No matter which I/O is used or what type of user is involved, the function of the UU are the same: transmit its own time slot signal burst, make TOA measurements on other UU's, relay TOA and send or request information from the MS via the I/O device.

COMIX Complex is a mobile embedded center with a high operational flexibility. It can be installed on helicopters (or optionally on vehicles) and performs the function of command and control of Army Light Aviation aircraft missions.

It is composed by an avionic computer based on Intel system architecture, a display with graphic capabilities, a solid state cartridge for mission information storage and data report (either initial data or mission execution data), a printer in case of need of physical report about particular data, and a basic COPA-PLRS transmitter-receiver UU that ensures the communication link among units via COPA-PLRS MS.

The overall Comix functions have been implemented making use of C and ASSEMBLER languages.

4. COPA-PLRS Operational Capabilities

COPA-PLRS is an accurate identification and positioning network of friendly aircraft, 3D navigation capabilities and jamming resistance communications, all-weather, day and night operation, map of the earth in the CORP area near or beyond FEBA (Forward Edge Battlefield Area).

The location and information data are processed and reported to the MS and to the command facilities, to provide Italian Army Light Aviation with the necessary capability and flexibility.

With timely and accurate positioning and navigation information, it allows effective control of maneuver elements, mission execution, helicopter navigation and a coordinated employment of fire and air support in a tactical environment. Such information are available under all conditions of terrain, weather, visibility, night operations and low intensity jamming attacks, providing flexibility to accomodate changing battlefield conditions.

The COPA-PLRS performs an instrumental flight support in the operational area, guidance in the terminal area and communications and data exchanges air/ground/air. The following shows the main COPA-PLRS capabilities:

*) Position Location

- control and maneuver of ground combat and helo units under wide geographic and environmental conditions during day and night;
- timely and accurate coordination of fire and air support;
- accurate positioning of surveillance and target acquisition;
- positioning and charting of barrier and minefields;

*) Identification

- minimizes possibility of inadvertent engagement by friendly units;

*) Navigation Aid

- increased speed of movement;
- air corridor/ lane guidance;
- exploitation or avoidance of natural terrain features;
- enhanced troop and friendly aircraft safety;
- instrumental fly;
- terminal area support and guidance;

*) Communications

- data exchange capability between members of the network;
- automatic response to predefined messages;
- reduced use of tactical voice radio nets;
- improved performance in EW environment;
- improved reliability;
- total crypto security;

Because it utilizes composite frequency-hop/direct sequence spread spectrum techniques, COPA-PLRS has inherently high jam resistance and can operate in hostile electro-magnetic environments.

*) COMIX Operational Features

- offer the mission commander a continuous monitoring and control of the mission;
- allow mission coordination and management as closely as possible to the final operative area;
- allow a "Data Report" to act on air units during mission when unexpected circumstances modify the "Flight Plan";
- ensure a continuous, safe and robust communication link;
- enhance and increase the Army Light Aviation Center terrestrial coverage, providing effective capability to meet the aircraft mission requirements;
- correlate and process data I/O to/from ground and to/from helicopters.

Figures 4-1 and 4-2 show, respectively, the main characteristics of COPA-PLRS network and a sample of mission involving Army troops.

COPA-PLRS MAIN CHARACTERISTICS

OPERATING FREQUENCY.....UHF, 420 TO 450 MHz

SYSTEM ARCHITECTURE.....TIME DIVISION MULTIPLE ACCESS (TDMA)

ECCM MEASURES.....SPREAD SPECTRUM, FREQUENCY HOPPING

SECURITY.....INTERNAL SECURE DATA UNIT

NETWORK MANAGEMENT.....AUTOMATIC, CENTRALLY CONTROLLED

RELAY CAPABILITY.....AUTOMATIC, FOUR LEVEL

SYSTEM COVERAGE.....400 USER UNITS (370 ACTIVE) PER MASTER
STATION, 50 Km X50 Km AREA

TYPICAL LOCATION ACCURACY.....15 METERS, CEP

POWER OUTPUT.....UP TO 100 w, FOUR PROGRAMMABLE LEVEL

Figure 4-1

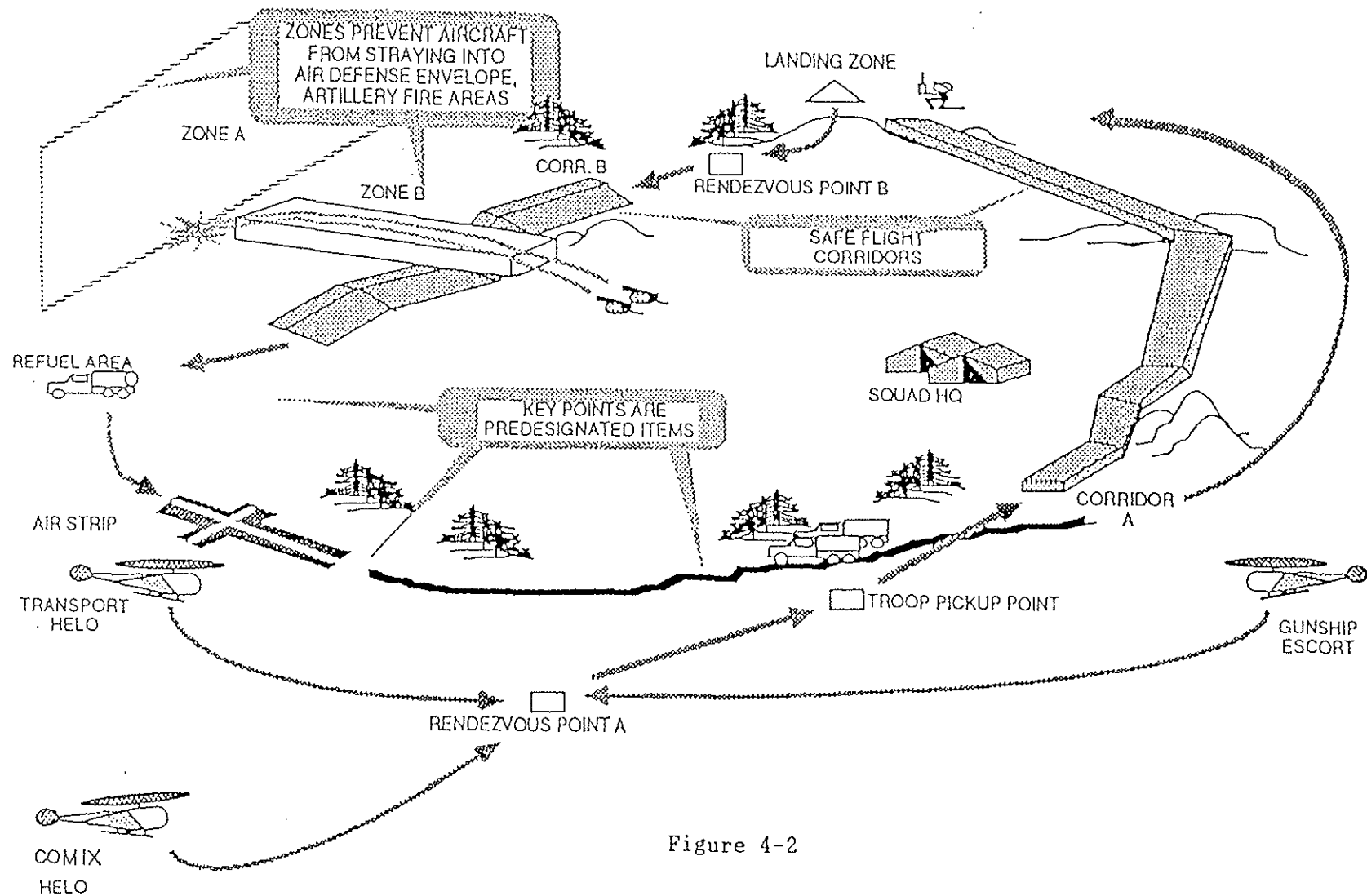


Figure 4-2

5. Conclusions

Because of its intrinsic characteristics, COPA-PLRS will allow Army Light Aviation to operate, in a safe manner, under all the worse environmental (either meteorological or tactical) conditions.

By deploying the units in the appropriate way, it will be possible to ensure a complete coverage of the mission area, increasing the operativity of the involved forces.

At this level it shall also be possible to control, from an helicopter (or truck), the entire tactical/ operative theatre and to perform command and control functions on the related mission activities.