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SYSTEM PLANNING CORPORATION

REMOTELY PILOTED VEHICLE (RPV): PROPOSED COMMAND, CONTROL COMMUNICATIONS (C3) STRUCTURE

FINAL REPORT

SPC 819

July 1982

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I. EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A. PURPOSE

This study was conducted for the Remotely Piloted Vehicle (RPV) Program Manager to: (1) identify the currently proposed command, control, and communications (C^3) structure associated with the RPV system, (2) identify and examine potential problem areas in the transfer of information to and from the RPV system, and (3) identify options for improving information transfer and estimate the degree of improvement to be expected.

B. BACKGROUND AND SCOPE

The RPV system is composed of a remotely piloted air vehicle with a stabilized imagery sensor and a laser rangefinder/designator, a launch unit, a recovery unit, a ground control station (GCS), associated ground support equipment, an antijam data link, and personnel to operate and maintain the system hardware. The system has the capability to detect, recognize, and identify targets deep within enemy territory with sufficient accuracy to permit engagement by field artillery and other weapons.

The function of the C^3 system associated with the RPV is to exploit the capability of the RPV in the performance of the field artillery mission by proper tasking and effective dissemination of the resulting data. The RPV Organizational and Operational (O&O) Concept describes, for the current division structure, the proposed tasking and reporting channels for the RPV section. At the time that the RPV is fielded in 1987 the Division 86 structure should be implemented in the Army. Although the O&O Concept for the RPV in the Division 86 structure has not yet been completed, the general C^3 structure for the RPV is not likely to be substantially changed. However, under Division 86´ a division may be assigned three, four, or five RPV sections. Each RPV section will be under the control of a field artillery headquarters that is supporting an operational unit. One section will normally be attached to each direct support artillery battalion in support of a maneuver brigade; the

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remaining section(s) will be under the control of Div Arty in support of the division.

The O&O Concept identifies five basic roles for the RPV; target acquisition, artillery adjustment, target designation, reconnaissance, target attack assessment. Each of these roles requires that information be passed accurately and in a timely manner to and from the RPV system. This study identifies the organizational elements that the RPV section must communicate with to perform these roles, the types of information that must be transferred, and the radio facilities available to the RPV section to accomplish the required communications. It is recognized that wire is the preferred means of communication and will be installed when time and circumstances permit. It is believed, however, that the RPV section will operate with FM radios a large portion of the time. Therefore, only radio communications are addressed in this study. The communication nets that will be used by the RPV section and the mechanics of accomplishing information transfer are examined. Potential problem areas are noted, and options for improvement are proposed.

C. STUDY APPROACH

The C^3 structure proposed by the Division 86 concept was first examined to identify available voice and digital communication nets that might support the five basic roles of the RPV. Data on operational and technical capabilities of these nets were obtained by survey and interviews with personnel within the Field Artillery School, and within program manager offices of major C^3 systems, such as TACFIRE. Several scenarios were then developed of representative situations involving acquisition and attack of both stationary and moving targets to exercise these nets and identify potential bottlenecks or other problem areas. The scenarios examined C^3 actions required during RPV mission planning, and those actions required for actual mission execution over the target area. Options for improving timelines, reducing workloads, or implementing missing communications links were proposed and analyzed.

D. FINDINGS

1. *An effective digital communications capability can significantly enhance the performance of the command and control actions associated with the RPV, reduce the workload on the crew of the GCS, and increase the likelihood of effective employment of the RPV system.*

The communications currently planned for the RPV will not provide efficient support for the command and control function. The proposed use of voice communications to transmit mission orders and intelligence reports requires a GCS operator to spend large amounts of time transmitting or copying and verifying messages. The time required to exchange these messages and the workload in

of the ongoing mission and unable to start planning for the next mission until the airborne RPV is headed for recovery. He will then have about 15 minutes to prepare and verify the plan before launching the next RPV. The preparation and verification of a mission plan with the proposed manual process is estimated to require about 40 minutes.

The previously mentioned automated computer-to-computer interface with TACFIRE can provide for the automatic receipt of the mission order and storage in the RPV computer. The addition of a map digitizer that is interactive with the computer would permit the automated composition, verification, and measurement of flight path. Until digital terrain maps are available, the operator would have to input terrain data to ensure line-of-sight and proper flight altitude planning. The planning aids being developed to assist in determining flight and sensor parameters should be computerized to essentially automate this part of the planning process.

the GCS during periods of intense activity may cause the delay of subsequent missions or the loss of valuable intelligence information.

The digital communications terminal currently programmed for the GCS has a capacity of only 48 alphanumeric characters per message and a capability essentially limited to the standard short messages used to conduct a fire mission and report artillery target information. Digital messages are composed manually and the digital communications net is monitored with earphones to ensure that it is clear of traffic when the message is transmitted.

The automated computer-to-computer interface, proposed in the TACFIRE-RPV Technical Interface Requirement (TIR) of July 1981, and an effective digital communications capability with the intelligence community can provide the communications required to support the command and control function in a timely and effective manner and increase the time available to the GCS crew for RPV mission activities.

2. *An automated mission planning process is necessary to ensure the effective employment of the RPV system.*

The proposed manual mission planning process requires much of the mission commander's time and may reduce the effective employment of the RPV. In a period of intense activity the commander will likely be completely occupied in the conduct

II. PROPOSED C³ SYSTEM

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The following basic assumptions are made to define the command, control, and communications (C^3) situation for this study.

- The time frame selected is the period when the RPV system is currently scheduled to be deployed to the field.

- Division 86 will have been implemented, but the basic employment concept for the RPV will not be changed.

- Both TACFIRE and the battery computer system (BCS) will be fully operational.

- Wire is the preferred means of communication and will be installed when time and circumstances permit. However, in a fluid battle situation, wire will not be available for a significant portion of the time and the GCS will have to operate with its complement of FM radios.

ASSUMPTIONS

▲ 1978 - 1990 time frame

▲ Division 86 implemented

▲ No change in basic employment concept for RPV

▲ TACFIRE and battery computer system operational

▲ Wire communications not normally available

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enemy territory. The C^3 system associated with the RPV should enable the GCS to receive and rapidly respond to specific requests for intelligence as well as to ensure the timely distribution of the intelligence information derived from this observation to the intelligence staff of the supported operational headquarters.

The current O&O Concept for the RPV [Ref. 1] identifies five basic roles for the RPV, which can be summarized as follows:

- **Target Acquisition:** To detect, identify, classify, and accurately locate targets in real time

- **Artillery Adjustment:** To conduct one-round adjustments for point or area targets

- **Target Designation:** To provide auto-tracking and laser spot illumination of both stationary and moving targets

- **Reconnaissance:** To detect activity and monitor movement in specific areas of interest and to confirm the locations of activity and movement

- **Target Attack Assessment:** To provide immediate attack assessment of indirect fire engagements.

Each of these roles requires the reliable exchange of information between the RPV ground control station (GCS) and the appropriate elements of its controlling field artillery headquarters.

In addition, the RPV may be the only system providing visual observation of selected areas of
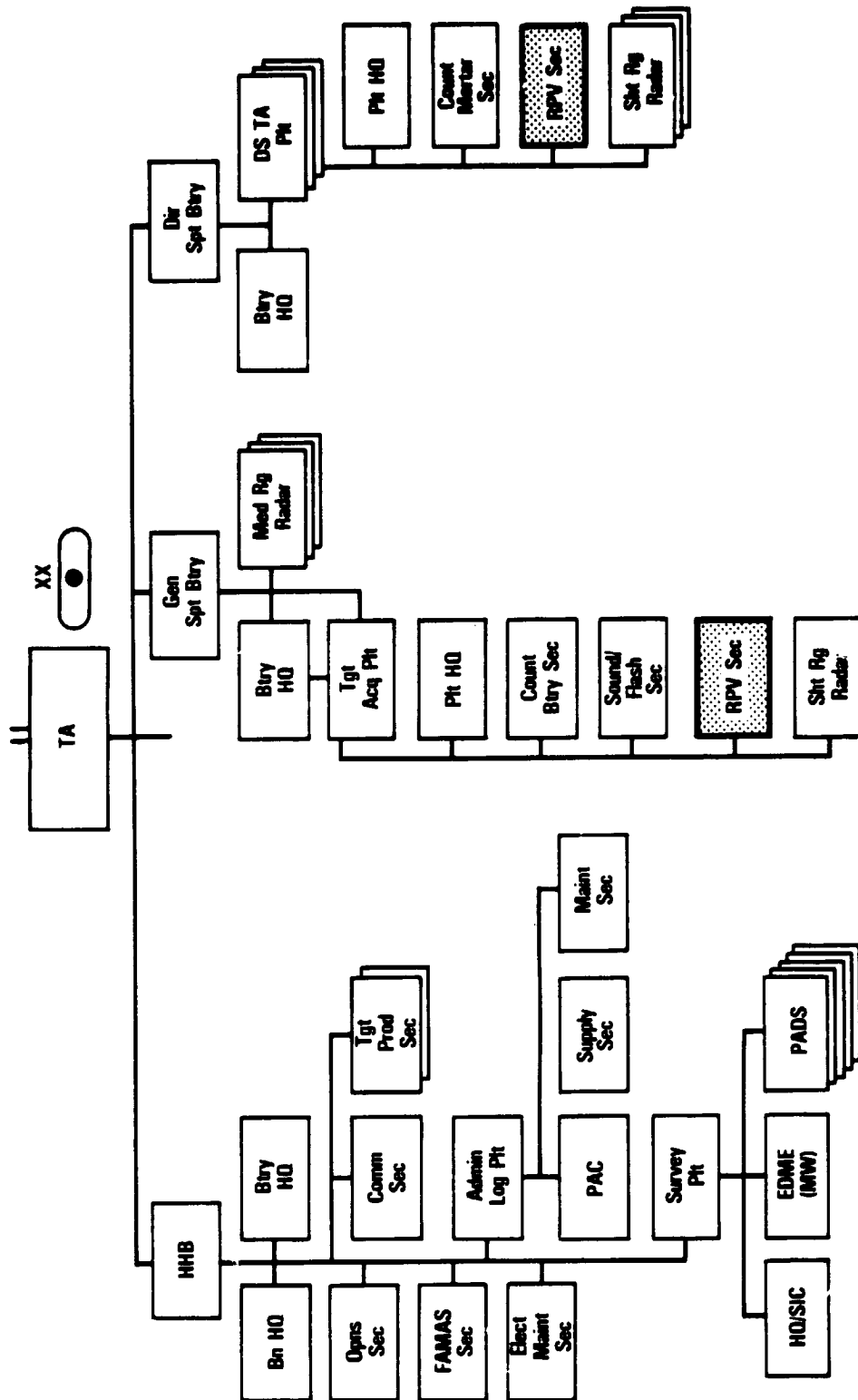
BASIC ROLES FOR THE RPV

▲ Target acquisition

▲ Artillery adjustment

▲ Target designation

▲ Reconnaissance

▲ Target attack assessment

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This chart shows the proposed administrative placement of the RPV sections in the Division 86 concept. The current thinking is that, depending on its peacetime deployment and approved war plans, a division will have three, four, or five RPV sections. An RPV section will be organic to a target acquisition platoon, which is in a target acquisition battalion. The target acquisition battalion has three direct support and two general support target acquisition platoons. Each RPV section will be under the operational control of a field artillery headquarters, which is supporting an operational unit. An RPV section in a direct support target acquisition platoon will habitually operate with, and be tasked by, a direct support battalion in support of a maneuver brigade. A section in a general support target acquisition platoon may be tasked by Div Arty or by the general support battalion in support of the division.

DIVISION TARGET ACQUISITION BATTALION ORGANIZATION IN THE DIVISION 86 CONCEPT

```
                                    ┌──────┐
                                    │  XX  │
                                    │  ●   │
                                    └──────┘
                    ┌──────┐
                    │  TA  │
                    └──────┘
        ┌──────────────┼──────────────────────────┐
        │              │                           │
    ┌───────┐      ┌─────────┐                 ┌────────┐
    │  HHB  │      │ Gen     │                 │  Dir   │
    │       │      │ Spt Btry│                 │ Spt Btry│
    └───────┘      └─────────┘                 └────────┘
        │              │                           │
┌───────────┐    ┌──────────┐              ┌──────────┐
│ Btry      │    │ Med Rg   │              │  DS TA   │
│ HQ        │    │ Radar    │              │  Plt     │
└───────────┘    └──────────┘              └──────────┘
```

HHB
- Bn HQ
- Ops Sec
- FAMAS Sec
- Elect Maint Sec
- Btry HQ
  - Comm Sec
  - Admin Log Plt
  - Tgt Prod Sec
  - PAC
    - Supply Sec
    - Maint Sec
  - Survey Plt
    - EDME (MW)
      - PADS
    - HQ/SIC

Gen Spt Btry
- Btry HQ
- Tgt Acq Plt
  - Plt HQ
  - Count Btry Sec
  - Sound/ Flash Sec
  - RPV Sec
  - Sht Rg Radar
- Med Rg Radar

Dir Spt Btry
- Btry HQ
- DS TA Plt
  - Plt HQ
  - Count Mortar Sec
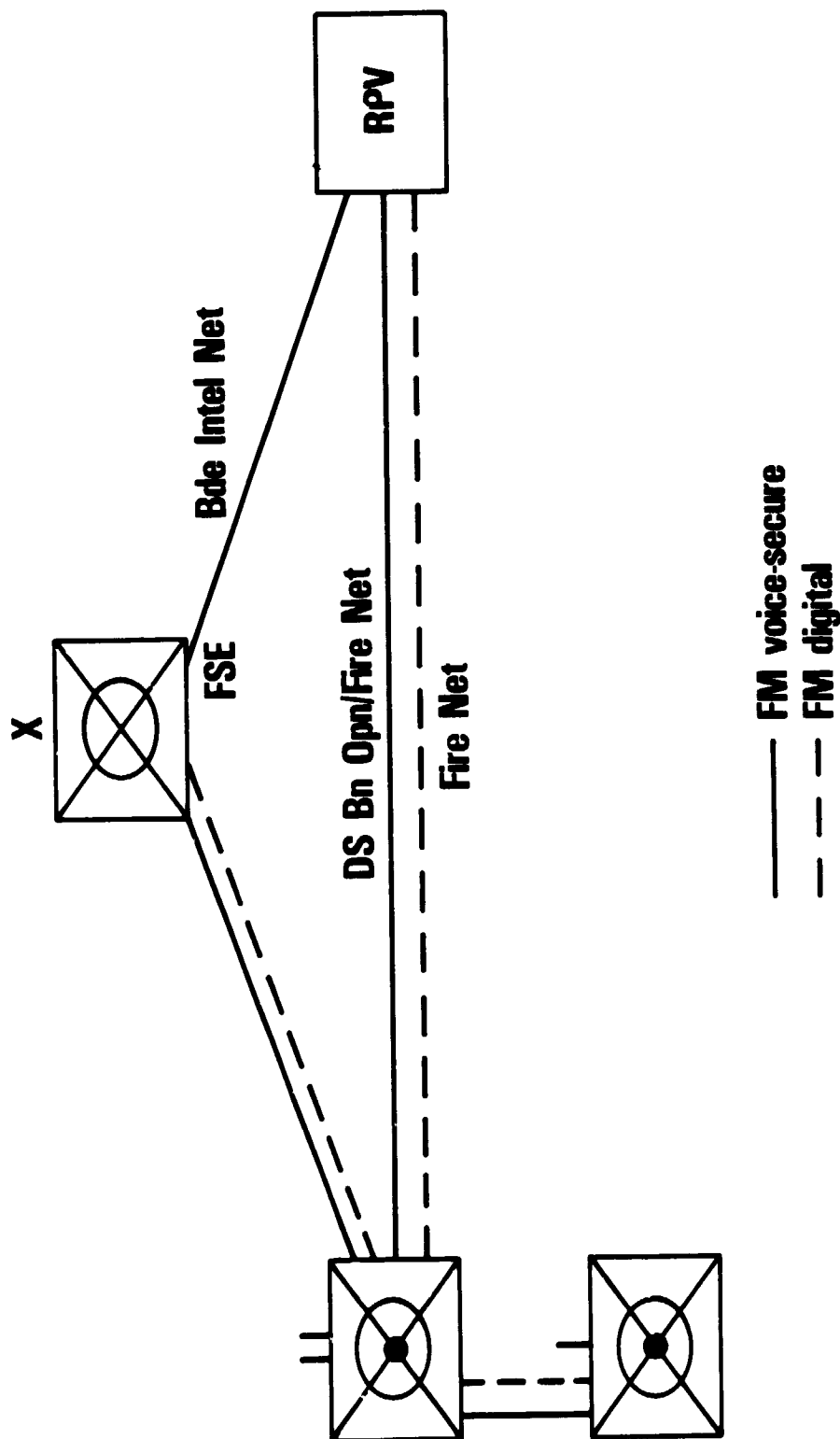 - RPV Sec
  - Sht Rg Radar

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An RPV section under the operational control of a direct support battalion in support of a maneuver brigade must have the capability to receive tasking from and make reports to the battalion fire direction center and the fire support element at the brigade headquarters. The conduct of a fire mission requires the rapid exchange of information between the GCS and the selected firing battery.

Under current plans the GCS will be equipped with three FM radios. The GCS will receive tasking and make reports on the FM voice-secure battalion command net. Fire missions will be conducted through TACFIRE, using the digital message device operating on the direct support battalion operation/fire digital net. The RPV section may be directed to operate in a fire net (FM digital) so that it can operate directly with a firing battery. Current plans are to use the standard TACFIRE DMD AN-PSG-2a; however, an improved DMD for the fire support team (FIST) is under development and is assumed to be available to the GCS.

The third FM radio allocated to the GCS would operate in the FM voice-secure brigade intelligence net to pass intelligence data directly to the brigade.
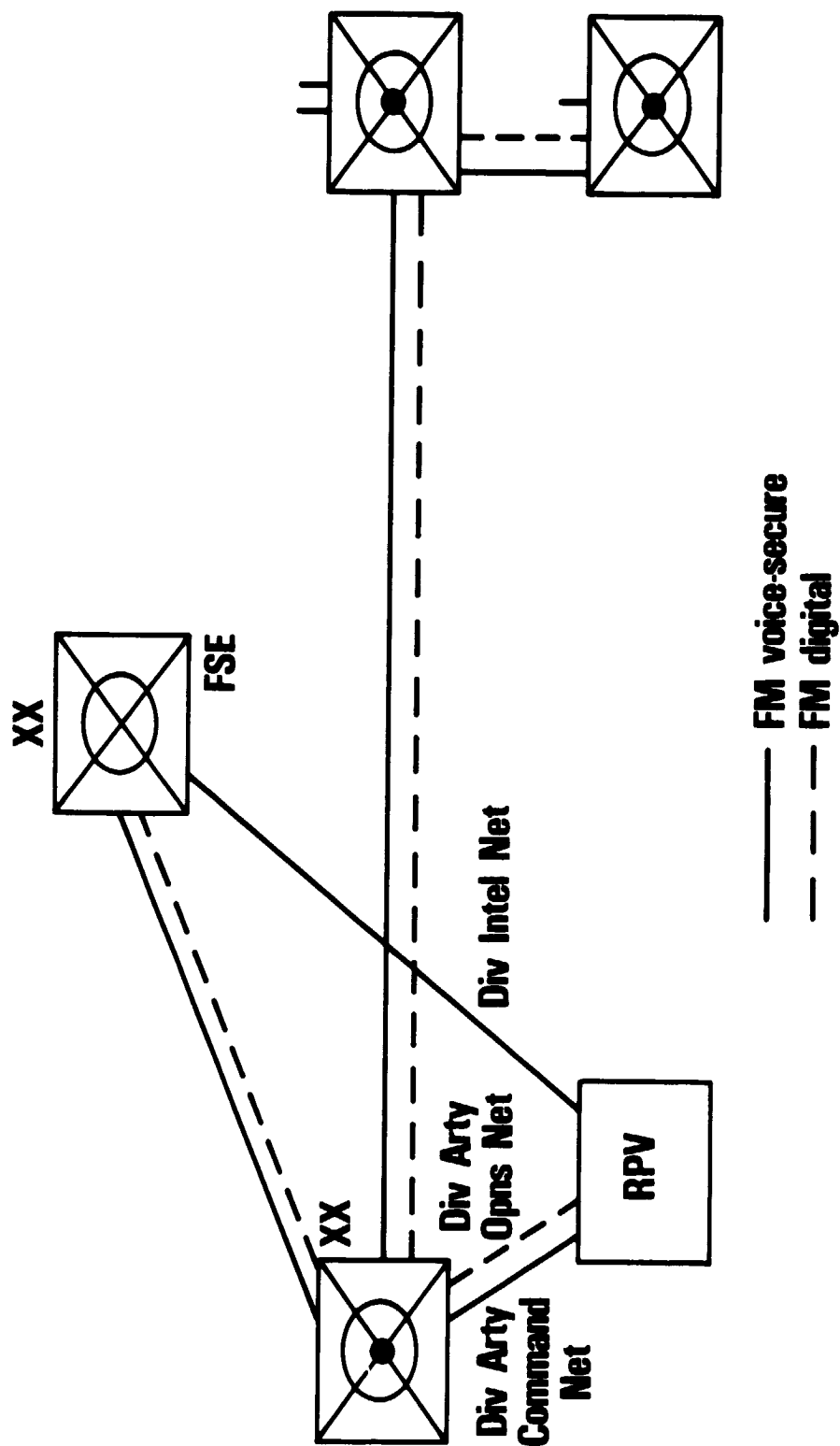
12

C³ STRUCTURE
DIRECT SUPPORT RPV SECTION

Bde Intel Net

RPV

X

FSE

DS Bn Opn/Fire Net

Fire Net

—— FM voice-secure
— — FM digital

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This chart shows the C^3 structure associated with a general support RPV section with Div Arty as the controlling artillery headquarters. The RPV section will normally receive tasking and make reports in the Div Arty target acquisition battery FM voice-secure command/intelligence net. It will be linked to the Div Arty TACFIRE on a Div Arty FM digital operations net. Fire missions with the GS battalion will be conducted through the Div Arty TACFIRE link with GS battalion TACFIRE. The RPV section will operate in the division FM voice-secure intelligence net to make intelligence reports to the division intelligence staff.

When the RPV section is attached to the general support artillery battalion, it will receive tasking and make reports on the battalion FM voice-secure command net and be linked to the battalion TACFIRE on a battalion digital net. It will continue to operate in the division FM voice-secure intelligence net.

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C³ STRUCTURE
GENERAL SUPPORT RPV SECTION SUPPORTING DIVISION ARTILLERY

XX

FSE

XX

Div Intel Net

Div Arty Opns Net

RPV

Div Arty Command Net

——— FM voice-secure

– – – FM digital

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The *Report of Artillery System Study Group (Task Force Battle King)* [Ref. 3] recognizes communications problems, stating: "Line of sight limitations and net overloading characterize the artillery radio communications systems. The future use of digital burst transmission will tend to alleviate the net loading problem. However, queuing delays associated with the present tactical radios (designed for analog voice) significantly increase the overall response time, thus compounding the net overloading."

None of the FM radio nets proposed for the C^3 system associated with the RPV is dedicated solely for RPV operations. Each net supports a broader mission and has many subscribers beyond those associated with the RPV system. A field artillery command net, for example, links the unit commander with all of his subordinate units. It is controlled by the unit operations center, and its use is restricted to ensure that the commander can reach any of his units or that they can reach him when an urgent need arises.
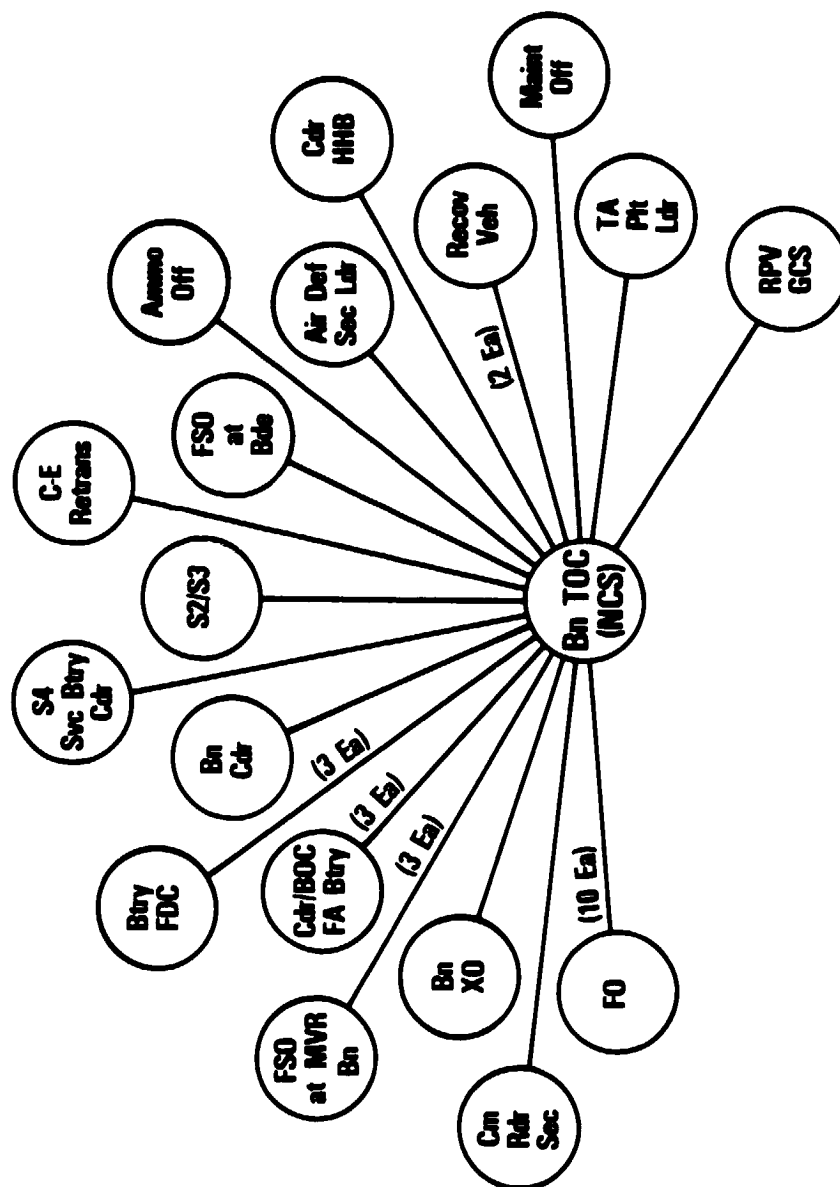
This chart, adapted from *Combat Communications Within the Division*, FM 11-50 [Ref. 2], shows that there are 35 subscribers in the direct support battalion command net in the current organizational structure. Similarly, the Div Arty command net has about 20 subscribers, while the general support battalion command net has about 30.

The number of subordinate units reporting to the commanders of field artillery units is not expected to change significantly with the implementation of the Division 86 Concept. The configuration of the fire support control system planned under the Command Control and Subordinate Systems concept and the Army Command and Control Master Plan (AC^2MP) has not yet been determined. It is expected, however, that the structure of the nets may change as the Army moves more toward digital communications.

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DIRECT SUPPORT BATTALION COMMAND NET
FM VOICE-SECURE

Bn TOC (NCS)

C-E Retrans
FSO at Bde
Ammo Off
Air Def Sec Ldr
Cdr HHB
Recov Veh
Maint Off
TA Plt Ldr
RPV GCS
S2/S3
S4 Svc Btry Cdr
Bn Cdr
Btry FDC
Cdr/BOC FA Btry
FSO at MVR Bn
Bn XO
Cm Rdr Sec
FO

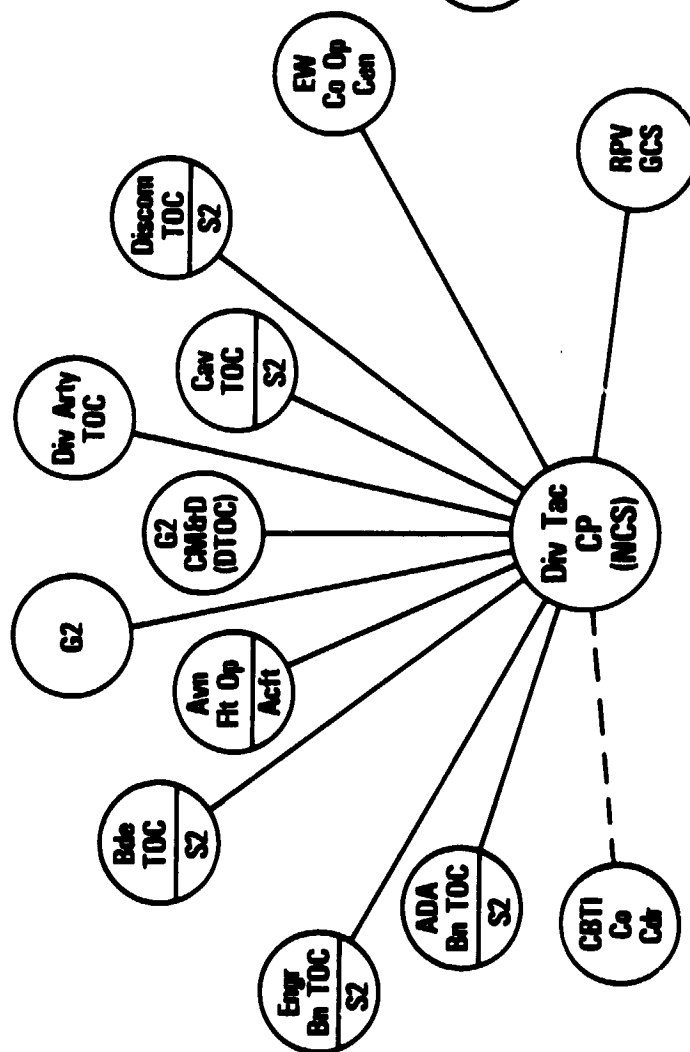(2 Ea)
(3 Ea)
(3 Ea)
(3 Ea)
(10 Ea)

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The current intelligence nets of the division and the brigade are shown on this chart. The GCS would use one of these nets to make intelligence reports to the G-2 or S-2 of the supported operational headquarters. There is no reason to believe that the communications difficulties would be less on these nets than on the artillery nets.
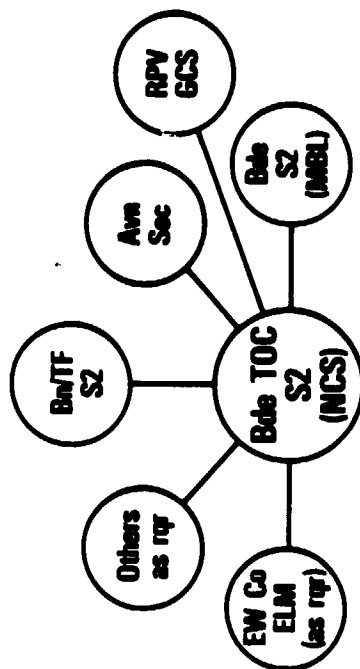
The intelligence community will undoubtedly participate in the Army's move to greater use of digital communications. However, specific plans are not yet available to permit the identification of possible links for the RPV.

INTELLIGENCE NETS
FM VOICE-SECURE

Brigade

Division

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pleted, the actual software to implement the computer-to-computer interface can be developed. A computer-to-computer interface is not scheduled for implementation before DT/OT II.

The GCS will normally operate in the battalion operation/fire net but may be directed to operate in one of the three fire nets to ensure real-time communications in the conduct of a fire mission.

The introduction of TACFIRE permits much of the information required in planning and conducting fire missions to be exchanged among the field artillery elements by digital communications [Ref. 4]. This chart shows the digital nets currently planned to support TACFIRE in a direct support field artillery battalion.
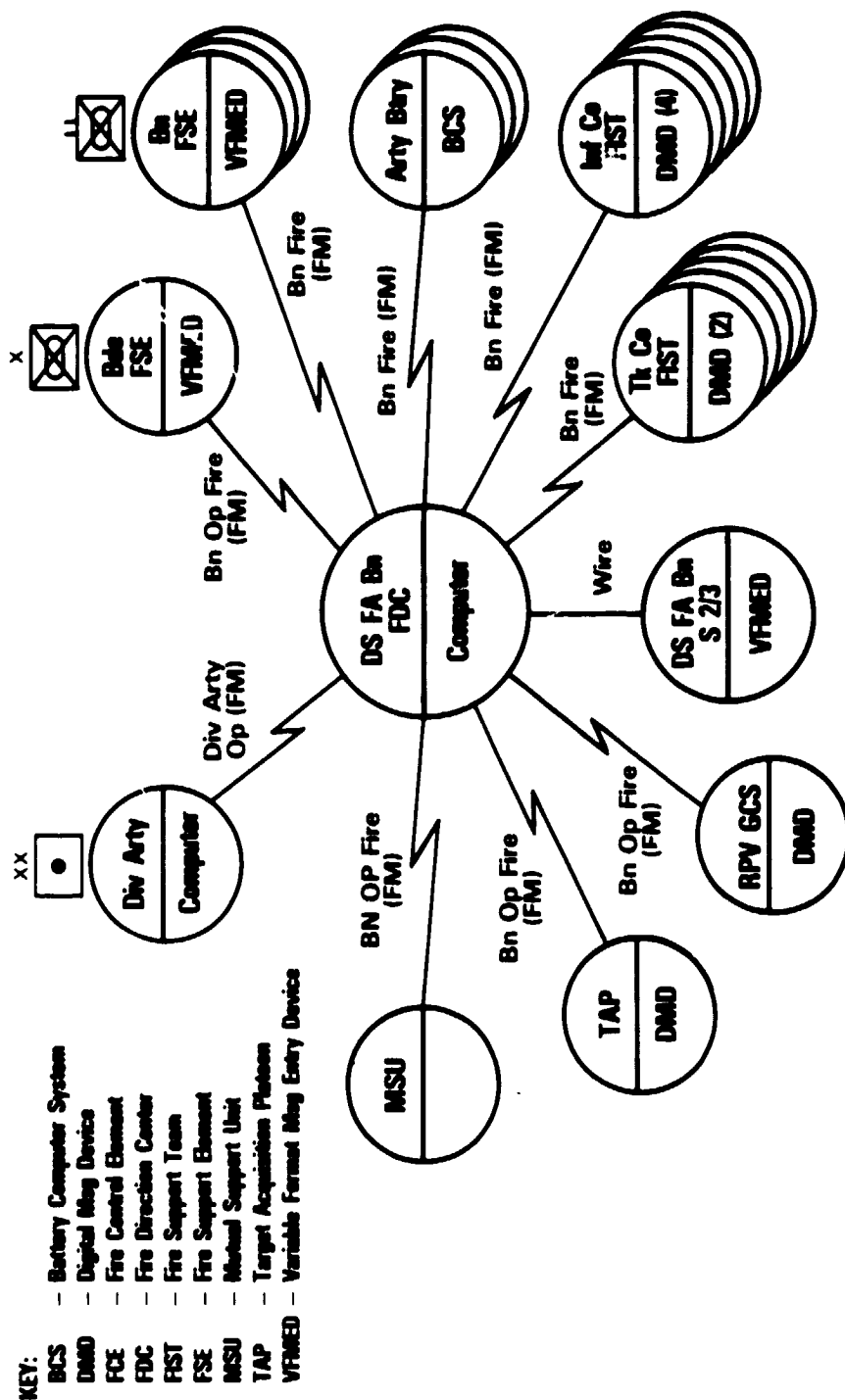
Current plans are for the GCS to communicate with TACFIRE using a digital message device (DMD) that was designed for the forward observer (FO). The DMD is preprogrammed for the standard messages that are sent and received by the FO in the conduct of a fire mission. The DMD has a capacity of only 48 alphanumeric characters per message. An improved DMD for the fire support team (FIST) is in full-scale development and is assumed to be available to the GCS. The FIST DMD will provide additional functions, especially for the conduct of missions with terminally guided projectiles, but, like the present DMD, it will have a capacity of only 48 alphanumeric characters per message.

A technical interface requirement (TIR) for a computer-to-computer interface between the GCS and TACFIRE has been prepared [Ref. 5]. The next step is to prepare a technical interface design plan (TIDP) that will contain all of the messages and the format of each message to be passed between the GCS and TACFIRE. Once the TIDP is com-

TYPICAL DIGITAL NETS – DIRECT SUPPORT BATTALION

Bn FSE / VFMED

Arty Btry / BCS

Inf Co FIST / DMD (4)

Tk Co FIST / DMD (2)

Bde FSE / VFMED

Div Arty / Computer

DS FA Bn FDC / Computer

DS FA Bn S 2/3 / VFMED

RPV GCS / DMD

TAP / DMD

MSU

Bn Fire (FM)

Bn Fire (FM)

Bn Fire (FM)

Bn Fire (FM)

Bn Op Fire (FM)

Div Arty Op (FM)

Wire

BN OP Fire (FM)

Bn Op Fire (FM)

Bn Op Fire (FM)

KEY:
BCS — Battery Computer System
DMD — Digital Msg Device
FCE — Fire Control Element
FDC — Fire Direction Center
FIST — Fire Support Team
FSE — Fire Support Element
MSU — Manual Support Unit
TAP — Target Acquisition Platoon
VFMED — Variable Format Msg Entry Device

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III. C³ ACTIONS FOR MISSION PLANNING

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conduct a fire mission or both. A fire mission may be conducted against a target identified by other sources and included in the mission order, or against a target of opportunity, detected by the RPV while carrying out the mission order.

These C^3 actions are addressed in the following charts.

Up to this point the individual parts of the C^3 system associated with the RPV have been addressed along with the organizational units involved and the communications means available to the GCS. The C^3 actions required for an RPV mission are shown on this chart. When a decision is made to employ the RPV, a mission order is prepared and transmitted to the GCS. The mission order may include such items as: the priority for the mission, the mission number, desired time over the target, purpose of mission, type of mission, engagement criteria, areas and items of interest, areas to avoid, reports that are required, and air space corridors.
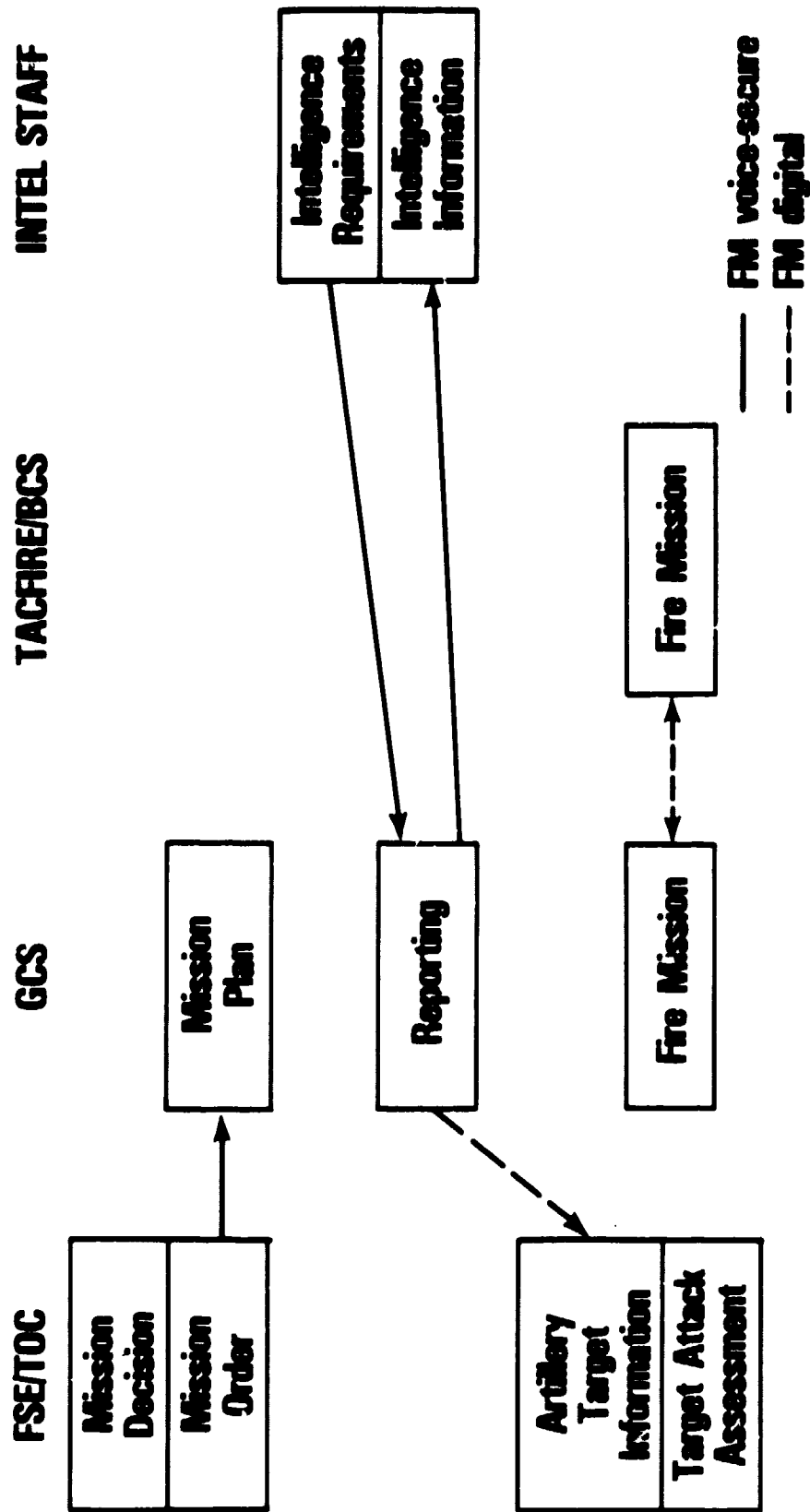
The GCS prepares a mission plan to launch or divert an RPV to carry out the mission order. To accomplish this the targets/areas outlined in the mission order are plotted on a tactical map, flight and sensor parameters for each target/area and ingress/egress routes are determined, necessary waypoints and the flight path are plotted, the time of flight for each leg of the mission and loiter time are computed to determine the estimated flight time, and finally the flight plan is entered into the computer and verified through a printout or graphic display.

The five identified roles of the RPV, mentioned earlier, indicate that on any mission the GCS will report the results of observation or

C³ ACTIONS ASSOCIATED WITH RPV

FSE/TOC	GCS	TACFIRE/BCS	INTEL STAFF
Mission Decision / Mission Order	Mission Plan		
	Reporting		Intelligence Requirements / Intelligence Information
Artillery Target Information / Target Attack Assessment			
	Fire Mission	Fire Mission	

——— FM voice-secure
- - - - FM digital

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The elapsed time from intelligence collection to mission decision will not be changed by modifications to the RPV system. It is nevertheless important to the effective employment of the RPV. *Task Force Battle King* [Ref. 3] considered the targets in the region where the RPV will operate and found that the potential artillery targets remain in one location for periods of time varying from 0.5 to 24 hours. It should be noted that fire support planning is one of the areas addressed in the *Army Command and Control Master Plan* [Ref. 8], and efforts such as the development of an all-source analysis center and a target integration center are aimed at more timely development of targets.
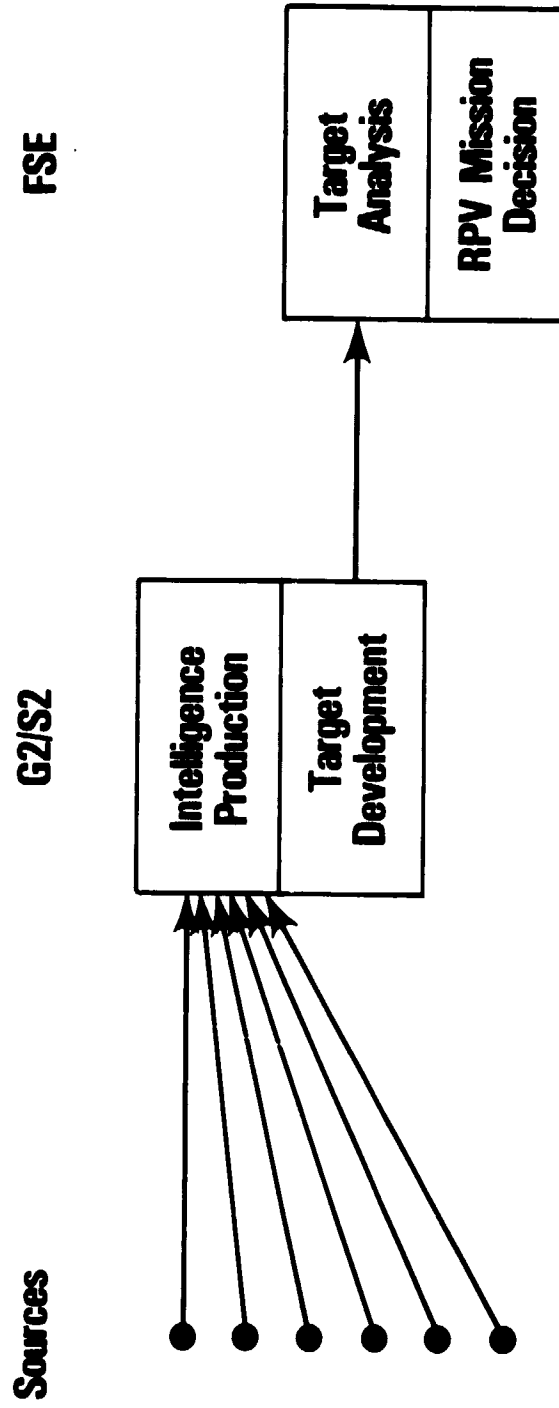
An RPV mission decision will, in general, be based on the nature of the targets provided to the FSE by the intelligence staff of the supported operational headquarters and the criteria established for employment of the RPV. In general, it is expected that when a decision is made to launch an RPV, it will be for a 2- to 3-hour flight with the mission requirements for the entire flight specified in priority order before the launch. The development of a high-priority time-sensitive target may require that an RPV be diverted from an ongoing mission, or that an RPV be launched immediately if one is not in flight. In this latter case, additional mission requirements will likely be provided to produce a 2- to 3-hour flight.

The time required to identify a potential target from intelligence sources depends on the nature and timing of the intelligence information, and can be expected to vary from a few minutes to several hours. In REFORGER 78 [Ref. 6], for instance, it took about 12 minutes for the intelligence staff to evaluate moving target information from SOTAS and provide the resulting targets to the FSE.

The time required by the FSE to analyze and process a target provided by the intelligence staff averaged about 5 minutes in TACFIRE OT II [Ref. 7].

RPV MISSION DECISION

FSE

Target Analysis
RPV Mission Decision

G2/S2

Intelligence Production
Target Development

Sources

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RPV mission orders will be prepared by the controlling field artillery unit, probably by the FSE in coordination with the S-3. A proposed format for a mission order is included in the RPV O&O Concept. The order will specify the geographic areas to be covered, the desired time of coverage, and target priority. It will also provide the air corridor for RPV flight over friendly territory. Time will not normally be a critical factor in the preparation of the order for a 3-hour RPV flight. It will likely be prepared by the FSE, using the VFMED and the TACFIRE computer, and sent through TACFIRE to the S-3 for review and approval. It will then be transmitted to the GCS by FM voice-secure radio.

A mission order to divert an RPV from an ongoing mission to one of higher priority may be time sensitive and contain the minimum amount of information to give the new target location and desired RPV mission. Coordination between the FSE and S-3 will have taken place in the mission decision phase so that it can be transmitted to the GCS without delay.

No data are yet available on the time required to prepare and transmit RPV mission orders. However, a mission order for a 3-hour flight may be roughly analogous to a battalion counter battery fire plan, which in TACFIRE OT-II required about 40 minutes to prepare and transmit

for approval, 35 minutes to review and approve, and 20 minutes to transmit by voice to the battery. A mission order to divert an RPV to a higher priority target is roughly analogous to a request for fire, which in TACFIRE OT II required about 3 minutes to prepare and transmit.

Efficient RPV employment may require that the order for an ensuing mission be received while a mission is being conducted. It is unlikely that, with the present manning, an operator will be available to copy and verify the RPV mission order while a mission is under way. The GCS needs a capability to receive mission orders on a digital net and to automatically store them until they are needed. This would reduce the workload associated with the receipt of mission orders essentially to zero. The capability to enter them directly into the RPV computer would significantly enhance the mission planning process.

RPV MISSION ORDER

GCS

Receive
and
Verify

S3

Review
and
Approve

FSE

Prepare
and
Transmit

——— FM voice-secure
– – – FM digital

29
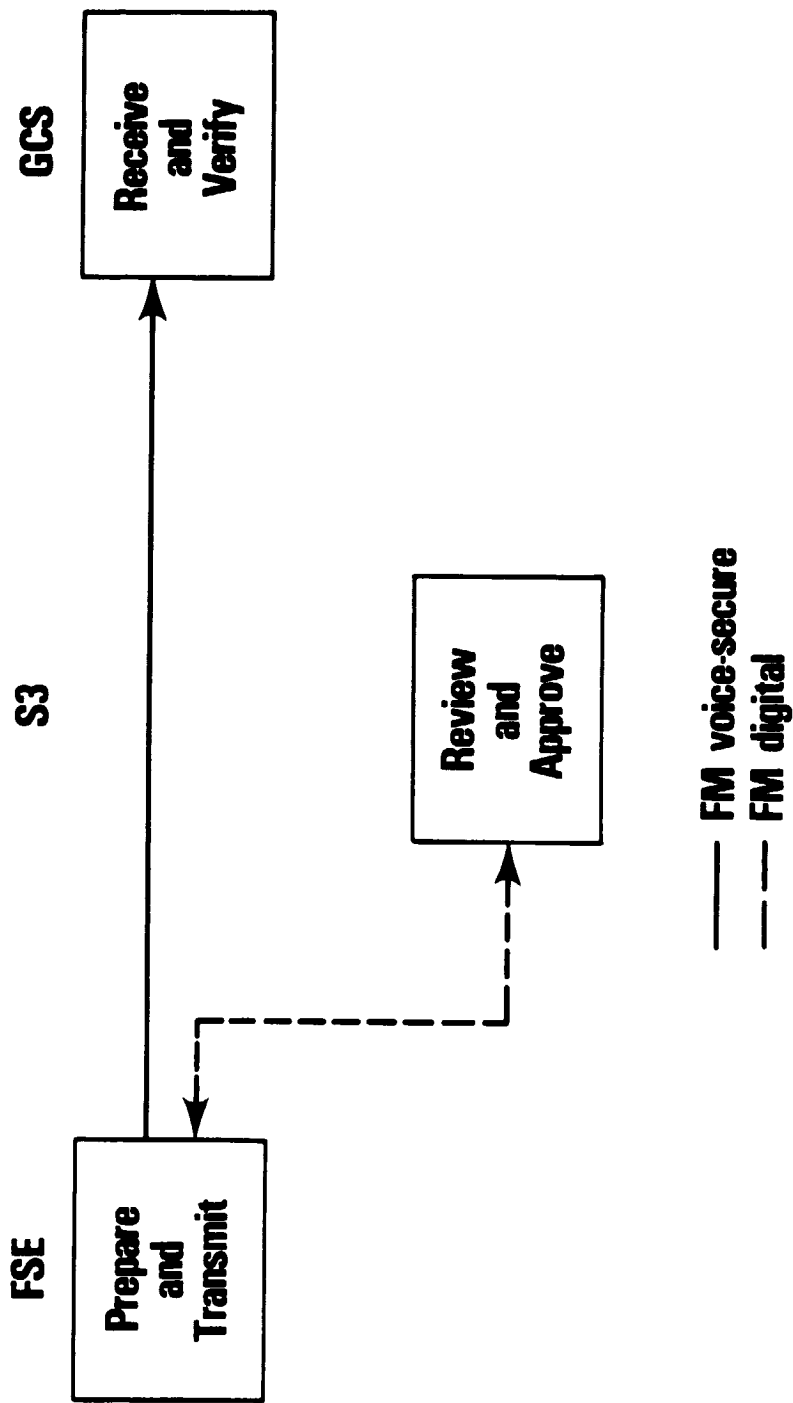
This chart shows the major steps in preparing an RPV mission plan. It is a manual process: the specified targets and the flight path are plotted on a 1:50,000-scale map; flight and sensor parameters are determined, using planning aids that will be developed as operational experience is gained; and the duration of the planned flight is determined by computing the flight time on each leg and at each loiter point of the flight path. Only when the mission commander is satisfied that the mission plan is complete is it entered into the computer via the teletypewriter and played back on the navigation display unit for verification. If errors or inconsistencies are found, they are resolved manually and the corrections are inserted into the computer.

As previously noted, data are not yet available on the time required to prepare a 3-hour flight plan; however, by analogy with TACFIRE OT II, it is estimated to require about 40 minutes.

The preparation of the mission plan to divert an RPV to a higher priority target is estimated to require about 3 minutes. The detailed mission plan will be prepared, verified, and transmitted to the RPV while the RPV is in transit to, or loitering near, the new target.

In a period of intense activity the mission plan for the next mission must be ready to load into the RPV waiting to be launched when recovery is completed on the previous one. The conduct of an RPV mission is likely to require the full time and attention of the mission commander. Planning for the next mission cannot start until the RPV is headed back for recovery. About 15 minutes will be available in which to complete and verify the plan.

The capability to receive the mission order on a digital net and to enter it electronically into the computer will ease the workload of the GCS operator. When the mission order is stored in the computer the mission planning process can be essentially automated by the addition of a map digitizer that is interactive with the computer and by computerizing the planning aids that are developed to assist in determining flight and sensor parameters.

RPV MISSION PLANNING

▲ Plot and annotate specified targets

▲ Plot waypoints and flight path

▲ Determine flight and sensor parameters

▲ Compute flight duration

▲ Enter flight plan into computer to verify

▲ Make corrections as necessary

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This chart shows the estimated times required to accomplish prelaunch activities for the current system compared with those for a system with computer-assisted message preparation and automated mission planning.

As mentioned earlier, the values shown for the current system are the times required to process a battalion counter battery fire plan in TACFIRE OT II and are estimated to be about the same as would be required for the RPV C^3 actions.

Giving the GCS the capability to receive the mission order on a digital net and to enter it electronically into the computer would reduce the GCS operator time associated with receipt of the mission order from 20 minutes to essentially zero. The automation of the mission-planning process is estimated to reduce the GCS operator time for this function by roughly 75 percent.

TIME LINES FOR RPV EMPLOYMENT
PRELAUNCH ACTIVITIES

ACTIVITY	TIME (MIN) CURRENT SYSTEM	TIME (MIN) ENHANCED CAPABILITY
RPV Mission Order Preparation and Approval	75	75
Transmission	20	1
RPV Mission Plan	40	10

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A number of possibilities exist for alleviating the workload associated with RPV mission planning. The previously mentioned map digitizer table allows the planning of a mission by placing the standard 1:50,000 military map on the table and tracing proposed routes with a "bug" that automatically feeds applicable data into the computer. Altitude data would still be entered manually.

A computerized terrain data base, which could be selectively displayed on a CRT, has potential and would eliminate separate entry of elevation data. However, such data are not available for all areas and require extensive storage.

The transparent electro luminescent displays offer possibilities, since they can be placed on top of a map and in turn used for tracing and entering flight routes. However, these units are not yet available at reasonable cost and size.

The 32- by 30-inch mission planning facility table within the GCS offers an attractive location for a map digitizer table.

ENHANCEMENT OF MISSION PLANNING PROCEDURES

▲ **Map digitizer table**
  - Available from commercial source
  - Accommodates standard 1:50,000 military map

▲ **Computerized digital terrain data base**
  - Not available for all potential areas of operation
  - Requires large storage capacity

▲ **Electro-luminescent transparent table**
  - Emerging technology with currently limited size

IV. C³ ACTIONS FOR MISSION EXECUTION

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The RPV system currently has the same C^3 capability to conduct a fire mission as a forward observer. The GCS has a DMD that permits it to communicate with TACFIRE and the Battery Computer System (BCS). The DMD has a limited message-handling capability and is preformatted to transmit and receive the short messages and signals necessary to a fire mission. The data for a GCS-originated message are extracted from the computer displays and entered manually into the DMD. When the message is ready for transmission, the GCS operator monitors the digital net with headphones to ensure that the net is clear of traffic when the message is transmitted.

The GCS, to initiate a fire mission, composes and transmits a fire request to TACFIRE. In conducting the fire mission, the GCS works with the BCS of the battery selected to provide fire. The GCS and the BCS do not normally operate in the same digital net; however, direct communications may be established by relay through the communications control unit (CCU) of TACFIRE. This relay capability is currently limited and may be overloaded in a period of intense activity. The proposed communications control system (CCS) will, when implemented, expand the current capability by a factor of four.

The GCS operator acts as a manual interface between the RPV computer and the DMD. In TACFIRE

OT II, forward observers, using an early version of the DMD, required an average of about 3 minutes to compose and transmit a fire request and about 1 minute to compose and transmit artillery adjustment data.

The GCS operator needs the capability to compose messages with assistance from the RPV computer. In addition to prompting on the message format, he should be able to incorporate data that exist in alphanumeric form in a computer display directly into the message and to rapidly enter his evaluation or observation from the video display. The message should be transferred electronically from the computer to a communications terminal for automatic transmission. This capability would permit the GCS operator to provide near-real-time data for conducting fire missions.

CONDUCT OF A FIRE MISSION

GCS	FDC (TACFIRE)	BATTERY (BATTERY COMPUTER SYSTEM)
Fire Request	Battery Selection	Message to Observer
Fire Command		Shot-Splash
Artillery Adjustment Data		
End of Mission		

Ten message formats are planned for information exchange across the TACFIRE/RPV interface. Although not yet finalized, the accompanying table illustrates one message format, namely an initial call for artillery fire. The occurrence category column identifies whether the entry is mandatory (M), conditional (C), or optional (O). Entries are generally designated conditional as a result of the type target, reporting source, or other factors.

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CALL FOR FIRE MESSAGE

SET IDENTIFIER	OCCURRENCE CATEGORY*	FIELD NO.	FIELD TITLE	ENTRY LENGTH†
MSGID	M			
	M	1	Message type	3A
	M	2	Originator	1-12X
TOM	O			
	M	1	Type of fire mission	2-4A
TNO	C			
	M	1	Fire support target number	6X
GRID	C			
	M	1	UTM 1-meter higher order easting	5-6N
	M	2	UTM 1-meter higher order northing	5-6N
	M	3	Altitude in meters	1-5X
	O	4	Earth hemisphere & grid zone designator	1-3X
DIR	O			
	C	1	Observer-target azimuth in mils	1-4N
	C	2	Gun-target line indicator	2A

SET IDENTIFIER	OCCURRENCE CATEGORY*	FIELD NO.	FIELD TITLE	ENTRY LENGTH†
TST	O			
	M	1	Target/unit type	3-6X
	O	2	Target/unit subtype	2-6X
	C	3	Degree of personnel protection	4-6A
	O	4	Number of target elements	1-4N
SIZ	O			
	M	1	Target/unit length in meters	1-4N
	O	2	Target/unit width in meters	1-4N
	C	3	Attitude in mils	1-4N
MOE	O			
	O	1	Type of adjustment	2-4A
	O	2	Type of trajectory	3-4A
MOC	O			
	M	1	Method of control	2-3A
	C	2	Time on target	5X
OBR	O			
	M	1	Observer number	1-3X

* M = Mandatory, O = Optional, C = Conditional
† A = Alphabetic, N = Numeric, X = Alphanumeric

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This chart shows the sets and fields that the RPV would normally enter as data for a typical fire mission. Up to 61 characters would have to be entered into the DMD. With a computer-to-computer interface the computer could be used to prompt the operator and to display all of the legal entries for each field. Some of the data, such as target coordinates, are already stored in the computer. Therefore, one entry into the computer could be the equivalent of entering numerous characters into the DMD. The 61 characters that would have to be entered into the DMD could be entered into the computer in 20 entries. While time might be saved in using the computer, an equally important factor is that the probability of making an error in entering the data, especially target coordinates, is greatly reduced.
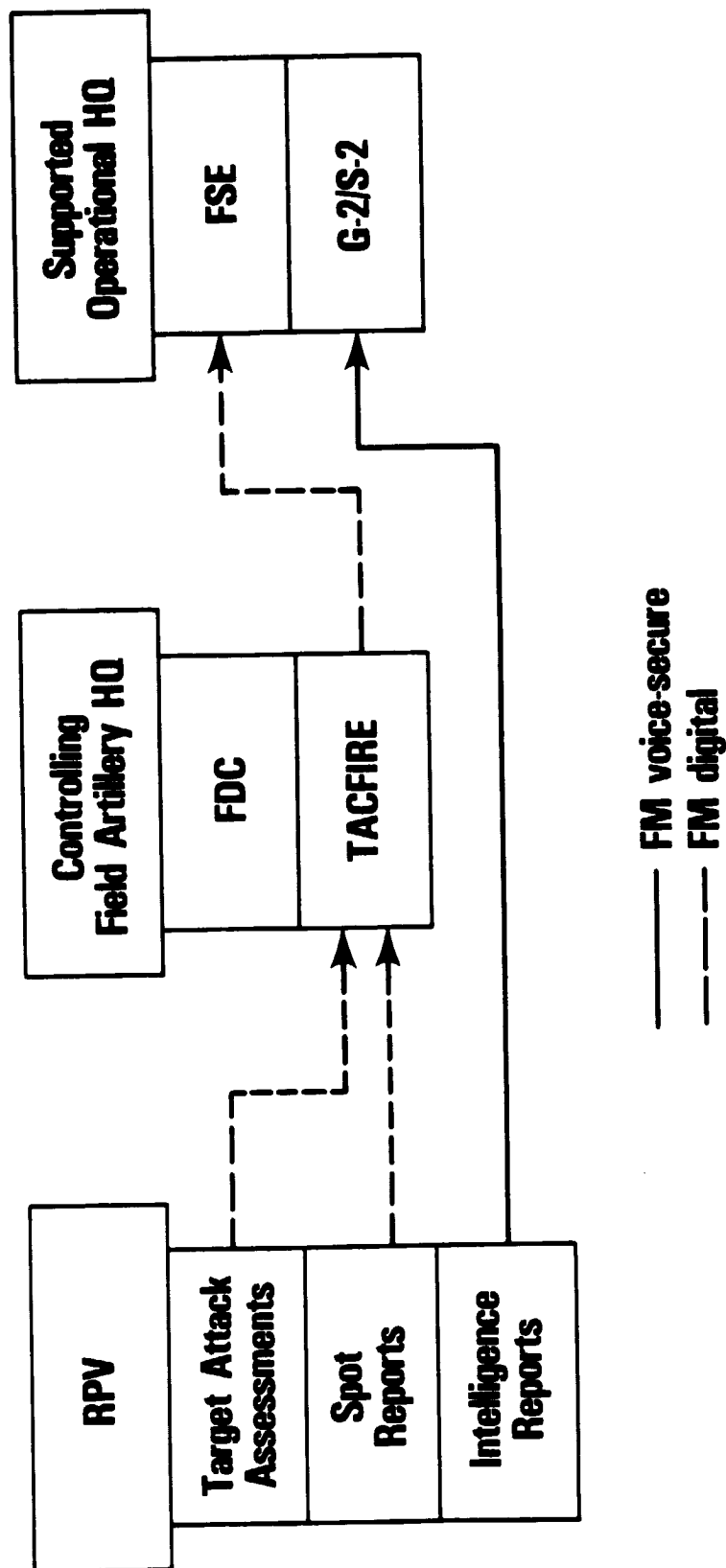
NORMAL RPV ENTRIES FOR CALL FOR FIRE

		CHARACTER ENTRIES	
SET IDENTIFIER	FIELD TITLE	DMD	COMPUTER
MSGID	Message type	3	1
	Originator	1-12	1
GRID	UTM 1-meter higher order Easting	5-6	1
	UTM 1-meter higher order Northing	5-8	1
	Altitude in meters	1-5	1
TST	Target/unit type	3-6	1
	Target/unit subtype	2-6	1
	Number of target elements	1-4	1-4
S12	Target/unit length in meters	1-4	1-4
	Target/unit width in meters	1-4	1-4
MOC	Method of control	2-3	1

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The primary reporting function of the GCS is to locate and identify potential artillery targets. Guidelines for this reporting will be provided in standard operating procedures and in RPV mission orders. These reports will be derived from sensor and computer displays, manually entered into the DMD, and transmitted through TACFIRE. The capability previously described to enhance the conduct of fire missions would also permit this reporting to be accomplished in a more timely manner with less consumption of operator time.

A collateral reporting function of the RPV is in support of the intelligence staff of the supported operational unit, since it may be the only system providing visual observation of selected areas behind enemy lines. These reports will be made by voice on the intelligence net of the supported operational headquarters. It has been suggested that in a target-rich environment the GCS operator will essentially keep an open microphone on the intelligence net describing what he sees as the RPV moves along its programmed flight path. It is unlikely that the net controller would allow the RPV to monopolize the net for a substantial period of time, but if the information is not transmitted as it is observed it may be lost.

The capability previously described for computer-assisted message preparation and automatic transmission would permit these intelligence reports to be composed and transmitted in a form that could be stored and recalled so that the intelligence information provided by the RPV would not be lost. These reports should go into intelligence channels such as those associated with the All-Source Analysis System, whose digital nets have not yet been identified.

RPV REPORTING

		RPV		Controlling Field Artillery HQ	Supported Operational HQ

RPV — Target Attack Assessments — Spot Reports — Intelligence Reports

Controlling Field Artillery HQ — FDC — TACFIRE

Supported Operational HQ — FSE — G-2/S-2

——— FM voice-secure
- - - FM digital

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This chart shows the estimated times required to decide that intelligence sources have found a high priority target that warrants immediate engagement, divert an RPV to the new target, and conduct an artillery adjustment mission.

These times have not been measured for the RPV system. Most of the times shown for the current system, FSE processing, mission order, mission plan, and conduct of fire mission are average times required to perform comparable functions in TACFIRE OT II. Observations during REFORGER 78 indicate that G-2/S-2 processing is unlikely to take less than 12 minutes. Time for transit to the new area and target acquisition is based on the assumption that the RPV is about 10 kilometers from the new target when it is diverted and the actual position of the target is close to the position provided by intelligence sources. It should be noted that when an RPV is diverted to a higher priority target the mission planning and transit to the new area could take place concurrently.

The capability to transfer data directly from the computer to a communications terminal and automatically effect transmission will reduce the time required by the GCS to accomplish its functions in the conduct of a fire mission. Reduction in the time to provide artillery adjustment data is especially important.

TIME LINES FOR RPV EMPLOYMENT
DIVERSION TO HIGHER PRIORITY TARGET

ACTION	TIME (MIN) CURRENT SYSTEM	TIME (MIN) ENHANCED CAPABILITY
Mission Decision		
G-1/S-2 Processing	≥12	≥12
FSE Processing,		
Decision to Use RPV	5	5
RPV Mission Order	3	2
RPV Mission Plan	3	2
Transit to Designated Area,		
Target Acquisition	4	4
Conduct of Fire Mission	3	2
Fire Request		
Select Battery,		
Compute Fire Mission	2	2
Lay and Fire	2	2
Time of Flight	1	1
Artillery Adjustment Data	1	<1
Compute Fire Data	1	1
Lay and Fire	1	1
Time of Flight	1	1

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V. SUMMARY

The communications currently planned for the RPV will not provide efficient support for the command and control function. The proposed use of voice communications to transmit mission orders and intelligence reports requires a GCS operator to spend large amounts of time transmitting or copying and verifying messages. The time required to exchange these messages and the workload in the GCS during periods of intense activity may cause the delay of subsequent missions or the loss of valuable intelligence information.

The automated computer-to-computer interface proposed in the TACFIRE-RPV Technical Interface Requirement (TIR) of July 1981, and an effective digital communications capability with the intelligence community, can provide the communications capability required to support the command and control function in a timely and effective manner and increase the time available to the GCS crew for RPV mission activities.

The proposed manual mission planning process requires a large amount of the mission commander's time and may reduce the effective employment of the RPV. In a period of intense activity the mission commander is likely to be completely occupied in the conduct of the ongoing mission and unable to start planning for the next mission until the airborne RPV is returning for recovery. He will then have about 15 minutes to prepare and

verify the plan before it must be loaded into the RPV to effect a launch at the desired time. The preparation and verification of a mission plan with the proposed manual process is estimated to require about 40 minutes.

The previously mentioned automated computer-to-computer interface with TACFIRE can provide for the automatic receipt of the mission order and storage in the RPV computer. The addition of a map digitizer that is interactive with the computer would permit the automated composition, verification, and measurement of the flight path. The automation of the mission planning process can significantly reduce the time required to prepare and verify a mission plan. This reduction is necessary to ensure the effective employment of the RPV system in a period of intense activity.

SUMMARY

▲ Effective digital communications capability required to:

  ● Improve performance of command and control actions

  ● Reduce workload on GCS operations

▲ Automated mission planning process required to ensure effective employment of RPV system

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