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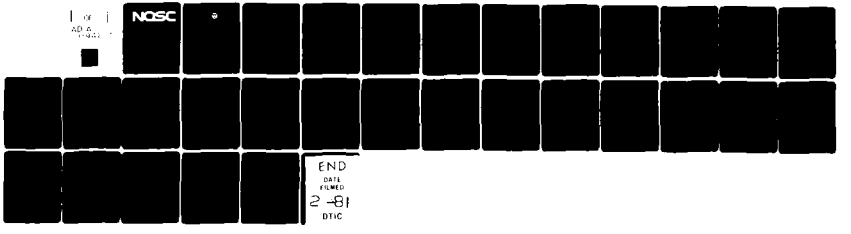

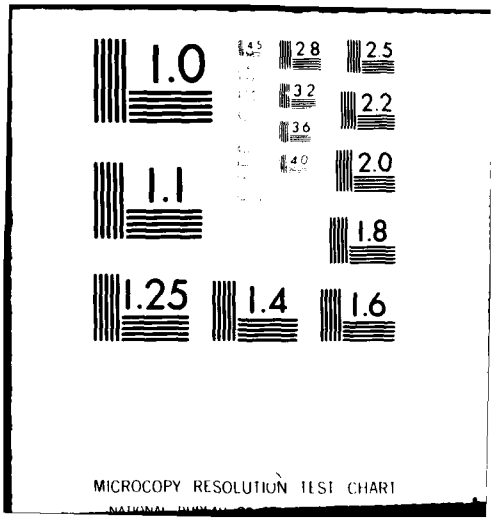
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(12) LEVEL II

NOSC TR 524

Technical Report 524

SOLID SHIELD '79 COMMON-USER DIAL COMMUNICATIONS

Application of Telephone Switchboard SB-3614(V)/TT aboard USS SHREVEPORT (LPD 12) for direct-dial ship-shore radio

EJ Reynolds

1 December 1980

Final Report for Period 10-21 May 1979

Prepared for
Naval Electronic Systems Command
PME 108-142

Approved for public release; distribution unlimited

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ADMINISTRATIVE INFORMATION

Work was performed under Program Element 28010N, Project X0700-CC, Task area X0700-CC (NOSC 831-CG45), by a member of the Systems Evaluation Branch (Code 8313) for Naval Electronic Systems Command, PME 108-142. This report covers work from 10 to 21 May 1979 and was approved for publication 1 December 1980.

Released by
SZ Mikhail, Head
C^3I Systems Engineering Division

Under authority of
VJ Monteleon, Head
Command, Control, Communications and Intelligence Systems Department

METRIC CONVERSION

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miles	km	~ 1.6

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NOSC Technical Report 524 (TR 524)

2. GOVT ACCESSION NO.: AD-A094217

3. RECIPIENT'S CATALOG NUMBER: (9)

4. TITLE (and Subtitle): SOLID SHIELD '79 COMMON-USER DIAL COMMUNICATIONS Application of Telephone Switchboard SB-3614(V)/TT aboard USS SHREVEPORT (LPD 12) for direct-dial ship-shore radio (6)

5. TYPE OF REPORT & PERIOD COVERED: Final rept., 10-21 May 1979

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): (10) E.J. Reynolds (12) 30

8. CONTRACT OR GRANT NUMBER(s): (17)

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Ocean Systems Center, San Diego CA 92152 (16)

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 28010N X0700 CC; X0700 CC (NOSC 831-CG45)

11. CONTROLLING OFFICE NAME AND ADDRESS: Naval Electronic Systems Command, PME 108-142 (11)

12. REPORT DATE: 1 December 1980

13. NUMBER OF PAGES: 28

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): (14) NOSC/TR-524

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Solid Shield '79
Telephone Switchboard SB-3614(V)/TT
Ship to shore
Trunks (communications)
Communication equipment
Operational effectiveness

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Observations were made of automated (direct-dial) ship-to-shore communications in connection with the Solid Shield '79 exercise of 10-21 May 1979. Various equipments were installed aboard USS SHREVEPORT (LPD 12) to form one AN/VCC-2 multichannel (MUX) radio rf trunk, on a common-user shared basis. This ship-board direct-dial/MUX radio system interfaced with one Marine Corps shore system, which provided access to the entire Solid Shield network. Full operational ship-shore trunking capability was available throughout the exercise.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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OBJECTIVE

Investigate the effectiveness of automated (direct-dial) ship-to-shore communications in connection with the Solid Shield '79 exercise of 10–21 May 1979 as the result of installing on USS SHREVEPORT (LPD 12) Telephone Switchboard SB-3614 (V)/TT and associated equipment. Observe operational ship-shore trunking capability throughout the exercise.

RESULTS

1. For the first time, a Navy task force commander employed direct-dial ship-shore communications to interoperate with other DoD direct-dial systems.

2. Direct-dial ship-shore and shore-ship operations were satisfactorily employed by Navy, Marine Corps, Army, and Air Force tactical commanders.

3. Telephone Switchboard SB-3614(V)/TT and Telegraph-Telephone Terminal Set AN/VCC-2 aboard USS SHREVEPORT operated continuously without failure during the entire exercise.

4. Although USS SHREVEPORT is equipped with three AN/VCC-2s, only one was used throughout the exercise. A second ship-shore trunk would have been advisable to accommodate peak direct-dial ship-shore traffic requirements and provide redundant ship-shore trunks.

5. The feasibility was demonstrated of using production model Keyer KY-65 in conjunction with the SB-3614(V)/TT–AN/VCC-2 system of USS SHREVEPORT and the Radio Terminal Set AN/MRC-135–Automatic Telephone Central Office AN/TTC-38 system of the Marine Corps' Force Service Support Group (FSSG) node, but interface problems were encountered that precluded full use of this crypto capability. Initial testing indicated that the production KY-65 is compatible with the AN/VCC-2 (ship) and the AN/MRC-135 (shore) multichannel radio terminal sets.

6. Four modifications to the AN/VCC-2 on USS SHREVEPORT resulted in full eight-channel operation of the AN/VCC-2 (ship) to AN/MRC-135 (shore) throughout the exercise. No adverse effects were encountered.

7. Although the antennas for the shore FSSG AN/MRC-135 were located in a swampy depression, normal direct-dial operations to USS SHREVEPORT were performed at ranges up to 45 miles before the MUX trunk was lost due to low radio-signal conditions. The ship-shore radio circuit was reestablished 2½ hours later from a range of 35 miles.

8. Although the NOSC investigations were not achieved during the exercise, two of the four prescribed tests were demonstrated. The inability to accomplish this investigative effort was more than offset by the positive demonstration of SB-3614(V)/TT operational utility.

RECOMMENDATIONS

1. Incorporate the four AN/VCC-2 modifications developed during the exercise into the AN/VCC-2s of major amphibious command ships as soon as possible.

2. Wire major amphibious command ships to allow "traveling kits" of SB-3614(V)/TTs and dial instruments to be used in high-priority applications, since portable (temporary)

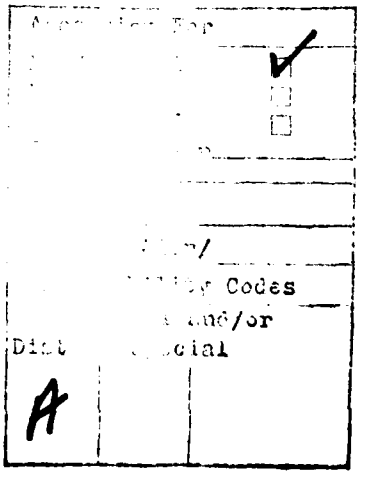
installation of the SB-3614(V)/TT is simple and expedient and will meet today's urgent shipboard requirements.

3. Immediately solve the interface problem between the KY-65 and the SB-3614(V)/TT so that the KY-65 can be used in key exercises.

4. Determine immediately whether or not the SB-3614(V)/TT is to be used aboard USS MT WHITNEY for Solid Shield '80. If it is, determine the specific sizing of the system and plan how the SB-3614 (V)/TTs are to be made available.

5. Accelerate NOSC effort to provide shipboard direct-dial hf and SATCOM capabilities to complement direct-dial short-range MUX radio capabilities.

CONTENTS



INTRODUCTION

This report summarizes one aspect of several interoperability studies currently underway at NOSC under NAVELEX PME 108-142 sponsorship (NOSC Project CG45). The studies encompass investigations of the interface problems that exist between the current (inventory) and future Naval Telecommunication System (NTS) and between current and future tactical (TRITAC) and long-haul strategic (DCS) telecommunication systems.

Documents that guided the NOSC studies include the following:

Naval Telecommunications Systems Architecture 1975–85

TT9, NAVY/TRITAC Interoperability Requirements, NAVSEC 6178C02, 22 September 1977

TTO-ENG-031-77, Architecture for Tactical Switched Communications Systems, TRITAC, December 1977

Landing Force Integrated Communications System Architecture, 1978–1990, USMC

MIL-STD-187-320, Long Haul Transmission Planning Standards for DCS, 14 November 1978

The specific study area summarized in this report concerns automated (direct-dial) ship-to-shore communications, specifically in connection with the Solid Shield '79 exercise of 10–21 May 1979. Limited observations are included of the results of equipping USS SHREVEPORT (LPD 12) with one 30-line Telephone Switchboard SB-3614(V)/TT, ten WECO-2500 touch-tone telephone handsets, and one production model Keyer KY-65. Eight SB-3614(V)/TT full-duplex voice circuits were combined to form one Telegraph-Telephone Terminal Set AN/VCC-2 multichannel MUX radio rf trunk, on a common-user shared basis. This shipboard direct-dial/MUX radio system interfaced with one Marine Corps shore system, which provided access to the entire Solid Shield Network. Thus automated (direct-dial) communications was available from USS SHREVEPORT NAVFOR (commodore's staff) to shore dial subscribers (Marine Corps, Army, and Air Force) and conversely from those shore dial subscribers to USS SHREVEPORT dial subscribers.

The initial application of the SB-3614(V)/TT was aboard USS BLUE RIDGE (LCC 19) during the October 1978 Okinawa US Marine Corps Exercise, MAFLEX 1-79. The feasibility of using the SB-3614(V)/TT in conjunction with the AN/VCC-2 was demonstrated, but several problems prevented the system from being of operational use. The shipboard and shore MUX radio deficiencies were corrected as preparation for Solid Shield '79 operations, thereby resulting in a full operational ship-shore trunking capability throughout this later exercise.

SOLID SHIELD '79 COMMON-USER COMMUNICATIONS NETWORK DESCRIPTION

The common-user or automatically switched (direct-dial) communication system employed for Solid Shield '79 is distinguished from dedicated communications systems such as Satellite Communications Set AN/WSC-3 (FLTSATCOM) in that the common-user network employs shared (pooled, demand-access) automatic switching systems, ie telephone centrals and switchboards.

Common-user dial communication systems provide varied capabilities. When fully employed, they will significantly reduce the reaction times for command and control operations now being performed by manually patched systems.

The Solid Shield common-user direct-dial network employed four different automatic switching systems in conjunction with wide-band multichannel radio (MUX radio) and troposcatter systems, to interconnect the major switch nodes (fig 1). Figure 2, a common-user trunking diagram for Solid Shield '79, shows the number of voice-frequency channels (in small circles) that each trunk accommodated for the exercise. The switching systems, listed in table 1, included telecentrals (AN/TTC-38) and switchboards (SB-3614(V)/TT) used by the Marine Corps Forces (MARFOR); telecentrals (WECO-400) used by the Army 11th Signal Group (ARFOR); a telecentral (AN/TTC-30) used by the Air Force (AFFOR); and a switchboard (SB-3614(V)/TT) used aboard USS SHREVEPORT by the Navy Afloat Forces (NAVFOR).

Each of the four-digit primary region and switch locator (PRSL) numbers within 12 of the large circles of figure 2 uniquely identifies each automatic telecentral and/or switchboard in the 12-node network. Individual shore and ship dial subscriber terminals are uniquely identified by three additional digits (xxx) immediately following the PRSL. For example, a II MAF subscriber is identified by 7263-xxx. When dialing within a PRSL, only xxx is required; whereas the full seven-digit dial address is required to call any other dial subscriber in the network.

Shore and USS SHREVEPORT dial subscribers that are associated with SB-3614(V)/TTs are required to dial a three-digit precursor when exiting their PRSLs. The AN/TTC-38 with which each SB-3614(V)/TT is associated (interconnected via cable or rf trunk) recognizes the initial three digits and returns a second dial tone to the SB-3614(V)/TT subscriber as notice that he can dial any other dial subscriber in the network. This PABX trunking was employed in conjunction with full-duplex DTMF confirmation signaling by the SB-3614(V)/TT system aboard USS SHREVEPORT.

The circles in figure 2 containing "K" represent nodes equipped with Keyer KY-65 and Joint Communications Support Element (JCSE) McDill AFB wire-line adaptors. This exercise marked the initial use of the production KY-65 in an operative system.

The internodal rf trunking employed to serve the figure 2 network is listed in table 2. The single-trunk, eight-channel AN/VCC-2 was used to trunk USS SHREVEPORT SB-3614(V)/TT voice traffic to shore and shore voice traffic to USS SHREVEPORT SB-3614(V)/TT (NAVFOR) subscribers. The AN/VCC-2 NAVFOR shore counterpart at 2nd FSSG was a jeep-mounted AN/MRC-135 that was supplied and operated by the Camp Lejeune 8th COMM BN.

The common-user trunking diagram (fig 2) shows the method used to accommodate direct-dial intersystem communications. Each line that interconnects two large circles represents one or more rf trunks, with rf trunking equipment as defined in table 2. The small encircled numbers associated with each interconnecting line represent how many analog voice frequency (VF) channels were active on each trunk. The seven VF channels between NAVFOR and 2nd FSSG and the single VF channel between NAVFOR and USFOR (noted with *) are associated with the one ship-shore MUX radio trunk between the AN/VCC-2 (ship) and the AN/MRC-135 (2nd FSSG). The single NAVFOR-to-USFOR VF circuit (dotted line) is distinguished from the seven between NAVFOR and 2nd FSSG in that

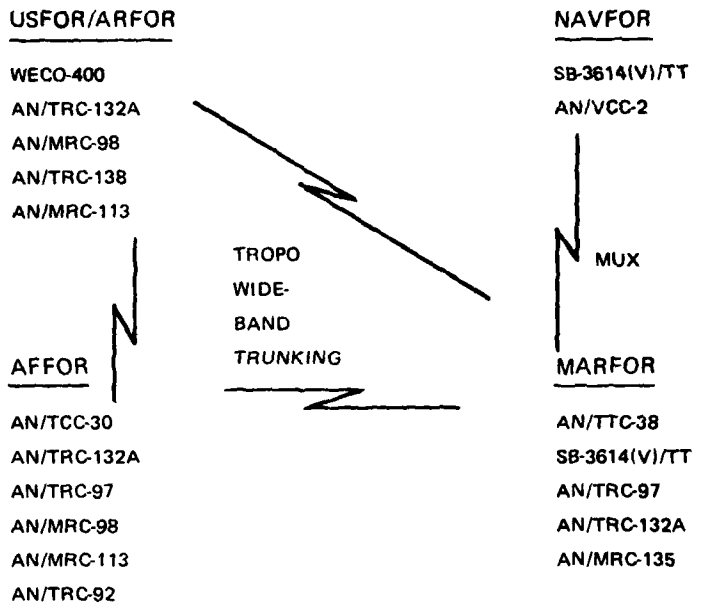


Figure 1. Solid Shield '79 common-user direct-dial rf trunking.

the former was dedicated (true "hot line"), whereas the latter were common-user circuits (sharable or demand access). Figure 3 provides additional detail on the trunking relationships between MARFOR, USFOR/ARFOR, AFFOR, and NAVFOR.

The USS SHREVEPORT NAVFOR direct-dial system is diagrammed in figure 4. Ten WECO-2500 touch-tone (DTMF) telephone sets were employed by NAVFOR (commodore and staff), and by other ship's communicators. The KY-65 was associated with the instrument entitled "flag sec comm." The SB-3614 (V)/TT was programmed to provide the J3-OPS instrument with priority to override one channel of the AN/VCC-2 automatically so as to provide a ship-shore circuit whenever the instrument went off-hook. The 2nd FSSG (shore) AN/TTC-38 was programmed to extend this priority to override a routine-priority FSSG subscriber and provide priority trunk service for the immediate connection of NAVFOR, MARFOR, and AFFOR command telephones. This resulted in a sharable or modified "hotline" capability between the tactical commanders.

To assure full eight-channel operation and optimum performance, the AN/VCC-2 (fig 4) for USS SHREVEPORT was equipped with four modifications* as follows:

> The receiver of Radio Receiver-Transmitter RT-524/VCC was modified to provide 40 kHz operation (eight-channel bandwidth).

*By Codalex Ltd, Montreal, Canada.

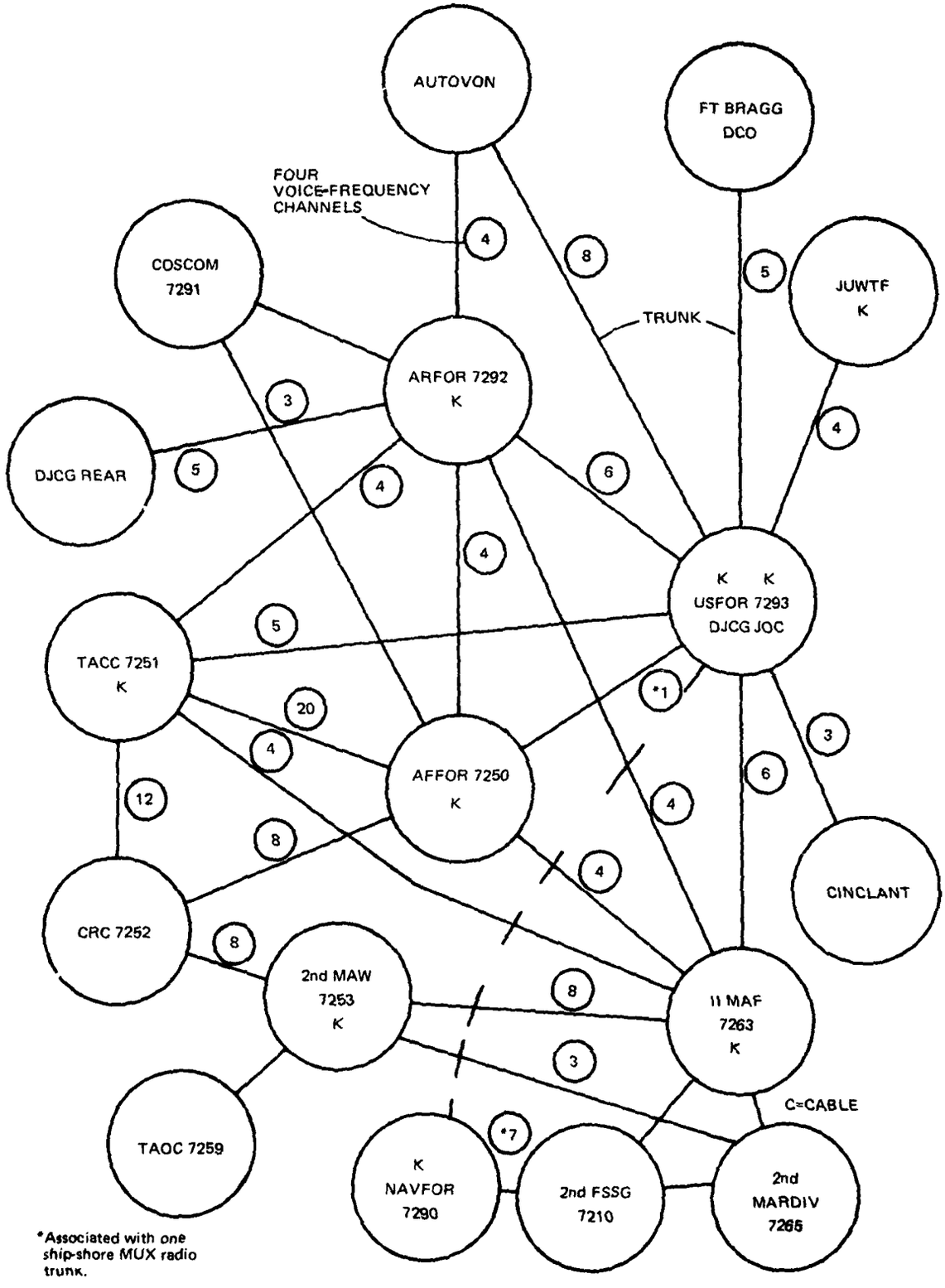


Figure 2. Solid Shield '79 common user trunking diagram.

Node	Switching System (Channels)	Location	Responsible Agency
II MAF	AN/TTC-38	Camp Lejeune	USMC 8th COMM BN
	SB-3614(V)/TT (90)	Camp Lejeune	USMC 8th COMM BN
2nd FSSG	AN/TTC-38	Camp Lejeune	USMC 8th COMM BN
	SB-3614(V)/TT (30)	Camp Lejeune	USMC 8th COMM BN
2nd MARDIV	AN/TTC-38	Camp Lejeune	2nd MARDIV
2nd MAW	AN/TTC-38	Cherry Point	2nd MAW
NAVFOR	SB-3614(V)/TT (30)	USS SHREVEPORT	NOSC
USFOR	WECO-400	Ft Bragg	USA, 11th Sig Gp
ARFOR	WECO-400	Ft Bragg	USA, 11th Sig Gp
AFFOR	AN/TTC-30	Shaw AFB	USAF
TACC	AN/TTC-30	Shaw AFB	USAF
CRC	AN/TTC-30	Atlantic CLF	USAF

Table 1. Solid Shield '79 automatic switching systems employed.

Radio-Frequency Equipment	Channels per Trunk	Number of Trunks	Nodes Served	Responsible Agency
AN/MRC-135 (MUX radio)	8	4	II MAF, 2nd MARDIV, 2nd FFSG to 2 MAW	USMC
AN/TRC-97 (tropo)	24	3	II MAF, 2nd MARDIV, 2nd FSSG to 2nd MAW	USMC
AN/VCC-2 AN/MRC-135 (MUX radio)	8	1	LPD 12 to 2nd FSSG	USN/USMC
AN/TRC-132A (tropo)	60	1	II MAF to Bragg rly	USA 11th Sig Gp
AN/TRC-132A (tropo)	60	1	Bragg rly to Shaw rly	USA 11th Sig Gp
AN/TRC-138 (LOS radio)	48	3	USFOR, JUWTFA, DTE to ARFOR	USA 11th Sig Gp
AN/TRC-138 (LOS radio)	48	1	USFOR to DTE	USA 11th Sig Gp
AN/MRC-113 (tropo)	60	1	Bragg rly to CRC	USAF Natl Gd
AN/MRC-98 (tropo)	60	1	Bragg rly to Shaw rly	USAF Natl Gd
AN/TRC-97A (tropo)	24	3	Shaw rly to AFFOR	USAF
AN/TRC-92 (tropo)	24	1	Shaw rly to TACC	USAF

Table 2. Solid Shield '79 wide-band rf trunking systems.

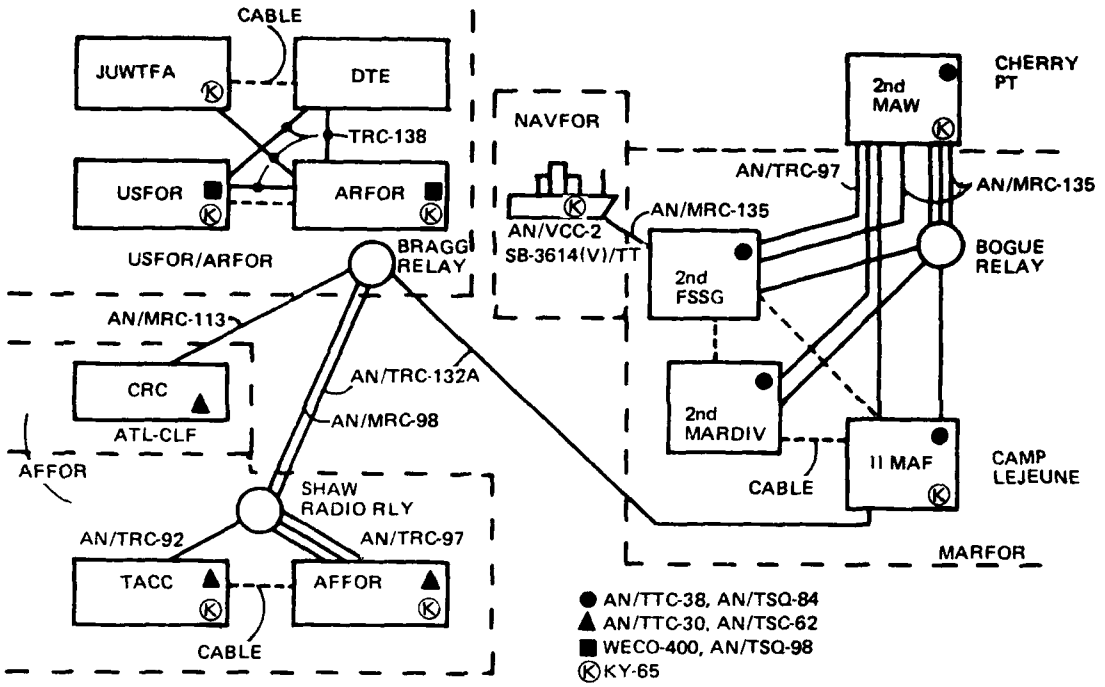


Figure 3. Solid Shield '79 common-user direct-dial communications.

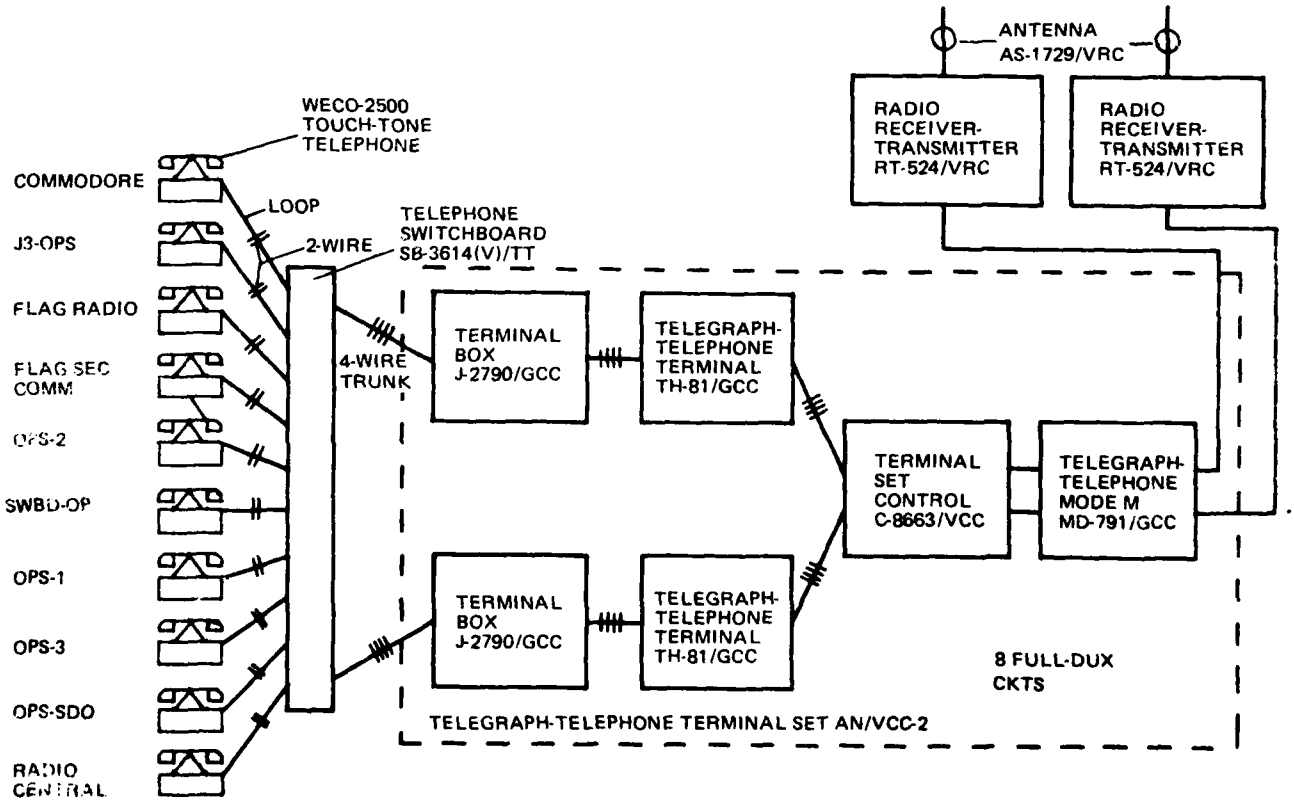


Figure 4. USS SHREVEPORT direct-dial multichannel radio system.

The transmit path of Terminal Set Control C-8663/VCC was equipped with a compensation network to assure linear operation over the eight transmit channels.

Telegraph-Telephone Modem MD-791/GCC was modified to include automatic constant modulation index for improved signal-to-noise operation at maximum ship-shore ranges.

The power supply was modified to include constant-current, low-voltage, short-circuit, and thermal-cutoff protection features.

Prior to the Solid Shield exercise, a preliminary MUX radio relay effort was supported by NOSC with the technical support of Codalex Ltd, Montreal, Canada. The 8th Communications Battalion, Camp Lejeune, provided the MUX and tropo systems for interconnecting the MARFOR nodes. The MUX radio relay was used for the first time in a full-scale operation and provided continual linkage of MARFOR and 2nd MAW nodes. The MUX rf relay was located (fig 3) at Bogue Field, which is located about midway between Camp Lejeune and Cherry Point.

TRAFFIC ACCOMMODATED BY SOLID SHIELD '79 AUTOMATIC SWITCHING NETWORK

Table 3 shows the total estimated number of narrow-band (3 kHz) analog nonsecure voice-traffic dial attempts registered by each automated switching system employed during the 8-day, 24-hour-per-day Solid Shield exercise. The number of call attempts registered includes the total local calls (calls within a switch node) plus the registered outgoing and incoming calls on all trunks of a switch.

The total number of call attempts registered by the three MARFOR AN/TTC-38 telecentrals is estimated at over 275 000; by the USFOR and ARFOR WECO-400s, over 270 000; by the three AFFOR AN/TTC-30 telecentrals, over 130 000; and by the NAVFOR SB-3614(V)/TT switchboard, over 4000.

The aggregate call total registered by all switching systems listed in table 3 is estimated at over 679 000.

The number of call attempts was limited by the shortened exercise that actually transpired. The estimates of table 3 probably would be higher by 10–25% had it been fully executed. Thus if a fully executed Solid Shield '79 exercise had transpired and if the common-user direct-dial network had been employed throughout the exercise, the aggregate call total registered by all switching systems might have reached 850 000.

NOSC EXPERIMENTS IN CONJUNCTION WITH SOLID SHIELD '79

Four direct-dial ship-shore experiments were designed in connection with NOSC interoperability studies, as follows:

MUX trunk loading

MUX channel preemption

Ship-shore preprogrammed conference

"Direct-dial modified hot-line" (DDMHL) or direct-access calling (DAC)

Switch Node	Switch System	Call Attempts, in thousands
II MAF	AN/TTC-38	100
2nd MARDIV	AN/TTC-38	80
2nd FSSG	AN/TTC-38	50
2nd MAW	AN/TTC-38	45
USFOR	WECO-400	160
ARFOR	WECO-400	110
AFFOR	AN/TTC-30	75
TACC	AN/TCC-30	40
CRC	AN/TTC-30	15
NAVFOR	SB-3614(V)/TT	4
Total		679

Table 3. Solid Shield '79 common-user dial call attempts (estimates).

Appendix B is the test procedure provided USS SHREVEPORT and 2nd FSSG switchboard operators. The experiments were designed to be accomplished on a not-to-interfere basis with exercise activities and to require minimum test instrumentation.

The goal of conducting the four tests at least six times in each 24-hour period was not accomplished. Trunk loading and MUX channel preemption tests were shown to be feasible, but systematic testing was not accomplished. The last two tests listed above were not undertaken.

Time to accomplish the four tests was sacrificed to permit investigation of the interface problems involved in integrating the production KY-65 equipment into the automatic switched network.

The DDMHL or DAC test, as conceived by the Joint Communications Support Element, McDill AFB, has been operationally successful on US Readiness Command exercises in which the KY-65 and AN/TCC-38 equipments were employed. DAC is provided to special touch-tone subscribers and consists of special software programming of AN/TTC-38 telecentrals to allow two-digit (priority) dial capabilities for high-level command purposes. The DAC capability allows the pooling of switched assets (ie switchboard and radio trunks) for all dial users as well as the use of the high-priority programming capability of the AN/TTC-38 in seizing a low-priority trunk when any DAC subscriber employs his special instrument. This service is instantaneously available to DAC subscribers.

Because the lack of precedence dialing in the WECO-400 switchboard precluded the use of DAC by WECO-400 subscribers, a true hot-line was provided between NAVFOR, MARFOR, USFOR, ARFOR, and AFFOR for Solid Shield '79.

Note that the DDMHL (DAC) capability has been employed in READCOM exercises where the WECO-400 and AN/TTC-38 are colocated.

In READCOM operations, DAC is accomplished as follows:

1. The WECO-400 is employed with the AN/TTC-38 in the same way that the SB-3614(V)/TT is used with the AN/TTC-38; ie, the WECO-400 and SB-3614(V)/TT are used as a dial exchange (PABX) or subordinate switch to the AN/TTC-38.

2. Before dialing the two DAC (hot-line) digits, WECO-400 PABX DAC subscribers must dial one initial digit to get a second dial tone from the AN/TTC-38 whereas SB-3614(V)/TT PABX DAC subscribers must dial three initial digits to get the second dial tone.

POTENTIAL APPLICATIONS OF DIRECT DIALING TO CURRENT C^3 NEEDS

Equipping major command ships at this time with direct-dial capabilities such as provided on USS SHREVEPORT for Solid Shield '79 would result in reducing the command and control reaction time between afloat, shore, and land forces. In the following examples of system applications, the shore systems have a common component that has been deployed in tactical field systems for several years: Automatic Telephone Central Office AN/TTC-38.

1. Amphibious command ships could interface with Marine Corps shore AN/TTC-38s. The need for this link has been documented in after-action reports; it was the basis on which NOSC outfitted USS BLUE RIDGE with the SB-3614(V)/TT and employed it in ship-shore MUX trunking experiments in October 1978 on the Marine Corps exercise MAFLEX 1-79. The feasibility of ship-shore direct-dial communication over MUX radio circuits was demonstrated during that exercise, but several problems precluded satisfactory operations. Those problems were subsequently corrected, and the shipboard SB-3614(V)/TT–AN/VCC-2 MUX radio system was used satisfactorily throughout the Solid Shield '79 exercise.

2. High-priority secure communications could be provided between afloat, shore, and air commanders. The Tactical Automatic Switching (TAS) system in use by the US Army, Europe, for example, contains 18 AN/TTC-38s, which are interconnected by wide-band trunked rf systems to comprise the most comprehensive known common-user tactical switched network. The TAS network is employed annually (Reforger operations) in a powerful architecture featuring tandem (relayed) switching, conferencing, four-level precedence dialing, and alternate routing for direct-dial common-user subscribers, broadly like the Solid Shield '79 network (explained in the next section). This is considered to be a potential direct-dial application for today's flag-configured ships. The basic direct-dial ship-shore features discussed for Solid Shield '79 apply to this application.

3. Afloat commanders could be provided with automatic (direct-dial) communications that will interoperate with the automated networks employed by the US Readiness Command (READCOM) during Brave Shield exercises. The automatic telecentrals employed in READCOM operations (AN/TTC-38, WECO-400, AN/TTC-30) are the same types as used in Solid Shield '79 and discussed herein. The direct-dial equipping of ships in READCOM operations is considered to be the most significant of these three applications.

These three direct-dial applications would satisfy real present needs of afloat commanders through a common engineering approach: the equipping of select ships with automated trunking interface capabilities that will allow direct-dial operations with shore systems employing AN/TTC-38s. These telecentrals are in wide use now and will remain so for some time. (Note: The dial signaling used by the SB-3614(V)/TT and the AN/TTC-38 is compatible with TRITAC digital switching systems now under development).

DIRECT-DIAL OPTIONS FOR FUTURE LARGE-SCALE AMPHIBIOUS COMMUNICATIONS EXERCISES

This section discusses several shipboard automatic switchboard and rf trunking options for consideration in future large communications exercises. It is assumed here that the afloat joint task force commander (AJTFC) will employ the types of communications assets installed on USS BLUE RIDGE (LCC 19).

Figure 5 shows a multinode network in which rf trunks and dial subscribers are in a common-user pool rather than in dedicated operations. The MUX radio, satellite, troposcatter, and hf trunks illustrated in figure 5 should therefore be considered as elements of a dial-signaling architecture of the type commonly employed in AN/TTC-38 networks today.

The USS BLUE RIDGE rf complex includes three 8-channel AN/VCC-2s, assorted hf gear, Satellite Communications Sets AN/WSC-2 through -6, and a WSC-3 fleet satellite system. The discussions in this section and the trunks illustrated in figure 5 assume that the SB-3614(V)/TT direct-dial capabilities will be employed, ie, full-duplex, four-wire trunks will be provided by each of these systems. Four examples of possible direct-dial systems will be discussed for possible use in ship-ship and ship-shore direct-dial use. Table 4 summarizes the dial and rf trunking options for three SB-3614(V)/TT ship configurations, as described in the following paragraphs.

System 1

One 30-line SB-3614(V)/TT is used. Ship-shore trunks include two 8-channel MUX radio shots between USS BLUE RIDGE and MARFOR, one 4-channel hf trunk connecting USS BLUE RIDGE, any of the three shore tactical commands (MARFOR, ARFOR, AFFOR), and NAVCOMSTA; and one 1-channel trunk via FLTSATCOM to the four land nodes shown in figure 5. Column 2 of the table summarizes the allocation of the 30-line (circuit) capability for a one-stack SB-3614(V)/TT.

Direct-Dial Circuit Types	Allocation of Direct-Dial Circuits				
	One SB-3614(V)/TT 30 Lines		Two SB-3614(V)/TTs 60 Lines		Three SB-3614(V)/TTs 90 Lines
	Column 1	Column 2	Column 3	Column 4	Column 5
Ship Dial Subscribers	22	9	34	24	52
Ship MUX Radio					
Trunks	1	2	2	3	3
Circuits	8	16	16	24	24
Ship hf Radio					
Trunks	0	1	2	2	2
Circuits	0	4	8	8	8
Ship Satellite Radio					
Trunks	0	1	1	2	2
Circuits	0	1	2	4	6

Table 4. Subscriber dial and rf trunking options for three SB-3614(V)/TT ship configurations.

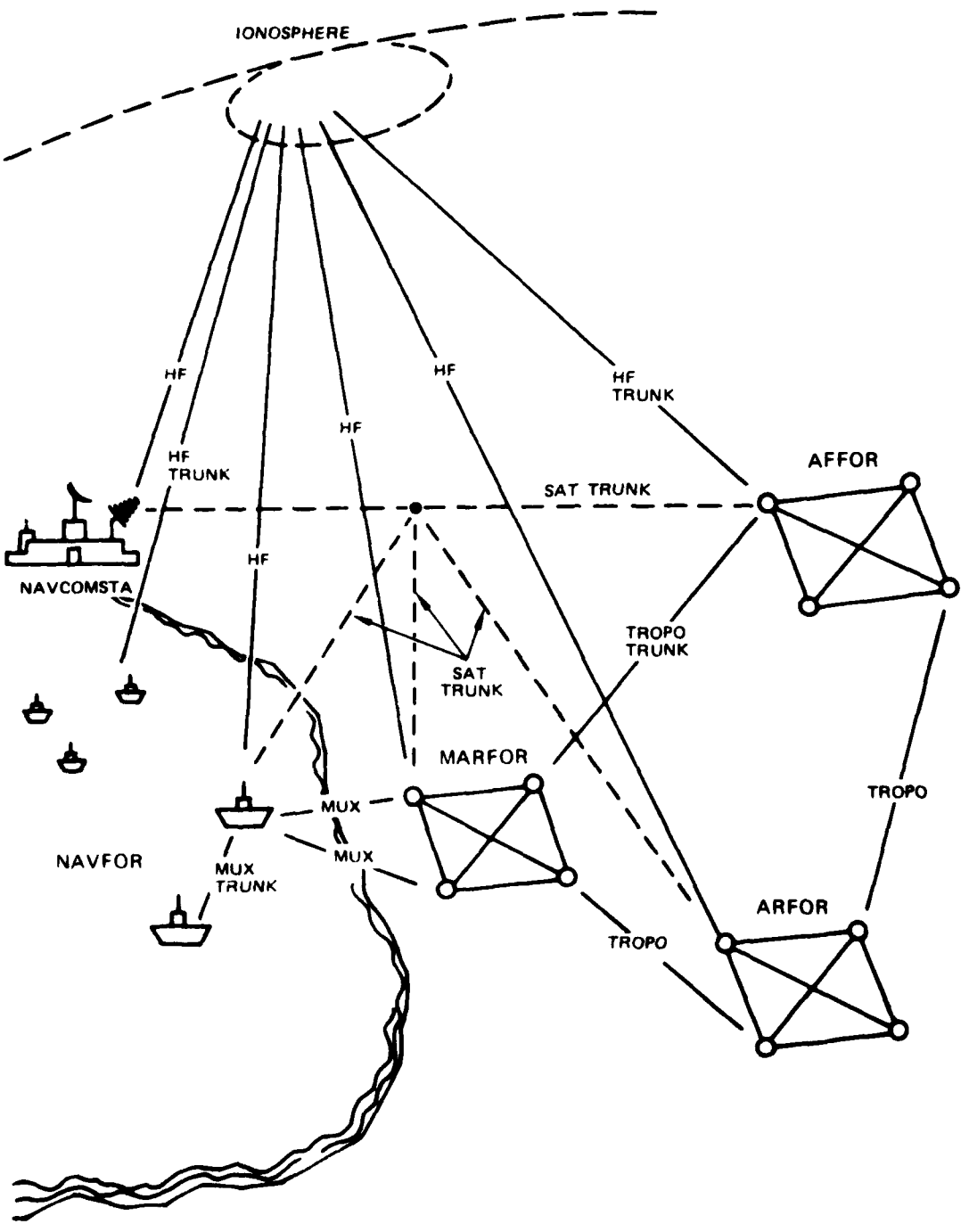


Figure 5. Direct-dial multitrunking concept.

(Note: Column 1 of the table presents the circuit allocation used aboard USS SHREVEPORT for Solid Shield '79 except that only 12 of the 22 available dial subscribers were activated.)

Assuming that the requirement exists for two MUX radio trunks, one hf trunk, and one SATCOM trunk, only nine dial instruments can be accommodated, which is probably insufficient for peak operating situations.

System 2

Two SB-3614(V)/TTs are used (column 3 of the table). Ship-shore rf capabilities include two 8-channel MUX radio trunks, two 4-channel hf trunks, and one 2-channel tactical SATCOM trunk. This trunking arrangement allows for a maximum of 34 off-ship dial instruments.

Perhaps the number of MUX radio trunks should be increased to allow for greater off-ship trunking flexibility. Increasing the trunks would decrease the number of dial subscribers (34), which may be excessive anyway.

System 3

Column 4 of the table addresses the problems of system 2. This third system approach employs two SB-3614(V)/TTs in a 60-line system. Provisions are made for three 8-channel MUX radio trunks, two 4-channel hf trunks, and two 2-channel tactical SATCOM trunks.

The three MUX radio trunks employ all three USS BLUE RIDGE AN/VCC-2s. Allocation of the trunks could be to three separate shore nodes if it is considered that maximum MUX trunking reliability is required during peak dialing periods. Or (see fig 5) if direct-dial ship-ship operation is required (one trunk), two ship-shore shots would then be available.

The 24 subscriber circuits available for off-ship dialing could be exceeded if all 24 MUX channels plus all 8 hf channels plus all 4 satellite channels (total 36) were required simultaneously. If the dial network priority capabilities are used, however, it is highly unlikely that all 36 on-board instruments would be required on an urgent basis. Thus this system could be the optimum one for the AJTFC.

System 4

This last example, for possible future AJTFC use aboard USS BLUE RIDGE or similar ships, uses three SB-3614(V)/TTs in a stacked configuration. The apportionment of this 90-line switchboard (column 5 of the table) differs from system 3 in two respects: it has six satellite channels (two more than system 3) and 52 subscribers (28 more than system 3). This excessive number of dial subscribers (52) has been provided to emphasize that the 90-line system can be outfitted to provide a maximum of 52 off-ship dial circuits. Or the system can be outfitted for 24 off-ship direct-dial instruments and 28 restricted on-ship dial instruments.

This 90-line system, using three SB-3614(V)/TTs, is considered sufficient to meet the peak planning requirements for the AJTFC. It is introduced should the requirement include a high ship-shore and a small ship-ship direct-dial requirement.

In summary, four candidate direct-dial multitrunk ship systems are introduced as study vehicles for consideration by future Solid Shield Navy communicators. The study includes the use of the SB-3614(V)/TT in conjunction with USS BLUE RIDGE rf trunking equipment. The four candidate systems are considered to bridge the gap from inadequate to excessive capability. Inventory assets are used in each candidate system. The SB-3614(V)/TT is used since it is in the DoD supply system, it has proven reliable, and its dial signaling is directly compatible with its shore counterpart, the AN/TTC-38, which is the mainstay of Marine Corps amphibious communications. The SB-3614(V)/TT was employed successfully in Solid Shield '79 and it can be expected to be of greater value to the AJTFC in future Solid Shield operations requiring direct-dial capabilities.

CONCLUSIONS

1. Solid Shield '79 was the first instance in which a Navy task force commander employed direct-dial ship-shore communications to interoperate with other DoD direct-dial systems.

2. Direct-dial ship-shore and shore-ship operations were satisfactorily employed by Navy, Marine Corps, Army, and Air Force tactical commanders.

3. Telephone Switchboard SB-3614(V)/TT and Telegraph-Telephone Terminal Set AN/VCC-2 aboard USS SHREVEPORT (LPD 12) operated continuously without failure during the entire Solid Shield '79 exercise.

4. USS SHREVEPORT is equipped with three AN/VCC-2s, but only one was used throughout the exercise. A second ship-shore trunk would have been advisable to accommodate peak direct-dial ship-shore traffic requirements and provide redundant ship-shore trunks.

5. Feasibility of using production model Keyer KY-65 in conjunction with the USS SHREVEPORT system (SB-3614(V)/TT AN/VCC-2) and the Marine Corps FSSG node system (Radio Terminal Set AN/MRC-135—Automatic Telephone Central Office AN/TTC-38) was demonstrated, but interface problems were encountered that precluded full use of this crypto capability. Initial testing indicated that the KY-65 is compatible with the AN/VCC-2 and the AN/MRC-135.

6. Four modifications to the USS SHREVEPORT AN/VCC-2 resulted in full eight-channel operation of the AN/VCC-2 (ship) to AN/MRC-135 (shore) throughout the exercise. No adverse effects were encountered.

7. Although the antennas for the shore FSSG AN/MRC-135 were located in a swampy depression, normal direct-dial operations to USS SHREVEPORT were performed at ranges up to 45 miles before the MUX trunk was lost due to low radio signal conditions. The ship-shore radio circuit was reestablished 2½ hours later at a range of 35 miles.

8. Although the NOSC investigations were not achieved during the exercise, two of the four prescribed tests were demonstrated. The inability to accomplish this investigative effort was more than offset by the demonstrated operational utility of the SB-3614(V)/TT.

RECOMMENDATIONS

1. Implement the four modifications of the Telegraph-Telephone Terminal Sets AN/VCC-2 of major amphibious command ships as soon as possible.

2. Wire major amphibious command ships to allow the use of "traveling kits" of Telephone Switchboards SB-3614(V)/TT and dial instruments in high-priority applications,

since portable (temporary) installation of the SB-3614(V)/TT is simple and expedient and will meet today's urgent shipboard requirements.

3. Immediately determine a solution to the interface problem between the KY-65 and the SB-3614(V)/TT and employ the KY-65s in key exercises.

4. Immediately determine whether or not the SB-3614(V)/TT is to be used aboard USS MT WHITNEY for Solid Shield '80. If it is, determine the specific sizing of the system and how the SB-3614(V)/TTs are to be made available.

5. Accelerate NOSC effort to provide shipboard direct-dial hf and SATCOM capabilities to complement direct-dial short-range MUX radio capabilities.

APPENDIX A: EXCERPTS FROM USFOR TELEPHONE DIRECTORY

TABLE OF CONTENTS

DIALING INSTRUCTION MATRIX

FROM \ TO	USFOR	ARFOR	NAVFOR	AFFOR	MARFOR	COSCOM	FT BRAGG
USFOR	DIRECT	9-XXX	5-7290-XXX	161-50-XXX	5-XXX	9-16-XXX	444-OPERATOR
ARFOR	9-XXX	DIRECT	7-7290-XXX	155-50-XXX	7-XXX	6-XXX	9-444-OPERATOR
NAVFOR	901-7293-XXX	901-7292-XXX	XXX	901-7250-XXX	901-7230-XXX	901-7291-XXX	OPERATOR ASSIST.
AFFOR	310-XXX	320-XXX	7290-XXX	DIRECT	7263-XXX	7291-XXX	310-444-OPERATOR
MARFOR	7293-XXX	7292-XXX	7290-XXX	7250-XXX	DIRECT	7291-XXX	5-63-444-OPERATOR
COSCOM	7291-800 THEN OPER. ASST.	7291-800 THEN OPER. ASST.	7290-XXX	7250-XXX	7263-XXX	DIRECT	7291-800 OPER. ASST.

NOTE: THE FORT BRAGG OPERATOR CAN REACH THE FOLLOWING SWITCHBOARDS AT THEIR RESPECTIVE NUMBERS: USFOR-MAG 3, 5, 6, 12 or 25; ARFOR-MAG 183, 130, 133, 134, 135 or 141; COSCOM-MAG 81, 89, 90 or 101

APPENDIX B: PROPOSED TEST PROCEDURES FOR DIRECT-DIAL SHIP-SHORE VOICE COMMUNICATIONS

1. The following are NOSC-831 suggested tests and are to be accomplished on a NIB with on-going operations. Decision to perform individual direct-dial (DD) tests is subject to approval of participants required to perform them. Test participants include personnel and comm assets of ship multi-channel (MUX) Radio and SB-3614 automatic (direct-dial) switchboard, (referred to herein as ship MUX/DD switchboard); and its immediate shore trunking interface (referred to herein as shore MUX/DD switch). The major ship MUX/DD system items include VCC-2 MUX radio and SB-3614 swbd; the major shore MUX/DD system items include the MRC-135 MUX radio, AN/TTC-38 swbd (automated telecontrol) and AN/TSQ-84 tech control.

2. The overall test objectives are to test the ship-shore trunking capability, employing the varied DD capabilities available.

3. Trunk loading test procedure.

a. Ship subscriber "1" dial shore subscriber "1." Ship subscriber "2" dial shore subscriber "2." Continue procedure until all MUX trunks are engaged. Ship and shore swbd and shore tech con monitor procedures and record following (see data sheet):

(1) Noise (dB) readings for each channel.

(2) Circuit quality (judgement by swbd/tech con operators). Employ code QE (excellent quality), QA (average quality), QP (poor quality).

(3) Audio level (judgement), using ALS (strong level), ALM (medium level), ALL (low level) and ALO (no audio).

(4) Shore swbd printout of subscribers, identifying each.

(5) Event number, date, and time are to be recorded.

4. MUX channel preemption test procedure. The purpose of this test is to demonstrate preemption of subscribers class marked routine by priority subscribers, when all ship-shore MUX channels are busy. The procedure of para 3, above, is used with an additional priority subscriber (ship or shore) dialing his counterpart (shore or ship). Ship and shore operators monitor test and note satisfactory (PREMP-S) or unsatisfactory (PREMP-U). Items 4 and 5, para 3 above, repeated.

5. Ship-shore conference test. Two ship and two shore subscribers shall be provided abbreviated dial conference call-up capabilities via ship and shore DD comm assets. For ship initiated conference, swbd operator assembles ship subscribers and release to shore swbd operator to complete assembly process. Shore initiated automated conferencing is to be provided each shore conference subscriber, along with abbreviated dial capabilities. Ship and shore swbd operators are to monitor conference and record "Q" and "AL" observations. Items 4 and 5, para 3 above, repeated.

6. Single subscriber direct-dial Hot-Line priority test procedures. This technique is also referred to as "Direct Access Calling" (DAC). Ship and shore switches shall be programmed to provide one ship and two shore terminals with DAC capabilities. Each ship or shore DAC subscriber shall be programmed to allow immediate access to any other DAC member with no more than four touch-tone dial operations. This is a single-call [illegible]

single-subscriber only test. "Q" and "AL" observations shall be provided to respective swbd operators by DAC users. Item 4 and 5, para 3 above, repeated.

7. A minimum of six tests each 24 hours is desirable. Tests should be accomplished concurrently in minimum time. Each set of test data is identified by successive event numbers and date/time recording. A sample data collection sheet is attached (exhibit B1).

CH NR	TIME _____ EVENT _____	TIME _____ EVENT _____	TIME _____ EVENT _____	TIME _____ EVENT _____	TIME _____ EVENT _____
1					
2					
3					
4					
5					
6					
7					
8					

DAY NR _____

Exhibit B1. Direct-dial phone data sheet.

GLOSSARY

AFB--Air Force Base
AFFOR--Air Force Forces
AJTFC--Afloat Joint Task Force Commander
AN/FTA-28--Telephone Terminal
AN/GRA-39--Radio Set Control Group
AN/MRC-98--Radio Set
AN/MRC-113--Radio Set
AN/MRC-135--Radio Terminal Set
AN/PRC-75--Radio Set
AN/PRC-77--Radio Set
AN/TRC-92--Radio Set
AN/TRC-97, -97A--Radio Set
AN/TRC-132A--Radio Terminal Set
AN/TRC-138--Radio Repeater Set
AN/TSC-15--Radio Teletypewriter Set
AN/TSC-62--Communications Central
AN/TSQ-84--Communication Technical Control Center
AN/TSQ-98--Control-Monitor Set
AN/TTC-30--Electronic Telephone Central Office
AN/TTC-38--Automatic Telephone Central Office
AN/VCC-2--Telegraph-Telephone Terminal Set
AN/WSC-1--Radio Set
AN/WSC-2 through -7--Satellite Communications Set
ARFOR--Army Forces
AS-1729/VRC, ( )/VRC--Antenna
ASRT--Air Support Radar Team
C-8663/VCC--Terminal Set Control
C^3--Command, control, and communications
CEO--Communications-Electronics Officer
CG--Commanding General
CINCLANT--Commander-in-Chief US Atlantic Fleet
CLF--Commander Landing Force
COMM BN--Communications Battalion
COMMSTA--Communication Station
COMNAVSURFLANT--Commander Naval Surface Fleet Atlantic
COMSERVRON--Commander Service Squadron
COSCOM--Corps Support Command
CRC--Control and Reporting Center
DAC--Direct-access calling
DASC--Direct Air Support Center
DCO--Dial Central Office
DCS--Defense Communications System
DD--Direct-dial
DIMHEL--Direct-dial modified hot line
DIV--Division
DTE--Data terminal equipment

GLOSSARY (cont)

DTMF - Dual-tone multifrequency
DUX - Duplex
EOW - Engineering order wire
FDUX - Full duplex
FLTSATCOM—Fleet satellite communications
FSSG - Force Service Support Group
J-2790/GCC - Terminal Box
JCSE - Joint Communications Support Element
JOC - Joint Operations Center
JUWTF - Joint Unconventional Warfare Task Force
JUWTFA - Joint Unconventional Warfare Task Force Atlantic
KY-65 - Keyer
LCC - Amphibious Command Ship
LOS - Line of sight
MAF - Marine Amphibious Force
MAFLEX - Marine Amphibious Force landing exercise
MAG - Marine Air Group
MARDIV - Marine Division
MARFOR - Marine Corps Forces
MASS - Marine Air Support Squadron
MAW - Marine Aircraft Wing
MCDEC - Marine Corps Development and Education Command
MD-791/GCC - Telegraph-Telephone Modem
MOTU - Mobile Technical Unit
MUX - Multiplex
MWCS - Marine Wing Communication Squadron
NAVCOMSTA - Naval Communications Station
NAVFOR - Navy forces
NIB - Noninterference basis
NTS - Naval Telecommunication System
PABX - Private automatic branch exchange
PRSL - Primary region and switch locator
READCOM - US Readiness Command
Rly - Relay
RT-524/VRC - Radio Receiver-Transmitter
RWI - Radio-wire integration
SAC - Strategic Air Command
SATCOM - Satellite communication
SB-3614(V)/TT - Telephone Switchboard
SF - Single frequency
SYSCON - Systems control
TA-838 - Telephone Set
TACC - Tactical Air Command Center
TAOC - Tactical Air Operations Center
TAS - Tactical Automatic Switching

GLOSSARY (cont.)

TH-81/GCC, -85/GCC—Telegraph-Telephone Terminal
TRITAC—US Joint Tactical Communications Program
Tropo—Troposphere, tropospheric
TTY—Teletypewriter
USA—United States Army
USAF—United States Air Force
USFOR—United States Forces
USMC—United States Marine Corps
USN—United States Navy
VF—Voice frequency
VOX—Voice operated transmitter keyer
WD-1/TT—Wire
WD-1A/TT—Telephone cable
WECO-400—Telecentral (non-GFE)
WECO-2500—Touch-tone telephone (non-GFE)

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