Study of U.S. and ROK Bilateral C³ Interoperability

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Abstract

Background/Objectives: In order to facilitate bilateral command, control and communication (C³) planning and coordination between the Republic of Korea (ROK) and the United States (U.S.), we studied command and control interoperability of two countries. Methods/Statistical Analysis: Survivability of C³ facilities, continued operational capability of ADP (Automated Data Processing) support and reconstitution of the U.S. and ROK telecommunications network are addressed in Phase 1 study. The Phase 1 study team identified the principal combined, U.S. and ROK C² facilities that house the interfacing C² organizations and the telecommunications networks that link the C² facilities. Findings: The survivability of the theater-level combined U.S. and ROK C² facilities, the capability for continued operation of the C² ADP systems and the U.S. Defense Communications System (DCS) transmission network in Korea that supports inter-facility communications are studied in this report. Improvements/Applications: From this Phase I study, we found that operations of a transportable Alternate Command Post (Alt. CP) need to be fully practiced to ensure the ability of exercising command and control under degraded situation.

Keywords: ADP Support, Bilateral Interface, System Interfaces, Telecommunications Networks, Theater-Level Operations

1. Introduction

It is the key to managing the battlespace and exploiting information superiority as enablers of all other operational and support missions. C³ provides the commander a significant capability to shape the battle space and impose his/her will directly on the enemy. Effective C³ assures situational awareness and provides the ability to control terrestrial, aerospace and missile forces at all levels of command. It focuses on getting the right information to the right users at the right time. C³ technology encompasses the capability to acquire, process and disseminate information across force elements. Interoperability assessment in the Phase 1 study centered on identifying modern tactical radios and associated digital information links, secure communications (COMSEC) equipment and Identification Friend or Foe (IFF) systems applicable to each bilateral operational interface and key operational and technical considerations for achieving ROK/U.S. interoperability of these systems. This Phase 1 study focuses on theater- and tactical-level automated Command and Control (C³) information management systems and theater-level command facilities and communications support. ADP systems investigated in the study are those that directly support operational C³ functions, including selected intelligence information management systems that support the major combined commands.

The survivability assessment in this study focuses on the physical survivability of C² facilities, the capability of the C² ADP systems to continue operation in a degraded environment and the sufficiency of inter-facility communications connectivity. The interoperability assessment focuses primarily on determining the most important interfaces potentially needed between the C² ADP systems and the corresponding level of the automated interface capability. The two aspects of the assessment are intertwined: C³ interoperability cannot be fully assessed without considering survivability needs of the facilities, systems and inter-facility communications. Survivability is one of the major driving needs for interoperability; interoperability, on the other hand, can enhance survivability.

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Figure 1 illustrates the Phase 1 study approach. Based on the bilateral operational interface need lines in the Phase 1 report, the study team identified the principal combined, U.S. and ROK C2 facilities that house the interfacing C2 organizations, and the telecommunications networks that link the C2 facilities. This was followed by survivability and interoperability assessments, as appropriate, of the C2 facilities and C3 support systems.

**Figure 1. Phase 1 study approach.**

## 2. Automated C2 Information Systems

### 2.1 Selected Improvement Options - Survivability

Prior to the 1980s, most of the information management tasks for operational C2 in the Korean theater were accomplished with slow and cumbersome manual methods. A number of C2 ADP systems have since been fielded, mainly at the theater-level combined commands and for combined tactical air operations. Physical survivability of ADP systems has been considered in that the systems are placed within hardened facilities where possible. However, most of the major systems have a high nodal dependency; damage to the central system or destruction of communications outlets for the central system’s facility could significantly degrade or incapacitate the operation of the central and remote systems. Further, plans for ensuring data communications linking the central and remote systems physically located at different facilities have not yet been completed or implemented in sufficient detail. Depending on the systems and functional activities involved, automated support is provided by the current systems range from sophisticated real-time air surveillance and control to routine office automation such as word processing and file maintenance. Most of the on-going initiatives involve modernizing the hardware and improving applications software to enhance the operational capability and efficiency of the existing systems. Further benefits can be obtained by improving the interaction, information exchange and systematic database management of existing and emerging ADP systems.

The Phase 1 report suggested the need for a bilateral operational concept for continuing tactical air operations with in-country and U.S. reinforcement forces. An overall bilateral operations concept needs to be fully developed and established concerning the relative roles and interactions of the U.S. reinforcement forces and supporting systems in backing up or reconstituting the key in-country capability when necessary. We developed a data communications support plan for inter-facility connectivity between the Theater Automated Command and Control Information Management System (TACCIMS) central nodes and remote user nodes.

TACCIMS can potentially become one of the most important C2 ADP systems in the Korean theater because the system directly supports Commander in Chief of Combined Forces Command in overall operational C2 and because TACCIMS remote workstations will be available at almost all the major theater-level combined, ROK and U.S. command facilities. A specific communications support plan for connectivity from the user nodes to the primary and alternate central codes needs to be fully developed. In particular, data communications to and from the Alternate CP (Command Post) when it is operating in field locations away from major command facilities need to be planned for and exercised. There is a requirement for dual connectivity, as a redundancy measure, between components such as central processors, workstations and remote terminals of a C2 ADP system that are in different facilities. In some cases, communications cables of different transmission networks such as U.S. DCS (Defense Communications System) and ROK Korean Telecommunications Agency (KTA) network are reportedly located in the same cable duct. In such a situation the same hostile action can disable both connectivity simultaneously. All of the major theater-level systems have a high nodal concentration in terms of database maintenance and communications connectivity. Destruction of or damage to, a central node could severely degrade the operational capability of the entire system. A certain degree of graceful degradation can be achieved by maintain duplicates of selected databases and applications - normally handled at the central node - on workstations at other nodes. Most of the workstations have a significant stand-alone capability. Additional
workstations can be used if necessary. Plans need to be made regarding the specific databases and applications software to be maintained at the remote workstations, the necessary frequency of information update and the means of passing information to other surviving nodes in a degraded situation. A distributed configuration appears particularly attractive for TACCIMS because the system is envisioned to support CINCCFC (Command-in-Chief, Combined Forces Command) and the component commanders in a full range of C² functions and because TACCIMS is planned to extend to a broad spectrum of users, including combined, U.S. and ROK organizations.

2.2 Selected Improvement Options - Bilateral Systems Interface

With the large number of operational and emerging systems, information identified in this study concerning the potential need for systems interface and the level of each interface can serve as a point of departure for bilateral efforts towards the establishment of bilateral systems interface requirements. Past experience has shown that the cost of providing interfaces for ADP systems would be far greater if interface requirements were addressed after the systems were developed. Interface and information exchange between most existing and pending C² ADP systems, the majority of which are associated with theater-level C², is currently limited to time-consuming manual methods. Although free text files produced from one system can sometimes be passed to another system, pertinent information still needs to be extracted from the files and entered into the resident databases by manual means. A capability referred to as parsing can significantly reduce the time required for and increase the accuracy of information exchange and database update. Common or related information in the interfacing systems’ databases needed to be identified and interoperable database and report formats need to be agreed on. Contingency TACC (Tactical Air Control Center) Automated Planning System (CTAPS) needs to interoperate with KCSS (Korea Combat Support System) for coordination and information exchange and to maintain up-to-date backup database. CTAPS also needs to interface with OIA (Operations and Intelligence Automation) sub-hosts at the Wings and Air Operations Support Centers for preparing and disseminating air tasking orders should KCSS become inoperative. A specific interface concept including the type and format of information exchanged and the level of interoperability needs to be developed.

2.3 Theater-Level Communications

The quality and capacity of the U.S. DCS transmission network in Korea were substantially improved in the mid-1980s when a modern digital fiber optics cable system replaced the aging analog microwave transmission backbone. However, the transmission backbone of the fiber optics system remains thin thread and can be served relatively easily. Recognizing this, the U.S. and combined staffs have been pursuing possible additional circuits from the ROK military and civilian networks to enhance the DCS redundancy as well as fielding U.S. tactical transportable systems to reconstitute some of the essential DCS connectivity. Although these are important initiatives, the resulting capacity is still expected to be very limited. The KTA network could be used to further expand the backup capacity and extend communications connectivity to combined U.S. organizations and tactical units when necessary. The ROK KTA transmission network with circuit terminations at almost all the combined and U.S. headquarters is much more richly connected than the DCS. For reasons of economy, automatic long distance dialing over the KTA network is restricted to selected subscribers. Through control at the local switches, this restriction can be quickly removed when necessary in crisis and war. Advanced planning is necessary concerning the specific combined and U.S. subscribers to whom the KTA in-and-out dialing service should be made available and the stage of crisis or war at which this would occur. The DCS should become seriously degraded and the U.S. backup capability severely strained or when U.S. tactical units are operating at locations outside the DCS service area, KTA circuits can serve as a conduit or pipeline for U.S. tactical units if appropriate interface terminals are installed at appropriate locations along the KTA network. These terminals could include the circuit and group conditioning equipment necessary to interface with DCS or tactical communications system, SPIDER⁶⁷. A similar arrangement implemented by U.S. Army, Europe, to access the European civil network has proved highly useful.

3. ADP Support

This section discusses the assessment of C² ADP support related to command operations for the theater-level commands and for tactical ground, air, maritime and amphibious operations. The assessment is based on the operational interface need lines identified in the Phase 1 report. Potential bilateral interactions needed between
ADP systems are identified and the associated interoperability implications are discussed. Physical survivability of the ADP systems is not treated separately here as it hinges on the survivability of the telecommunications networks that connect ADP systems located at different C² facilities. Both of these considerations are addressed elsewhere in the discussion.

3.1 Existing ADP Support

Prior to 1980, there was virtually no ADP support for command operations functions in the Korean theater. The introduction of ADP systems since then has brought about varying degrees of automated support to most of the command organizations and many of the functional activities. The existing ADP system applicable to Korean theater operations are summarized in Table 1.

Table 1. Summary of major existing ADP systems

<table>
<thead>
<tr>
<th>System</th>
<th>Principal Users</th>
<th>General Description</th>
<th>Functional Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theater-Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWMCCS/WIS</td>
<td>USFK</td>
<td>Honeywell mainframe and remote terminals</td>
<td>Status U.S. forces, admin./log</td>
</tr>
<tr>
<td>TACCS-K</td>
<td>CFC</td>
<td>WICAT 161 hosts and IBM AT workstations</td>
<td>Combined forces operations C²</td>
</tr>
<tr>
<td>CW/OIA KCSSa</td>
<td>ACC/7AF</td>
<td>IBM 4381 mainframe and remote terminals</td>
<td>Air operations planning/tasking</td>
</tr>
<tr>
<td>CW/OIA KAI Sa</td>
<td>7AF</td>
<td>IBM 4381 mainframe and remote terminals</td>
<td>Air-oriented intelligence</td>
</tr>
<tr>
<td>KISS</td>
<td>CFC/GCC</td>
<td>IBM 4381 mainframe and remote terminals</td>
<td>Joint intelligence with ground orientation</td>
</tr>
<tr>
<td>Tactical Ground</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCS</td>
<td>USA</td>
<td>Transportable/ portable processors</td>
<td>Tactical maneuver control</td>
</tr>
<tr>
<td>TACFIRE</td>
<td>USA</td>
<td>Transportable processors</td>
<td>Ground fire support</td>
</tr>
<tr>
<td>Tactical Air²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project 222</td>
<td>MCRC</td>
<td>Hughes 5118 processor and surveillance/control consoles</td>
<td>KTACS air surveillance/control</td>
</tr>
<tr>
<td>CAFMS</td>
<td>Reinf. TACC</td>
<td>Perkin-Elmer 3230 mainframe and terminals</td>
<td>Tactical air planning/tasking</td>
</tr>
<tr>
<td>E-3</td>
<td>USAF</td>
<td>Airborne system</td>
<td>U.S. reinf. Air surveillance/control</td>
</tr>
<tr>
<td>TACS ADP</td>
<td>Reninf. CRC</td>
<td>Hughes 4118 processor and consoles</td>
<td>Reinforcement USAF air surveillance/ control</td>
</tr>
<tr>
<td>TSQ-73</td>
<td>USA &amp; ROKA</td>
<td>Transportable TSQ-73</td>
<td>HIMADS air defense C²</td>
</tr>
<tr>
<td>TAC/OC OM</td>
<td>USMC</td>
<td>Transportable/modular system</td>
<td>Air surveillance/control/message translation</td>
</tr>
<tr>
<td>NTDS/ATDS</td>
<td>USN</td>
<td>Shipboard and airborne system</td>
<td>USN air surveillance/control</td>
</tr>
<tr>
<td>Tactical Maritime</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTDS</td>
<td>USN</td>
<td>Shipboard system</td>
<td>Composite warfare C²</td>
</tr>
</tbody>
</table>

3.1.1 Theater-Level

Most of the in-country systems are for theater-level commands or for theater/tactical organizations directly involved in air operations (e.g., TACCS-K (Theater Automated Command and Control System, Korea), KISS (Korean Intelligence Support System) for CFC and GCC (Ground Component Command), CW/OIA (Constant Watch/Operations and Intelligence Automation) systems for ACC (Air Component Command) and subordinated tactical units). Each system designed to support functional activities of a primary user organization and is usually extended to other organization via remote terminals or interconnected workstations. Within a single organization such as CFC and ACC, there is usually more than one ADP system, with each system oriented towards information of a particular functional area (e.g. opera-
tions, intelligence support). As a result, there are layers of independent and overlapping ADP networks at each of the major theater-level commands.

3.1.2 Tactical Ground Operations

The 2nd ID and its subordinate brigades and artillery units are equipped with the MCS (Maneuver Control System) and TACFIRE (Tactical Fire Direction System) systems. The same types of systems are expected to be deployed with any reinforcement U.S. Army units. The ROKA currently has no ADP support capability for ground operations although such a capability is reported to be in development by the ROK government.

3.1.3 Tactical Air Operations

A high degree of automated support already exists for tactical air operations, especially as related to tactical air surveillance and control functions. Under a ROKAF program known as Project 222, an ADP system was installed in the MCRC (Master Control and Reporting Center) in 1982 to support track initiation, correlation, identification, etc. leading to the construction of a comprehensive, real-time air picture. The CW/OLA systems also support tactical-level offensive air planning/tasking functions and provide intelligence support to the combined Tactical Air Command Center (TACC) as well as subordinate units.


3.1.4 Maritime Operations

U.S. 7FLT is supported by a number of C2 information management and fusion systems. For the purpose of this discussion, the principal systems are Navy Tactical Data System (NTDS) and Airborne Tactical Data System (ATDS). The former maintains and disseminates information ranging from situation and status to real-time surface and subsurface tracks and the latter maintains and disseminates real-time airborne track data. Data communications between the USN (U.S. Navy) tactical units are accomplished primarily through Tactical Digital Interface Link (TADIL) - A known as Link 11. Figure 2 shows interfaces and connectivity options for MACCS (Marine Air Command and Control System) to interface with joint and multinational forces. Army tactical data link-1 (ATDL-1) is a secure, full-duplex, digital data link that interconnects Tactical Air Control Systems (TACS) and Army or Marine tactical air defense oriented systems. It transmits at the rate of 1,200 bps. Ground-Based Data Link (GBDL) is a simplex or half-duplex digital data link used by air defense units. Tactical Air Operations Center (TAOC) provides real-time surveillance, direction, positive control and navigation assistance for friendly aircraft. TAOC can be connected to Control and Reporting Center (CRC) by TADIL A, B, or J.

4. Accessment and Discussion

The type and physical characteristics of principal theater-level C2 facilities in the Korean theater is shown in Table 2. All of the facilities currently exist and there is no known plan for additional major C2 facilities in the foreseeable future. The table shows that CFC (Combined Forces Command), ROK Ministry of Defense (MND), and USFK (U.S. Forces, Korea) are each supported by separately located, fixed-site peacetime and wartime HQs.

In addition, a transportable Alternate Command Post (Alt. CP) is available for CINCCFC (Commander-in-Chief, Combined Forces Command) to conduct operations away from the fixed-site facilities. Transportable alternate CPs are also available for the combined and ROK field armies. Most important physical characteristics for survivability considerations are shown in the table, namely the hardness for the structure and the facility's distance from DMZ (De-Militarized Zone). Soft and semi-hardened facilities, especially those located on fixed sites can be
easily targeted and are particularly vulnerable to physical attack. Among the hardened facilities are under as many as 100 feet or more of rock layers while others are covered by earth or concrete over-burden. Distance to the DMZ is also an important consideration. Facilities close to the DMZ are expected to be particularly susceptible to air and ground artillery fires, SOF (Special Operational Forces) threat and potential overrun by the North Koreans. A considerable amount of variation exists in the structural type and internal accommodation of the facilities.

Major theater-level command centers such as CP TANGO, HTACC (Hardened Tactical Air Control Center), KCOIC (Korean Combat Operations Intelligence Center) and the new Command Center (CC) Seoul are modern facilities constructed or significantly improved in the 2000s. They are sufficiently hardened and should be able to withstand a direct attack by conventional air- or ground-delivered weapons and are now capable of providing overpressure and biological/chemical protections. Among the tactical-level C2 facilities, the Army or Marine forces’ HQs normally operate from transportable Tactical Operations Centers (TOCs) and CPs while most of the Air Forces’ Operational Facilities (OPFACs) operate from fixed-site installations. The hardened C2 facilities suffer from certain vulnerabilities as well. These facilities are located between 35 km and 90 km from the DMZ.

Because of the shirt distances, the facilities or their communications outlets are susceptible to ground and air attacks, SOF (Special Operational Forces) sabotage and potential overrun by the enemy. Although survivability of the communications outlets has been improved with installation of the fiber optics cables that enter the facilities underground, external communications connectivity can still be seriously impaired by enemy hostile actions. The satellite ground terminal antenna outside CP TANGO and the antenna towers outside HTACC/ KCOIC are vulnerable. A transportable CP is available as a backup to support CINCCFC should the need arise. A suite of transportable communications equipment known as Road Warrior can provide CINCCFC and his staff with minimum essential connectivity for external communications. To ensure the ability of exercising command and control under degraded situation, operations from only the Alt. CP need to be fully practiced. C2 for air operations is concentrated at the HTACC and KCOIC facilities, which are situated adjacent to each other. There is no alternate in-country facility for HTACC and KCOIC.

5. Conclusions

This Phase 1 report relates to three areas of the combined C2 infrastructure for Korean theater military operations. The first area concerns the survivability of the theater-level combined U.S. and ROK C2 facilities and their communications outlets for external connectivity. The second area concerns the capability for continued operation of the C2 ADP systems in a degraded environment and the potential need for bilateral interface and information exchange.
among the systems. The third area concerns the U.S. DCS
transmission network in Korea that supports inter-facility
communications and the reconstitution of communications connectivities should the DCS be degraded by
hostile actions.

6. References

1. Deakin RS. Battlespace technologies network enabled
2. Di Genio J. U.S. Forces in Korea face unique challenges.
3. Park YC. Interconnection study of joint tactical communica-
4. Lucian I. Standardization and interoperability in land
forces and providing the necessary capacity to act within military operations. Revista Academiei Fortelor Terestre.
5. Mansourov AY. Bytes and bullets: Information technology
revolution and national security on the Korean Peninsula.
6. Park YC. Verification of the transfer address digits from spi-
Institionalization. Carbondale: Southern Illinois University;
9. Sorroche J. 2006 CCRTS the state of the art and the state
of the practice: Tactical Digital Information Link-Technical Advice and Lexicon for Enabling Simulation (TADIL-
1–7.
10. Cordesman AH, Hess A. The evolving military balance
in the Korean Peninsula and Northeast Asia: Strategy,
resources, and modernization. Rowman and Littlefield;