Command Post Anywhere –

Exploiting the Use of TeamSight for Ops Concepts

ABSTRACT

The concept of Command Post Anywhere (CPA) revolves around the ability to disperse the Command Post (CP) footprint among one's forces in order to achieve pervasive command presence, such that the CP no longer presents a significant target for the enemy to detect and destroy. With CPA, every functional cell of the Brigade CP operates physically apart from one another over wide distances in an area of operation, but is still connected wirelessly with one another via TeamSight – a collaborative environment consisting of a team operating picture and a suite of communication tools. This concept was field-tested in an experiment in conjunction with an Armoured Brigade CP exercise conducted at Shoalwater Bay Training Area (Queensland, Australia) from 21 to 23 October 2004.

In evaluating the feasibility of CPA, several aspects were considered: sensemaking ability, situation awareness, operational tempo and survivability. The findings from this experiment, as determined by three measures (communication activity, situation awareness assessments and contextual inquiry) successfully demonstrated that CPA, supported by TeamSight, is indeed a viable concept.

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INTRODUCTION

A Command Post (CP) is an organisation of people and systems by which a commander exercises his command and control (C2) of forces. We often associate it with fixed physical structures but this mental construct is based on yesterday's technology and equipment that require fixed structures to contain and operate. In the age of network-enabled warfare, a CP is more appropriately seen as an information structure supporting rich communication and collaboration between a commander and his staff, regardless of physical separation. Modern technology affords the ability to reconstitute existing structures to overcome physical constraints and to improve the information flow between key personnel in a CP.

BACKGROUND

The concept of Command Post Anywhere (CPA) is an effort to move away from traditional tenets of what constitutes a CP, of which the major ones are described below.

Physical Co-location

It has long been accepted that a CP serves the function of a physical meeting place for the commander to confer with his staff. Each Principal Staff Officer (PSO) has dedicated sources of information and areas of expertise to assist the commander in decision making. Hence, there is a need for the command team to meet for the purpose of knowledge sharing. Currently, the primary means to support the complex and interactive nature of discussions is face-to-face communication among a physically co-located team. However, with modern technology offering greater bandwidths for communication and data throughput, it is possible for individuals who are physically separated to communicate and collaborate via these tools as if they were physically co-located.

Command Brief

In a similar vein, the practice of conducting a command brief at periodic intervals – gathering of the principal staff to update one another and the commander on recent developments-exists in today's CP. However, this may not be necessary if the team members were constantly communicating with one another via communication and collaboration tools. Collation and analysis of information can be performed and disseminated in real time among the command staff, instead of waiting for the scheduled briefings, which is the current practice.

Hierarchical Command Structure

A conventional CP is organised hierarchically in order to handle the high complexity of war fighting by delegation of authority to sub-commands – the principle of divide and conquer. This need for centralised command is a function of the complexity of the problem space. It is manifested in the way PSOs currently update and receive guidance from the commander primarily at the scheduled command briefs, instead of being able to exchange information continually between cells (including the commander's cell). With the availability of an information structure that facilitates the lateral exchange of information, adaptive teams predicated on self-synchronisation could be constituted to better manage the complexities of warfighting.

Sequential Planning

In addition, it is assumed that hierarchical CPs have to work in sequence, i.e. higher commands cascade plans downwards to ensure higher-HQ intent is fulfilled by ground units. A process strings together the decision products of these hierarchical CPs. Hence, the Operations Order developed by a Brigade is handed to the Battalion HQ, which in turn will develop their sub-level intent and plans and so on. While some parallel planning is attempted today, the process is by and large

sequential to ensure that coordination points are properly dealt with. This could be a result of current technology not being able to support the high degree of coordination required between horizontal domains and vertical command structures for parallel planning to take place.

Brigade Main and Tactical CP

Lastly, and perhaps most importantly, an organisation like the Brigade commands and controls forces spanning 15km - 30km in depth and 10km - 20km in width. With such a wide area of operation, a Brigade CP is often separated into the Main and Tactical CPs. The Brigade Commander is usually positioned right up at the front with his manoeuvre units to enable him to directly experience the battle, provide a command presence, and to make critical decisions regarding the activation of reserves or request for reinforcements. It would however be impractical for the commander to bring his entire command team with him as it would be too big a target and very immobile; hence, only the Fire Support Coordinator (FSCOORD) and the Intelligence (S2) cell follow him, while the rest remain stationary at the Brigade Main CP to manage resources. Clearly, in such an arrangement, the mobility of the commander and his team is constrained by the ability to establish communication links between the manoeuvre forces, the Brigade Main CP and the commander.

COMMAND POST ANYWHERE

The idea of CPA is to be able to disperse the Brigade CP footprint of one's forces in order to achieve pervasive command presence, and such that the CP no longer presents a significant target for the enemy to detect and destroy. With CPA, every functional cell of the Brigade HQ operates physically apart from one another over wide distances in an Area of Operation (AO), but is still connected wirelessly with one another (a typical Armoured Brigade HQ is composed of the S2, Operations (S3), Combat Support Services and Fire Support cells located at each corner of the Brigade Tactical Ops Centre (BTOC), with a Command and Control Centre in the middle). This connection enables the sharing of a common operating picture and allows personnel in each cell to conduct meaningful collaboration whenever necessary. The technological environment that supports this capability is described later under 'TeamSight'. In essence, CPA presents a fundamental contrast with the conventional concept of the centralised CP, where the cells are physically co-located with the commander and not usually mobile. It is founded on previous attempts at experimenting with a similar concept (Gorman, 1980), with the added benefit of technological advancements today.

This move towards adopting the CPA concept is driven by two main factors. Firstly, there is a need to enhance battlefield survivability. In both the current and future battlefield, it is envisaged that the Brigade HQ's BTOC conventional centralised configuration would offer too large and significant a target, making it easier for the adversary to identify and strike. There is therefore a need to reduce this operating footprint significantly so as to enhance the BTOC's battlefield survivability. One means afforded by technology is to physically distribute and disperse the cells, while remaining virtually connected.

Secondly, enhanced C2 could potentially be enabled by distribution. The ability of the Brigade Commander and PSOs to operate while dispersed over an area of 25km - 30km radius would allow the Brigade HQ to be positioned at decisive and critical points within the Brigade's AO to exercise command emphasis, and to allocate resource support to the battalions. More importantly, the distributed Brigade HQ's span of influence is likely to be more effective compared to the conventional centralised BTOC, as the BTOC

would no longer be bound to a single location. Currently, the location of the centralised BTOC is governed to a large extent by communications considerations. The centralised BTOC infrastructure is also cumbersome to deploy and displace, and could hamper the Brigade Commander's ability to effectively command and control the Brigade's fighting units. The distributed BTOC would allow the commander and the respective PSOs to optimise their locations to exercise the most effective influence on the battlefield. For example, the commander could be positioned with the Brigade's main effort to offer command guidance; the S2 could be positioned at a vantage point to receive enemy input and offer updates to the fighting units; the S3 could be located with the Brigade's reserve units, co-ordinating its launch at the decisive time and place; the S4 could remain with the Combat Service Support (CSS) elements right behind; and the FSCOORD could be with the forward Fire Support Officer or with the guns. Regardless of their locations, the commander and his PSOs would still be capable of virtual collaboration with one another through the TeamSight environment as described later.

The full benefits of the CPA concept are premised on the availability of broadband connectivity in the battlefield. While this requirement for pervasive networks in the battlefield would seem to make the CP more susceptible to being disabled due to attacks on the communications network, there are varied ongoing experimentation efforts that seek to mitigate this vulnerability. One prong of experimentation addresses the setting up of a low-cost adaptive network to provide the necessary coverage within the AO. Another prong of experimentation addresses the development of adaptive command teams that are able to quickly change their organisational structure in response to changes in the scenario and environment. These experimentation efforts together serve to strengthen the CPA concept.

Essentially, CPA enables us to break mindsets that were structured by limitations in technology and archaic ideas. It is the model of next generation command teams at the battalion, brigade and even division levels, centred around the idea of command on-the-move, where the CP can be with the forces and optimal positioning of Brigade staff can enhance battlefield coordination and C2. CPA is effectively supported by the TeamSight environment in MissionMate, which attempts to level the sensemaking capability of the distributed command team with that of the physical CP of today.

Figure 1.
Components of TeamSight

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TEAMSIGHT

TeamSight gives the Brigade Commander, the most experienced officer on the field, a separate view of each of his staff's screens, in addition to an aggregated picture which may be missing some important details. It consists of the Team Operational Picture, Team Power Board, and communication tools like video conferencing, text chat and emails that work together to provide the Command Team with continuous and shared situation awareness (see Figure 1).

The Team Operational Picture (TOP) is a Geographic Information System (GIS)-based collaborative tool that allows each individual to view his team-mates' workspaces to understand and collaborate on their situational constructs while at the same time maintaining a workspace for his own situational constructs. One advantage of the TOP is the reduced need to disseminate information during scheduled meetings, given that each user is able to monitor the planning outcomes of his counterparts in the command team and the current status of manoeuvre units.

Another main advantage of the provision of individual workspaces is that it allows every member of the command team to develop his product at the level of detail required without cluttering the common operating picture. An aggregated operating picture is maintained for the commander's overview by allowing him to select the overlays that he would like to see. Such an environment allows the command team to quickly fuse all available information to generate a second-order inference or to obtain a common value for existing information. This gives rise to "collaboratively generated information", based on information elements either actively shared via voice or video conferencing, or simply placed on the network for retrieval when necessary (Kingston & Martell, 2004).

Having multiple workspaces available for viewing by any user of the system is also in line with "the established wisdom that commanders and planners must visualise the battle two echelons down and understand it from the perspective of the commander two echelons higher" (de Czege & Biever, 2001) as well as that of adjacent organisations.

DISTRIBUTED HUBBING

As an operating concept, Distributed Hubbing (D-Hubbing) is the first step towards attaining the larger goal of CPA. Basically, it involves a distributed operation without the element of mobility. This concept was tested in conjunction with an Armoured Brigade CP exercise (EX WALLABY) conducted at Shoalwater Bay Training Area (Queensland, Australia) in October 2004.

EXPERIMENT OBJECTIVES

There are three key hypotheses which we wanted to investigate in this experiment:

a. D-hubbing augmented with TeamSight will have the same sensemaking ability as a Centralised CP - For the purpose of this experiment, sensemaking is quantified in the form of situation awareness level possessed by members of the Brigade HQ, and indicated by the communication content between and within the cells.

b. D-hubbing augmented with TeamSight will provide continuous situation awareness, thereby increasing the operational tempo of the Brigade - In addition to situation awareness questionnaires administered on a regular basis, supporting evidence of an anecdotal nature will also be used.

c. D-hubbing will enhance Brigade CP survivability with increased physical separation of the cells.

MEASURES AND METHODS

A total of three measures were employed in the course of the experiment.

1. Situation Awareness Assessment

Situation awareness (SA) levels in each cell were measured to provide an indication of whether the PSOs were able to maintain a comparable level of SA regardless of the distance between the cells and the communication means made available to them. It is assumed that maintaining SA is necessary for making and executing decisions; in this case however, aspects of decision-making were not assessed. It is also assumed that a higher level of SA is correlated at least with the speed of decisions, if not quality, giving rise to a superior operational tempo. Whether this relationship indeed exists will be investigated in subsequent experiments.

An adaptation of the Situation Awareness Global Assessment Technique (SAGAT) (Endsley, 1995) was used to evaluate the level of SA. This measure is also based on Endsley's model of SA: Level 1 (Perception), Level 2 (Comprehension) and Level 3 (Projection) of information elements, and was first field-tested in a similar Division-level exercise (Teo et al., 2004). At various times when an assessment of SA was deemed appropriate, SAGAT questionnaires were administered to the Brigade Commander and his PSOs.

2. Analysis of Communication Patterns

To better elucidate information flow at both the inter- and intra-cell levels, communication activity was monitored for the duration of each experimental run. This was done via two methods: observer ratings and recordings of all communication activity that took place.

(i) Two observers in each cell monitored the communication activity that took place within the cell and between cells. Each observer kept a log of the transactions that took place and completed a subjective rating template every 30 minutes to reflect, in the most recent time interval, the following types of communication.

1) Dissemination of Information
2) Clarification
3) Exchange of Ideas
4) Building of Shared Understanding
5) Team Monitoring and Self-Correction
6) Others

Behaviourally Anchored Rating Scale

An observation template was handed out to the observers at the start of each run. A Behaviorally Anchored Rating Scale (BARS) (Alberts and Hayes, 2002) was employed to record the different proportions of each type of communication activity, where each number on a five-point scale is associated with explicitly described behavioural indicators to guide judgment. This enabled a certain degree of numerical comparison based on the value averaged across all observers for each category.

(ii) In addition to observer ratings, all the communications that took place either face-to-face or via other modes (text chat, video conferencing, voice via Very High Frequency (VHF) radio) were also recorded to facilitate subsequent analysis of the communication patterns.

3. Contextual Inquiry
(Holtzblatt and Jones, 1993)

Post-hoc interviews with the Brigade Commander and PSOs conducted at the end of each experimental run according to a semi-structured field interviewing method served to supplement and fill in the observation gaps. At the end of the exercise, an After-Action Review was held to elicit feedback from the Brigade PSOs on the perceived ease of operation in the various setups.

Preparation for Experiment

Prior to the exercise, the Brigade was trained in the usage of the MissionMate system over three days for the purpose of employing TeamSight in a distributed environment. In addition, they had also gone through two exercises with the same system in the months

leading up to this exercise. This ensured they were reasonably proficient in operating the system during EX WALLABY 2004.

EXPERIMENTAL CONDITIONS

The experiment took place from 21 - 23 October 2004. A total of six runs were conducted, with two runs per day. Over the course of the runs, each lasting for two and a half to three hours, the Brigade HQ had to plan, execute and coordinate Brigade-level tasks.

Centralised CP

The first run was conducted with the Brigade HQ operating in a centralised CP setup to serve as a baseline for comparison with subsequent D-hub setups. The layout was similar to a conventional Armoured Brigade CP set-up with a footprint of 30m by 25m, clustered in a wired Local Area Network (LAN) environment.

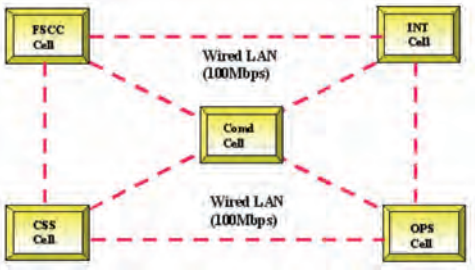

Figure 2. Centralised CP Configuration

D-Hub CP

For the subsequent runs, the Brigade was split into two main clusters separated by a distance of 10km. The main cluster consisted of the Commander, the S2 and S3 Cells, while the other cluster consisted of the FSCC and the CSS Cells. Within each cluster, the Cells were further separated by about 1km to 2km. To enable this layout, a high bandwidth wide-area communications setup was employed. Within the cluster, a wireless LAN conforming to the 802.11 standards was employed, while between the clusters, another form of wireless line-of-sight communications conforming to the 802.16 standard was used (See Figure 3). In each cell, the PSO was given two to three screens to support the TeamSight environment.

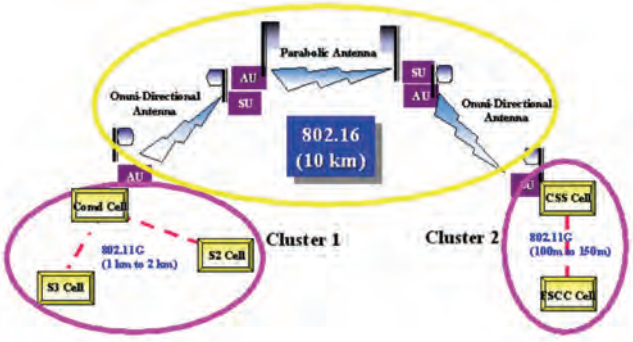

Figure 3. D-Hub Configuration for a 10km Brigade CP footprint

For the first two D-Hub CP runs, all the communication means were activated – video conferencing, text chat and TOP, along with voice communication via VHF.

Subsequent runs were aimed at investigating the feasibility and success of operating in a distributed environment under conditions of degraded network performance. In Run 5, the video conferencing and text chat capabilities were removed, with communication allowed only via VHF radio and the TOP.

A number of different conditions were incorporated into Run 6. Firstly, the ideal D-Hub configuration was further disrupted by disabling both VHF radio communication and video conferencing, resulting in purely 'silent collaboration' (via text chat) between the cells. Secondly, links to the S2 and S3 cells were intentionally disabled in turn midway through the run for about an hour each. The intent of these manipulations was to assess the Brigade HQ's ability to quickly adapt, synchronise and assume additional responsibilities so as to continue effective planning and execution in the event of network degradation.

FINDINGS AND DISCUSSION

The statistical findings coupled with anecdotal evidence support the hypotheses put forth prior to the experiment:

a. D-hubbing augmented with TeamSight provides the Command Team with the same sensemaking ability as in a Centralised CP. For this purpose, the nature of communication activity taking place within the team and their level of SA is indicative of the sensemaking ability of the Command Team. A non-parametric test (Friedman test) on the SA levels and communication profiles showed no statistical differences (at 90% confidence level) in the various D-hub setups as compared to the Centralised CP, suggesting that TeamSight effectively facilitates sensemaking despite the distributed operation of the Brigade CP.

Observations made during the experiment elucidated some trends in the communication patterns between the Centralised CP and D-hub CP (full suite). The D-hub CP with full suite of TeamSight tools, as compared to the Centralised CP, gave rise to a greater proportion of communication devoted to the exchange of ideas (21% vs 10%, $p = 0.109$) with a correspondingly lesser proportion on information dissemination (14% vs 26%, $p = 0.109$) and building shared understanding (19% vs 25%, $p = 0.102$). This could be a result of operating in the TeamSight environment. Aided by the TOP, there is a reduced need for Commander and the PSOs to explicitly disseminate information and build shared understanding, thus freeing up the time to exchange ideas.

The communication recordings provided an insight into the usage of the various communication tools for different purposes. It was observed that in the D-hub setup (full suite), dissemination of information was achieved more via text chat (26% vs 19% via voice communications) while the building of shared understanding was supported more through voice communications (45% vs 30% via text chat).

In an attempt to correlate communication means with SA levels, it was found that Levels 2 and 3 SA of D-hub (text chat only) were significantly higher than that of both D-hub (full suite) and D-hub (voice only) ($p = 0.066$, $p = 0.102$ respectively). This could be a result of text chat generating a record of the updates, discussions and deliberations between the cells that transpired during the run, allowing the Commander and PSOs to refer back when necessary. In fact, this was reported by some of the PSOs as a notable advantage of text chat over voice or video conferencing, although others preferred video conferencing for its interactive value and ease of communication in building shared understanding (as reflected in the analysis of communication recordings detailed earlier).

Subsequent experiments will be conducted to further investigate the relationship between communication patterns, SA levels and sensemaking ability, as well as how they translate into performance measures such as decision and plan quality.

b. D-hubbing augmented with TeamSight will provide continuous situation awareness thereby increasing the operational tempo of the Brigade. In the Centralised CP, the commander would walk around to confer with the various PSOs separately before the scheduled Command Brief. This was observed to be an information bottleneck – there were occasions when some PSOs worked on their respective plans without awareness of the relevant updated information due to the staggered meetings. Another issue of interest was the time-resource dilemma faced by the PSOs when working in a Centralised CP setup. They had to attend the scheduled Command Briefs (which took up 20% of their time) while at the same time having to complete certain tasks or provide guidance to their staff.

With a D-hub CP setup, the PSOs and Commander operated within the collaborative TeamSight environment, allowing a greater amount of concurrent activity. The command team was collectively aware of the current situation and they were able to fulfill their specific functional roles and update the rest of the command team concurrently. Two assessments of SA were administered for each run, and the results showed that the SA levels increased from the first to second administrations across all roles. This can be attributed to a better understanding of the situation picture with the availability of TeamSight as each run progressed.

The ability of TeamSight in support of the D-hub setup was further tested in Run 6 where links to various cells were disabled in turn to simulate a case of degraded networks. It was found that the team was able to adapt and compensate for the disabled cell. For example, when the link to S2 cell was down for an hour, intelligence reports were disseminated to all other cells instead. This ensured that the rest of the CP was made aware of the enemy updates promptly, such that when the link to S2 cell was restored, this cell was able to reassume its role quickly.

c. D-hubbing enhances Brigade CP survivability with increased physical separation of the cells. The Brigade CP was distributed over a distance of 10km, with each cell comprising only a tent and an armoured vehicle. The small size and distributed location of each cell greatly reduces the visual signature of the CP as compared to the conventional cluster of tents and vehicles, making it less detectable from the air (as noted by visitors who were flown in by helicopter). One potential drawback of the physical separation of cells is the accompanying high volume of communication traffic between cells that could possibly result in an increased electromagnetic signature. This will be investigated in subsequent experiments.

CONCLUSION

This experiment is a culmination of a series of smaller scale exercises in which the D-hub concept was tested in a TeamSight environment. The findings and observations indicate the feasibility of such a setup for a brigade level CP, paving the way for subsequent experimentation to strengthen and extend this concept.

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BIOGRAPHY

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LTC Chew Lock Pin is Head, Command Post of the Future (CPoF), SCME, and is concurrently Programme Director (Exploration and Experimentation) in DSTA. He has been involved in the conceptualisation and development of the Integrated Command and Control (IKC2) with the SAF. His current work involves Command Post Experimentation with the Military Services. He is also involved in the IKC2 Enterprise Architecture Developments, Information Architecture Developments for Command and Control Information Systems, and the development of the prototype Mission Mate system in the SCME. He has a Master of Technology Degree in Knowledge Engineering from the National University of Singapore and a Bachelor of Science Degree in Physics from Imperial College.

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