Developing Contemporary Operating Environment Opposing Force Alternative Communications Means

Joe R. Gonzalez Jr.
Texas A&M Engineering Program
College Station, TX
jgonzalez@tamu.edu

ABSTRACT

With the introduction of the Contemporary Operating Environment (COE) Opposing Force (OPFOR), as reflected in Iraq, Afghanistan and elsewhere, into the OneSAF system a different and lethal set of tactics, forces and equipment has been developed to represent the current ground truth faced by the Armed Forces of the United States and its allies. The COE OPFOR comprises the collective set of organizations (combatant, noncombatant, corporate, non-government, government and international) existing in and acting on the environment in the Blue Force (BLUFOR) area of operations as representative of current military operations. They can be categorized as conventional forces (Regular Armed Forces) or irregular forces (Paramilitary, Guerrilla, Terrorist, Militia, and Combatant and Non-combatant Civilians on the Battlefield). A critical component for the accurate portrayal of these organizations in the OneSAF is the representation of the command and control means by which the components of the COE OPFOR will synchronize and direct their activities. The COE OPFOR will use components of the Civilian Information Infrastructure (CII) as a principal or alternate Battle Command System and Information Operations mechanism. These CII means are collectively termed Alternative Communications Means (ACM) as they represent a departure from the use of combat net radios for battle command system use. Irregular COE OPFOR forces will use ACM as both their primary battle command system and information operations mechanism. Conventional COE OPFOR forces will use ACM; as a parallel battle command system and as the primary information operations mechanism since they anticipate their tactical communications will be disrupted or destroyed over time and know BLUFOR is reluctant to disrupt the CII. This paper describes the identification and decomposition of these ACM, the description of their performance, how they can be used by the COE OPFOR and how they can be integrated into the OneSAF, and other simulations.

ABOUT THE AUTHOR

Joe R. Gonzalez Jr. works for the Texas Center for Applied Technology, a center of the Texas Engineering Experiment Station, part of the Texas A&M Engineering Program of the Texas A&M University System. He is currently supporting the development of the COE OPFOR capabilities in the OneSAF for the TRADOC Intelligence Support Activity-Threats and PM OneSAF. Mr. Gonzalez is a retired Army officer who has held the positions of Associate Professor, Department of Civil and Mechanical Engineering, United States Military Academy, West Point, NY; Deputy Vice Director of the Battle Command Battle Laboratory, Fort Leavenworth, KS; Deputy Director, Experimental Force Coordination Cell, Fort Hood, TX and Deputy TRADOC System Manager Force XXI, Fort Knox, KY. He holds a B.S. in General Engineering from the United States Military Academy and a M.S. in Mechanical Engineering from Kansas State University.

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INTRODUCTION

With the introduction of the Contemporary Operational Environment (COE) Opposing Force (OPFOR), as reflected in Iraq, Afghanistan and elsewhere, into OneSAF a different and lethal set of tactics, forces and equipment has been modeled to represent the current ground truth faced by the Armed Forces of the United States and its allies. Numerous COE organizations must now be accounted for by the Blue Force (BLUFOR) in their area of operations. Equipment is being used in new and innovative ways by these organizations. In particular is their use of the communications means components, Alternative Communications Means or ACM, of the Civilian Information Infrastructure (CII) for command and control.

For simulation, used for operational preparation, to remain relevant the knowledge base must be kept up to date to the current and expected threat environment. In this context the decomposition of the COE OPFOR battle command means are critical. The development of the ACM and their characteristics, the CII and its capabilities and a feasible messaging process provides the ability to more accurately portray the COE OPFOR's battle command messaging in simulation. This enhances the fidelity of the threat's capabilities and will generate communications indicators that can allow for BLUFOR interception and interdiction of COE OPFOR activities and intent.

This document describes the COE OPFOR, their use of ACM in the CII, the set of ACMs, the CII (via regional communications tiers), how ACM coverage areas are determined, how damage is assessed, how transmission success is calculated, the message transport process, message generation and content distribution.

THE COE OPFOR

Components of the COE OPFOR

The COE OPFOR is comprised of the set of organizations (combatant, noncombatant, corporate, non-government, government and international) existing in and acting on the environment in the BLUFOR area of operations as representative of current military operations. They can be most broadly categorized as conventional forces (Regular Armed Forces) and irregular forces (Paramilitary, Guerrilla, Terrorist, Militia, and Combatant and Non-Combatant Civilians on the Battlefield). The irregular category, Paramilitary consists of Border and Security Brigades, Special Purpose Forces, Militia, National Police, District Police and Local Police. Civilians on the Battlefield - Combatant, consists of Combatant Civilians, Private Security Organizations and Drug and Criminal Organizations. Civilians on the Battlefield - Non-Combatant consists of Indigenous Civilians (Locals), Displaced Persons and Transients, Trans-national Corporations, Media (Local, National and International), Foreign Government and Diplomatic Personnel, Humanitarian Relief Organizations (including both Private Volunteer Organizations and Non-governmental organizations) and Medical Teams (See Figure 1).

The irregular COE OPFOR can be anywhere on the battlefield performing almost any function. They can perform missions that are neutral, cooperative, complementary or in opposition to the BLUFOR mission. The relationship between components of the COE OPFOR and the BLUFOR can be dynamic. The COE OPFOR also cannot always be clearly identified from the local population or one another by a distinctive uniform.

The CII, ACMs and the COE OPFOR

The CII is the power, communications, transportation, services and supporting structures that form the backbone for the exchange of information for any geo-political region. The CII can be characterized from local to global. The ACM are the means within the CII that perform information transmission and receipt. They are both components of and external to the CII. The COE OPFOR will use the CII as their source of command and control and are dependent upon these

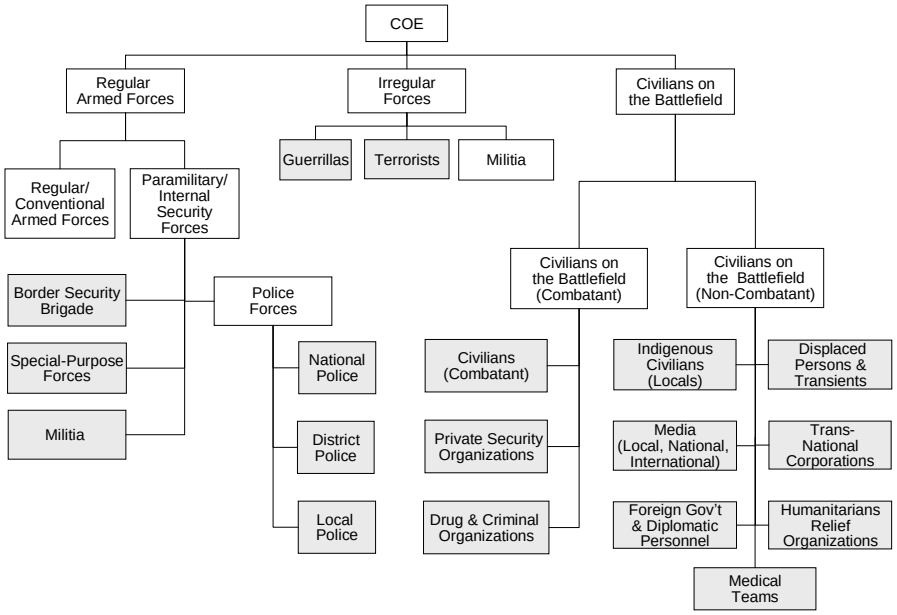

Figure 1. COE Organizations (in gray)

means of communication to perform their tasks effectively. The BLUFOR does not usually act unilaterally against the COE OPFOR command and control means as they are component parts of the CII and interdicting them will have a net effect on the performance of the CII and thus the general civilian population at large.

For the accurate portrayal of these forces and groups in the OneSAF the representation of the command and control means by which the components of the COE OPFOR synchronize and direct their activities must be developed. The COE OPFOR will use the ACM components of the CII as a principal or alternate Battle Command System (BCS) and Information Operations (IO) mechanism. The use of ACMs represents a departure from the use of combat net radios (analog and digital) for BCS use. Irregular forces will use ACM as both their primary BCS and IO mechanism. COE OPFOR conventional forces will use ACM; as a parallel BCS and as the primary IO mechanism since they anticipate their tactical communications will be disrupted or destroyed over time and know BLUFOR is reluctant to disrupt the CII.

ACM are available to COE OPFOR organizations based on the organization's mission, expected technical resources and location in the CII. All organizations have been aligned with sets of potential ACM based on these factors as well as expected transmission and reception capabilities. Not every ACM will be in every organization and not every member of an organization will have access to an ACM even though it is part of their organization's equipment list.

ACM DESCRIPTION

ACM Types

Alternative communications means are the collective set of most commonly used CII information transmission/exchange devices in the COE. We have assumed that the COE OPFOR cannot possess in simulation the same range and variety of possible means of communications as the COE threat possesses in actual operations therefore a finite list of methods and limitations to those methods have been developed.

- Hand Held Radios: Battery operated, very low power, line of sight. No supporting infrastructure is required.
- AM/FM Radio: AM and FM band ground based transmissions. Commercial, private or government owned. A supporting infrastructure is required.
- Broadcast TV: UHF/VHF ground based transmission. Commercial, private or government owned. A supporting infrastructure is required.
- Satellite TV: A space based television distribution medium. Commercial or government owned. No

supporting infrastructure is required in the area of operations.

- Cable TV: Ground based distribution medium. No over the air transmissions are made. Commercial or government owned. A supporting infrastructure is required.
- Newspaper: Printed daily or weekly in local language. Distributed to newsstands. A supporting infrastructure is required.
- Magazine: Printed weekly or monthly in local language. Distributed to newsstands. A supporting infrastructure is required.
- Flyer: Printed anywhere and distributed to designated locations for viewing.
- Landline Telephone: Corded or very short range wireless (interior of building) portable. A supporting infrastructure is required.
- Telephone Based Facsimile: Land line phone based document transmittal. A supporting infrastructure is required.
- Cell phone: Battery operated wireless telephone system without internet access. A supporting infrastructure is required.
- Cell Text Messager: Text messaging capability based on cellular phone system. A supporting infrastructure is required.
- Pager: A radio frequency network system to receive incoming pages. A supporting infrastructure is required.
- Pager Text Messager: Pager based short text message system. A supporting infrastructure is required.
- Satellite Phone: Battery operated satellite based telephone system, also capable of text messaging. Commercial or government owned. No supporting infrastructure is required in the area of operations.
- Website: Web location where instructions and information can be posted for reading or download. Requires laptop and connection to internet. A supporting infrastructure is required.
- Chat Room: Web location where instructions and information can be posted and information exchanged. Requires laptop and connection to internet. A supporting infrastructure is required.
- BLOG: Web location where instructions and information can be posted. Requires laptop and connection to internet. A supporting infrastructure is required.
- Email: Computer based electronic mail service where information and documents can be transmitted and exchanged. Requires laptop and connection to internet. A supporting infrastructure is required.
- Computer Based Facsimile: Computer based document transmittal service where documents can be distributed. Requires laptop and connection to internet. A supporting infrastructure is required.
- Instant Messaging: Computer based message exchange service where information can be disseminated and exchanged. Requires laptop and connection to internet. A supporting infrastructure is required.
- Courier: An organic organizational position or designated individual combatant temporarily assigned to personally convey messages.

Descriptive Characteristics

Each ACM device has been identified and then characterized by various measures to describe its capability and limitations. Performance measures and variables have been limited to a feasible set capable of being utilized by the OneSAF without interfering with other simulation activities. The descriptive characteristics used are:

- General Class: These are the categories of shared communications methods and characteristics with other communication types. This measure categorizes the ACMs into the following classes: two-way radio, one-way broadcast, telephonic, web based and courier.
- Infrastructure Type: Does this ACM require a component in the infrastructure to enable its ability to communicate? There are three infrastructure types; infrastructure dependent, not infrastructure dependent, and not infrastructure dependent - service area.
- External Requirements: What infrastructure features are required for this ACM to operate?
- Transmission Type: By what means is information transmitted? Types are radio frequency (air or wire), visual and manual.
- Range Limit: Is the ACM, as normally used, limited by distance? This assumes any required ACM specific infrastructure is in place (see External Requirements above).
- Receipt Latency: Is there a delay between transmission and receipt? Latency is variable based on means, network traffic and distribution delay. Latency will determine how quickly a recipient acknowledges receipt or can take action on the information.

- Action Latency: Describes how quickly the recipient can act on the information received. Action latency is variable based on distance to point/area of action from ACM receipt point.
- Recipient Quantity: The number of recipients that receive the information at the same time. Recipient quantity categories are; small, medium, large, very large and enormous.
- Coverage Geometry: What is the shape of the ACM coverage area? The coverage area for some ACMs requires Subject Matter Expert/Controller expertise in region to determine.
- Communications Tier Dependent: Is the ACM's expectation of service or receipt latency variable based on the regional communications tier it is operating in?

Performance Characteristics

Each ACM has a set of characteristics that describe its performance envelope. They assist in determining which ACM's can meet the requirements of specific organization's and missions and are adequately defined to produce a unique signature in the simulation. Currently radio transmission frequencies, their wavelength signature, their interaction with the environment (terrain and weather) as well as accurately rendered antenna performance are not included in this description. However sufficient detail is expressed so that intervention, tracking and monitoring can occur via controller action. These characteristics are used in the determination of message success rates.

Some performance characteristics are variable. Performance characteristics play a key role in defining the ACM's coverage area. Each ACM has a sub-set of the following performance characteristics:

- Power: Radio frequency transmission power. For one way broadcast media this is defined as Effective Radiated Power. Power influences ACM Range.
- Range: The maximum transmission range for an ACM.
- Line of Sight: ACM types limited to line of sight for proper operation.
- Minimum Frequency: The minimum available frequency assigned to this ACM type for its use.
- Maximum Frequency: The maximum available frequency assigned to this ACM type for its use.
- Publication Frequency: For print media ACM. How often the document is published.
- Circulation: For print media ACM. Number of copies of the document produced for one issue.
- Market Range: For print media ACM. The physical size of the distribution area for the printed matter based on ethnic, physical and political considerations that will define the coverage area.
- Connection: The connection device enabling the ACM in the coverage area. Inside the coverage area polygon the connection is 'on,' outside the coverage area polygon the connection is off.
- Speed: The maximum speed for a courier based on the individual combatant's mode of travel.

Infrastructure Dependence

Certain ACMs are dependent upon supporting components in the local infrastructure to function properly (See Table 1). These components enable broadcast transmissions and the distribution and routing of telephone and internet network traffic. These broadcasting and distribution components must be present in the simulated environment's infrastructure to enable these ACMs to function. These ACMs are called Infrastructure Dependent (ID).

Alt Comms Means	General Class	Structure Type	Functional Component
AM Radio	Broadcast	Tower	Antenna
FM Radio	Broadcast	Tower	Antenna
TV - Broadcast	Broadcast	Tower	Antenna
TV - Cable	Broadcast	Building	Switch
Telephone	Telephonic	Building	Switch
Facsimile	Telephonic	Building	Switch
Cell Phone	Telephonic	Tower	Antenna
Cell Text Msg	Telephonic	Tower	Antenna
Pager	Telephonic	Tower	Antenna
Pager Text Msg	Telephonic	Tower	Antenna
Web Site	Web Based	Building	Switch
Chat Room	Web Based	Building	Switch
BLOG	Web Based	Building	Switch
Email	Web Based	Building	Switch
Computer Based Fax	Web Based	Building	Switch
Instant Msg	Web Based	Building	Switch

Table 1. Infrastructure Dependent ACMs

Each ID ACM requires a structure and functional component to operate. The structure provides housing, enabling environment and support to the functional component. The functional component is the transmission or distribution device for the ACM.

For antenna based ACM the structure is a tower and the component is an antenna. For a switch based ACM the structure is a building and the component is a switching device. An antenna is required to provide a source for a broadcast signal or to receive and send radio signals. An antenna requires a tower to provide adequate ground clearance to make the transmission range operationally feasible.

A switch is required to route and connect traffic for telephone and computer based communications. A switch will connect compatible ACMs together in a specific service region, to connect to external coverage areas and will usually reside in a building (owned by the local service provider).

ID ACMs performance is thus dependent on the performance of the supporting CII. The CII in various regions of the world have been classified into regional communications tiers.

REGIONAL COMMUNICATIONS TIERS

The world is not homogeneous with regards to CII maturity and supportability. The Regional Communications Tiers account for these differences to define the expectation of message delivery via a specific ACM in any geo-political area of the world. They provide a probability of message receipt for point to point and for percentage coverage of intended target population for broadcast messages as well as the additional message latency due to the CII. This definition includes wired, wireless and broadcast means as well as printed matter distribution pathways. Tiers are based on two primary factors; technology maturity and infrastructure support (Table 2).

Technology maturity focuses on wired and wireless communications, internet access, radio and television broadcasts. There are three ranges for technology maturity:

- High: Very robust analog and digital communications networks.
- Medium: Robust analog and developing digital networks.
- Low: Fragile communications networks with little digital technology.

Infrastructure support is the existence of government, commercial or private sustainment and maintenance capabilities in place to support established communications or print media distribution pathways. Infrastructure support is critical to retaining throughput in modern information infrastructures. There are three ranges for infrastructure support:

- High: A very robust support structure with multiple alternative and backup communications pathways available.
- Medium: An established support structure supporting the primary pathways but with few backup communications pathways available.
- Low: Single or fragile pathways vulnerable to single point failure with little to no established support structure.

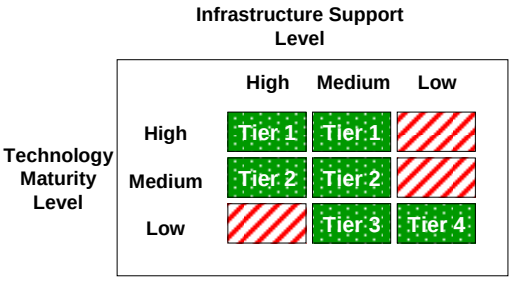

Table 2. Regional Communications Tiers

Expectation of Service and Latency

For each Communications Tier, ID ACMs have been designated an expectation of service (EOS) and expected transmission latency (Latency) factor. ACMs that are not infrastructure dependent do not have EOS or Latency susceptibility via the regional communications tiers.

EOS is the probability that the desired service is not available at the time of desired use or that a message sent will not be received. The primary causes of service failure are the reliability of the service provider and the ability of the power grid to provide continuous and reliable power. At lower tier levels these capabilities become less reliable. For each regional communications tier, ID ACMs have been designated an expectation of service factor that ranges from High to Low (1 to 3).

- High (1): No service loss expected.
- Medium (2): Minor service loss but not excessive based on ACM type.
- Low (3): Significant service loss possible.

Latency is the additional time required for delivery of a message from its standard performance based on insufficient or inadequate infrastructure. The primary causes of latency fall into two categories; printed media distribution pathways and web based distribution throughput. Print media latency is caused by delays induced by power grid reliability, supply shortages, inadequate transportation infrastructure, reduced print plant operational availability, fragile distribution pathways and little to no redundant capabilities. Web based services latency is caused by a lack of multiple available service providers, insufficient pathways to route packet data and a lower density of servers providing switching. For each regional communications tier ID ACMs have been designated a Latency factor that ranges from High to Low (1 to 3).

- High (1): Little to no transmission latency expected.
- Medium (2): Latency longer than expected, but not excessive based on ACM type.
- Low (3): Significantly longer than expected latency.

COVERAGE AREA DETERMINATION

Key characteristics that define the practical implementation of the size and shape of ACM coverage areas are Infrastructure Type, Transmission Type and Range Limit. Infrastructure Type indicates if the ACM requires support from the CII to enable its ability to communicate. Transmission Type describes how information is transmitted via an ACM. Range Limit tells if an ACM has a finite transmission or distribution range. Taken together, these characteristics describe a service range limit. This service range limit describes boundaries for local connectivity, although this does not restrict the ACM from communicating with like or compatible systems in separate coverage areas (e.g. a cell phone in one coverage area to a land line telephone in another coverage area). This service range limit describes the outer boundary of the ACMs coverage area. The coverage area is a finite area of defined shape within which point to point ACMs can effectively communicate or broadcast ACMs can distribute information effectively.

ACM that have line of sight dependencies have no-service areas subtracted from their coverage area. Special calculations are made to account for an average of no-coverage areas based on terrain relief.

Infrastructure Dependent ACM

Tower/Antenna systems provide a source for RF transmission capability. Tower dependent ACMs are: AM Radio, FM Radio, Broadcast TV, Cell Phones, Cell Text Messaging, Pager and Pager Text Messaging. The coverage area is determined by the characteristics of the ACM transmitter.

Building/Switch systems provide telephone connection capability and information routing and distribution. Switch dependent ACMs are: Cable TV, Land Line Telephone and Telephone Facsimiles. Web Site, Chat Room, BLOG, Email, Computer Based Fax and Instant Messaging. The coverage area is determined by an application of the regional political and cultural characteristics as described in the Road to War, assigned Regional Comms Tier, exercise/event objectives and other available background information.

Non- Infrastructure Dependent ACM

Coverage areas are enclosed polygons where the ACM will function but has no requirement for a structure/component system located in that area. The three types of non-ID coverage areas are:

- Service Limit Coverage Area: ACM's in these areas function only inside the coverage area polygon. These ACMs are Newspapers and Magazines.
- Courier Enabled Coverage Area: Couriers are the means used to transport Flyers. The coverage area is determined by time and speed of the courier.
- Satellite Coverage Area: Satellite phones and satellite TV do not have finite coverage areas. Service is either turned on or turned off. Line of sight checks are performed by the system.

DAMAGE CALCULATIONS

Any ID ACM is subject to reduced capabilities based on Battle Damage Assessment (BDA). As the tower or switch system becomes damaged, deliberately or collaterally, its ability to operate is reduced. For tower systems the reduction is a function of range and for switch systems it is a function of active coverage area.

AM radios, FM radios and broadcast television are dependent upon a tower and antenna being in place and functional in the infrastructure to broadcast the signal. Cell phones, cell text messagers, pagers and pager text

messagers are dependent upon a functional network of cell towers supporting a coverage area.

Cable television, land line telephones and telephone based facsimile machine are dependent upon a switching system supporting a coverage area to communicate. Web sites, chat rooms, BLOGs, email, computer based facsimiles and instant messaging are dependent upon a switching system supporting a coverage area to access the web and email.

Damage to towers occurs when the vertical stability of the tower is compromised through damage from an attack. Damage is provided as a percentage (0% to 100%). Undamaged the tower is vertical and allows the antenna an optimal transmission range. As the tower is damaged (non-zero BDA assessed) and flexes in its elastic region (below the yield strength of the material) the antenna is taken off the vertical axis and suffers a proportional reduction in its transmission range. Once the tower is damaged to the point it is permanently deformed (above the yield strength of the material) the antenna has reached the limit of its functional ability and will no longer transmit.

Damage to switches occurs when the integrity of the switch is compromised through damage from an attack. Undamaged the switch will distribute and connect ACMs inside its coverage area and outside its coverage area to compatible ACMs in other coverage areas. As the switch is damaged (non-zero BDA assessed) a net reduction in its coverage area occurs. However the switch represents a network of virtual subordinate switches manifested by the BDA assessment grid overlaid on the coverage area. As BDA is assessed BDA assessment grid rectangles are randomly removed reducing the effective coverage area. Switch coverage areas will retain some portion of their coverage area until the cumulative BDA reaches 100%.

BDA is cumulative and subsequent BDA will further decrease the range of the antenna or the coverage area of a switch. However repair and replacement of tower systems and switches are available based on the assigned regional communications tier.

DETERMINATION OF SUCCESSFUL TRANSMISSIONS

There is a sequence of checks and calculations that take place to determine if any message is transmitted and if transmitted, is received. The variables are the existence of and performance characteristics of like and compatible ACMs, the EOS and Latency associated with the regional communications tier, any damage that has taken place to ID ACMs and the expectation of delivery for broadcast ACMs to their target audience.

Expectation of delivery is the likelihood that a message transmitted via a broadcast ACM will be delivered and acted upon by the intended target audience. In the case of specific sub-populations, irregular groups, sleeper cells or organizations the assumption is that the target audience will be aware that instructions for action will be delivered via a specific set of ACMs and they will carefully monitor those means. Therefore the target audience, attuned for operational reasons, will be much more likely than the population at large to notice communications via these ACMs. For these reasons, for any message delivered by broadcast means, the expectation of delivery is 90% of the target audience who receive a message will act on that message.

Population density is assumed to be uniform. Total population of cities will be divided by total city area to determine density and total population of rural area will be divided by total rural population to determine rural population density. These factors are used to determine the actual population in the coverage area by proportion to total city/rural populations. Message delivery attenuation is accounted for by subtracting proportions for remaining coverage area and affected sides. This factor is specific to broadcast means.

MESSAGE TRANSPORT PROCESS

Messaging Sequence

There are two types of message processing sequences; one to one and one to many. One to one also accounts for a limited numbers of recipients based on ACM type and one to many represents broadcast ACM types.

Figure 2 represents an example of the one to one messaging sequence. Steps 2 – 5 are repeated as required by the processing tables for multi-echelon message transmittal.

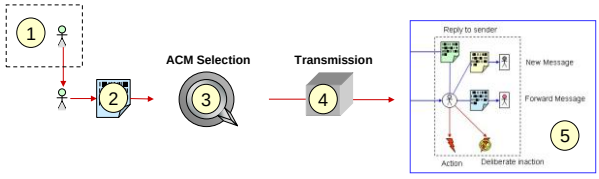

Figure 2. One to One Messaging Sequence

1. Controller establishes behavior sequence based on COE OPFOR plan and desired outcome to support training. Can also determine ACM to be used if desired. Controller loads sequence of tasks to appropriate organizations.
2. Agent consolidates necessary information and acts as directed to generate messages to subordinate(s).
3. Based on type of behavior and available organizational means the most appropriate ACM is selected, unless it has been directed in step 1.
4. Based on selected means; environment variables are set that read ACM performance, EOS, BDA, coverage area and transmission latency. The transmission is made with means specific conditions.
5. Recipient action based on received message.

Figure 3 represents an example of the one to many (broadcast) messaging sequence. Broadcast messaging is assumed to be direct from the sender to the target audience. The target audience must be known prior to message transmittal.

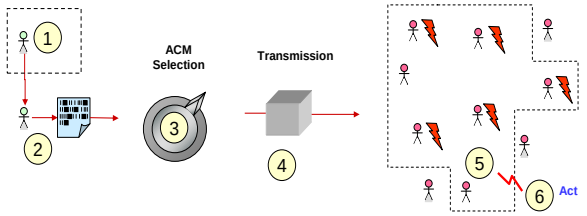

Figure 3. One to Many Messaging Sequence

1. Controller establishes behavior sequence based on COE OPFOR plan and desired outcome to support training. Can also determine ACM to be used is desired. Controller loads sequence of tasks to appropriate organizations.
2. Agent consolidates necessary information to generate message to target audience.
3. Based on type of behavior and available organizational means the most appropriate ACM is selected, unless ACM has been directed in step 1.
4. Based on selected means; environment variables are set that read ACM performance, EOS, BDA, coverage area and transmission latency. The transmission is made with means specific conditions.
5. The expectation of delivery, population density and sides relationships are used inside the coverage area to determine final target population message receipt.
6. Recipients act based on message content.

MESSAGE GENERATION AND CONTENT DISTRIBUTION

Message Generation

The behavior motivation message generation sequence for COE OPFOR can be broken into three categories: Development, Preparation and Execution.

Development: Once the OneSAF exercise objectives have been determined the exercise director and/or OPFOR controller will determine which message enabled COE behaviors can be used to support the objectives. Once these behaviors have been identified and sequenced (put in appropriate order of execution or dependency) the mission specific information required to enable the behaviors is developed (specific route guidance, engagement areas, time for execution, targets, etc.).

Preparation: The units to execute these behaviors are identified as well as any remaining mission specific information that is still required. The behavior specific information is entered into the appropriate behavior message table. Organization and Task Organization components can have a separate message table created or sub-unit unique information for a single behavior can be included in the base message table.

Execution: Behavior message tables are sent on command or at specified date-time-groups as determined by the OPFOR controller. Once messages are received and behaviors are being executed the OPFOR controller will interact with message responses (based on stimuli table thresholds) via the OneSAF Battle Command Frame for information on behavior status and results.

Behavior Message Content Table

Each COE behavior has a behavior message content table. It is via these tables that a higher echelon leader can direct subordinate organizations to perform specific behaviors or sequences of behaviors. These tables share the same format and it is only the specific behavior message content lines that are different. The table format includes:

- Sending and receiving unit, role and echelon.
- ACM order of preference for use.
- Behavior name and required discrete tasks.
- Data required to perform each task in order.

- Required checks that need to be performed in OneSAF to ensure each task is achievable.
- Listing of required message content including content name, dimension, data type and remarks.

If multiple subordinate units (*n*) are required to accomplish a specific behavior and any one/each subordinate unit requires unique information then the table can create *n* instances of sub-unit information. The number of instances of additional table entries can be determined by the number of sub-units from the task organization or organization listing for the behavior. These additional tables are part of the Behavior Message Content table and can be extracted based on the sub-unit designation once the message had been received by the executing unit. There is no requirement to embed multiple unit behavior message content in a single table for execution. A single table can be generated for each sub-unit if desired.

Iterative Message Transport and Receipt

The OPFOR Controller will introduce the behavior message table at the appropriate leadership position and echelon of the organization intended to perform the behavior. The message will travel downward by echelon (via the message path diagram, network topology table and processing tables) to the subordinate unit(s) intended to perform the behavior. The message will travel to the lowest unit level with discrete behavior functions. The sub-unit at each execution level will be able to access their respective behavior information by their unit name. If a separate message table has been created for each sub-unit the same distribution process will be executed for each message.

CONCLUSION AND FUTURE WORK

The development of the ACM and their characteristics, the CII and its capabilities and a feasible messaging process provides the ability to more accurately portray the COE OPFOR's battle command messaging in simulation. This enhances the fidelity of the threat's capabilities and will generate communications indicators that can allow for BLUFOR interception and interdiction of COE OPFOR activities and intent.

The level of fidelity of the models can be increased as simulation capabilities increase by using this work as a foundation for capability and resolution. These models and processes can be adapted to other simulations and projects.

The set of ACM and the CII are currently being updated to account for additional functional and technical capabilities in the 2015-2025 timeframe. For specific ACM and supporting data from this work see the University XXI Research Report (2005-2006), Texas A&M University, February 2007.

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