Content Centric Battlefield Visualization Mechanism and Solutions

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***Abstract*— We are designing a content centric battlefield architecture model to support Soldiers/Army, which are going to visualise and analysis of the Input receive raw data at data mining station. Previously, we had limited traffic in Battlefield networks and small number of known private servers with their contents and security concerns. The users of secured server interacted with limited number of servers which were known in advance. Today, the Battlefield networking, surveillance traffic, content servers and hybrid information have increased dynamically. The present Battlefield architecture is handling only data streams of bits between-end-to-end system for content of Battlefield services and its objects. The modern battlefield techniques and architecture is constantly evolving. Therefore, we need more resources to effectively visualize the pattern of the battlefield objects and situations.**

This paper presents a novel architecture model for interaction between battlefield entities based on content model for search. Where the basic object of battlefield is use as content irrespective of its location to be used for higher interaction between entities.

***Keywords*—Battlefield networks, Battlefield monitoring, Intelligent system, Soldiers Applications**

I. INTRODUCTION

A battle is a conceptual component in any warfare between two or more armed forces or combatants. Technically a war may consist of multiple battles. The duration of any battle, the area of the battle space and the forces participating in the battle space is approximately defined beforehand. Behind every battle there are a purpose of achieving a goal by the usage of military strategy and forces [1]. Victory in the battle is achieved if either of the combating sides forces the other sides to retreat or surrender or renders the military capability ineffective, of the other sides, for further operations. And when we talk about the battlefield then we are visualizing the two forces from different nations in fight over a large terrain. Battlefield is a combined strategy to combine all forces for the military operations which includes land, water and air space, environment, terrain, weather etc. to successfully demonstrate the combat capability of the unit. Weapons and equipment used in any battle field can be a decisive factor in the outcome of the battle. An army in possession of an advanced weapon proves to be a deterrent to its opponents [3].

The battlefield consists of various objects ranging from Army Humans, Army Weapons, Army Communication Equipment, Army Sophisticated weapons from both sides of the fighting armies. In any battlefield, information is power. The present war scenario has converged up to the fact that whichever army gets the details of enemy information in advance will definitely land in advantage. Only information alone cannot put an army on winning edge. It is the processed information from various resources which needs to be effectively visualized. A visualization of the information can be of single equipment to multiple clusters of equipment. If the content rich visualization pattern becomes available before hand, then there is a better chance to counter the offensive operations from the enemy [4]. With the heavy use of private networks of battlefield, the distribution of content becomes an issue which has to be created in to the system for effective content semi nation and dissemination. Since the battlefield objects and their information are highly secured so we can look up to the content-centric privacy scheme for Information-Centric Networking [2,7]. Content centric Battlefield architecture has to visualize for many content based servers which is redundant in many locations.

As we know the present model of communication in Battlefield is based on TCP/IP protocol and usually server oriented with servers and user devices are identifiable with their IP-addresses. And there are no distinctions between content centric and bit stream centric architecture. In this paper, we proposed a new visualization architecture which is Content Enabled Battlefield (CEB). In a way we can have cluster of important content servers of attributes of a specific domain centric objects. These attributes based on a single entity or a group of entities of any specific domain in which we are interested [5].

This paper is organized into sections as follows: Section II provides Problem in Battlefield Space. In this section, we briefly describe the problem space of battlefield with the respect of contents. In Section III, we present complex scenario and solution space for battlefield where we explore BECO with respect of battlefield tank and end user (EUSER). In Section IV, we conduct our main discussion based on future

aspect of battlefield based on content, user and End-user to improve the effect of battlefield services. In Section V briefly discuss the high light of content centric battlefield and its visualization aspects.

II. DEFINING THE PROBLEM SPACE

The present Battlefield usage is concerned by discovery of content and services and their retrieval. The user is just focused on the content and services and its speedy delivery of the data on to the user's system. The user is not at all concerned about the location of the servers as well as the quality of the content. These servers can be in any remote location, the user is not concerned about its physical location. As long as reliable, secure and private data is streamed, the user is happy with the present Battlefield architecture.

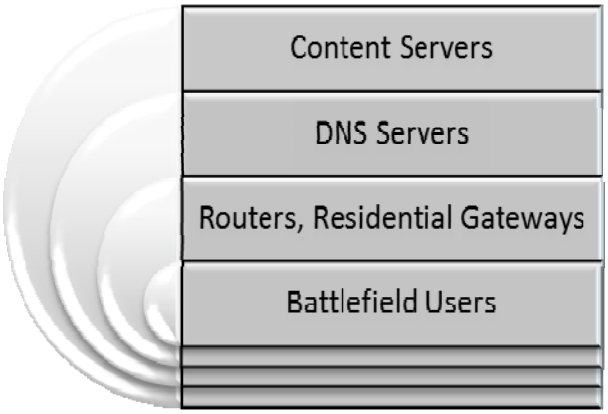

Figure 1. Battlefield Intranet

The present Battlefield architecture is as follows:

- Content/Information Servers.
- Another set of servers which include search engines and supporting servers such as DNS servers etc.
- Routers and residential gateways.
- The users which are connected via wired, wireless or mobile terminals.

The present system of battlefield visualization has become primitive. It uses symbols and that too on some static maps. We need more enriched content and symbols must be replaced by the content specific to the ontological meaning of the symbol that is being used in the map. Thus, specific content will need specific content servers which can be placed near the battlefield or at any remote stations. Here are some an intelligent Battlefield step search mechanism.

- ***Content Search by Private Search Engines:*** The search engines crawl the Battlefield Content Servers (BCS) to find the desired content and classify index of the contents. The search engines in case of battlefield are likely to be proprietary.
- ***Content Discovery by the User:*** The end user performs the searches and gets the feedback about the number of Uniform Resource Locator (URL) for battlefield entities.
- ***Content Delivery or Content Streaming:*** The user selects a URL and the content is delivered or streamed to the user.

III. EXPLORING SOLUTION SPACE

A. *The Battlefield Enriched Content Objects (BECO)*

Let us define a Battlefield Enriched Content Object (BECO) as a powerful, polymorphic object which will have enriched audio, video, images inference rules, behavior rules and rules regarding the combination of attributes of BECO object. Battlefield networks will be a large network panning across a large area of surveillance. Let us say there is a huge network of battlefield objects in a scale free formation [4]]. Let us say that there is a hierarchical structure command (HSO) under which all the army is aggregated and reported. Let us assume that there are five basic but distinct blocks of identification pattern. We will also need terrain objects as per their location of surveillance. These terrain objects can be images, videos, or any satellite images. We have given then small names to distinguish them. Let us divide them as follows:

TABLE 1. SPECIFIC DOMAIN UNDER GENERIC MILITARY BATTLEFIELD

S. No.	*Distinct Entity*	*Distinct Name*
1	Army Humans	AH
2.	Army Guns	AG
3.	Army Tanks	AT
4.	Army Engineers	AE
5.	Sophisticated Weapons	SW
6	Terrain Objects	TO

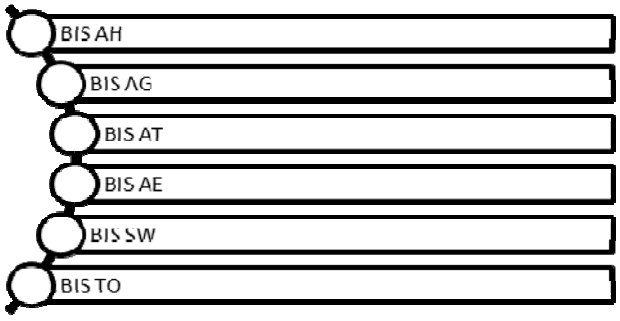

Figure 2. BIS specific content under Generic Military Battlefield

Table 1 abbreviation and their respective information are stored in a server which can be randomly located in a secure manner. The only objective is that the content delivery must be fast for the commanders to visualize the patterns developing in to the system.

For Example, Let's denote the battlefield end user as EUSER and we are talking about an enemy tank. We have described the attributes of BECO with respect to this tank. So we need to improved following mechanism.

1) ***Enhances audio-video experiences:*** Any audio/video which a EUSER can believe and perceive as tank from all directions can be created and used from the Battlefield Image Servers (BIS). These BIS will host specific images/audio and video for specific purposes as per the Figure 2. These BIS servers, according to their category, will send the content information to the EUSER for enhanced visual experience.

2) Inference Rules: BECO objects will have entries of rules regarding their manufacturing to usage, characteristics, ease of use, previous scenario of usages, previous history of battlefields, usage in offensive or defensive operation. Rules regarding the BECO object streaming to authenticate EUSER. Rules regarding the editing of BECO object must be there so as to make this as a new content object.

3) ***BECO Behaviour Patterns:*** These patterns can refer to the way one BECO object affect another BECO object.

Relationships between different BECO object at the same time and space may have different meaning to the strategy of battlefield. These inter object BECO relationship pattern must be present in to the system. BECO objects can be modified, organized in the way EUSER wants and merged with other BECO objects to create a new content BECO objects. BECO object use to travel in to the battlefield network to add/split in the network itself based on the intelligent network battlefields and the intelligent preparation of battlefield [5]. These pattern results are use in the system for variation in behavior of BECO objects. The behavior pattern can be edited as per the user requirements.

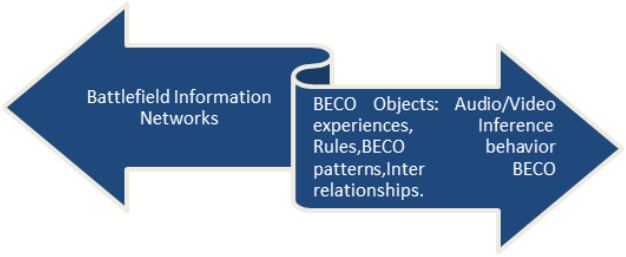

Figure 3. BECO Object

For Example in Figure 3 illustrate, the presiding officer just draws/writes a text in the simple manner. The drawing board is connected to the BIS server. As soon as the drawing is finished, the BIS server sends the audio/video/images of the drawn object and the BECO object is utilized effectively. This is an efficient and a rich BECO architecture/mechanism.

B. *Complex Scenario and Management Mechanism*

When thousands of battlefield users concurrently logs in to the server analyze the battlefield scenario, the bandwidth, security and latency issue arises. There is lot of challenges involved in the system. Following suggestions can be implemented so as to improve the current challenges in the Battlefield Content Servers.

- Content storage may be close to the end users thus implying the content delivery would have been much easier.
- If somehow there could exists a possibility that routers deployed in the system would be able to read the contents flowing inside them then the battlefield search engines would really help them out in to the system[6]. These routers need to be secured under the security aspects of the battlefield norms. If these routers are safe and secure they can be granted legitimate status of observing data contents flowing through them.
- The network should be an intelligent network so as to identify the chain supplements and the best path to the battlefield user.
- Content selection and adaptation in to the contexts that is present at that particular time. For example if there is an intelligence report of enemy occupying a strategic location then the Content Server shall start fetching the enemy data along with its capabilities and start constructing and playing the scenario on the high definition TV.

IV. Future Battlefield Perspective

Future battlefield will be divided in to many different units. These units may range from Infantry, to artillery units to tanks etc. Suppose we say that we have *n* numbers of these different *X* units. Some basic blocks of information will be common to the different *X* units. All these common information can be summated from number of units starting units to end units. This is represented by the equation: $\sum_{1}^{n} X$. The future of the battlefield mechanism will try to support following aspects.

- The common blocks of information, and the flexible creation of information, publishing of the information, discovery and usage of these common blocks of information.
- Location independent discovery of content must be enabled so as to make this information available to other contents searcher.
- Common services must be identified and listed for various purposes.

Future battlefield will be rich in content-centric data networks.

A. *Effects of the Services: User and End User-Centric View*

Content based media will be a huge advantage in terms of intranet usage and traffic. The quality of the media will increase further and experience of content becomes active and the number of EUSERS will increase exponentially in case the service attempts to create the user centric rich experience. The technology in any form will be useful for the higher commanders only if the ground level person is able to understand it and gives the desired information accurately. Thus, the end user is absolutely important for the technology

can bring ease in to his working style by the sheer use of technology. This will be the force to design for Future Battlefield and the applications that it can support. The following points will be considered while designing such a battlefield.

- The man nearest to the operation site is the end user. Let us denote him by EUSER.
- This EUSER is the end point rather than his machine/devices.
- Future Battlefield will be lot of service oriented capacity. There will be lots of service available to the user. The EUSER will have different compatibility and competency. But each of these EUSER must be allowed to explore these services for the better evolvement of these services.
- EUSER must also become part of the content production and if at all other users need their content data, they can access this data from EUSER via service-oriented networks.

There are two points in consideration. First that EUSER is intelligent enough to process the raw data in to intelligent processing of data. Second that the network used for EUSER can be an Intelligent Network. This intelligence of the network must not, in any way, bother the experiences by the EUSER. The importance of human EUSER must not be compromised on the basis of suggestions of Intelligent Network.

B. *Effects of the Services: Content-Centric View*

In the context of future Battlefield, we are relying on the three aspects of Battlefield. The three aspects are Service View, User View and Content View. Each of these three perspectives is an important driving force for Future Battlefield. The user is concerned about the user experiences and believes that Battlefield to be a network of military media users. The service oriented view is that of building faster and efficient applications using latest web technology. The content orientation provides the content creation and transfers can impact the network operation. Content-centric services include content distribution networking for both on-demand and live media distribution, content publishing, discovery, adaptation and processing services, DRM services, conferencing services, media annotation, indexing and search services [7].

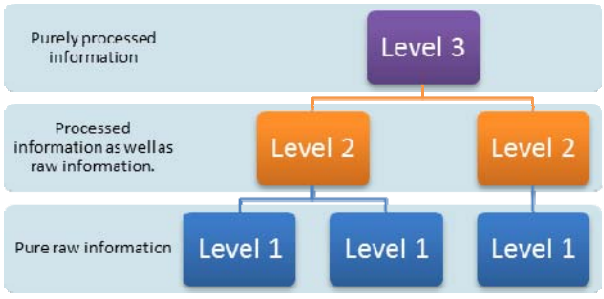

Figure 4. Multiple levels of Battlefield

A distributed processing must be implemented for concentrating on content rather than bit streams. Cloud computing can offer us vast resources for content centric battlefield evaluation. Raw information, processed information and combination of raw and processed information can be described as content. Basically, we can divide the content in to various levels. Each level has a slightly higher matured content than previous one. The processing standards of information for higher levels will be greater than the previous level of information. Content can be archived data, live data, static data, dynamic data etc. In the Figure 4, the level 2 content is called hybrid content as it contains information as well as raw information.

1) ***Battlefield Information:*** Any content in isolation can never be any information. It needs to be processed number of times so as to become information. Not only that every information can be processed number of times either sequentially or recursively so as to get the desired information.

2) ***Battlefield Services:*** Services are churned out of content or information or both. Recursive application of service creation modules need to be looked in to. Automatic handling or manual handling of these services is done so as to further create more services.

3) ***Battlefield End User Experience:*** Encompasses all aspects of the last man at the front with the services and the media that is being provided.

Battlefield Security and Privacy need to set of battlefield content, battlefield information and battlefield services and battlefield infrastructure.

V. Final Remark and Future Plan

In the battlefield, the information content creation is a lengthy process. Content components are created, and joined in a presentable manner and for better inferences. This completed content information is transmitted in to bit streams and which is assembled at the EUSER terminals and then played. What we can do is to identify the useful portions of the content and the near real time integration of useful sub contents which can result in real time experience.

What we visualize is that the EUSER application experience of the content will be rich but it will also fetch similar content information from other EUSER to enhance the content application experience. Let us describe a military content object from EUSER report to the commander. This report could have been in textual or any report form which is being described to the commander as enriched media content. This helps the commander in understanding the situation on the EUSER perspective. This reuse of content from an existing content to create a more rich content experience for EUSER and others will greatly enhance the situation analysis and understanding of the commander. This can also lead to an online intranet creation of audio-video content creation. To enhance the users experience the audio visual content can be inserted in to relevant intelligence report so as to visualize better understanding of evolving battlefield. For Example, There is a hostile situation development between two nations.

A battle space situation has arrived in the form of texts which says:

- Activity observed on mountain KX420 at night.
- Possible Missile Launchpad Seen at mountain KX420.

This will lead to the textual assessment of the situation development report and the key words from the report shall be extracted as per the military ontology.

Extraction of keywords shall reveal us the following information:

- Mountain KX420
- Night
- Missile Launchpad

After the extraction of key words, we now turn up to the Battlefield image servers for fetching the images/videos of the said keywords described in the assessment report. Fetching of Images:

- Image of Night Mountain KX420 from Terrain Objects Server.
- Images of Missile from Sophisticated Weapon Server.

Figure 5. Missile: Semantically Enriched Battlefield Content from various BIS (Battlefield Image Server).

The above situation report has been drafted in to the above image information. This will enable the user to have a clear visualization of about the terrain, the missile information as a BECO objects. The user can now know anything and everything about the BECO objects which is present in to the system.

We believe that in order to achieve the vision of a future battlefield fully suited to future EUSERS needs, several aspects need to be considered. To list a few, battlefield network structure complexity vs. battlefield engineering design simplicity, battlefield scaling vs. delivering quality and battlefield critical response time, battlefield efficiency vs. EUSER friendliness, services and BECO location. The suggested visualization patterns need to be fast, and latency issues have to be resolved. Even the BECO objects can be used for the future network fusion products in future battlefield intranet [8]. The foremost part is that of security. Each content server will have to enhance their security features. The communication channel will have to secure them. In future we will try to incorporate the content visualization with respect to heavy military security measures.

Finally, the EUSER can always alter this content to create a new personalize content which can be stored in the battlefield content server for further future battlefield scenarios. The EUSER can have multiple scenarios where each of the BECO objects involved will have their content fetched in to the system. Thus content rich visualization of the battlefield will be created with respect to the Terrain Objects also. This will greatly enhance the commander situation analysis and he can greatly adapt his strategy for his respective operations.

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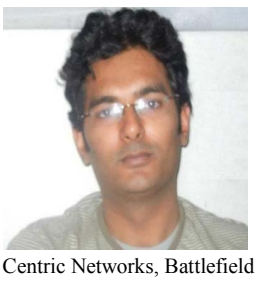

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