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Tailored Information Delivery and Service for Network-Centric C2 Support

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Tailored Information Delivery and Service for Network-Centric C2 Support

Abstract

In modern warfare, C2 center staff can face “cognition overload” when presented with an overwhelming amount of information (relevant and otherwise). A concept for alleviating this problem, “What You Get Is What You Need (WYGIWYN)”, is discussed in this paper. Tailored Information Delivery and Service (TIDS) uses the WYGIWYN concept to provide information that is essential for decision-making and task performance by weighting incoming data according to the accuracy of the sources and selecting, organizing, and delivering data according to the needs and priorities of different users. TIDS reduces data redundancy and overall quantity of delivery; the information is therefore less confusing and overwhelming to the users. Built as a Knowledge-Enabled Multi-Agent System (KEMAS), TIDS extracts, collates, and distills information from multiple sources; correlates, fuses, and packages the information according to each user’s unique operational requirements; ultimately delivers and displays information that has been customized according to mission priorities, user preferences, and other characteristics as indicated by metadata stored in a user-profile registry. TIDS’ agents can also take into account the degree of uncertainty inherent in sensory measurements and intelligence acquisition. By locating and extracting relevant information clusters, the TIDS maximizes decision-making capabilities and supports C2 personnel’s operational responsibilities.

Key terms: information-sharing, information service, network-centric warfare, C2 decision support, tailored information objects, software agents

I. Introduction

Warfare technology is advancing at a fast pace. Electronic technology provides warfighters with increasingly powerful sensory capabilities regarding space, air, ground, and underwater conditions. Powerful computing facilities collect and evaluate a vast amount of Intelligence, Surveillance, and Reconnaissance (ISR) data. Robust software systems generate hundreds, if not thousands, of complicated action plans and alternatives. These systems also provide “down to the point” assessment of possible outcomes. Automated systems ease the burden on personnel by reducing the number of physical units and the amount of mental effort that must be deployed to provide situational awareness. As a result, automated systems allow more time for personnel to train and to develop better responses to complicated situations; this time is an essential element in reacting correctly to asymmetric threats and combat. However, we are told by users in the field that information provided by poorly-chosen technological services is sometimes detrimental, perhaps less useful than information that would have been provided without technological assistance. For example, providing personnel with improperly organized information can overload warfighters and decision-makers by requiring them to sort meaningful from superfluous information. Because personnel would be thus distracted from focusing on key aspects of the battlespace and from critical decision-making tasks, it is conceivable that the quality and timeliness of their responses may be diminished.

As the U.S. military transforms from platform-centric to Network-Centric Warfare (NCW), one key to success is effectively sharing the right information, with the right people, at the right time and place. Or, as previously expressed, “the ability to achieve a heightened state of shared situational awareness and knowledge among all elements of a joint force, in conjunction with allied and coalition partners, is increasingly viewed as a cornerstone of transformation” [AGF99]. The stringent rules of engagement under which today's forces operate demand appropriate examination of data sources and optimal presentation of ISR information to warfighters. Delivery of information must be tailored to the operational requirements and specific missions undertaken by different command center personnel who may be focusing on different situational aspects and goals at the same time. To accomplish this tailored delivery, the information delivery system must clearly recognize which "pieces" of information are needed by which personnel – and when. Furthermore, system processes must be dynamic, able to reflect changing field conditions and shifting priorities. Effective tailored delivery of relevant information would reduce workload, alleviate task saturation, improve situational awareness, and increase decision effectiveness.

This paper presents a design concept for gathering, organizing, and delivering an extensive variety of ISR information to warfighters engaged in different aspects of a theater operation. Specifically, we tackle the problem of providing Tailored Information Delivery and Service (TIDS) to operational units or members of a C2 center. TIDS information is "tailor-made", adapted and dispersed specifically to users in order to accomplish assigned tasks. Throughout this paper, "tailored" means "a targeted and expeditious dissemination of selective information" (or, "What You Get Is What You Need (WYGIWYN))." Such information is operationally-focused and mission-relevant, designed to improve situational awareness and assessment. If users spend less time scrutinizing and filtering data, they have more time to draw accurate conclusions and make effective decisions.

TIDS requires system structures and techniques that allow for explicit collection of certain meta-data about data sources such as content, accessibility, quality, and usefulness, as well as categorization schemes used to re-organize and package information objects. For example, in the realm of information security, people with different security clearances have differing rights to access categories and pieces of data. Especially in the global war on terror, which involves a world-wide alliance of U.S. military operations, information would be accessed by or delivered to forces, alliances, and friends - or possible friends - in different locations worldwide. Availability of certain detailed information would vary, depending upon user roles and security levels. The TIDS approach could provide the necessary facilities and functionalities to associate information with contingent roles of users and tasks, while ensuring that services are in compliance with security settings.

This paper/project does not address the issue of information-management security in depth. Although security is indeed a vital issue, the primary focus of this paper is to discuss research tasks that will be required to develop the concepts discussed. It is believed that various existing security measures can be adapted and readily incorporated into TIDS system design.

The paper is organized as follows: In section II, we present the basic concept of TIDS operations. Section III discusses the software system model for the TIDS development. A conceptual TIDS system architecture and its functional blocks are described in section IV. Section V summarizes the TIDS effort with concluding remarks.

II. TIDS Concept

From the perspective of effectiveness, the existing model of information service for C2 operation leaves a gap between the cognitive abilities of many users and the information processing that the users must perform. There are many problems associated with information delivery and sharing, including bandwidth limitations, rapid delivery requirements, data condensation, intuitiveness of information presentation, etc. However, the challenge of delivering adaptive, targeted information is one problem that deserves particular attention. There has been much research directed toward the development of effective solutions to this problem. For example, there has been research toward leveraging information gateways to allow seamless sharing of information between data links, toward transmitting selected information into and out of battlespace, and toward providing timely, relevant data links to warfighters. New information delivery and service models, represented by the commercial Internet and Web technologies, provide great promise in the effort to ease information bottlenecks. However, more needs to be done to alleviate the “overload” problem and to improve efficiency in C2 information service.

The TIDS challenge is to design coordinated ways to collect, extract, fuse, and package pieces of data from multiple sources to create information that retains the degree of commonality required for efficient collaboration and is at the same time tailored to individual needs. Processes involved in a TIDS operation typically would include:

1. Search for, extract, and distill large amount of information from multiple sources in the NCW environment, according to the C2 mission and operational situations (as denoted by a common data specification stored in a metadata repository).
2. Correlate, fuse, organize, and package the integrated and selected information according to each user’s operational requirement and specification (as stored in a user registry).
3. Deliver and display the customized information securely, according to information priority, with respect to the C2 mission and operation, to individual user’s preferences, and to the cognitive characteristics of the information and the individual users.
4. Interpret, explain, and perform reasoning on the delivered information to produce a user-specific, integrated battlespace picture and to provide actionable knowledge according to the user’s operational responsibility and mission requirements.

For effective C2 operations, it is generally understood that sensors, geospatial databases, force locators, and automated reasoning systems within the command centers should operate on a common network. The required capability to correlate, integrate, and disseminate disparate “pieces” of information from heterogeneous sources (which are provided with differing degrees of certainty and reliability can impede crucial military operations [SZ96, KA97, RJ00]. Our view of human-system interaction in TIDS is toward the maximization of the C2 system’s overall capability (both human and computer) as it pertains to the information exchange-and-sharing environment. That is, the relationship between humans and computer systems should be mutually complementary. For example, sense-making (which includes situational awareness), mental models, intuition, knowledge, understanding, and decision-making, all occur largely in the cognitive domain. These tasks are also affected by individual psychology, professional expertise, and collaboration in communities of interest (COI). In this paradigm, the automated system is not a replacement of the human system (except perhaps in hazardous and humanly unreachable environments, where automated systems are *supposed* to replace humans). The principle upon which the automated system is developed is that the system should enhance human capabilities; in other words, the system should free human hands from tedious tasks and assist humans to do their best work[1]. The system should work with well-trained, knowledgeable operators to act as a “force multiplier” and to strike a balance between providing decision-makers with crucial information while at the same time not overloading them with extraneous information.

Domain-customization (a domain is simply an area of interest) is an important area of concern in TIDS development. Because users’ information requirements are dynamic and cannot always be anticipated, customization may be difficult. A quick, easy way to adapt information extraction to new and changing information requirements would incorporate users’ knowledge of revised requirements into the domain registry via on-line assistance. The task would be performed proactively as relevant information becomes available (from potentially multiple sources), executed by intelligent software agents within a Service-

[1] Because humans and machines (especially computers) possess separate yet mutually complementary capabilities, it is essential to let each do what they do the best; thus the outcomes of combined human-machine efforts are multiplied according to mutual capability enhancement.

Oriented Architecture (SOA). The incorporation of TIDS into an SOA will make viable the creation of domain-specific brokering environments. This architecture provides a foundation and a construct to deliver tailored information in the publish-and-subscribe model.

III. TIDS Models

A tailored information delivery and sharing system must be carefully designed so that it does not fail to deliver critical information to key personnel. TIDS system design and development must therefore be based upon a systems engineering approach that incorporates serious consideration of major system components and their links. The considerations include:

1. Use of the appropriate knowledge-engineering process for dealing with metadata, its repositories, and its representation (including user-profiles and registries), as well as the process used for information search, collection, extraction (filtering), and distillation. These processes must be considered during the design, construction, and implementation phases of the TIDS.
2. Use of distributed system controllers for maintenance of metadata repositories, user registries, tailored information objects, user interfaces; and coordination of the collaborative activities of the system components.
3. Software agents to act as Information Brokers (IB) for the integration and packaging of Tailored Information Objects (TIO) with respect to user requirements and metadata specifications.
4. Development of an SOA that would facilitate secure, reliable information delivery and service, and provide flexibility of the system configurations.

III.1 The role of knowledge engineering

It has been said that “shared information does not automatically, if ever, lead to shared understanding,” [Kau05]. There are significant differences between information and knowledge. Effective information-sharing relies on the presence of fundamental knowledge at all points, which enables information recipients to correctly process, understand, and react to the information. A robust, flexible knowledge engineering (KE) process is essential if users are to have a clear picture of environmental situations within the battlespace.

A well-designed TIDS scheme functions to aid warfighters by specifying what information is needed and by then extracting, packaging, and promptly delivering the necessary information. To ensure that tasks will be carried out efficiently and accurately, a TIDS system must be designed with the whole mission in mind and with specific situational knowledge in hand. For example, the system must consider the following:

1. What tasks are to be performed by each of the users?
2. When is a given task to be conducted (in time and sequence) by an individual user?
3. How is each task to be performed (i.e., what specific actions are to be taken)?
4. What information - general and specific - is required for optimal completion of each task?
5. What feedback needs to be shared with other users, and when should the feedback be offered?

This knowledge set is critical to TIDS’ performance. IBs can handle some information needs in real time, but it is nonetheless also necessary to build a user-profile registry. The TIDS KE process must establish a common dictionary of the data and metadata notations used within all functional components. A common framework for encoding meanings of information objects (into a mission-critical requirement matrix) should also be established. A correlational bridge must be formed between the high-level information objects and the lower-level data-encoding agents in order to support low-level data classification activities; these activities must be able to recognize the information objects with respect to the higher-level semantic and synonym-set representations that reflect battlespace situations. A TIDS belief-projection framework would provide the basis for calculating the degree of confidentiality and integrity necessary for secure communication. To provide maximum flexibility, the TIDS KE process must have a system-configurable semantic and inference mechanism which enables the problem space of the deployed environment to guide the activation of these functions.

III.2 The role of distributed system controller

The theoretical foundation of TIDS must incorporate the structure of a dynamic system [AH00] that uses software-agent technology for control, coordination, and operation [DS97, AKZ98, GPS00]. TIDS processes must have the ability to adapt to diverse and dynamic environmental variations and information objects with respect to type, meaning, and format. TIDS processes must also have the ability to adapt to frequent situational changes in order to dissect, re-assemble, deliver, and share information effectively.

TIDS system processes would evolve from the consistent activities and collaborations of three functional sub-systems: (1) a Client Management (CM) sub-system, (2) an Information Management (IM) sub-system, and (3) a Persistence Management (PM) sub-system. CM maintains the User Registry/Profile Repository (URPR) that holds each user's mission-relevant information requirements. IM collects, dissects, and re-assembles information into tailored Information Objects (IO) that match the user's needs. IM maintains the Information Object Repository (IOR) which holds information that is available to users and includes a timely repository-updating mechanism. IM also maintains the Metadata and Ontology Repository (MDOR) which contains information that regulates metadata categorization. To execute TIDS, the MDOR must contain information-object schemas that define various attributes of the user's information needs. Information requests, along with certain user characteristics, are mapped into the metadata categorization from the URPR to the MDOR. PM oversees maintenances of the URPR, IOR, and MDOR, ensuring that data held in the different repositories and registries are consistent and are updated timely with respect to situational changes and time lapses.

There would be at least three operational modes of TIDS processing:

1. <u>IO-Push Mode</u>: When a new or updated piece of information object is collected, the information would be placed into the IOR. An IO service-agent would scan the IOR to determine whether the new information matches characteristics specified by any users.). If a match is found, the information would be processed as necessary and conveyed to the specific user by a TIDS agent.
2. <u>IO Pull Mode</u>: A user would be able to initiate a request for specific information. Upon receiving the request, a task-coordinating agent would create a task plan; the IO extraction and fusion agents would scan the IOR, perhaps by instructing a retrieval-coordinating agent, would retrieve available relevant information, and would then package and deliver the tailored IO to the requesting user.
3. <u>IO Pick Mode</u>: When a new information object type is created in MDOR (as a result of new sensor type or ISR source installation), the TIDS engine (user interface agent) would send a message to all registered users describing the new IO, alerting all users that a new IO is available, and notifying specific users that relevant information is available, as indicated by a match to the users' profiles. However, the IO would actually be retrieved by a user agent at a specific time, as determined by the user's task schedule and current activity.

The degree of complexity inherent in the computational structure of TIO extraction and packaging would be determined by the breadth and depth of mission requirements, user knowledge levels and responsibilities, and allocation of computational resources. TIDS system components could be developed into functional blocks that are scalable to intrinsic information dimensions and knowledge levels. For example, the recording, evaluating, and interpreting components would form three aligned blocks of functionality. The recording block would consolidate data into groups of related information and place those groups into a lower level of the IOR. The evaluating block would rate incoming information with respect to existing knowledge (metadata) for relevance, accuracy, and reliability, and would then move the IO to a middle level of the IOR. When enough information has been accumulated into the middle level of the IOR by the evaluation agent so that a pattern is detected, that pattern would trigger an automated action of the data fusion agent which would generate a set of hypotheses. An evaluation of the hypotheses, in terms of state changes, would then occur in the interpretation block. The interpretation block would take output from the evaluating block, analyze the information in relation to what is already known, and would place the information, along with an indication as to the degree of significance of that information, into a high level of the IOR.

III.3 The role of software agents

Information brokering or mediation of high-quality information is a complex intellectual activity which cannot be fully replaced by automated methods. Fundamental functions of an Information Broker (IB) include the collection and utilization of metadata to support retrieval, selection, and distribution of relevant information. An appropriate operational environment would considerably alleviate the processing burden placed on human experts and enhance the experts' productivity. To provide users with a timely, well-organized service featuring highly integrated and customized information, the TIDS IB would play a unique role in conducting queries to information sources, improving the human-system interactions, and enhancing data discrimination and integration capabilities.

In TIDS processing, the IB would consider many variables and their relationships, including the following:

1. Prioritization of tasks and schedules – to know not only what operations are required, but also to prioritize them.
2. Collection, fusion, and organization of diverse data (e.g., terrain, threats, capacity, location, time) that may contain varying levels of uncertainty.
3. Qualitative and quantitative evaluation and assessment as to the feasibility and effectiveness of various hypotheses.
4. Resolution conflict regarding data received from dissimilar sensors - the ability to distinguish real-time sensor data from archive database data.
5. Correlation of data according to time, location, taxonomy, etc.
6. Maintenance of data reliability with regard to data sources, time latency, sparseness of data collection, etc.

The IO extraction-and-packaging agent is also a key component of the TIDS concept. The IO extraction-and-packaging primary functions would include the following:

1. Management of targeted acquisition, filtering, dissection, distilling, and re-assembly of information objects according to the metadata categorization and ontology.
2. Association/correlation of information obtained from multiple sources that may have different levels of certainties, and

3. Integration of *a priori* knowledge with dynamic data to create a comprehensive picture of battlespace conditions, including estimates of uncertainty.

Additionally, TIDS processing would weigh the degree of uncertainty present in sensor measurements and intelligence sources. A collection of "degree-of-belief" propagation and updating algorithms would be applied to the IM agents' functional blocks, performing quantitative evaluations with respect to relevant assessment propositions.

III.4 The role of SOA

A Web-based SOA would facilitate customer-tailored secure and reliable information service by allowing TIDS to distribute timely, integrated information to targeted users. The publish-and-subscribe service model is inherent in SOA design and Net-centric environments. This model provides fast delivery and easy sharing. However, if implemented inappropriately, the publish-and-subscribe model could increase information overload. Therefore, tailored information service should be considered in conjunction with the publish-and-subscribe model.

IV. TIDS System

IV.1. TIDS architecture

The software prototype of TIDS would be built as a Knowledge-enabled Multi-Agent System (KEMAS) in which intelligent agents are deployed to search, extract, and distill information from multiple sources; and then correlate, fuse, organize, and package information according to each user's operational requirement and specification (as stored in a user registry). The TIDS KEMAS would be organized into three layers (Figure 1):

1. The User-Interface Agents (UIA) layer;
2. The Information Delivery and display Agents (IDA) layer; and
3. The Information Extraction and Fusion Agents (IEA) layer.

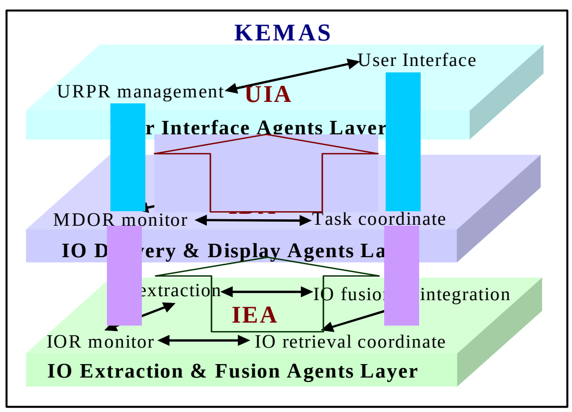

Figure 1. TIDS architecture

IV.2. TIDS functional blocks

The UIA Layer

The UIA layer holds three agents (Figure 2): a user-interface agent, a URPR management agent, and an IO display agent. The user-interface agent provides adaptable, real-time communication and data exchange between TIDS and users. The URPR management agent creates, stores, and updates user information according to user requirements. The URPR integrates mission and battlespace situation changes to ensure system interoperability. The information display agent maintains a built-in Display Preference Table (DPT) that specifies the location and format (visual, voice, light, etc) of information presentation in terms of warfighter attention span, task assignment, and psychophysics. The DPT entries are established by metadata categories as specified in the MDOR.

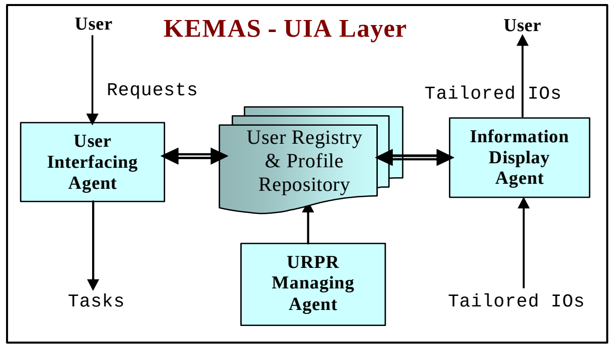

Figure 2. The UIA layer of TIDS

The IDA Layer

The IDA layer contains three agents: a task-coordination agent, a MDOR monitoring agent, and an IO delivery-facilitation agent (Figure 3). These agents create and deliver tailored ISR information packages. Information requests and user characteristics are mapped into the MDOR from the URPR at the IDA layer. The task-coordination agent manages the processes of mapping specific user requests to metadata categories and generating task plans for IO retrieval and extraction. The task-coordination agent oversees IO subscription and publishing processes, ensuring consistency and timeliness with respect to situation changes and elapsed time. The MDOR-monitoring agent maintains the MDOR which contains information object schemas, metadata tags, and categorical specifications that define attributes for the information to be collected, extracted, fused, packaged, and delivered. The delivery-facilitation agent takes IO from the extraction and fusion agent at the IEA layer, assembles tailored information packages, and then performs IO delivery via the user interface. All actions rely on MDOR metadata tags to result in selection and delivery of appropriate information.

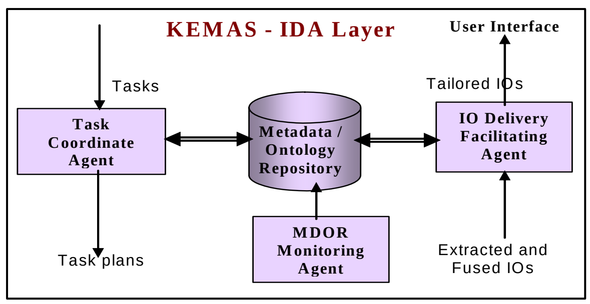

Figure 3. The IDA layer of TIDS

The IEA Layer

The IEA layer has four agents: an IO search-and-retrieval agent, an IO retrieval-coordination agent, an IOR monitoring agent, and an IO extraction-and-packaging agent (Figure 4). These agents interact to capture and generate tailored information objects that meet user requirements. The IO search-and-retrieval agent responds a given task plan (which has been output by the task-coordination agent of the IDA layer) by examining the current state of the IOR, and by generating IO queries (which are sent to the retrieval-coordination agent). The IOR monitoring agent collects IOs from the retrieval task-coordination agent, organizes and stores the IOs in the IOR, and updates the IOR as appropriate. The IO retrieval-coordination agent interacts with ISR sources and coordinates information retrieval by activating various query and search processes, thus retrieving the latest relevant information. The IO retrieval-coordination agent also responds to query requests from the IO extraction agent, interacts with the information sources, sends newly acquired information to the IOR, and notifies the IO extraction-and fusion agent. IEA agents seek to retrieve information from certain sources from relevant ISR sources and contents. Both the IOR monitoring agent and the retrieval-coordination agent have the capability to handle a large volume of IO throughput. The IO extraction-and-packaging agent interacts with the IOR to associate, correlate, partition, and re-assemble IOs in terms of metadata categorization, and to create information clusters that match user specifications (publishing).

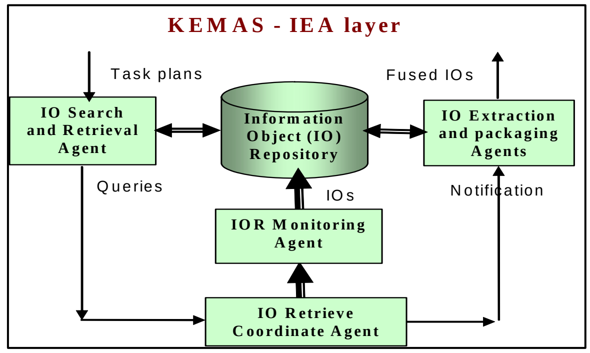

Figure 4. The IEA layer of TIDS

Major functional components of the TIDS system would include the following:

1. Metadata repository – to maintain a set of common language terms for both information provider and consumer (sender and receiver);
2. User (subscriber) registry/profile/ontology– to maintain information specifying the user's role, characteristics, and information requirements (Knowledge management); and
3. IBs – to extract, fuse, package, and deliver information tailored to each user's specifications.

Auxiliary components would include a user-system interface, a system controller/coordinator, a visualization display, and additional agents to search and collect information. KEMAS would include two types of agent interaction.

1. Vertical agent interaction – agents operate in a "request-and-service" mode between layers, and
2. Horizontal agent interactions – agents operate in "negotiation-and-collaboration" mode within a given layer

V.3. Data extraction and IO packaging techniques

Data extraction-and-packaging agents consist of the following three primary types of computational components:

1. Continuous computational component to handle variables in an analogical representation of environmental knowledge,

2. Discrete computational component to handle variables in prepositional representation of environmental knowledge and inference outcomes, and
3. Hybrid computational component to handle measurement and evaluation functions applied to continuous and discrete variables.

In an example of a simple configuration, a continuous component would be constructed to serve as a representation of image frames that have been retrieved from an environmental-terrain database. A discrete component would extract the state representations of object identities from the images through integration of the environmental knowledge with the real-time sensor inputs. The hybrid component would use evaluation criteria and cost functions, applied to continuous and discrete representations, to provide a situational assessment about the scene pictured in the images. Statistical and symbolic logic, based inference mechanisms such as the Dempster-Shafer's belief combination [Ba91], Hidden Markov Models (HMM) [Ma97], and first-order predicate logics [DT99], can be applied to these computational components. A typical inference process could include operations for sequential invocation of the space decomposition, truth propagation, parameter modification, and proposition repositioning. A relevance-feedback technique, using automatic parameter modification based on judgments regarding the relevance of the information, would be applied to process components [LCV02]. The process would also apply reasoning to derive meaning from observed data.

Functional components of the IO extraction-and-packaging agents also include those that interact with information objects in the IOR and use cues to find missing data for various intelligence resources that are difficult to determine the context automatically. The hierarchical alignment of the functional components renders the TIDS system considerably scalable. In a typical TIDS process, the bottom layer of the system hierarchy is devoted to *interaction with information sources*. The agents at this layer make use of various computational mechanisms to support the real-time data filtering, extraction, and distilling processes. In the middle layer, the functional components are set for *real-time data integration and reasoning with an application of various inference mechanisms*. At the top of the hierarchy, the functional components accommodate the *evaluation and presentation of information*. Adaptation takes place at all layers by adjusting agent function parameters. Control functions, embedded in these layers, regulate how state changes affect and propagate the IO. The KEMAS implementation of TIDS would provide a domain-specific solution to information sharing. TIDS would be easily deployed and managed, would be extensible and automatically modifiable, in accordance with security requirements and physical limitations of end system connections.

V. Conclusion

One reality of modern battlespace is that warfighters may be presented with voluminous information from multiple sources. To be successful, C2 operation must have the ability to share critical information and knowledge with networked forces in a timely manner. The very nature of asymmetric warfare requires rapid, coordinated, and systematic responses to threats from all dimensions. The possession of an information-integration capability would be a valuable asset. TIDS would enable warfighters to operate from improved situational awareness, to reach faster conclusions, to develop more effective responses to threatening situations, and to seize opportunities faster than their opponents. Summarized, TIDS would provide NCW forces with superior information, knowledge, and decision-making abilities.

Command-and-control (C2) operational environments are "information-intensive". Information sources that are efficiently and fully exploited are more likely to provide information enabling commanders to obtain relevant information and to make informed decisions. The synergistic integration of humans with autonomous systems (software agents), active and passive sensors, and data fusion engines is crucial to create a cohesive loop of information gathering, analysis, management, dissemination, and decision making. However, the viability and successful operation of TIDS requires systematic construction of a metadata repository, a carefully-defined domain ontology, proper set-up of user registries, and a thorough understanding of user needs. We believe that failure to properly implement tailored information delivery and service will one day be seen as regrettable, if not disastrous.

The foremost objectives of a multi-service information delivery enterprise, as studied in this paper, are to extract, deliver, and share the "right" information, with the "right" people, at the "right" time and place. Tailored information service is about determining and executing what is "right". To optimize information utilization for warfighters, to improve human-system integration, and to enhance combat capabilities in complex battlespace situations, TIDS will be essential. Therefore, research to develop the TIDS concept is imperative. An ultimate goal of the research is to create a system of information management that demonstrates advanced human systems integration and to establish how communities of warfighters and commanders can realize significant improvement in their abilities to strategize, act, and to complete their missions successfully.

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