

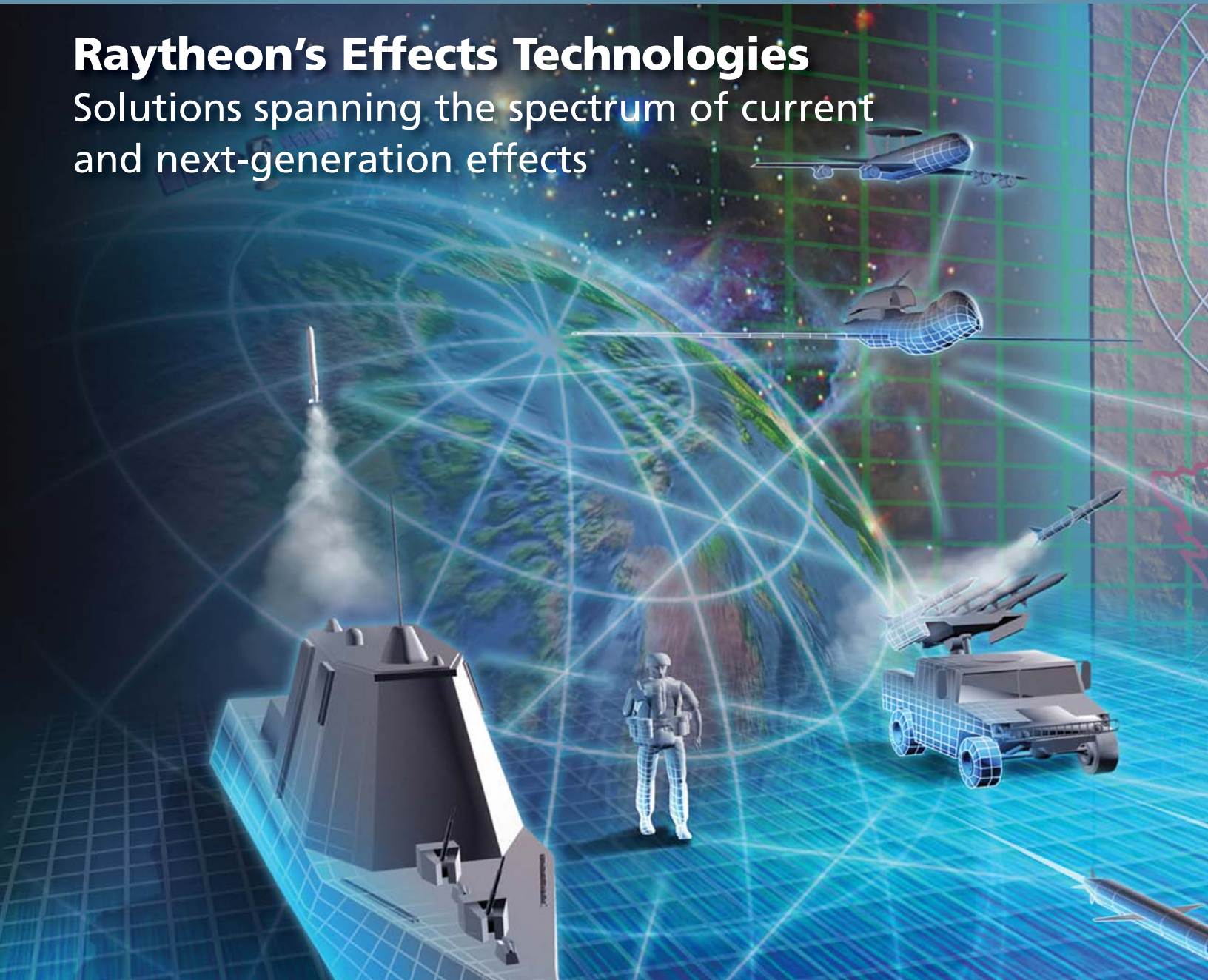
Technology **Today**

HIGHLIGHTING RAYTHEON'S TECHNOLOGY

2008 ISSUE 2

Raytheon's Effects Technologies

Solutions spanning the spectrum of current and next-generation effects



Raytheon

Customer Success Is Our Mission

Pushing Information Technology to the Tactical Edge

Information Technology (IT) is a key element in Raytheon Missile Systems' (RMS) drive to expand its core effects market and expand into adjacent markets. The Innovation and Technology Directorate identifies, develops and champions technology research to make Raytheon a leader in net-centric systems.

During the last two years, the directorate has addressed complex questions related to the tactical edge of military operations, and making Raytheon weapons part of the net-centric environment (NCE). As described in this issue's articles about Project NINJA and net-enabled effectors, creating a netted-weapons system requires collaboration among many different expertise areas.

Within a net-centric environment such as the Global Information Grid (GIG), creating actionable information from data that are streaming in from hundreds or thousands of sources is beyond current capabilities. Numerous problem areas must be addressed to provide our customers with even the basic tools and infrastructure to realize the potential of netted weapons. Achieving this vision presents significant computing challenges that exceed current net-centric warfare practices, paradigms and infrastructures, which are based on static, pre-orchestrated and centrally mediated models and implementations.

The Tactical Edge

The tactical edge presents a number of problems that must be addressed to achieve the goal of weapon net-centricity. Providing communication and control through enhanced onboard systems does not provide the full functionality warfighters require. Net-centric operations involve:

- Intermittent network connectivity
- Registration and authentication requirements

- Synchronous versus asynchronous applications and communications
- Cross-system data fusion
- Information timeliness
- System interoperability and data transparency
- Bandwidth constraints
- Command and control
- Integration of domain-specific architectures

The major factor is intermittent network connectivity. Battlefield network connections are unreliable, and cannot sustain operations that demand full-time, reliable, high-bandwidth connections.

Identifying workable solutions to each of these issues will require considerable effort. RMS IT is exploring asynchronous processes and cross-system data fusion, primarily related to authentication and authorization, as well as decision services for weapon selection, and predictive methodologies.

NetFx

Initially our effort was under the label *Netted Effects* (NetFx), but this effort focused on only a few aspects related to tactical-edge services. In addition, we developed a core set of services to test initial concepts related to environments that have intermittent, asynchronous communications.

NetFx is a service-oriented architecture (SOA) that is fully consistent with work of the Defense Information Systems Agency and the office of the Assistant Secretary of Defense—Networks and Information Integration to build a GIG evolution infrastructure. The NetFx project was an integrated team collaboration between RMS' Advanced Programs product line, RMS Engineering's Netted Weapons Systems

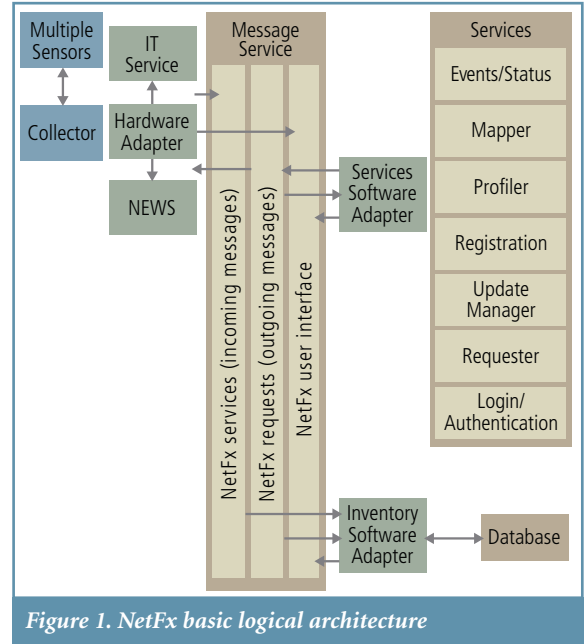


Figure 1. NetFx basic logical architecture

Solutions group, and RMS IT's Innovation and Business Solutions directorates.

SOA, Services, and the Tactical Edge

Applying the supporting infrastructure of an SOA to the tactical environment is a resource-constrained problem. Identification of a tactical edge implies a concentrated area, but most people think of the NCE as a larger area. The NCE is where most computations must occur, due to limited computing resources on-board the weapons. However, Raytheon distributes the computational problem by positioning services across the tactical edge. These edge services will be able to provide in-place solutions, partial feedback, or input to other services within the NCE or any combination of all of these.

We make the distinction between edge components and the main NCE by our designation of where services primarily reside and the amount of core capability required by the service bus. We consider services that are within the NCE to be part of our Universal Data-acquisition, Analysis

Decision System (UDADS). It maintains a core set of services on the bus to provide primary connection capabilities, such as authentication, as well as more computationally challenging applications, such as ranking engines. The amount of computational effort for UDADS services requires the type of high bandwidth, high availability, and network connectivity associated with the NCE. In order to maximize the scalability of the system at the tactical edge, we are working with Advanced Programs to develop a lightweight Tactical Service Bus (TBS), which provides a more limited core capability that can be used with minimal infrastructure requirements. Initial TSB versions developed by RMS' Advanced Programs product line have been used successfully on unmanned aerial vehicles.

Web-based Versus Autonomic Services

The predominant approach to services under SOA is Web-based, using either Simple Object Access Protocol or Representational State Transfer. Accessing these services through a Web browser is both convenient and efficient if the operation is relatively simple and requires human interface. However, human operators cannot integrate sensing, platforms, policies and actuation with physical models in a dynamic and data-driven manner to enable end-to-end discovery cycles, based on the level of dynamism and adaptability that must be supported. These requirements include the amount of system and information uncertainty that the applications must tolerate.

To address shortcomings of the Web-based approach, RMS is focusing considerable effort on developing autonomic services. Similar to Unix® daemon processes, autonomic services examine message traffic being generated by all of the network-attached devices and users, and determine whether messages contain information the service could use. One service might use the data and add its results to the cloud of data crossing the network. Other services might combine those data with other data to continue developing better information.

Services RMS is developing can be categorized as:

- Core: authentication, authorization and policies
- Analysis: data transformation, statistics
- Synthesis: multidomain data fusion
- Predictive simulation: multifactor scenario generation
- Visualization: multidimensional representations

The following sections discuss some current RMS focus areas.

Semantic Technology

Semantic technology includes methods and tools for data integration, modeling, reasoning and inference. The Department of Defense mandates describing net-centric information via metadata, modeling and service standards. These requirements change a historical focus on data storage and manipulation to intelligent integration of disparate sources modeled by domain experts in a dynamic, scalable way.

We also incorporate emerging semantic technology standards in concept proofs and prototypes. In addition to Resource Description Framework (RDF) and the Web Ontology Language, concept proofs employ a standard processing and RDF-query language for querying, storing and operating on rules with the Semantic Web Rule Language.

Asynchronous, Autonomic Services

One of our main objectives in autonomic computing is to generate continuous, if minimal, solutions to multiple problem scenarios. We term this type of action Accelerated Discovery Cycles (ADCs). These work by coupling recent advances in computational models and cyber systems with net-centric applications and devices.

ADCs are predicated on the premise that a partial solution to a problem is always possible. The associated confidence level of any particular solution can be increased by identifying that which is reducing confidence, then requesting additional appropriate data acquisition to strengthen the confidence.

The inherent dynamic nature of the problem means that all solutions are related to the data at that point in time. The hallmark of ADC is its ability to dynamically couple and autonomously configure real-time complex and customized interaction between physical models, environmental sensors and effectors, and experimental protocols.

Information Assurance (IA)

IA is the practice of managing information-related risks to protect data confidentiality, integrity, availability and delivery systems. These goals are relevant whether the data are in storage, processing or transit and whether threatened by malice or accident.

As part of Raytheon's ongoing IA efforts, RMS has been examining methods to provide security both on the tactical edge and between the edge and the main NCE. One of our primary considerations is the use of autonomic services to allow sophisticated software agents to perform intrusion detection, cyber-threat mitigation, and network protection. Research areas include self-healing networks, power management, automatic application isolation, and automated recovery initiation.

RMS IT has adopted a forward-looking stance for developing new technologies in support of netted weapons and other aspects of Raytheon products. We are working with academic research labs to identify technologies that might be applicable to customer needs. We actively seek collaboration with other Raytheon businesses, national laboratories, and industrial partners in this ongoing effort.

"IT is taking on a challenging new role," stated RMS IT Vice President Styne Hill. "We are helping extend Raytheon's core products as well as contributing to the development of technology and information solutions that expands adjacent market opportunities." ●

*Dr. George L. Ball
george_ball@raytheon.com
Dr. Kevin Lynch
kevin_j_lynch@raytheon.com*

UNIX is a registered trademark of X/OPEN COMPANY LIMITED CORPORATION

Copyright © 2008 Raytheon Company. All rights reserved.

Approved for public release. Printed in the USA.

Customer Success Is Our Mission is a registered trademark of Raytheon Company.

Raytheon Six Sigma, MathMovesU and NoDoubt are trademarks of Raytheon Company.

MATHCOUNTS is a registered trademark of the MATHCOUNTS Foundation.

Capability Maturity Model, CMM and CMMI are registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

Raytheon

Customer Success Is Our Mission