DARPA plans for Dispersed Computing (DCOMP) program that dynamically boosts computing power for real-time battlefield understanding

In military applications, particularly those oriented toward real-time battlefield understanding, synthesis of actionable information from diverse data sources in near real-time becomes an important requirement.

In the current art, users with significant computing requirements have typically depended on access to large, highly shared data centers to which they backhaul their data (e.g., images, video, or network log files) for processing, says DARPA. However, in many operational scenarios, the cost and latency of this backhaul can be problematic, especially when network throughput is severely limited or when the user application requires a near real-time response.

Dispersed computing is an approach that can leverage the collective computing power of dissimilar, dispersed edge devices such as smart phones, sensors, and microclouds available "locally" (in the sense of latency, available throughput, or similar measures that are relevant to the user or mission) . Users can borrow processing and communications resources from its many nodes as and when needed to accomplish whatever task or mission .

This research program has the potential to give our warfighters a significant information advantage by enabling warfighters to collect, transmit, and process information even in situations where where network connectivity is highly

variable and degraded and access to a remote data or operations centers– or even a reliable laptop computer–cannot be counted on.

US Army has also planned for dispersed computing. The future Army network will be a highly dispersed computing infrastructure consisting of and leveraging the computational capabilities of assets that span Soldier-carried devices, apparel, weapon systems, command post servers and higher-echelon systems, according to Army's new, long-term, network strategy called "Shaping the Army Network (2025-2040)."

Dispersed Computing Program

The Dispersed Computing program seeks scalable, robust decision systems that enable secure, collective tasking of computing assets in a mission-aware fashion by users with competing demands, and across large numbers of heterogeneous computing platforms. The envisioned computing paradigm aims to enable the strategic, opportunistic movement of code to data, and data to code, in a fashion that best suits user, application, and mission needs.

However, in the decades since the Internet architecture and its main protocols were first defined (such as the initial description of the Transmission Control Protocol (TCP) in 1981), network transmission capacities have grown by many orders of magnitude, users' application requirements have changed enormously, and programmable, secure high-speed information processing within the network is now technically feasible.

These advances warrant a fundamental reconsideration of how one might leverage programmable execution environments that are located along the path between end-points to boost performance through, e.g., dynamic modification of protocol logic, or localized in-path analytics to facilitate efficient

diagnostics and corrective actions.

Dispersed Computing also seeks innovation in network protocols. The lack of programmable computing capabilities within data networks, together with the “end to end” design principle that has guided Internet architecture from its beginnings, have resulted in application-layer and transport-layer protocol logic largely being confined to the end points that act as sources and sinks of the data.

According to Dr. Stuart Wagner, Information Innovation Program Manager at DARPA, DCOMP is seeking to design protocol stacks that are as streamlined and synthesized as possible for rapid data transmission in areas where network access is limited.

The project seeks to create programmable platforms networked computation points (NCPs) that use Dispersed Computing software. An NCP could execute functions in support of user applications, network protocol stacks, or both.

The current DCOMP program is designated to be four-years long with two 24 month phases, and it is made up of three Technical Areas: Algorithms for Dispersed Mission-Aware Computation, Programmable Nodes and Protocol Stacks, and Technology Integration.

Algorithms for Dispersed Mission-Aware Computation

The first technical area will develop algorithms and control mechanisms to enable efficient use of networked, geographically dispersed, heterogeneous computing capabilities.

These algorithms will benefit users whose tight constraints on

latency make interactions with distant data centers difficult, and whose computational complexity may preclude sole reliance on the user's end device. In such cases using computing power from nearby networked computation points may enhance user performance.

New algorithms also could help with processing sensor data when users are limited to nearby computers to reduce the need for high-volume backhaul of unprocessed information to distant data centers. Algorithms must be able to rank the importance of available computer resources among competing tasks and users. Systems should be able to scale to thousands of simultaneous users and computing locations.

Programmable nodes and protocol stacks

Programmable platforms incorporating Dispersed Computing software will be referred to as Networked Computation Points, or NCPs. A given NCP could execute functions in support of user applications, network protocol stacks, or both.

The second technical area, programmable nodes and protocol stacks, seeks to develop programmable protocol logic within the network – primarily at the transport and application layers of the five-layer protocol stack model.

These may include new functions on user devices that interact with networked computation points to optimize overall performance, such as localized probing, measurement, and analytics for network diagnostics; on-the-fly synthesis of protocol logic; dynamic modifications of NCP platform resource allocation; or adaptive packet or flow manipulation at NCPs.

The four companies carrying out the DARPA DCOMP program are Raytheon BBN Technologies in Cambridge, Mass.; Applied

Communication Sciences, a Vencore Labs company, in Basking Ridge, N.J.; the BAE Systems Electronic Systems segment in Burlington, Mass.; and LGS Innovations LLC in Florham Park, N.J.

Raytheon to develop new software for dispersed computers

Raytheon BBN Technologies will develop new software for the Dispersed Computing (DCOMP) program that is designed to increase mission data computation capabilities and improve network reliability in the field by leveraging local computing resources, according to the Pentagon.

DARPA awarded Raytheon a $10 million contract to develop software algorithms and protocol stacks that will allow commanders to bypass the overburdened data processing centers, or at least supplement them with other infrastructures, for their mission computing needs.

Raytheon believes these programs and applications will boost computational capability and to process more complex data demands by using local computer resources. They are also designed to distinguish available computer resources and designate them to data computing tasks in order of importance.

The programs and applications developed from the algorithms will be supported by programmable software platforms using DCOMP software called Networked Computational Points, according to DARPA.

LGS Innovations

LGS Innovations announced today it has been awarded a four-year, $7.5 million cost-plus-fixed-fee contract by the Defense

Advanced Research Projects Agency (DARPA) under the Dispersed Computing (DCOMP) program.

Under the terms of the contract for the first phase of the program, LGS will develop algorithms and protocols for identifying, connecting, and tasking dispersed computing assets for simultaneous users with competing demands at different priority levels in a dynamic network environment.

The program also seeks to reinvent and innovate the network protocols that have traditionally guided Internet architecture. Goals for the first phase of the program include a significant reduction in latency and bandwidth consumption and significant, measurable gains in application performance utility.

“The possible applications for a fully developed dispersed computing approach are readily evident and game changing,” said Kevin Kelly, CEO of LGS Innovations. “This research program has the potential to give our warfighters a significant information advantage.”

LGS will partner with BAE Systems and Princeton University on the program.

Vencore Labs

Vencore Inc., announced today that its innovative research arm, Vencore Labs, has been awarded a $10.3M prime contract to provide research and development services in support of the Defense Advanced Research Project Agency’s (DARPA) Dispersed Computing (DCOMP) program. Work on the cost-plus-fixed-fee contract will take place in Basking Ridge, New Jersey through 2021 and has a value of

The DCOMP program aims to remedy the cost and latency issues of data computation in a rugged, operational environment where

network connectivity and power is limited. By leveraging dispersed computing systems, the DCOMP program seeks to create software instantiations of protocol stacks and algorithms to improve performance of networks and applications.

Under the contract, Vencore aims to provide DARPA with innovation in network protocols. Specifically the company proposes a solution leveraging programmable network elements that collect in-path network data for analytics and uses these analytics with programmable protocol logic for boosting network performance.

“Today’s network is pretty static,” says Petros Mouchtaris, president of Vencore Labs, which is exploring programmable networks for DARPA as part of the DCOMP program. “The computing capabilities we have in our hands, at what we call the edge of the network, have really changed dramatically since the internet was invented. At same time, the core technology of the internet hasn’t really changed at all.”

Updating that core technology, according to DARPA, will require overhauling the very stuff that knits the internet together: its protocols. “Melding computing into communication is a dramatic rethink of the models and architectures we have become accustomed to,” says Jonathan Smith, DARPA’s program manager for DCOMP. The TCP/IP protocols, in use since the early 1980s, are good for getting information from one place to another, but that’s no longer enough.

One of the challenges, Mouchtaris says, is to help the network avoid navel-gazing. “When you try to make things adaptable, there’s a lot of work you want to do to check how things are,” he says. “That generates a lot of overhead. You want to very quickly find out about what’s changing in the network and adapt quickly, but you don’t want to flood the network with requests for information about what’s going on.

“This work leverages Vencore Labs’ industry-leading expertise

in networking and analytics," said Petros Mouchtaris, Ph.D., president of Vencore Labs. "We look forward to expanding our relationship with DARPA to bring them an innovative solution in support of this important mission."

References and resources also include:

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