

# Homeland Defense

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**“YOU ARE NOT AN ENEMY COMBATANT.  
YOU ARE A TERRORIST.  
YOU ARE NOT A SOLDIER IN ANY WAR.  
YOU ARE A TERRORIST.  
TO GIVE YOU THAT REFERENCE,  
TO CALL YOU A SOLDIER GIVES YOU  
FAR TOO MUCH STATURE.”**

**— JUDGE WILLIAM YOUNG TO “SHOE BOMBER” RICHARD REID**

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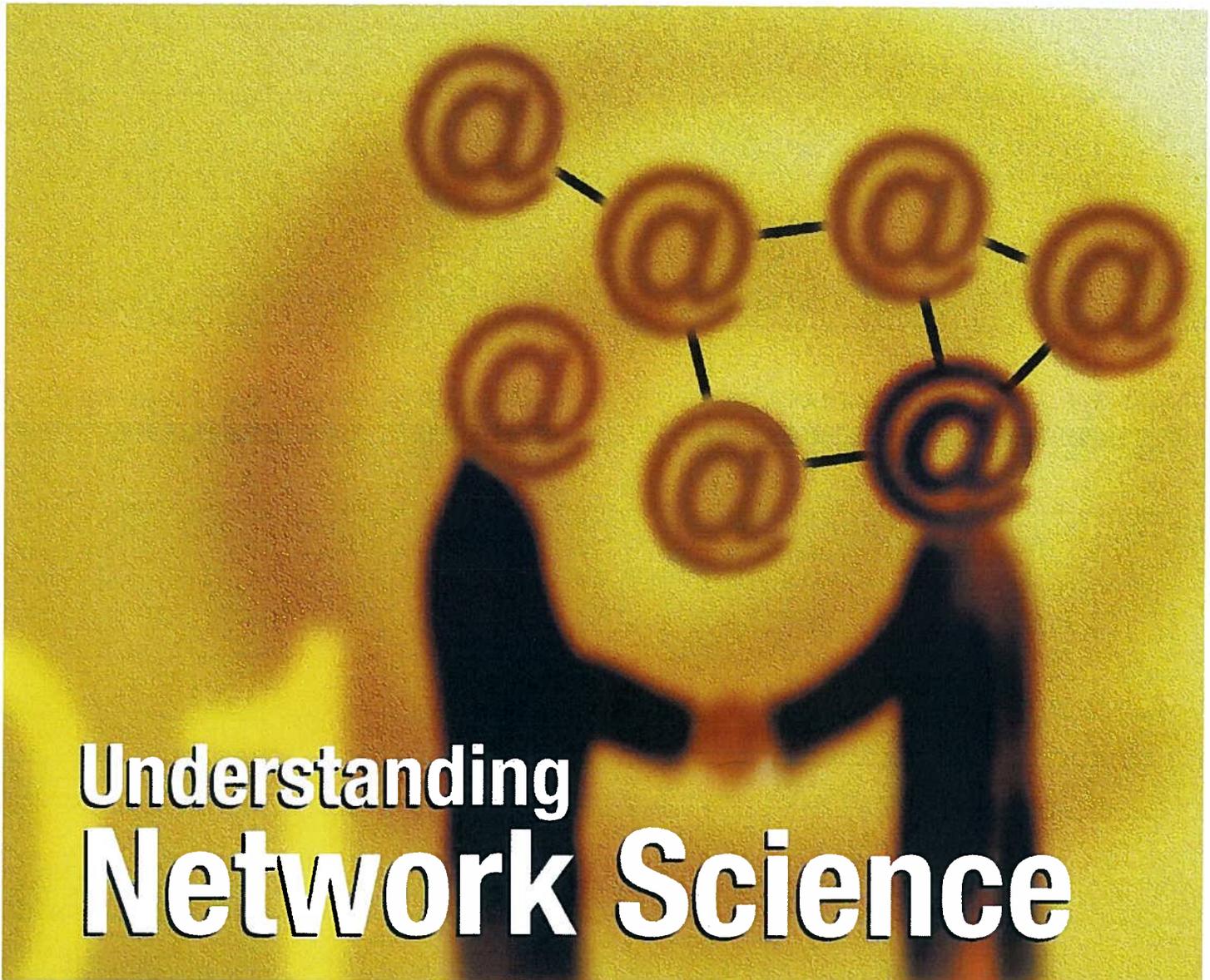
## DATA SECTION

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DATA SECTION ARTICLE



# Understanding Network Science

by Paul Serluco

**W**hat do captured enemy documents, Internet communities, IEDs and text messaging have in common? They all depend on networks: networks of people, influence and technology. And they're all subjects of an emerging new discipline called Network Science.

An interview with Dr. Frederick Moxley, Defense Information Systems Agency Fellow and Visiting Professor at the U.S. Military Academy (USMA) follows. He is one of the leaders guiding the development of Network Science and its application to today's defense challenges. We interviewed Dr. Moxley regarding the new Network Science Center being stood up at West Point and the results already achieved.

**Q: What exactly is Network Science and why do we need a new discipline?**

Our world is getting more and more interconnected as a result of technologies, such as the Internet, cell phones and text messaging. Network science is the disciplined study of these and many other types of interconnections. Network scientists establish the methodologies appropriate to various domains and use them to gain new knowledge of how these networks behave and proliferate.

**Q: Can you give us any examples of Network Science at work?**

Homeland Defense readers will remember the dramatic video of Saddam Hussein being pulled from a hole in the ground. He'd been moving among a number of hiding places for months and wasn't using cell phones – but he was depending on a network of supporters. By patiently mapping this social

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network, based on open-source information and the results of interrogations, analysts were able to narrow his likely hiding places to just a few, which they kept under surveillance. In addition to the social dimension, there are also networks of shared beliefs and mindsets, networks of information sharing among businesses and agencies and, of course, the communications networks that enable it all.

### **Q: How did Network Science get started?**

Actually, network science can trace its roots back to the 18th century when discrete mathematics evolved into what came to be known as graph theory. Graph theory was first used to describe the properties of diverse linkages and pathways – what we now refer to as networks. The focus today however, is much broader, in that quantitative methods are now used to assess real-world and non-static networks, which are much more complex in nature. What's more, we now have the ability to access empirical data pertaining to network instantiations as they begin to form and appear – hence the need to understand their development by using a scientific method.

The Department of Defense (DoD) has been interested in networks and networking and its effect on command and control for sometime now. For instance, in books, such as *Network Centric Warfare*, *Power to the Edge*, and *Understanding Command and Control*, Dr. David Alberts from the Office of the Secretary of Defense, laid out the impact of information and networks and the threats we face and the opportunities we have to counter those threats.

And last fall, the National Research Council of the National Academy of Sciences issued a major report that urged the Army to catalyze Network Sciences as a broader discipline. That report noted that networks occur at various levels to include communication networks that carry information, information networks that bring data together, biological networks that form metabolic pathways, cognitive networks that provide a shared understanding of the situation and common doctrines and social networks of trust and influence. Each of these encompasses specific domains, but they have certain issues in common as well.

### **Q: What is the Army doing as a result of that report?**

Recognizing the current state of the field, it became obvious that we needed to have new tools and insights in order to better understand and affect each kind of network we want to build or counter. Also, predicting the behavior of networks is difficult, most notably, the behavior of all kinds of networks as they continue to increase in size. So, the ability to obtain and assess this type of data was considered to be in high demand, as well. However, in order to understand these issues would require training over the long term.

Anticipating this need, the idea for a center and curriculum was presented to the USMA, and the appropriate wheels were set in motion. Subsequently, it was decided that standing up a Network Science Center and affiliated curriculum were in the best interests of the Academy.

### **Q: Have there been any results to date? And what's in the works?**

We've already had successful outcomes of network science

research at USMA. In particular, several cadet projects have produced results that not only benefit our military forces, but have contributed significantly to the field as a whole. For instance, one project known as ELICIT, is a five-year experiment that provides us with the ability to better understand shared belief in hierarchical and self-organizing organizations. This effort is producing insights into how the Internet and other information technologies allow us to understand the links that are formed between people and how people form hubs, in turn, to attain certain levels of informal power. From this we can learn how terrorists promote their ideology.

Another project involves a device developed at USMA known as Ancile that utilizes Tactical Internet (and beyond) capabilities in order to warn soldiers regarding their proximity to Improvised Explosive Devices (IEDs). This project is sponsored by the Joint IED defeat office (JIEDDO) and utilizes a combination of social, cognitive and information networks. There are also other research projects in the works that will help to validate and refine the net-centric paradigm, both idealistically and operationally.

### **Q: Is the USMA network science effort limited to research projects?**

No. For instance, I presently serve as the center's Research Director, but I've also been teaching a network science course for the past two years at the Academy. Each term, we take a look at various domain areas to learn about and analyze. In addition, we eventually plan to launch a peer-reviewed journal with a highly regarded editorial board that we believe will be a key venue for publishing the best work in the field.

### **Q: Does the USMA Network Science Center have external proponents?**

First, let me say that, within the Academy, this is an initiative that has support from senior leadership across many departments. Network science draws on many disciplines and domains and it definitely has direct relevance to Army needs, so we're pleased to have contributions and support from a wide range of subject-matter experts at West Point.

From outside the Academy, perhaps our two best-known proponents are Dr. Alberts, who is the Director for the Command & Control Research Program in OSD, and Dr. John Parmentola, who is the Army's Director for Research and Laboratory Management. Their encouragement, insights and support will continue to be important to the center and to the new discipline itself as it continues to grow and evolve over time.

### **Q: Do you have any quotes you'd like to leave with our readers?**

There are so many ... Dave Alberts summed up the defense challenge well when he wrote in *Network Centric Warfare* that, "The Information Age is different, particularly for the military, than past eras in four fundamental ways that makes 'business as usual' increasingly obsolete." And from the National Research Council report, "Investment in network science is both a strategic and urgent national priority."