

**DARPA Tech, DARPA's 25<sup>th</sup> Systems and Technology Symposium  
August 8, 2007  
Anaheim, California  
Teleprompter Script for Dr. Charlie Holland, Director, Information  
Processing Technology Office**

Decision Dominance

» **CHARLIE HOLLAND:**

Welcome to the Information Processing Technology Office----IPTO.

The world contains a vast amount of data –  
some of it generated by humans,  
some by sensors, and much of it by computers.

Increasingly, this data is shared and accessible.

Much is stored and available on the Internet and, as a result,  
online data repositories are multiplying exponentially and increasing in  
complexity.

Consider, for example, multi-media databases like YouTube with videos  
on just about any subject.

Buried in this vast wilderness of data is a lot of useful information.

Images and videos, blogs, news reports,  
chat sessions, postings, and interviews.

But what does it all mean?

We need new techniques for taming this wilderness – for filtering,  
fusing, structuring, and organizing all this data.

And if we want to derive meaning from all this raw information,  
these techniques must also be able to correctly interpret the  
contradictions,  
contra-indications,  
and ambiguities inherent in the data.

When bulk data is converted into relevant, useful information,  
we call the result information understanding.

In a warfighting and command and control context, deriving meaningful  
information from the complex data environment –

and doing it quickly –  
is crucial for effective decision-making.

Furthermore,  
we cannot use armies of trained data analysts.

We need this capability with less, not more, people, so that our  
“tooth to tail” - the ratio of numbers of warfighters to numbers of support  
and logistics staff, increases.

This in turn will increase our agility, flexibility, and lethality.

As in industry,  
where first-mover advantage can enable a company to lock out the  
competition, our military must be able to decide and act more rapidly  
and accurately than its adversaries.

IPTO’s mission is to give our warfighters that capability by developing  
technologies to process information,  
extract its meaning,  
and deliver it  
where it’s needed.

We aim at giving warfighters full information understanding.

Information understanding that provides immediate situational awareness – eliminates the complexity that makes decision making difficult –

and enables communication of information needed to make rapid, informed decisions.

In other words, the kind of information understanding that results in decisive military advantage.

We call military advantage derived from information understanding decision dominance.

The key to decision dominance is information processing, and in this arena IPTO has a proud legacy to build on.

IPTO helped invent large parts of the computing field in the usual DARPA way.

We mined the far side, when Licklider created the galactic computer group.

We took risks,

betting on packet switching when the rest of the world used circuits.

We expanded traditional notions of information processing to include human-computer interaction, robotics,

and more.

Most important,

we trusted good, smart people – and there are far too many to mention.

We've done this for the last 50 years.

Everyone knows that the Internet is a direct descendent of the original ARPANET, but DARPA's investments in computing have produced many other phenomenal achievements in areas such as computing theory, algorithms,

data structures, databases,

computer graphics, artificial intelligence and cognitive systems, and software engineering.

In fact, his 1997 book *What Will Be*,

Michael Dertouzos credits DARPA with "...*between a third and a half of*

*all the major innovations in computer science and technology.”*

But with these advances have come new challenges.

Many computing and informational technologies, and much of the data that we use to extract information,

are also available to our adversaries.

The conduits we use for e-commerce are used by insurgents for recruiting and propaganda.

And as recent events in Estonia demonstrate,

the prospect of “cyber-wars” is very real and poses a truly global threat.

The fact that many of our most useful computational and informational tools can be used against us makes attaining decision dominance much more complex and difficult.

But this complexity can be turned to our advantage.

We can tame the data wilderness by developing the capability to access, gather, and organize data faster than anyone else and with far fewer people “in the loop”.

More importantly, we can derive relevant, accurate, and actionable meaning from data automatically

as rapidly as that data

is available.

Let me explain how IPTO is doing just that.

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One area that exemplifies getting meaning from data is our work in language processing.

Much of the data wilderness consists of information written, spoken, and broadcast in foreign languages.

And translation of a foreign language is essentially a matter of extracting meaning from that language's text and sounds -- meaning that takes into account cultural and situational contexts.

Realizing that human translators can not keep pace with the volume of foreign language,

DARPA recognized long ago the urgent need for automated real-time translation capabilities.

Translation for everything from monitoring foreign language broadcasts, road signs, graffiti...

to interpreting voice and written enemy communications.

DARPA has long played a key role in developing automated translation capabilities.

In a few minutes,

Joe Olive will be here to explain the progress we've made and why we're more excited than ever about the prospect of achieving this elusive goal.

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Understanding language is *one* key element of decision dominance.

But our understanding must extend to all types of data, and this requires cognitive systems.

Cognitive systems seek to use reason to explore alternatives and identify the best solution for a given situation.

IPTO has long funded a wide range of R&D efforts in cognitive systems, including work in robotics, expert systems,

scene understanding, and knowledge-based systems.

And now, IPTO has a major thrust in

Cognitive Systems.

Through this work

we've realized that,

even in limited domains, we cannot afford to manually encode all the sets of rules in human knowledge.

Not only is manual encoding difficult and time-consuming, it is often done without a clear understanding of which data is relevant and worth encoding.

And it does not adapt easily to the kinds of changing situations posed by active, intelligent adversaries who continually change tactics.

What is needed are computing systems that learn and reason, can structure massive amounts of raw data into useful, organized knowledge with a minimum of human assistance, and adapt to new situations.

IPTO has several such systems in development.

And Dan Oblinger will be along later to describe the most promising and exciting directions.

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Gleaning information understanding from the data wilderness requires massive computer power.

Fundamental advances in computer performance have always been important to the DoD.

From the ILLIAC IV and the Strategic Computing Initiative to the more recent efforts you'll be hearing about here, DARPA has played a major role in developing specialized hardware, multiple processors, parallel algorithms,

and other techniques to improve computation efficiency.

Hardware cycles were once seen as the fundamental bottleneck.

But we now recognize that increases in hardware speed are not enough to break the barriers computing faces.

There is a huge need for improvements in software development.

We need at least an order of magnitude improvement in our ability to quickly develop efficient, problem-solving software, and code for flexible, adaptable applications.

We also need new

run-time systems that execute code an order of magnitude more efficiently on the heterogeneous hardware that is becoming increasingly common in computers and microprocessors.

The High Productivity Computer Systems project is the latest of our programs focusing on computing systems.

It has ambitious goals to fulfill these needs.

Chuck Morefield will talk about this project and our plan of attack for meeting the next generation of hardware and software productivity challenges.

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So far, I have ignored a fundamental element for achieving decision dominance –

the largest source of complex, multi-faceted, and confounding information in the data wilderness: people.

Our adversaries have incredibly complex, culturally-influenced goals

and value systems.

They are organized in  
vast webs of informal and formal relationships,  
from families and clans  
to nation-states.

These organizations and the sets of individuals that comprise them are not static; they continually change in incredibly complex ways.

IPTO is going to tackle the problem of developing information understanding of these communities.

The social sciences have developed theories of some aspects of community, but more needs to be done if the information is to be useful to our combatant commanders.

Advances in computing, language processing, and cognition, are leading to a new scientific discipline.

It's multi-disciplinary "computational social science."

It integrates knowledge from fields such as psychology, sociology, and

economics with advanced computational approaches to tackle bold new challenges.

For example, the ability to better understand and possibly predict occurrences of instability in an operation.

Later in this session

Sean O'Brien will tell you more about this and other potential outcomes of our work in this area.

The proliferation of data and communications and the democratization of information could work against us, or work for us.

If it is to work for us, we must learn to understand the information all around us –  
and do it faster and  
more accurately than our adversaries.

We need to do this with fewer humans so that the “tooth to tail” ratio remains high.

Only through advanced automated information processing can we achieve this goal and reach both information understanding and decision dominance.

But don't take my word

for it.

Instead, join me now in listening to those who are actively involved in taming the data wilderness –

the program managers of IPTO.

First up, Chuck Morefield will talk about

“Extreme Computing”.

Chuck ...