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Teleprompter Script for Mr. Preston Marshall, Program Manager,
Strategic Technology Office – Networks Presentations**

Tactical Networking:

It's More Than Just Command and Control

» **PRESTON MARSHALL:**

Now, we get to the exciting part of networking;
the portion that makes the military user so unique.

Tactical Networking.

Bringing information to warfighters at the very tip of the spear.

Let's think about how tactical edge communications has changed.

Not too long ago, communications to the edge consisted of reports from
the edge to headquarters,
and voice command and control back.

Information was received, analyzed, and decisions were made in the
rear, because that's where the information was.

That was the situation with Captain Kirk and Mister Spock.

They had a voice communicator to talk to the unlucky first crewmember to beam down, but not to share data, imagery, or other insights.

The bridge crew often saw that his demise coming, but he could not access the information to save his life!

Today, our vision of edge communication exceeds that of StarTrek!

Most people think of Star Trek as future technology; we strive to leave StarTrek communications far behind.

We have a new concept of the edge.

Today, we talk about the judgments and decisions that will be required of the “strategic private.”

At the new edge,
the quality of the soldier’s decisions have far-reaching significance;
not just their ability to execute orders.

We used to study the decisions of Generals or Admirals to understand the outcome of armed conflict.

Fifty years from now,
we will be studying the decisions of Privates.

Each soldier is a decision making node.

High quality decisions require access to high quality information.

Each of our warfighters needs the resources once limited to commanders in Command Centers.

Our objective over the last decade has been to develop self forming networks that could organize their routing automatically, without manual planning or intervention.

We succeeded,
and today,
this technology is on its way to the warfighter.

But voice and command and control were still the “killer apps”.

This vision is inadequate to create an immersive info-sphere around our edge forces.

We do not want to just convey direction to our edge forces.

Instead, we need to enable their decision-making regarding the best course of action.

Our new vision is self forming information infrastructures, which automatically organize services and applications, position them in the network, advertise their existence, and adapt them as the needs change.

The system we envision forms and operates autonomously; untouched by human minds.

This is a fundamental change in vision.

To get to this vision, we discard the partitioning of networking hardware, software, and applications.

Previously, we have focused on integration of networking hardware and software technology; but little has been done to bring the organization of information into this framework!

Today, we design networks around a preconceived and static allocation of services.

But we envision a future in which networks not only design themselves, but also collaborate with application services to jointly optimize performance.

We need ideas on how to do this because our operational tempos,

dynamics, and physics dictate that we must.

The tactical edge is,

or soon will be, richer in information than the core.

Programs such as

DARPA WASP, WOLFPACK and Command Post of the Future provide the edge with independent Surveillance and Reconnaissance,

Signals Intelligence, and collaborative capabilities.

These will drive tactical networking from transient, non-persistent voice Command and Control to long persistence imagery, intelligence and tracking applications.

Persistent information changes tactical networking from a telephone system to an information infrastructure!

We recently demonstrated dynamic spectrum access, and are transitioning this to military radios being used in Iraq and Afghanistan.

We are evolving technology to recognize content moving through networks to make it more accessible.

Over the last months,

we developed the design for an affordable

wireless node,

with four independent multi-Gigahertz transceivers that will cost under

500 dollars.

This platform will be the basis for our adaptive networking technology development and builds the affordable, densely connected network that the edge must have.

These are necessary first steps, but they do not address how we organize the information within the network.

This will be more important to network performance than how we optimize its waveforms, point its antennas, or route its packets.

The growth of the Internet made us rethink communications; changing our vision from the hub-spoke topology of the telephone system to the flat, peer-to-peer Internet architecture.

When we began
self-forming networks,
we shifted from a concept of topology as something we statically plan,
to something we dynamically discover.

We made all nodes peers.

Any two nodes could form a network, and deliver communications!

But, we blew it!

The applications we run all re-impose the very hub-spoke architecture we thought we had discarded.

Name, Mail and Chat servers are as hub-spoke as the telephone was.

This architecture forces manual planning and fixed topologies;
distorts our networks;
and adds unnecessary traffic to the most challenged portion of our networks.

It is an obstacle to the high tempo operations we need to support.

Why would I store the location of my squad members in a server far to the rear?

Our challenge is to make highly capable networks with a fraction of the bandwidth available to other enterprises.

In DARPA, we have several hundred gigabits of bandwidth.

If DARPA needs more,
we can just go buy it!

In wireless networks,
we are limited to small spectrum band, and military spectrum is only a small fraction of this.

To be successful,
we must move not just packets, but the information applications, as well.

This is the next step in tactical networking.

Creating dense networks at the edge stresses hardware technology
as well.

Antennas remain one of our largest shortfalls.

In the High Frequency era, antennas were too large to move, point,
or maintain.

Today, as we move to exploit ever higher frequencies, antennas
become too small to capture enough energy to effectively communicate.

Engineers have become so accepting of this constraint that they have a
frequency specific term in the propagation equation, even though every
physicist knows that energy propagates independent of frequency!

Our mobile communications is crowded below three Gigahertz because
the capture area of antennas becomes too small to be effective at
higher frequencies.

Our current spectrum shortfall is a direct consequence of poor antenna
performance.

We must learn how to maintain antenna capture performance independent of frequency.

Antennas are one of the most fundamental obstacles to the rich edge network we contemplate.

It may sound simple,
but it's not!

Another problem is analog linearity and filtering.

Our very success in creating dense RF environments is stressing the linearity of our technology.

We are pumping more and more energy into the RF spectrum, and even if we have a clear channel, the inter-modulation among these signals constrains the performance of our systems.

Incremental improvement is not an option, so we need fundamentally new approaches to operation in the dense RF environments resulting from our own success.

And one last challenge is affordability.

When radios were rare on the battlefield, cost was not a fundamental constraint to deployment of military capability.

But, to make networks dense and pervasive,
cost must be reduced to the point where they can be widely deployed.

The ultimate radio that costs a hundred-thousand dollars is not going to empower the edge.

Technologies that can enable military capability by affordability are as critical as those that enable it by new technologic capability.

Not only do we want more than Captain Kirk.

We want more flexibility, more power,
and we need to empower all crewmembers,
not just the bridge crew.

And, instead of the Enterprise's complex communications station, we want something as simple to use as the Internet jack in your office, and the phone
on your desk

So, the bottom line:

How can you help us make our troops more aware, more collaborative, and more effective than Captain Kirk's crew?

Thank you.