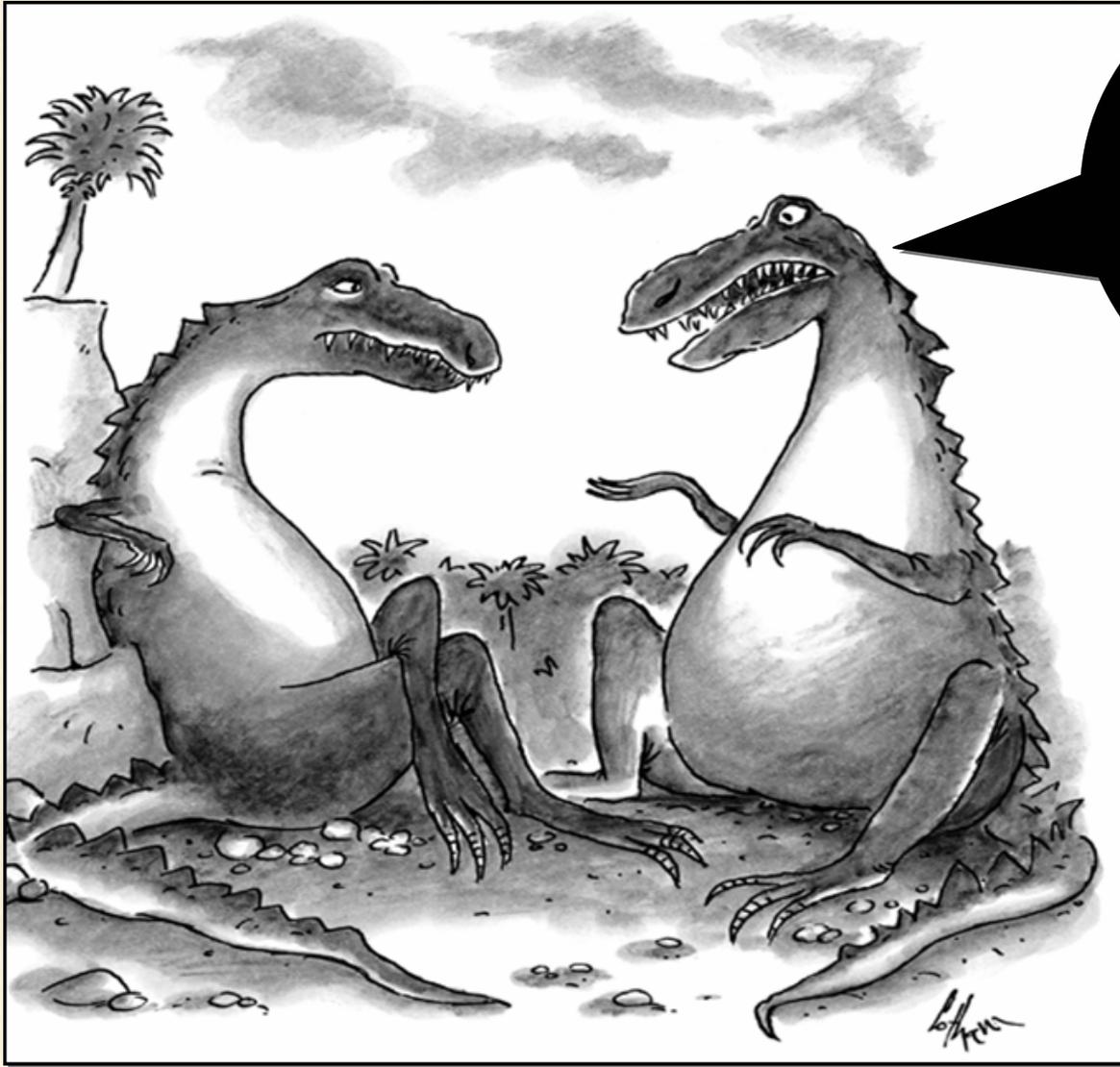


# **Oak Ridge National Laboratory Technology to meet the Threat**

Presented to:  
**NDIA's 22d National Logistic Conference**

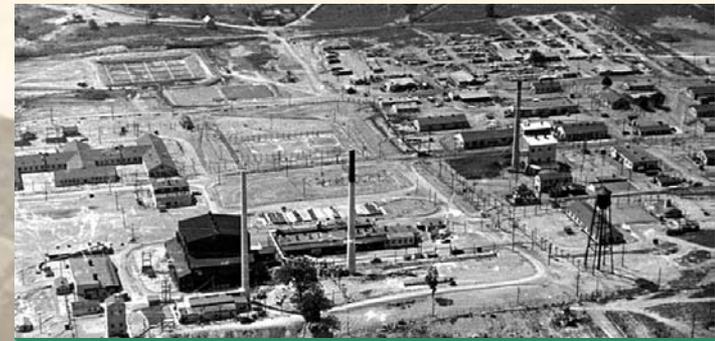
**Dennis K. Jackson**  
Director, Logistics Innovation

Miami, Florida  
April 18, 2006



**“All I’m saying is, now is the time to develop the technology to deflect an asteroid.”**

# The Manhattan Project—Oak Ridge's first grand challenge!



The Clinton Pile was the world's first continuously operated nuclear reactor

Senator  
Kenneth D.  
McKellar



OAK RIDGE NATIONAL LABORATORY  
U. S. DEPARTMENT OF ENERGY

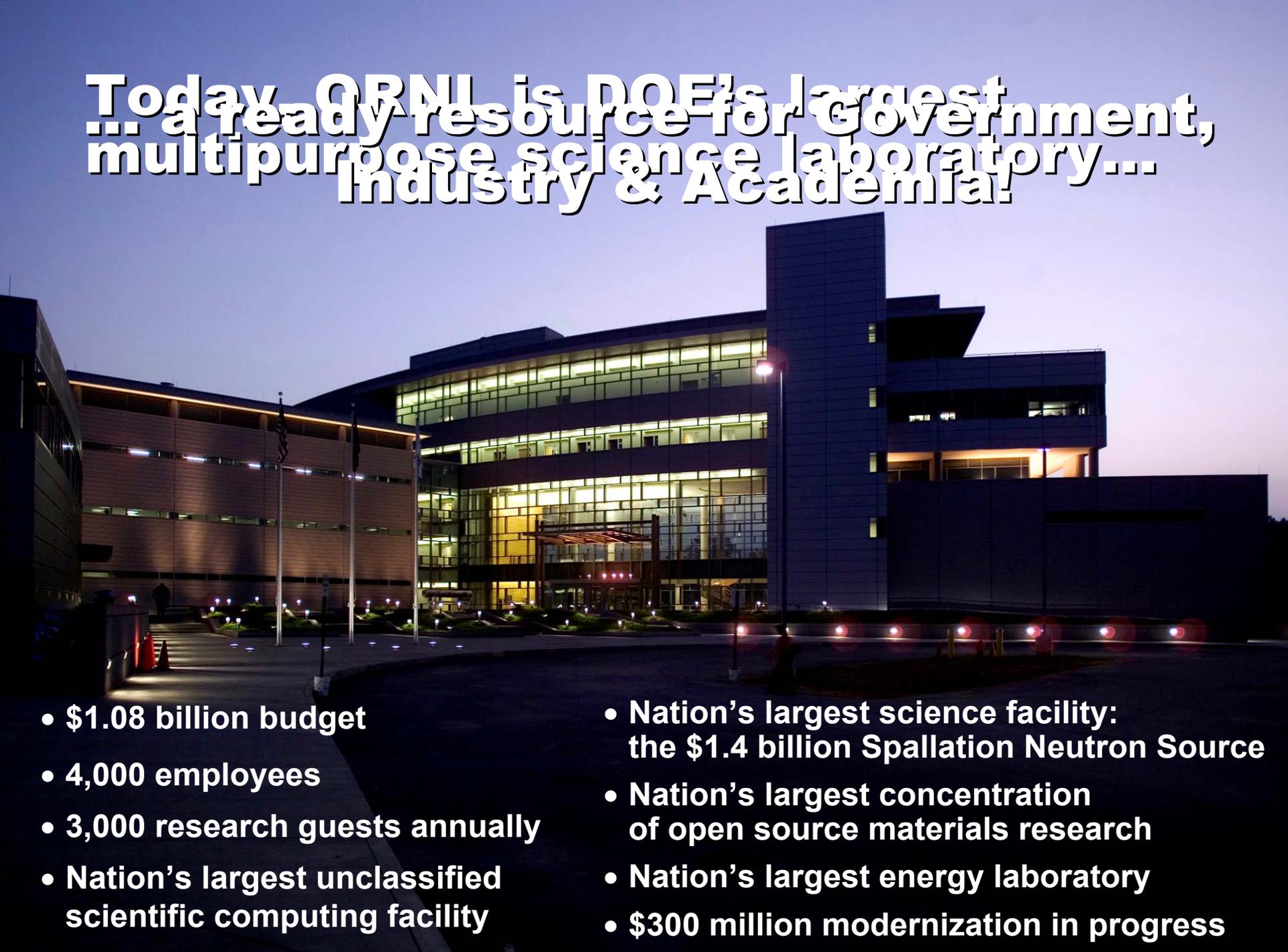




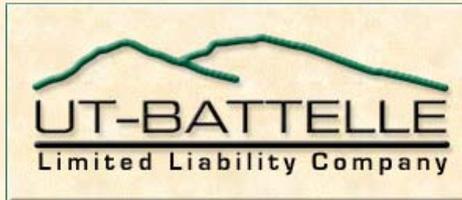
**“Most people skate to where the puck is . . . I skate to where the puck is going to be.”**

**– Wayne Gretzky**

# **Today, ORNL is DOE's Largest ... a ready resource for Government, multipurpose science laboratory... Industry & Academia!**

- 
- **\$1.08 billion budget**
  - **4,000 employees**
  - **3,000 research guests annually**
  - **Nation's largest unclassified scientific computing facility**
  - **Nation's largest science facility: the \$1.4 billion Spallation Neutron Source**
  - **Nation's largest concentration of open source materials research**
  - **Nation's largest energy laboratory**
  - **\$300 million modernization in progress**

# ORNL is managed and operated by UT-Battelle

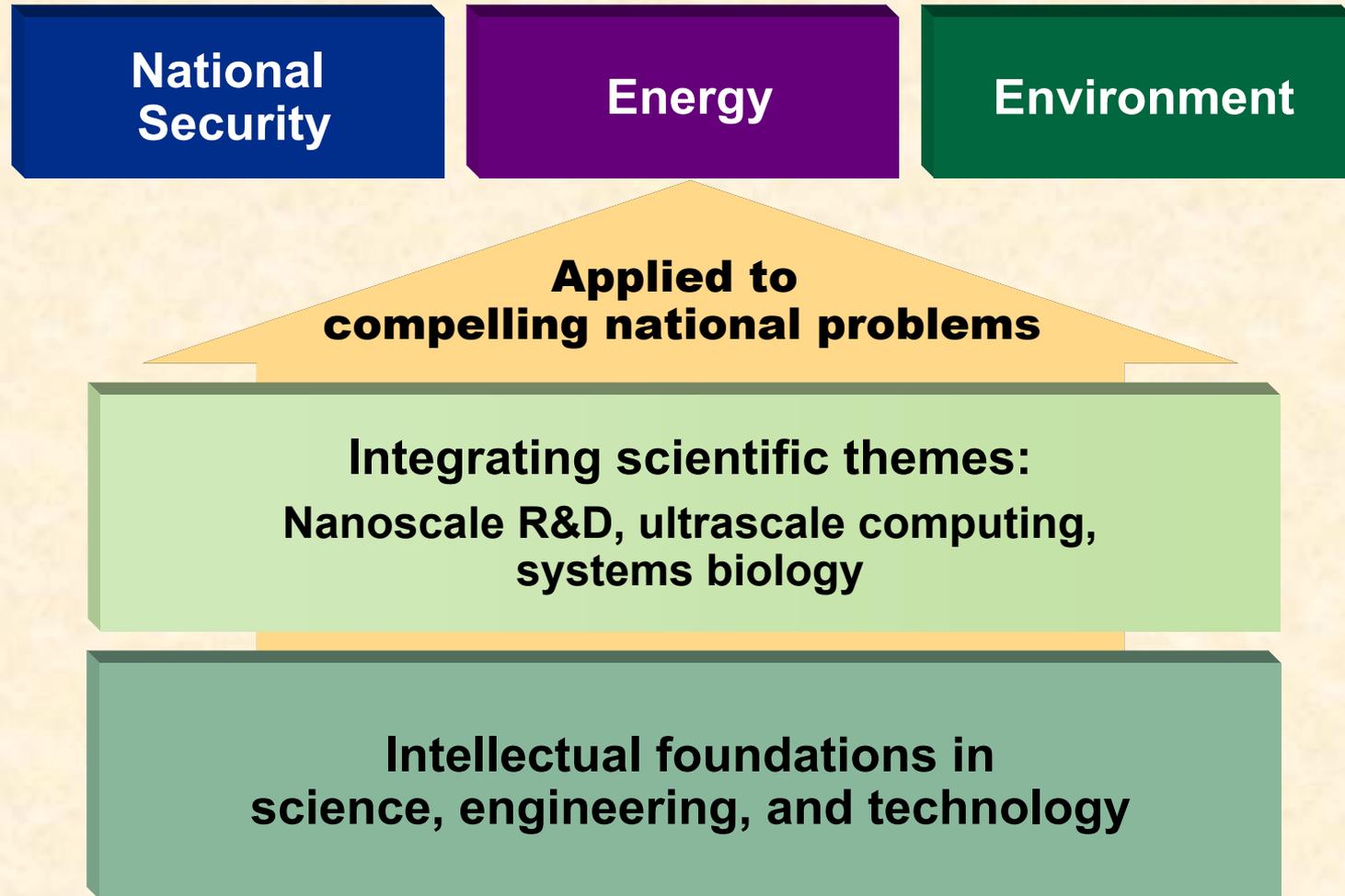


**The University of Tennessee  
Knoxville, Tennessee**

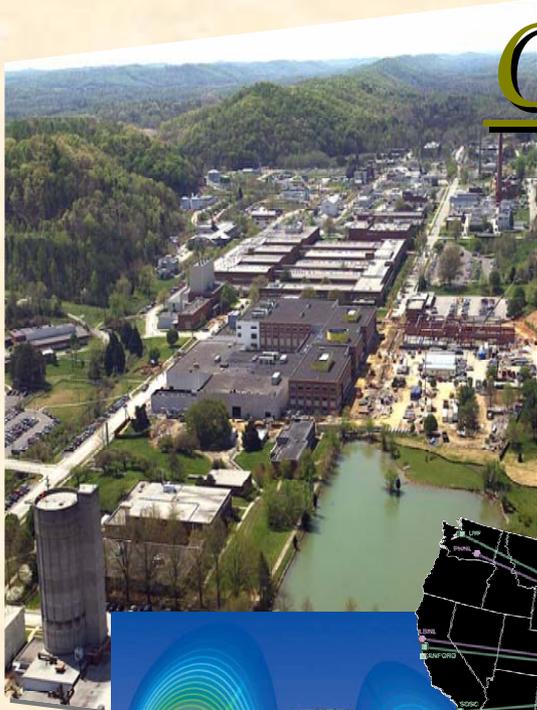


**Battelle  
Columbus, Ohio**

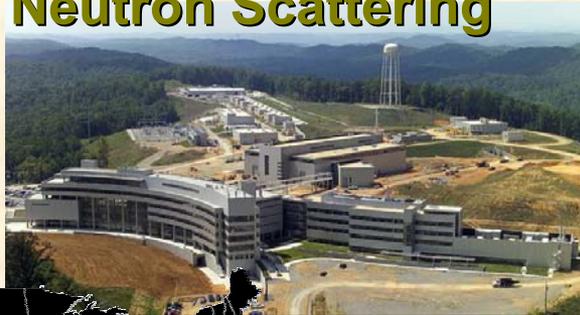
# Our research framework focuses our resources on national needs



# ORNL... World Class in:



- **Neutron Scattering**



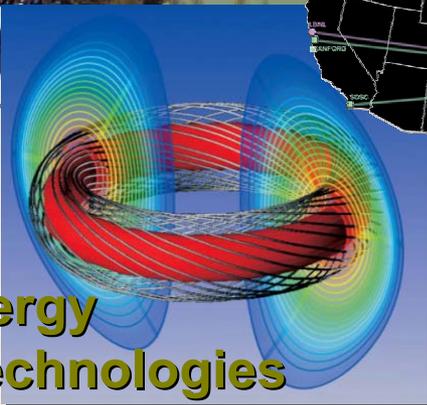
- **Life Sciences**



- **High-performance Computing**



- **Energy Technologies**



- **National Security**

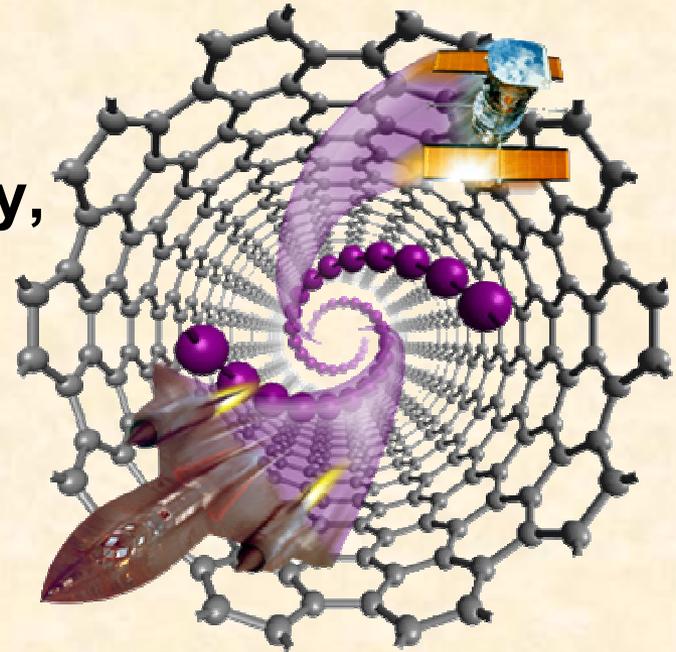


- **Materials Science**

## **Our Aspiration:**

# **Best lab in the world at what we do...**

- **Control of functionality at the nanoscale**
- **Leadership-class computing for the frontiers of science**
- **Integration of biology and ecology, based on the foundation of understanding molecular-level interactions**
- **Integration of science, technology, and thought leadership for energy**
- **Innovative solutions that improve national, homeland, and global security**

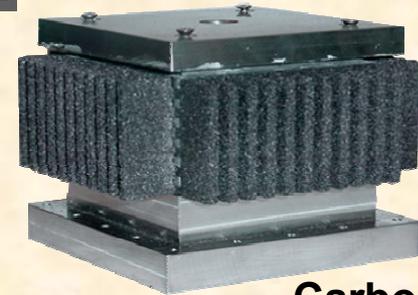


**“ Those who say it cannot be  
done should not interrupt the  
person doing it.”**

**– Chinese Proverb**

# Partnerships are essential to our success!

- Other national laboratories
- Universities
  - UT-Battelle/ORNL core universities
  - UT-ORNL Center for Homeland Security and Counterproliferation
- Other government agencies
- Education/Training With Industry Program (U.S. Air Force and U.S. Army)
- ORAU post-docs
- Industry
  - National Security Technology Consortium
  - United Defense
  - National Safe Skies Alliance
  - NucSafe



Carbon foam

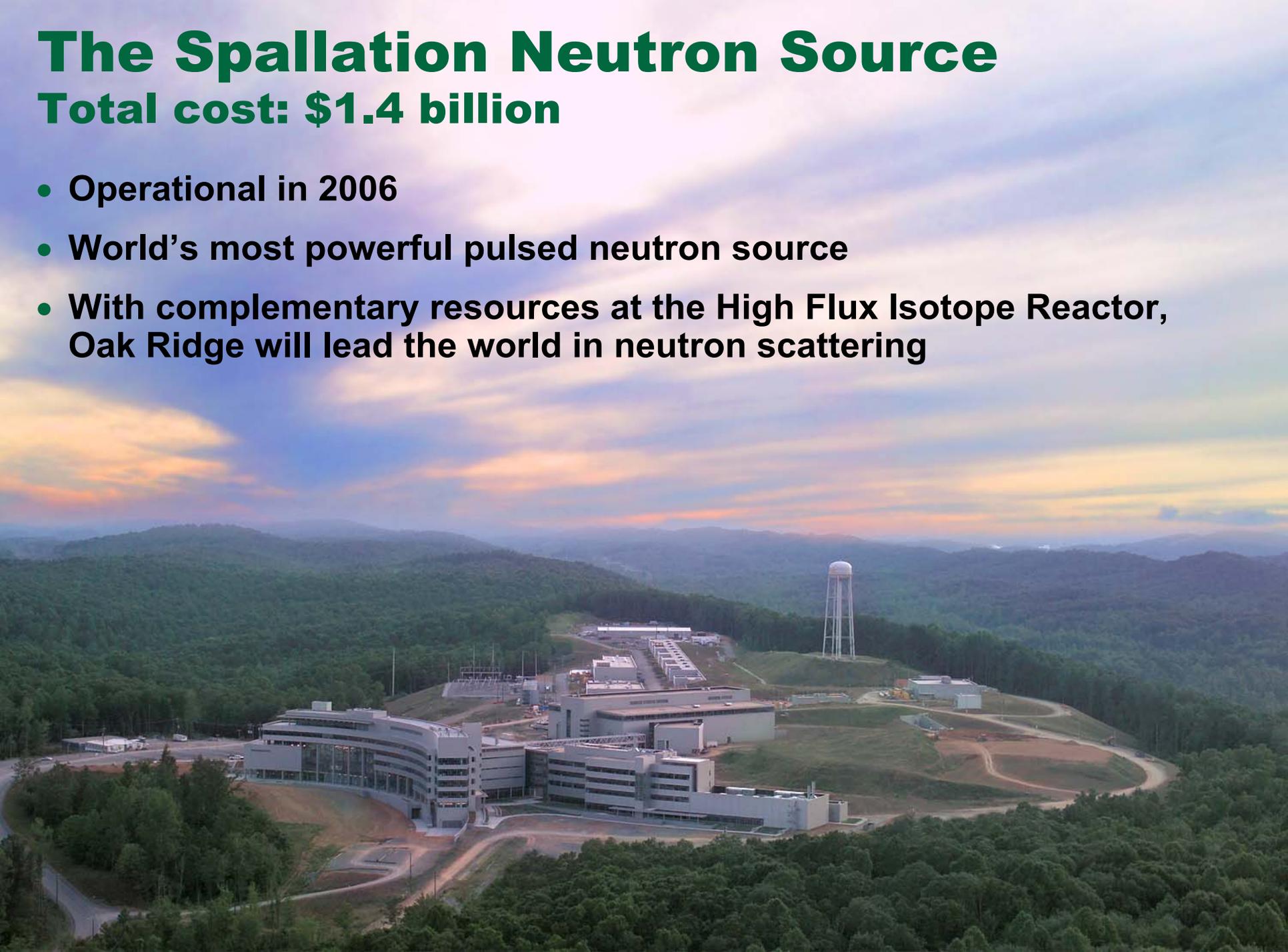


AquaSentinel

# The Spallation Neutron Source

**Total cost: \$1.4 billion**

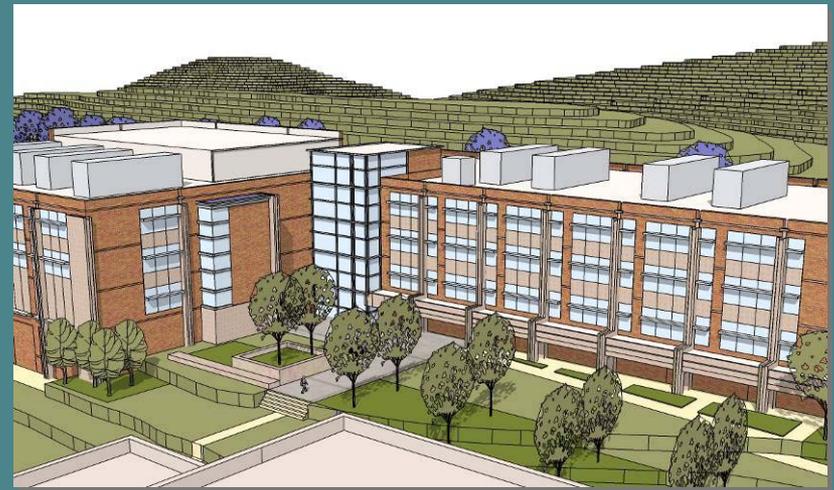
- Operational in 2006
- World's most powerful pulsed neutron source
- With complementary resources at the High Flux Isotope Reactor, Oak Ridge will lead the world in neutron scattering





# ORNL's East Campus

## Multiprogram Research Facility



- 200,000 ft<sup>2</sup>
- Light labs, computing space, and offices
- Capable of handling the full range of national and homeland security work

# We operate user facilities that serve an international research community



**Buildings  
Technology  
Center**



**High Flux  
Isotope  
Reactor**



**High  
Temperature  
Materials  
Laboratory**



**Metals  
Processing  
Laboratory  
User Center**



**National  
Environmental  
Research  
Park**

**Providing access to unique and expensive tools and facilities  
for cutting-edge research**

# We committed to become a key resource for national security

## Nuclear Security



## Department of Defense



## Homeland Security



## Today

- Leading key NNSA initiatives
- \$150M program
- Broad connections to the defense and intelligence communities
- Multiprogram Research Facility
- Expanding state and regional partnerships
  - SensorNet
  - Safe Cities



*"No, I don't want to play chess. I just want to reheat the lasagna."*

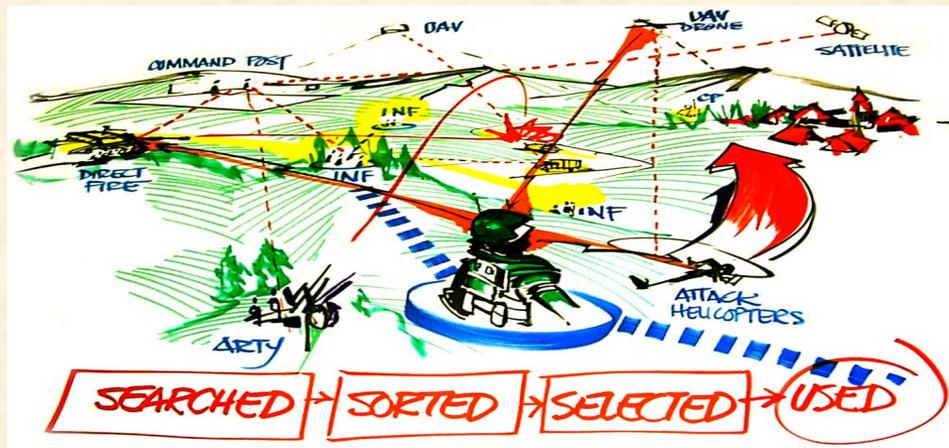
# We are applying our S&T resources to national and homeland security

- Deploying integrated systems for incident awareness, detection, and response
- Creating tools for information management, synthesis and analysis
- Expanding modeling and simulation for threat analysis and response planning
- Delivering enhanced protection and new capabilities to warfighters
- Applying advanced materials to security applications
- Detecting, preventing, and reversing the proliferation of weapons of mass destruction



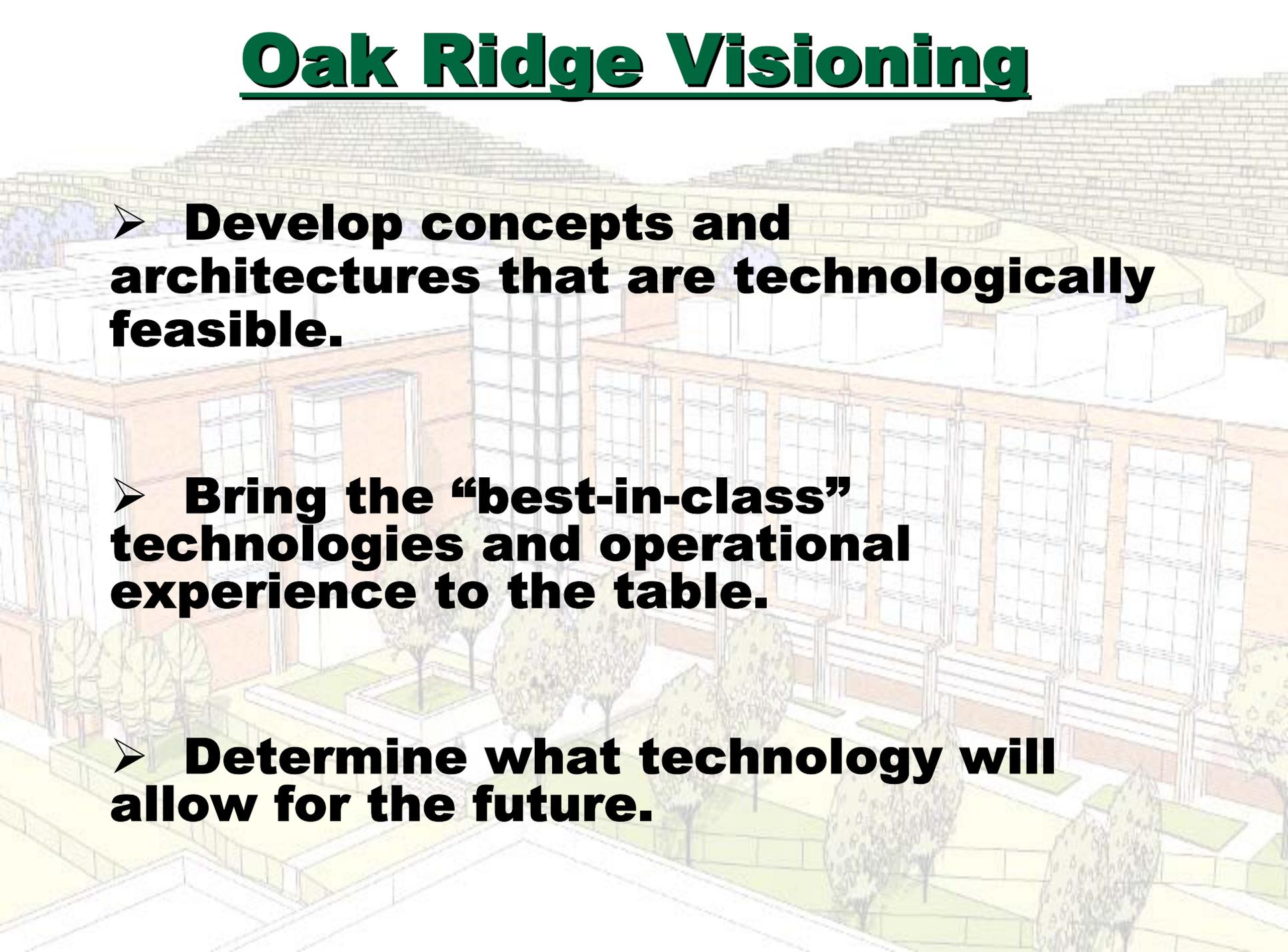
# Potential DOD Applications

- Intelligent agents
- Comprehensive assessment methodology
- Special materials
- CBRNE detection
- 6D gyroscopic sensor navigation
- Mobile ad hoc networking
- Advanced sensor/wireless
- Advanced propellants
- Water purification
- Ballistic protection
- Power

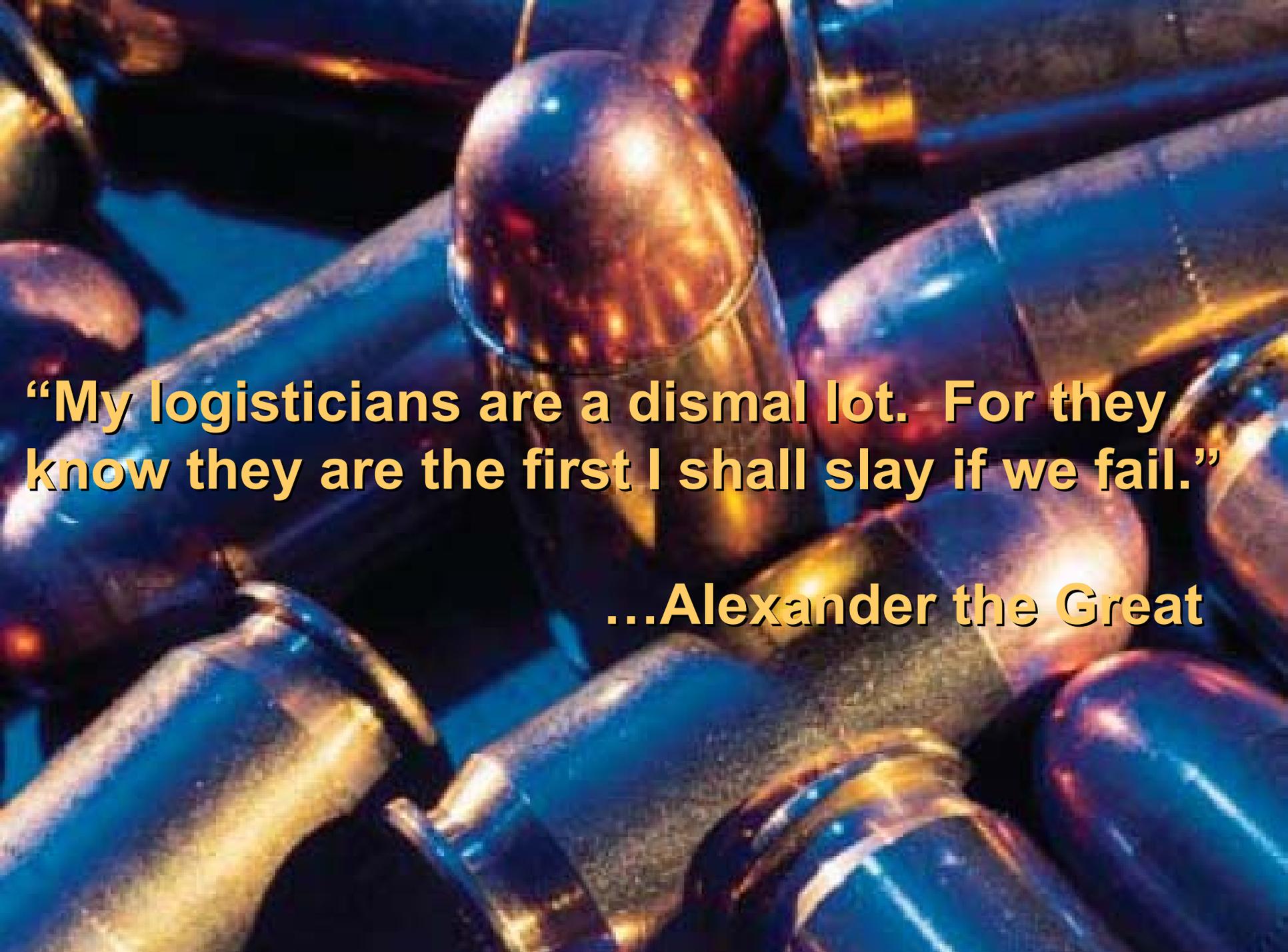


- Gun barrel technology
- CFAST
- Micro-climate conditioning
- Smart minefields
- Medical diagnosis
- Signature management
- Visioning – what will technology allow

# Oak Ridge Visioning

An architectural rendering of a modern building complex. The buildings are multi-story with large windows and a mix of brick and light-colored panels. A central courtyard features several trees and a paved walkway. The background shows a hillside with a grid-like pattern, possibly representing a site plan or a topographical map.

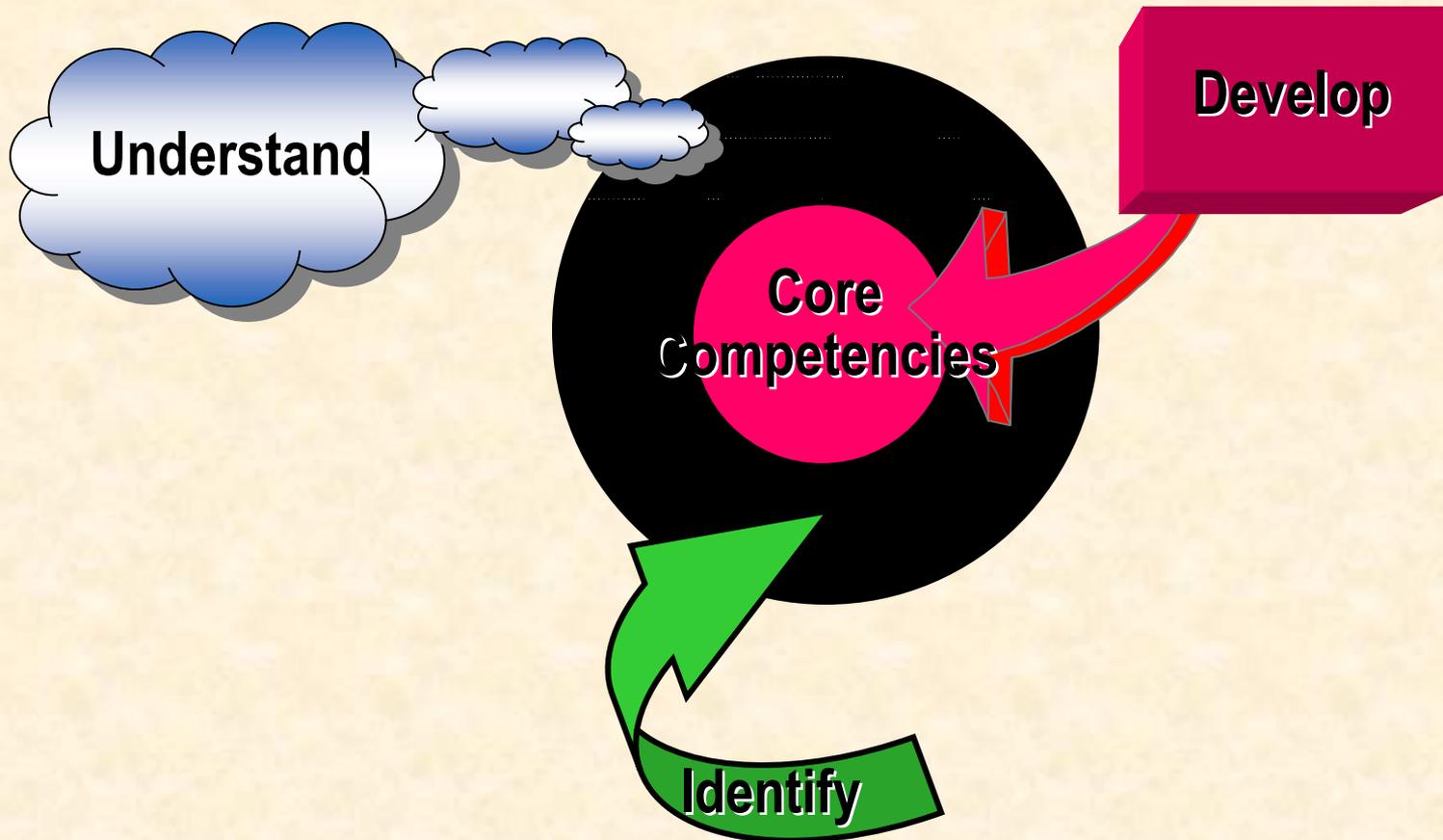
- **Develop concepts and architectures that are technologically feasible.**
- **Bring the “best-in-class” technologies and operational experience to the table.**
- **Determine what technology will allow for the future.**



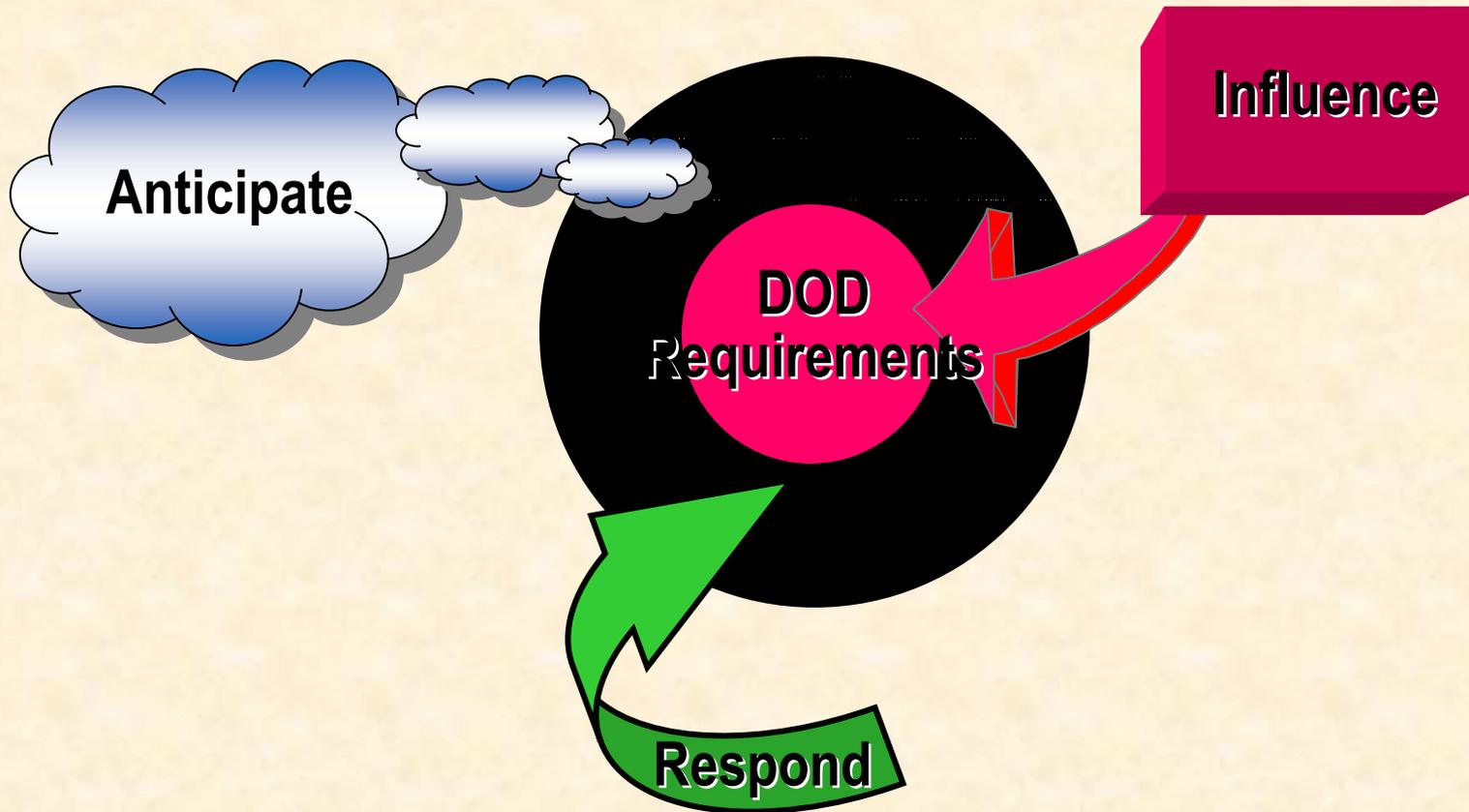
**“My logisticians are a dismal lot. For they know they are the first I shall slay if we fail.”**

**...Alexander the Great**

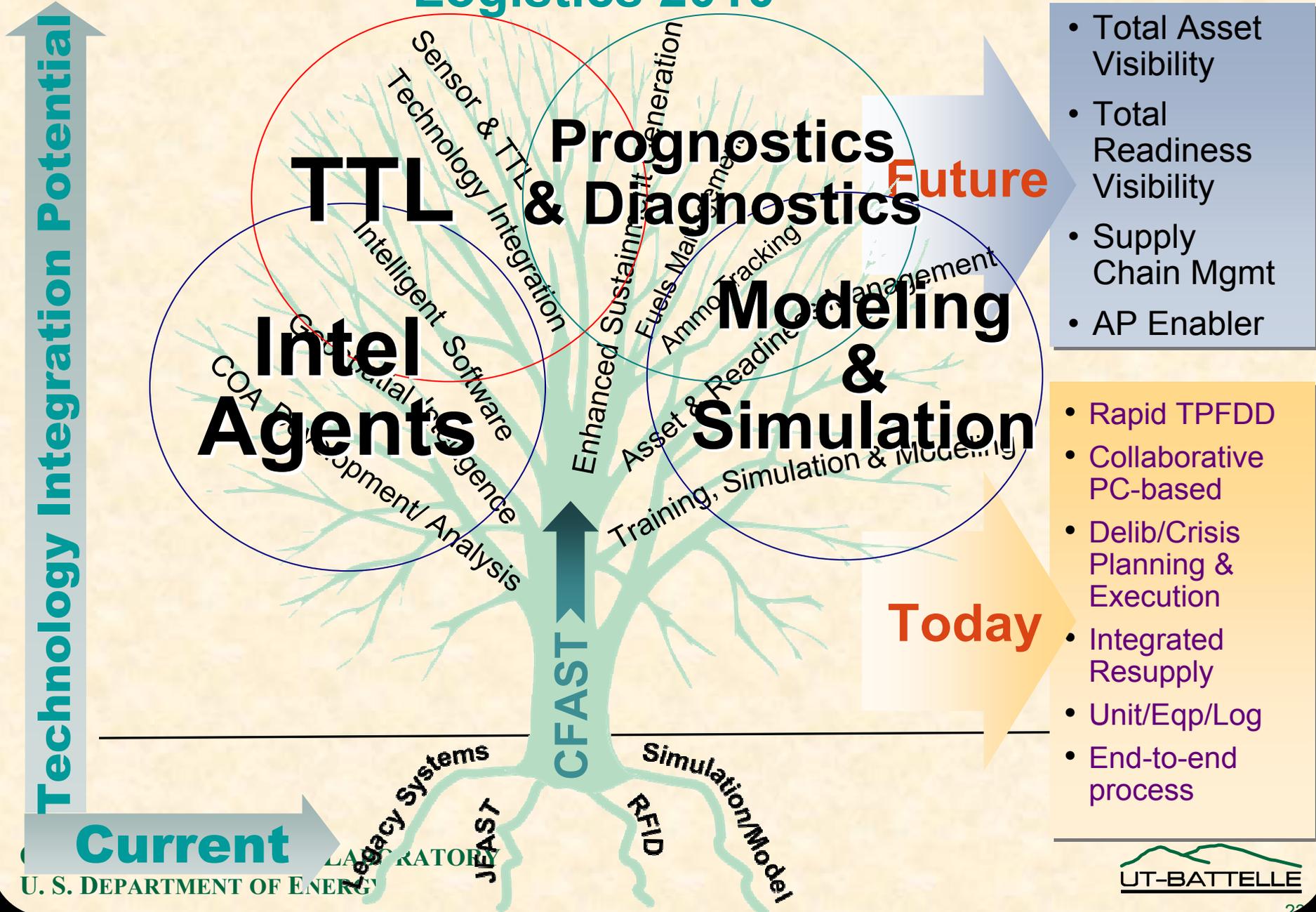
# Logistics “Transformation”



# Logistics “Transformation”



# Logistics 2010



Technology Integration Potential

Current

Future

Today

- Total Asset Visibility
- Total Readiness Visibility
- Supply Chain Mgmt
- AP Enabler

- Rapid TPFDD
- Collaborative PC-based
- Delib/Crisis Planning & Execution
- Integrated Resupply
- Unit/Eqp/Log
- End-to-end process

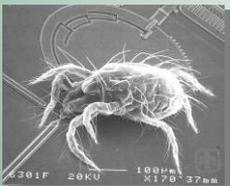
# Simulating the inaccessible, ...discovering the unknown!



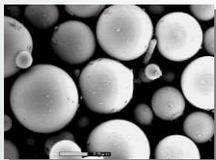
Ant



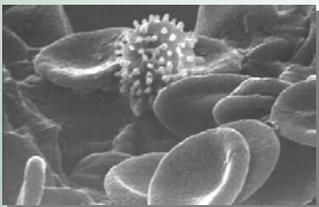
Human hair



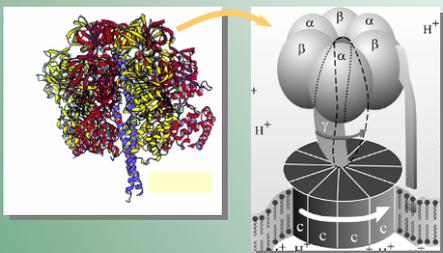
Dust mite



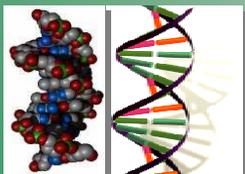
Fly ash



Red blood cells

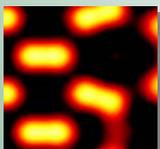
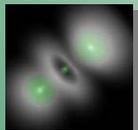


ATP synthase

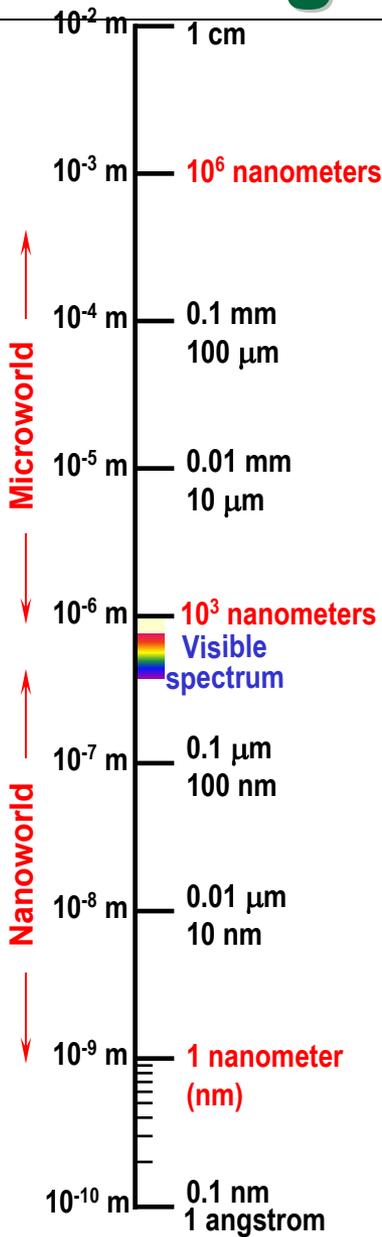


DNA

Hydrogen atom

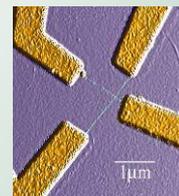
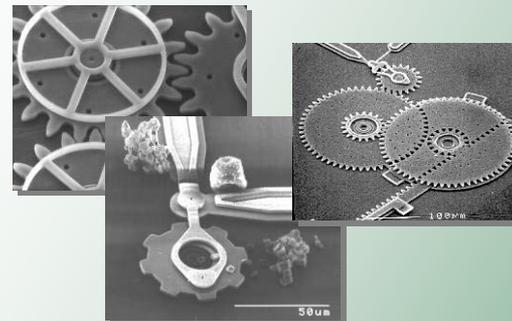


Silicon atoms

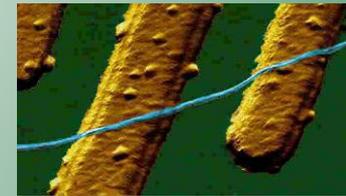


Pin head

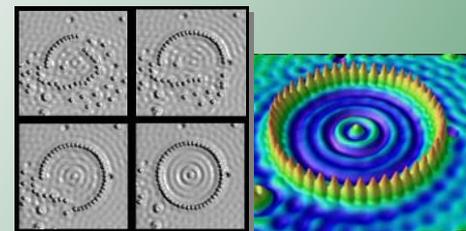
Microelectromechanical devices



Nanotube electrode

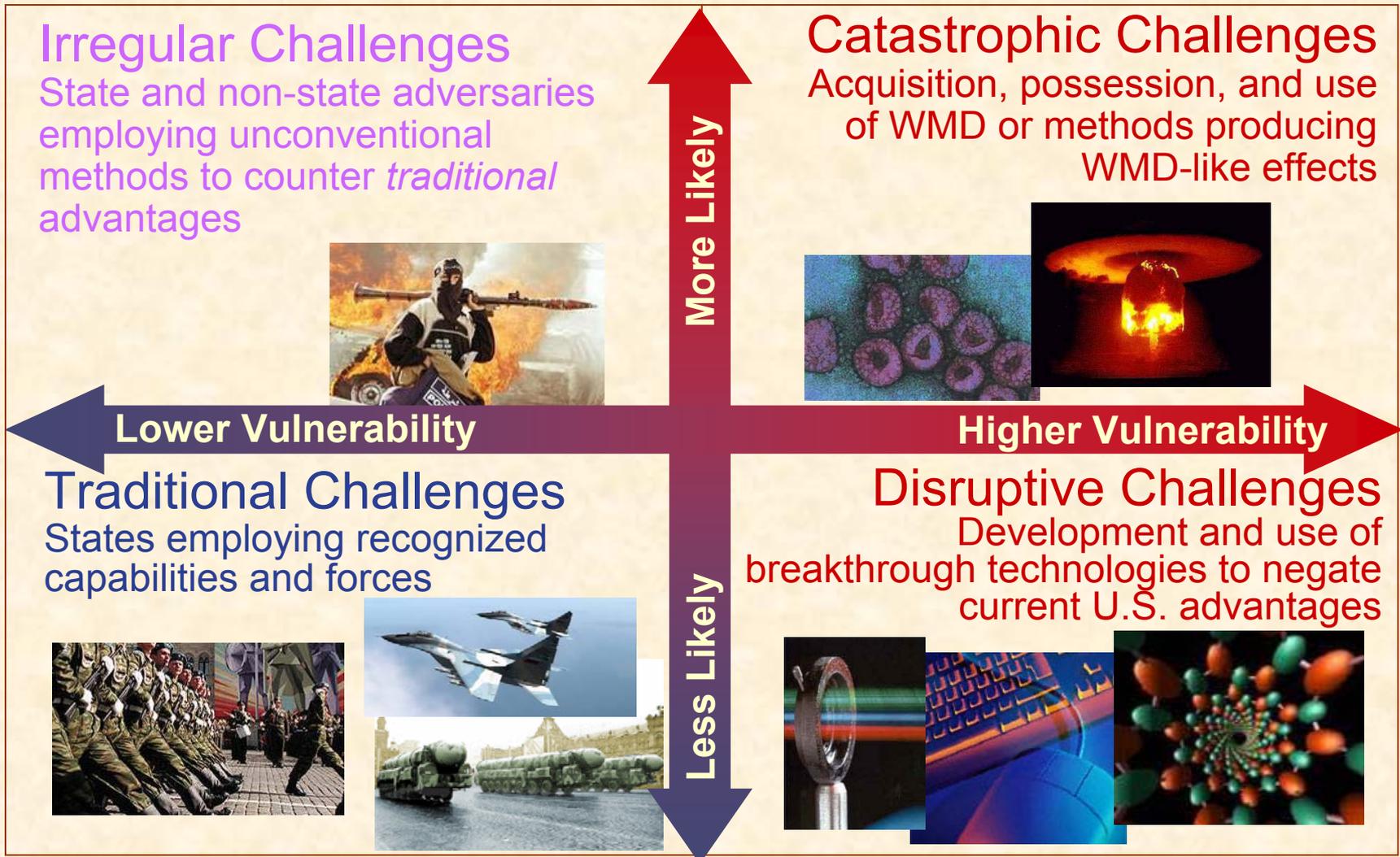


Nanotube transistor

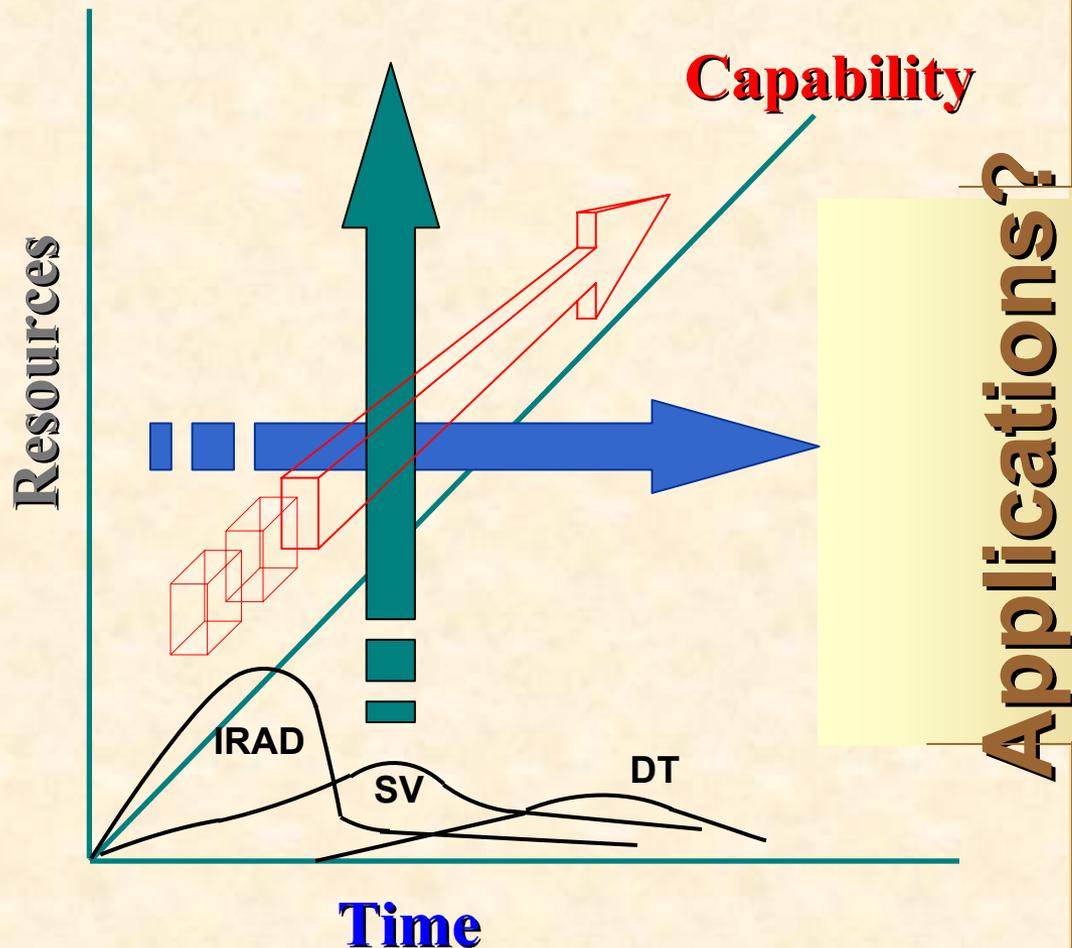


Quantum corral of 48 iron atoms  
(14 nm diam)

# Persistent and Emerging Challenges



# Disruptive Technologies

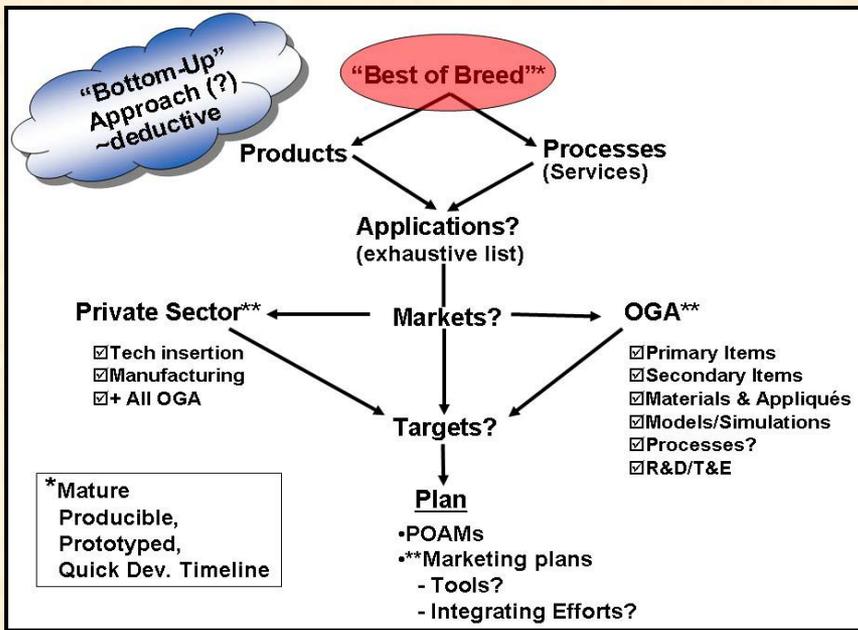


- Tagging, Tracking & Locating
  - Multi-capable Readers
  - Advanced Waveforms
- Supercomputing & Modeling
- Intelligent Agents
- Sensor Integration
- Advanced Materials
- Super-Hydrophobics
- Brazing & Welding techniques
- Advanced Water Filtration
- Deployment & Sustainment Enablers
- Fuel Cells

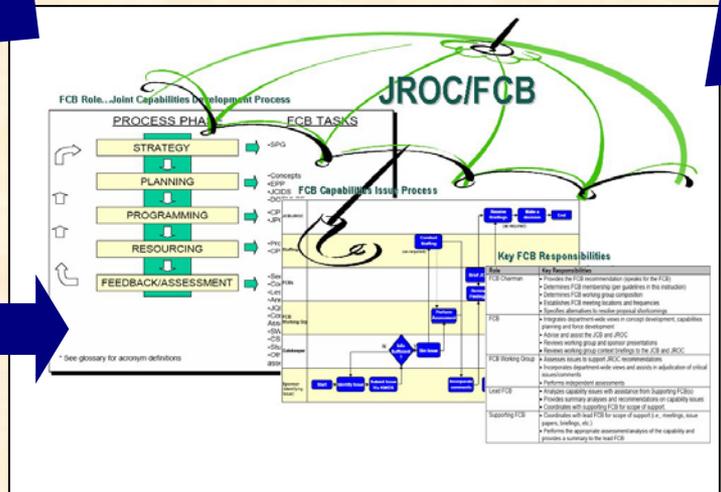
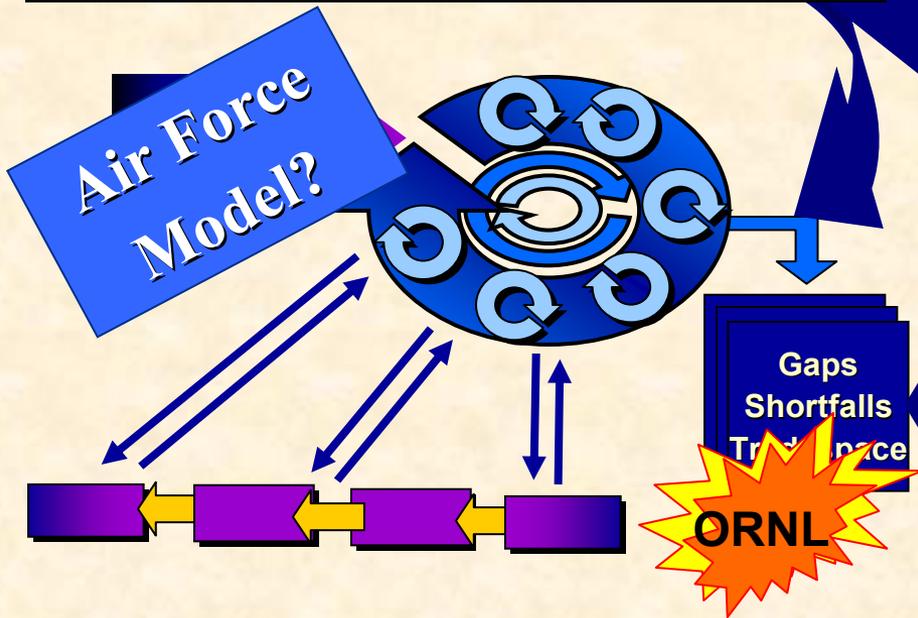
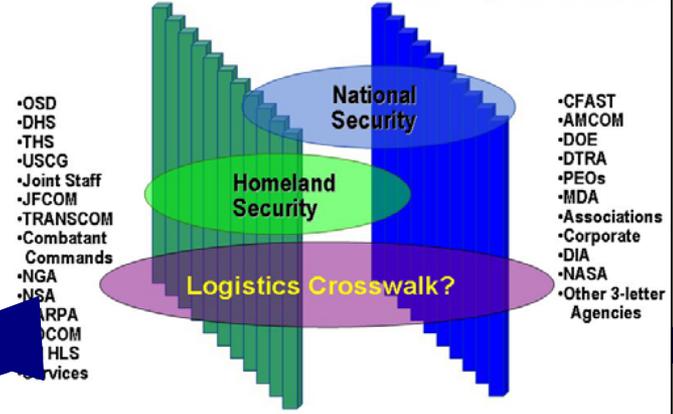
Denny Jackson  
Logistics Transformation

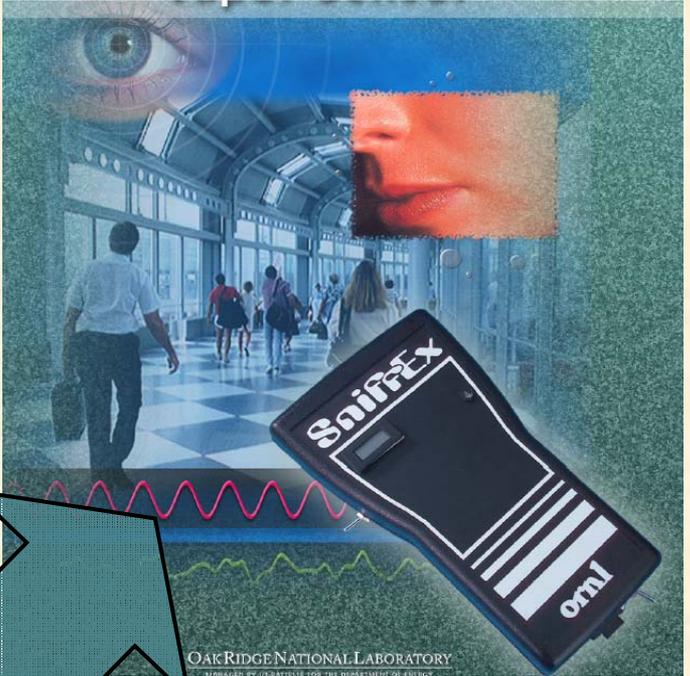
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U. S. DEPARTMENT OF ENERGY



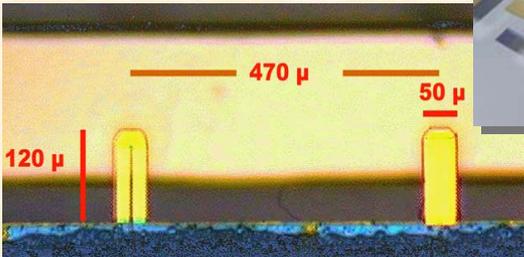
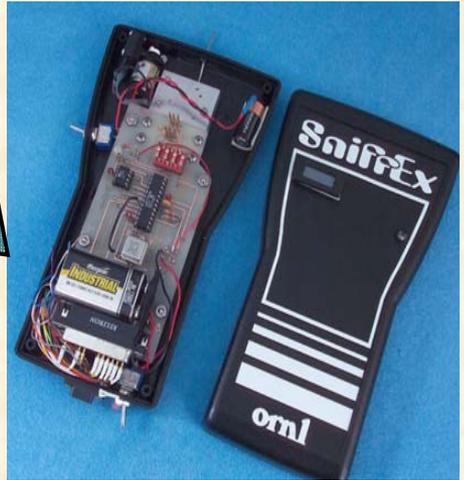
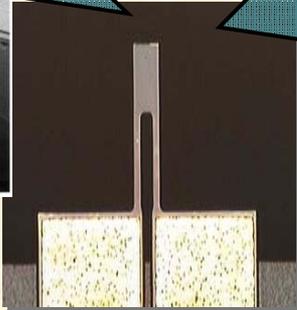
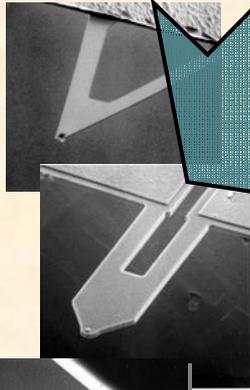
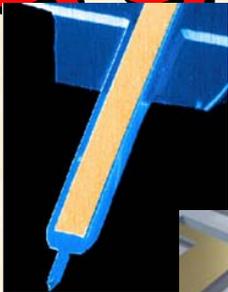


### Logistics “Transformation”... and the Customer Management Matrix



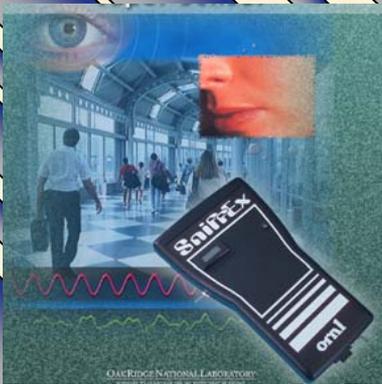


# Imagine...



OAK RIDGE NATIONAL LABORATORY  
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE



## Evacuation Monitoring and Accountability System

*Providing Accountability for Personnel and Critical Assets During Evacuation*

- An automated system
- Latest radio frequency identification (RFID) technology
- Custom designed software that can be used either with or without current building access control system
- Tracking of personnel and equipment within zones of the building allowing first responders to know where to target their search and rescue efforts.



- Fires, acts of nature and acts of terrorism
- Sophisticated tool and extremely robust system
- Extremely flexible architecture can be designed to meet user requirements/budgets

- Duplicates accountability data at a remote site
- Facility managers and first responders are able to track the evacuation progress on PDAs or laptop computers
- Updated in real time
- Provides for the accurate and timely accountability of personnel and equipment during an emergency evacuation



**OAK RIDGE NATIONAL LABORATORY**

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY





## SensorNet

INTELLIGENT SYSTEMS

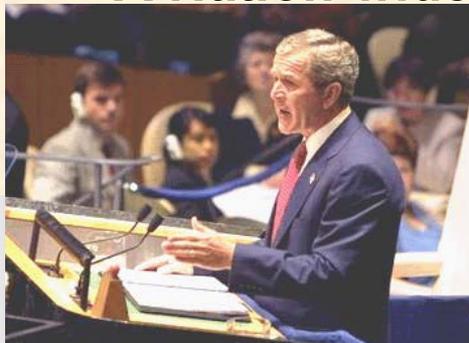
### Advancing Sensor Web Interoperability

SensorNet is a framework to tie together sensor data from all over the country to create a real-time detection and alert system for various threats, whether they are chemical, radiological, biological, nuclear, or explosive.

Bryan L. Gorman, Mallikarjun Shankar, and Cyrus M. Smith, SensorNet Program, Oak Ridge National Laboratory

**S**ensorNet is a vendor-neutral interoperability framework for Web-based discovery, access, control, integration, analysis, and visualization of online sensor, sensor-derived data repositories, and sensor-related processing capabilities. In other words, SensorNet attempts to create a wide-area system to collect and analyze data from sensors all over the country to monitor and detect threats, and then alert agencies, emergency responders, and others as necessary. It is being designed and developed by the Computational Sciences and Engineering Division at the Oak Ridge National Laboratory (ORNL), in collaboration with the National Oceanic and Atmospheric Administration (NOAA), the Open Geospatial Consortium (OGC), the National Institute for Standards and Technology (NIST), the Department of Defense, and numerous universities and private-sector partners. The acronym of SensorNet is to include

## A Nation-wide Problem



*“It is crucial for ... personnel to have and use equipment, systems, and procedures that allow them to communicate with one another.”*

The National Strategy for Homeland Security

➤ The Nation’s public safety information infrastructure...

**“stove-piped” or “island” networks.**

➤ No **“universally available, affordable data infrastructure”** for public safety.



# Material Protection, Control & Accountability Program



Fig. 2 Cargo Railcar

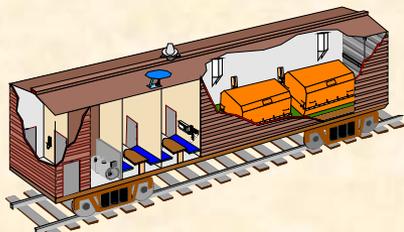


Fig. 3 Cargo Railcar Layout



Fig. 4 Guard Railcar



Fig. 5 Security Overpack



Fig. 6 Escort Vehicle



Fig. 7 Cargo Vehicle

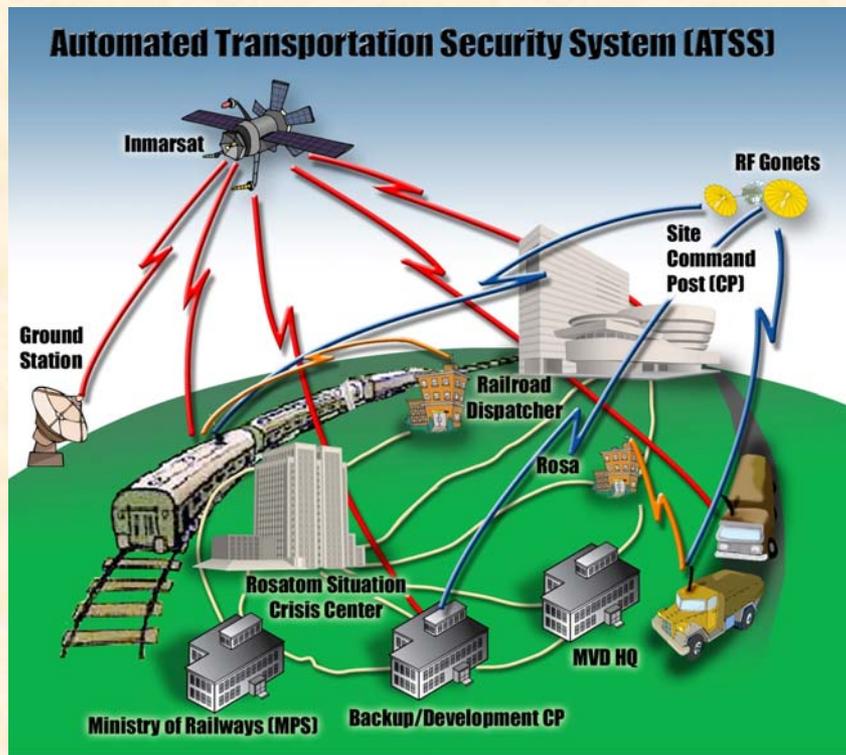


Fig. 1 ATSS



Fig. 11 Command Post Screens



Fig. 10 Satellite Communication Equipment



Fig. 9 Command Post Monitors



Fig. 8 Sarov Demonstration

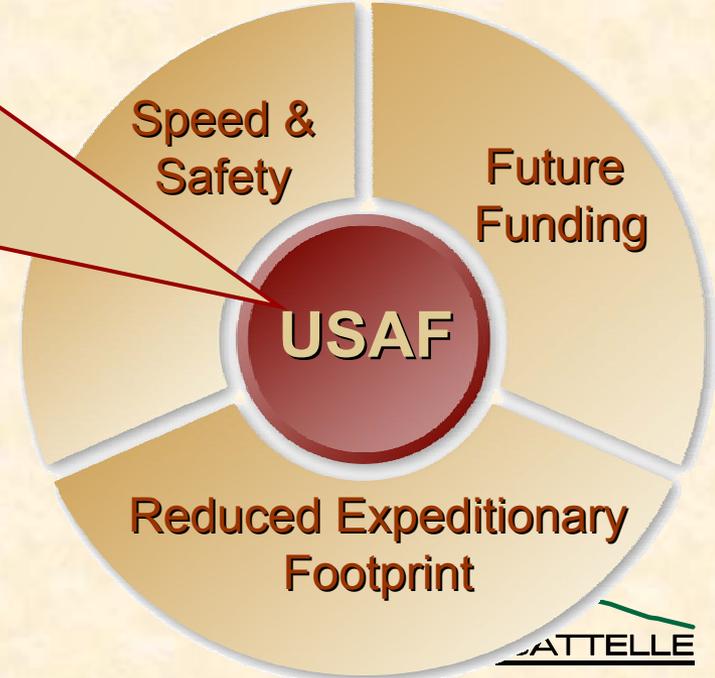
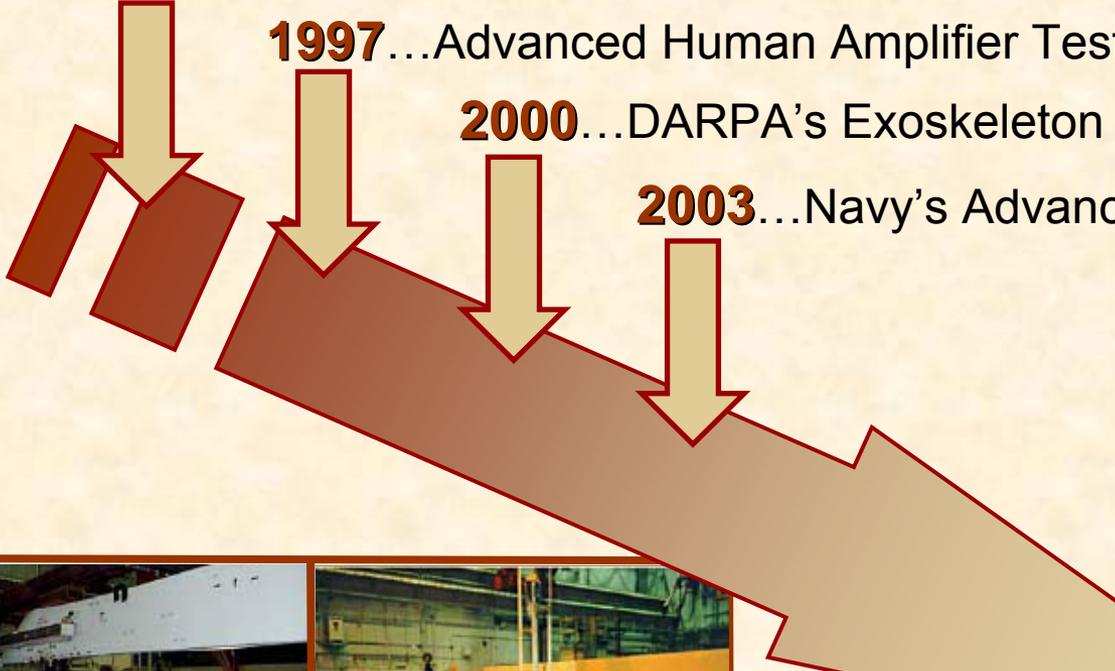
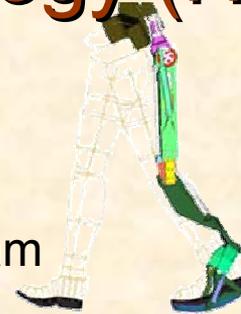
# Human Amplification Technology (HAT)

**1995**...Next Generation Munitions Handler System

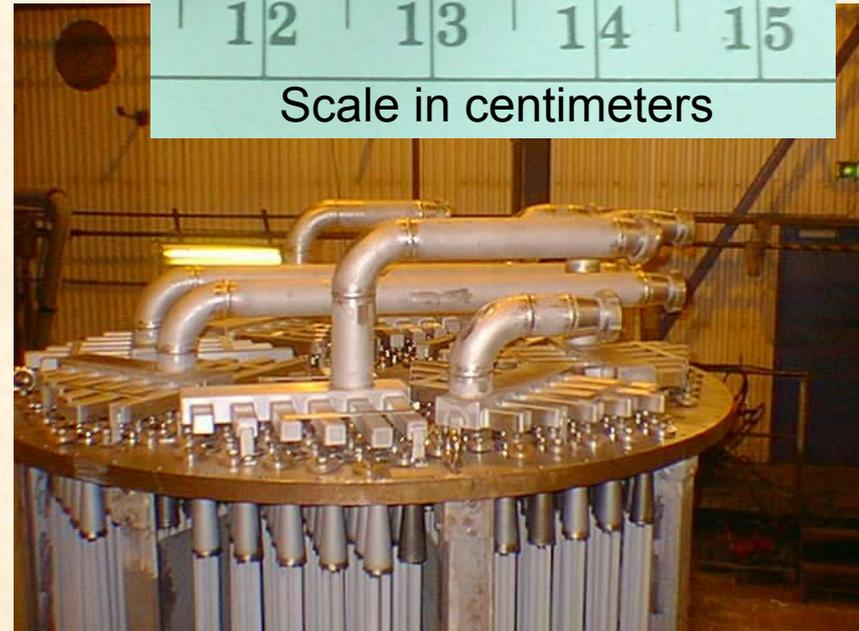
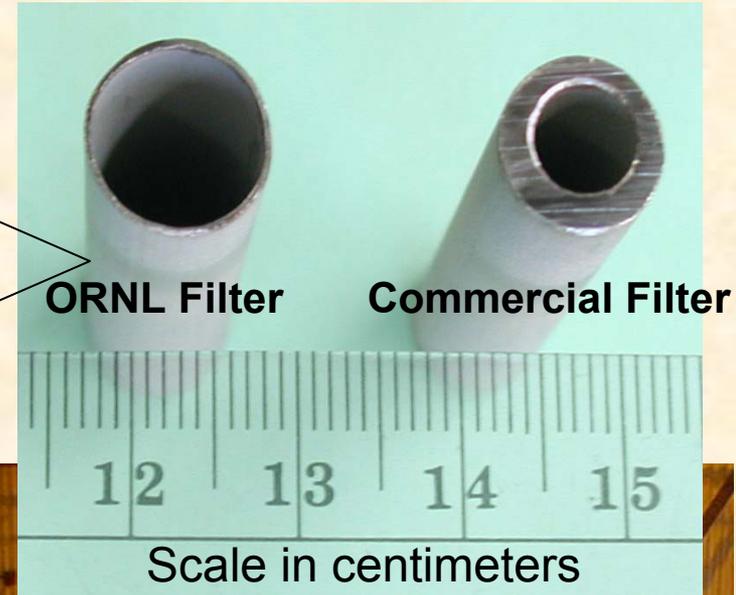
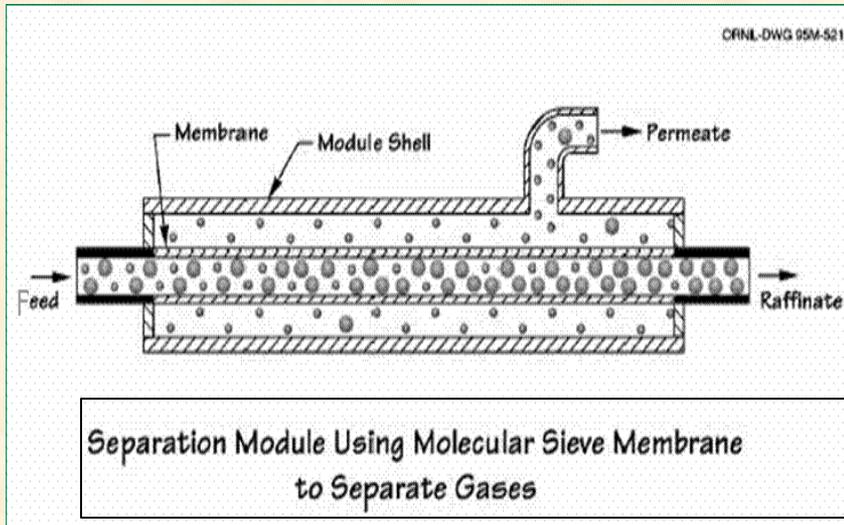
**1997**...Advanced Human Amplifier Testbed

**2000**...DARPA's Exoskeleton Program

**2003**...Navy's Advanced Omni-Directional Transporter



# ORNL's Inorganic Membranes—Great Potential for Water/Air Purification



- ✓ Membranes are robust—sterilized with steam, heat, microwaves, direct resistance heating
- ✓ Membranes are rugged & last for tens of years
- ✓ Manufacturing costs are low
- ✓ Purification does not rely on chemicals
- ✓ Membranes may be used to polish air/water supply systems or functionalized variants of the ORNL membranes
- ✓ Systems can be scaled
- ✓ Filtration performed at surface (i.e. not a depth filter)...membrane is cleanable
- ✓ Cross-flow configuration can minimize fouling

# Chameleon...Cognitive Radio for TTL (SF2CR)

## ORNL's State of the Art:

- Software Defined/Cognitive Radio Rapid Development Platform (~3.5"x5"x2")
- Multi-waveform capable & software reconfigurable
- RFID, SATCOM, GPS & Sensor capable
- Can provide cross-banding between CR tags/nodes, other sensors/networks, other tags C4ISR networks, UAVs, and SATCOM reach-back
- Functional gateway for other tags--passive/active
- An Agile, Tagging, Tracking, Locating, Sensing & Communications Platform

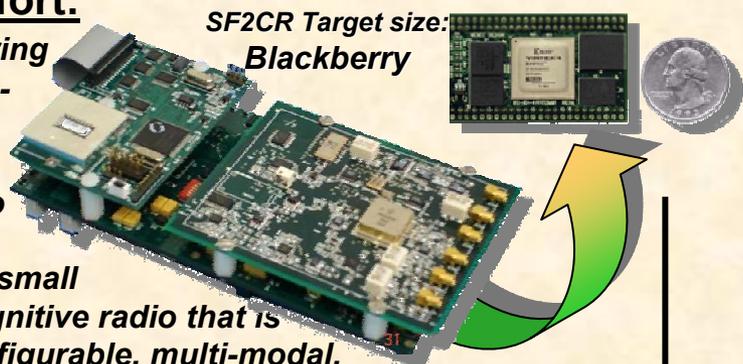
## ORNL Potential:

- Baseline for CR capabilities supporting global real-time in-transit visibility initiatives

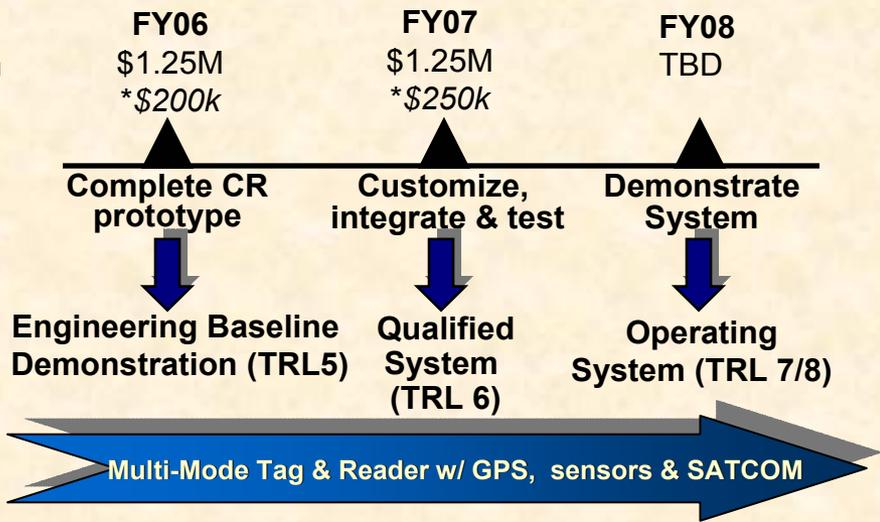
Application	Traditional Approach	ORNL Approach
Tag	Preconfigured, single-mode	Multi-mode, software reconfigurable (SR)
Reader	Single-mode, limited coverage	Multi-mode, SR
Network	Fixed infrastructure, limited connectivity	Mesh Networks: Multiple tiers—Radio to Radio, Tag to Tag
Data	Specified fixed format & path	Customizable to multiple standards

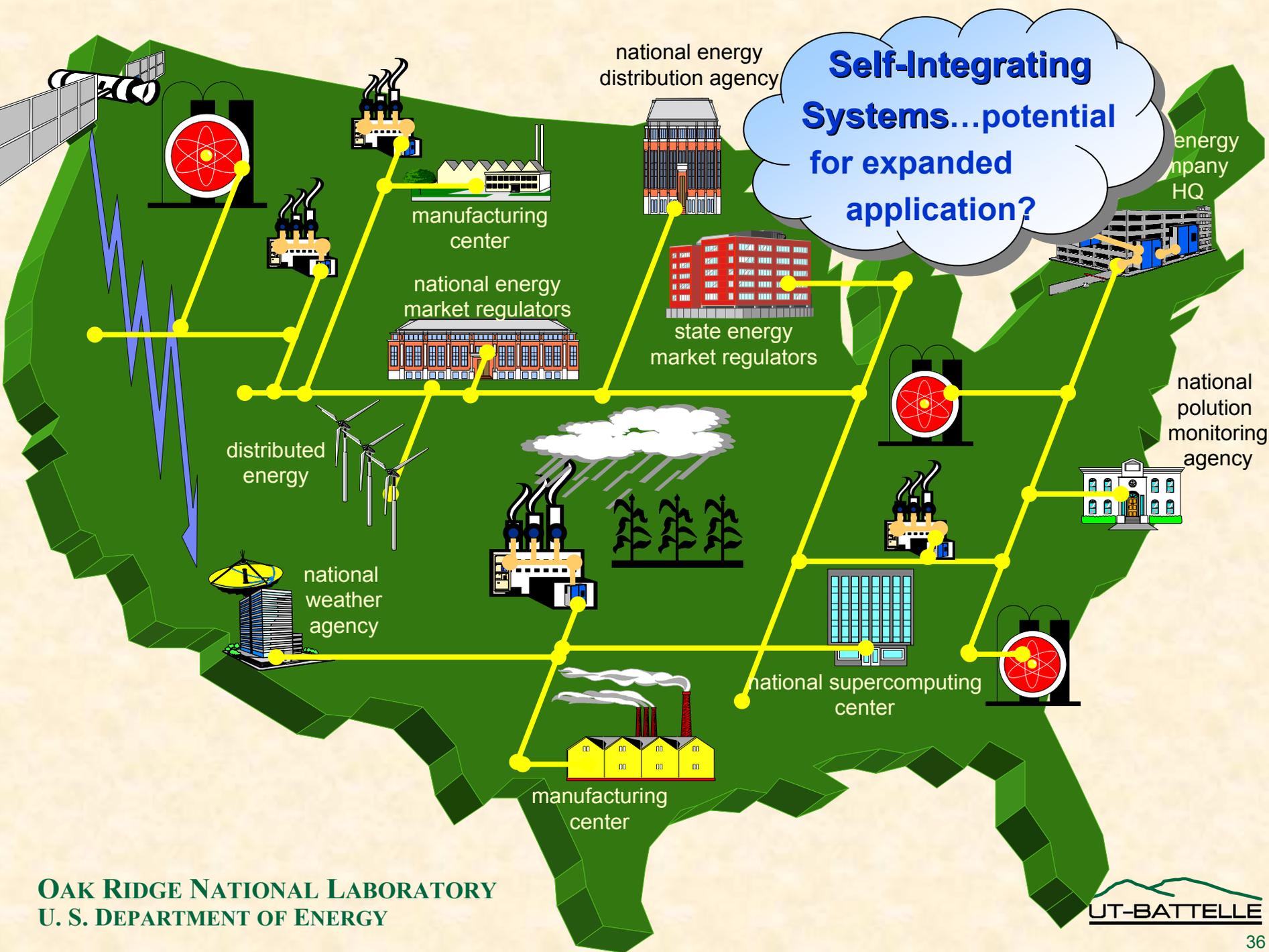
## Focus of Effort:

Leverage maturing ORNL software-defined radio prototype development to produce and demonstrate a small form-factor cognitive radio that is software reconfigurable, multi-modal, and able to operate on multiple waveforms (asymmetric with adjustable bandwidth and low probability of intercept and detection) to provide sense and respond operating data and asset visibility information.



## Cost/Schedule





# *DOD Requirements*



# *ORNL Capabilities*

Visibility, Communication  
and Dynamic Adjustment

- TTL &
- Sensors

➤ Cognitive Radio, RFID,  
Multi-capable Readers

Knowledge Processing and  
Decision Management

•Situational Awareness

➤ CFAST Applications

- Log C2
- Information  
Operations

➤ Intelligence Generator

➤ Knowledge Management

➤ Intelligence Agents

➤ AmmoGen

Derived Efficiencies

- Materials
- Fuels
- Energy

➤ Superhydrophobics

➤ Metals, Ceramics, Composites  
Carbon Foam, Titanium

➤ Gas to Liquid Processes

➤ Inorganic Membranes

➤ Diagnostics/Prognostics

➤ Electrical Signature Analysis

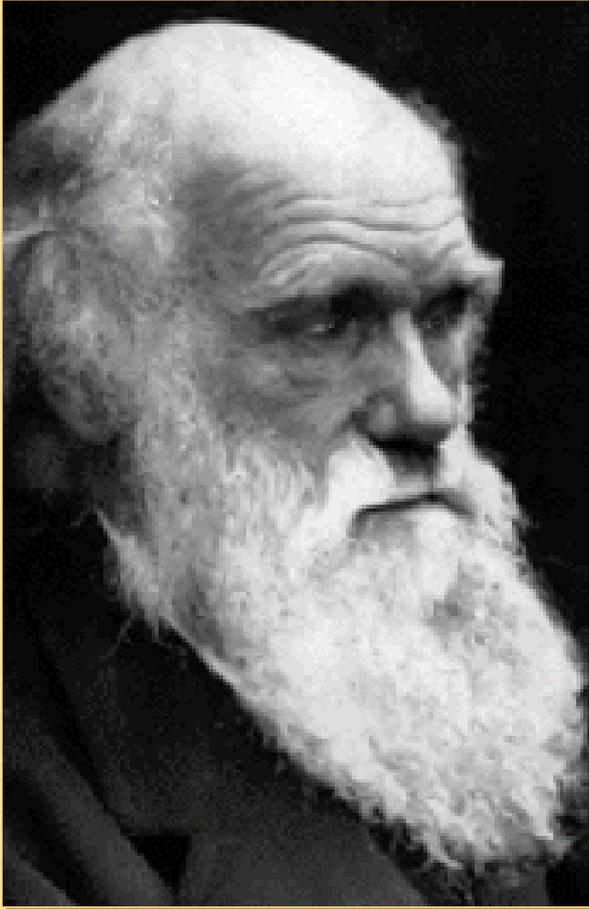
➤ MABES/SURGE

➤ Hybrid Lighting

➤ Weigh-In-Motion

Task Execution and  
Battlefield Functions

- Supply Chain  
Exe/Mgt
- Infrastructure &  
Power Projection
- Maintenance



**“It is not the strongest  
of the species that  
survive, nor the most  
intelligent, but the one  
most responsive  
to change.”**

**– Charles Darwin**



**“The woodpecker might have to go”**

ORNL... ready for the next

Grand Challenge!



**OAK RIDGE NATIONAL LABORATORY**  
**U. S. DEPARTMENT OF ENERGY**

The logo for UT-Battelle, featuring a stylized green mountain range above the text "UT-BATTELLE" in a bold, sans-serif font.