17th ITEA Engineering Workshop:

System-of-Systems in a 3rd Offset Environment: Way Forward

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TRMC Mission

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T&E Infrastructure

- **MRTFB Planning, Assessment and Oversight**
- **Strategic Plan for DoD T&E Resources**

Updated every 2 years in coordination with the Military Departments, Defense Agencies, and specified OSD offices

- **T&E Budget Certification**

Certify to the Secretary of Defense adequacy of DoD T&E Budgets

T&E Investments

- **Test & Evaluation/Science & Technology (T&E/S&T) Program**

*T&E advanced **technology** development*

- **Central Test & Evaluation Investment Program (CTEIP)**

*T&E **capability** development*

- **Joint Mission Environment Test Capability (JMETC)**

*T&E distributed test **integration***

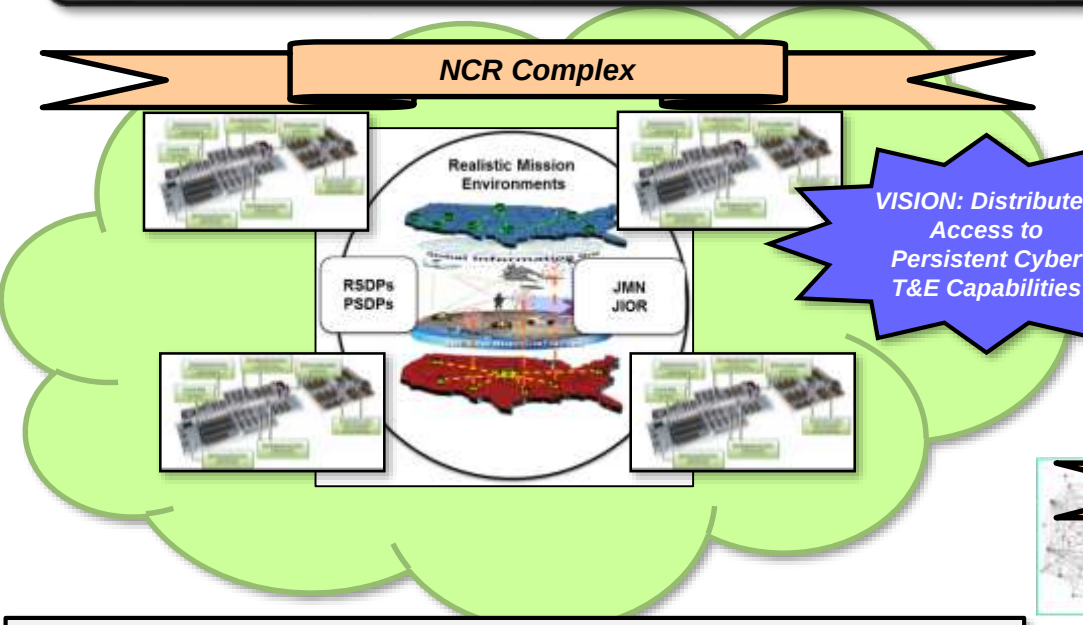
- **National Cyber Range (NCR)**

***Cyber** T&E Environment*

NCR Complex Concept

Mission: Improve the resiliency of our warfighters in the cyber-contested battlespace by conducting testing and training events in operationally-representative cyberspace environments

NCR Complex

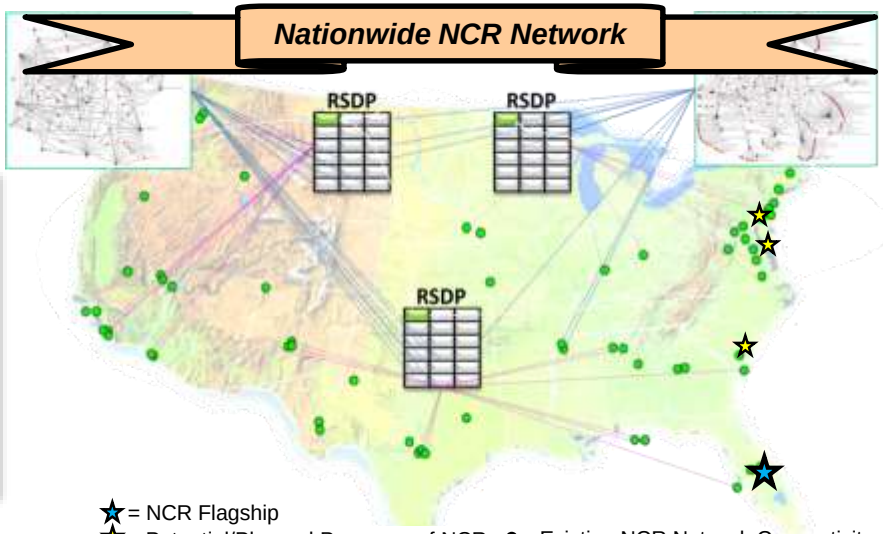


VISION: Distributed Access to Persistent Cyber T&E Capabilities

- **FY17 (Current): 8 Test Beds, OPTEMPO of 70 events/year, Single Location with distributed capability via JMETC MILS Network (JMN) and Joint Information Operations Range (JIOR)**
- **FY21 (Future): 40 Test Beds, ~400-500 events/year, multiple locations seamlessly integrated via JMN & JIOR**

- Refinement of operating processes and improvements in automation tools will promote significant efficiencies across the NCR Complex along with seamless interoperability, leading to reduced operating costs.
- Augmenting existing capabilities to deploy ALL Current and Future Systems to include avionics HW&SW, ICS/SCADA, and more.
- The NCR Complex will be adaptive, rapidly reconfigurable, modular, and scalable to support all needs of the Services.
- The NCR Complex Flagship is in Orlando, FL.

Nationwide NCR Network



Third Offset Strategy

- **"Third Offset Strategy"**
  - To ***"offset" advances in Anti-Access/Area Denial systems***
  - Promising technology areas include: robotics and systems autonomy, human systems, miniaturization, biotechnology, advanced computing and big data, and advanced manufacturing
  - Potential components include:
    - **Autonomous Learning Systems Making Time Critical Decisions**
      - **Delegating decisions to machines in applications that require faster-than-human reaction times, i.e. Cyber Defense, Missile Defense, EW**
    - **Human-Machine Collaborative Decision Making**
      - **Exploiting the advantages of both humans and machines for better and faster decisions, i.e. humans providing strategic guidance combined with the tactical acuity of a computer**

Third Offset Strategy (Cont'd.)

- Potential components include (cont'd.):
  - **Machine-Assisted Human Operations**
    - **Machines helping humans perform better in combat**
  - **Advanced Manned/Unmanned Systems Operations**
    - **Employing innovative cooperative operations between manned and unmanned platforms, i.e.. "swarm operations"**
  - **Network-Enabled, Autonomous Weapon Systems, Hardened to Operate in a Future Cyber/EW Environment**
    - **Enabling for cooperative weapon systems operations in communications-denied environments**

FY 2017 will be a year of considerable war-gaming and testing of theories and operational concepts.

The strategy is constantly being updated.

DoD Needs to Develop New Ways to Project Power

- Improved Intelligence, Surveillance, & Reconnaissance
- Electronic Attack / Electronic Protection
- Surface to Surface Ship Missiles
- Ballistic and Cruise Missile Defense

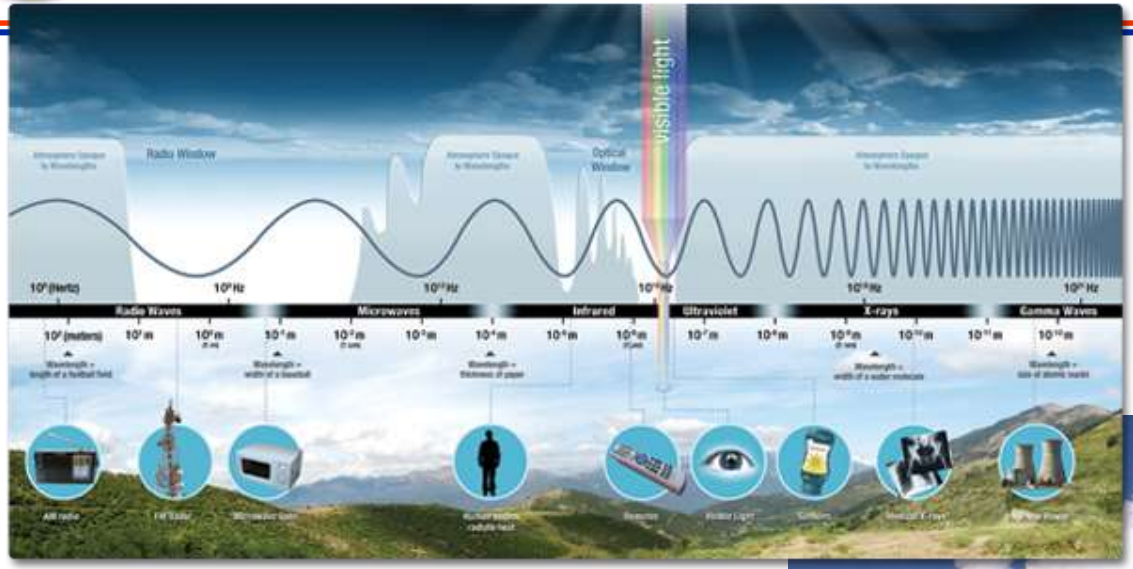
Systems Sea Lightning EX system

- Improved Long-Range Precision Strike
- Cyber and Space Capabilities
- Undersea Warfare
- Advanced Air Defenses

Technologically advanced capabilities needed for the future

Taken from the Deputy Director, Plans & Programs (R&E)'s briefing to the NDIA S&T Conference (April 2016)

Rise of the Commons
Cyber, Electromagnetic Spectrum & Space



Military operations increasingly depend on being able to operate in places "no one owns" – *the Commons*

Taken from the Deputy Director, Plans & Programs (R&E)'s briefing to the NDIA S&T Conference (April 2016)

Engineering's Best and Brightest

- Visual representation of subject keywords of 2015-2016 accepted doctoral dissertations from the top 12 engineering graduate schools, as ranked by *U.S. News and World Report*
- Data Source: ProQuest Dissertations & Theses Global Database // Word Cloud Generator: Tagul

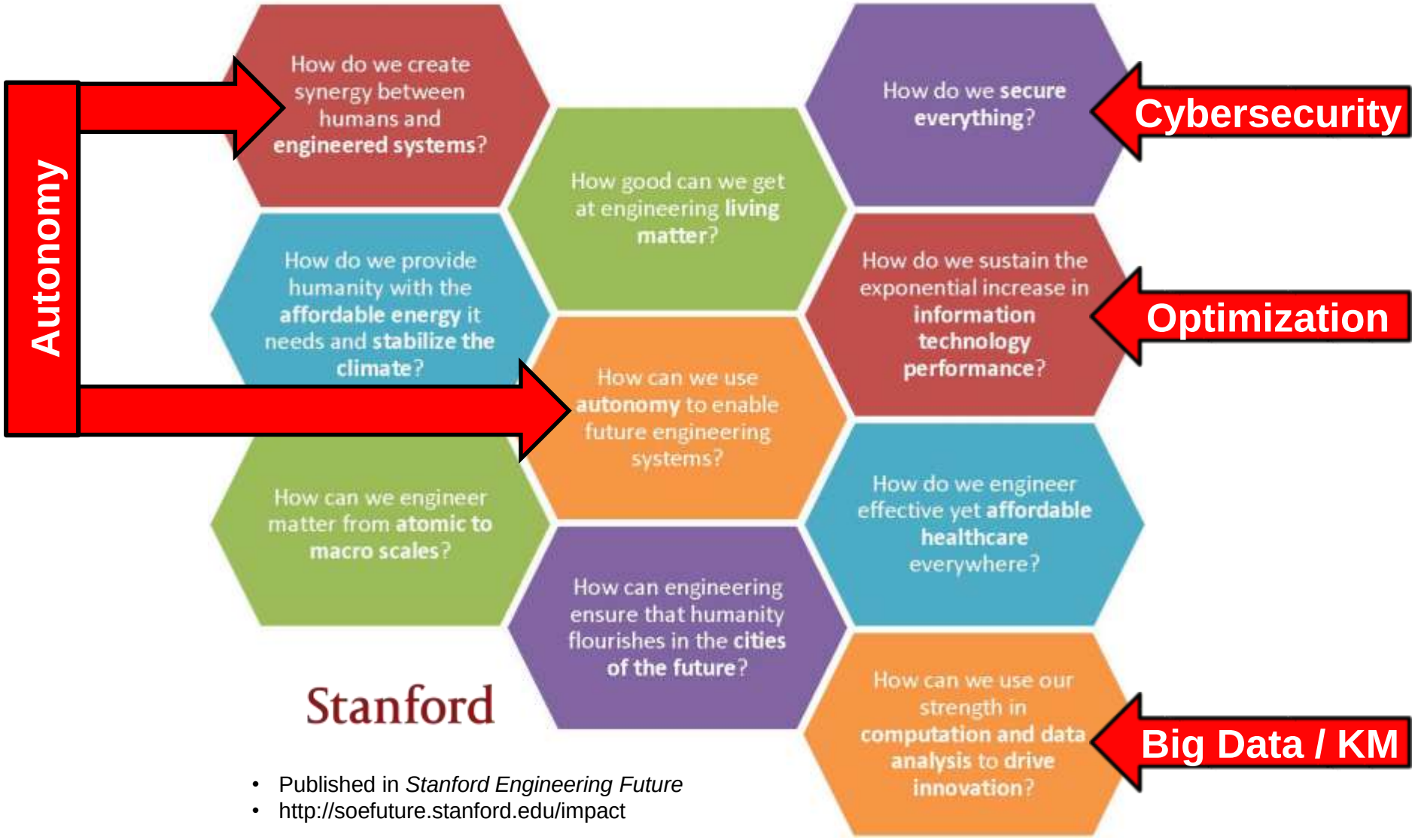
Engineering's Best and Brightest

2015-2016 Accepted Doctoral Dissertations at Top 12 Engineering Schools

- 20% related to optimization
- 12% related to autonomy
- 10% related to RF spectrum / wireless / LTE

- Visual representation of subject keywords of 2015-2016 accepted doctoral dissertations from the top 12 engineering graduate schools, as ranked by *U.S. News and World Report*
- Data Source: ProQuest Dissertations & Theses Global Database // Word Cloud Generator: Tagul

10 Grand Challenges Where Engineering Can Have an Impact



- Published in *Stanford Engineering Future*
- http://soefuture.stanford.edu/impact

Defense Research and Engineering (R&E) Strategy

1. **Mitigate** current and anticipated threat capabilities
   - Cyber
   - Electronic Warfare
   - Counter Space
   - Counter-WMD
   - Missile Defense

2. **Affordably** enable new or extended capabilities in existing military systems
   - Systems Engineering
   - Modeling and Simulation
   - Capability Prototyping
   - Developmental T&E
   - Interoperability
   - Power & Energy

3. Create **technology surprise** through science and engineering
   - Autonomy
   - Data Analytics
   - Human Systems
   - Hypersonics
   - Quantum Systems
   - Basic Sciences

Technology Needs

- Cyber / Electronic Warfare
- Engineering / M & S
- Capability Prototyping
- Protection & Sustainment
- Advanced Machine Intelligence
- Anti-Access/Area Denial (A2/AD)

Taken from the Deputy Director, Plans & Programs (R&E)'s briefing to the NDIA S&T Conference (April 2016)

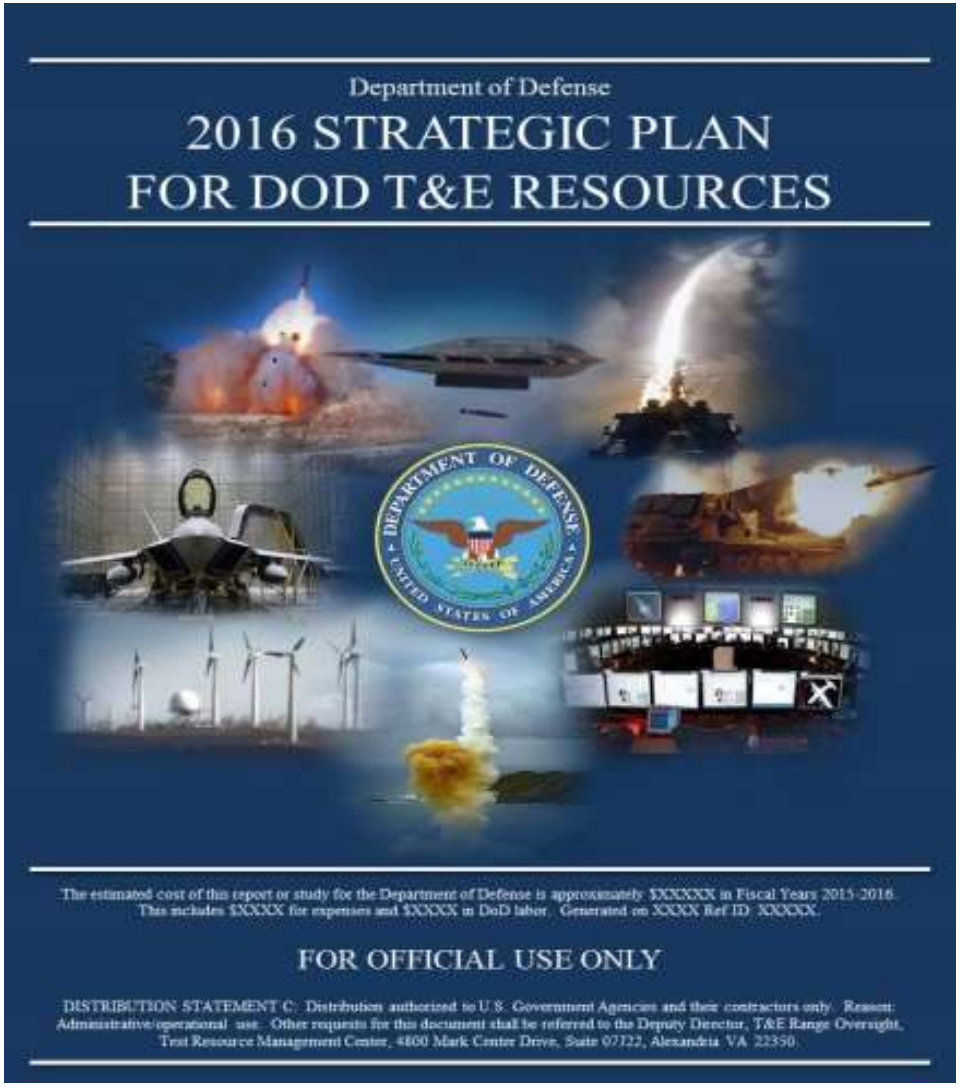
Examples of FY 2017 S&T Investments Aligned to Defense R&E Strategy

- **Mitigate**
  - Counter Weapons of Mass Destruction (~$0.9B)
  - Cyberspace and Space (~$1.0B)
  - Electronic Warfare (~$0.4B)
- **Surprise**
  - High-speed Strike Weapons (~$0.3B)
- **Affordability**
  - Advanced Manufacturing (~$0.14B)
  - Prototyping Efforts (~$0.3B)

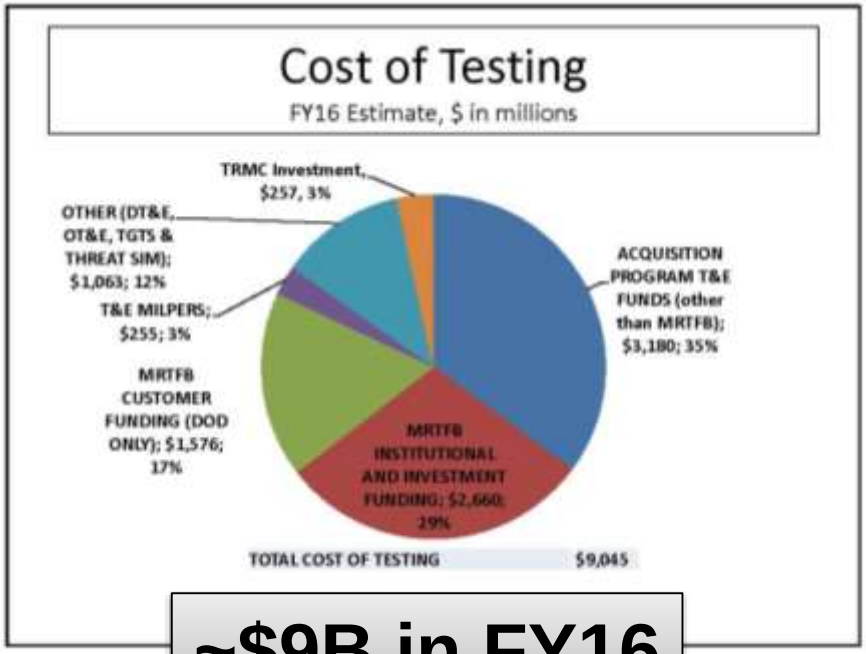
~$3.0B in S&T activities that align with the 3 principles

Taken from the Deputy Director, Plans & Programs (R&E)'s briefing to the NDIA S&T Conference (April 2016)

2016 *Strategic Plan for DoD T&E Resources*



Goal: Actionable Strategic Plan to Guide DoD T&E Spending



~$9B in FY16

Source: Institute for Defense Analyses (IDA) Report
"Cost of Testing Analysis Origin, Description, Data Sources, Assumptions and Limitations, and Results" June 2015

Finally ……

- **The Threats to National Security are Real**
  - **Significant technological advantage is the goal**
  - **Industry, Department, Congress all have a role**
  - **MUST keep pressing for holistic approaches**
    - **Effective and affordable**
- **Opportunities to Excel for all of us**
  - **Unapologetically demand more from each other**
  - **Speed Matters – Risk Taking Authorized**
  - **MUST drive towards DELIVER warfighting advantage – MOST Important outcome !!!!**

Follow through continues on MOST of the key topics at the next Range Commanders Council