47th ANNUAL TARGETS UAVS & RANGE OPERATIONS SYMPOSIUM & EXHIBITION

"Test and Training in a Time of Change"

21-23 October 2009

Agenda

Thursday, 22 October 2009

SESSION I: ***RANGES AND RANGE OPERATIONS***

- ***National NAVAIR Range Complex***: Mr. Terrence (Terry) Clark, SES, Director, NAVAIR Range Department, Pt. Mugu
- ***Capabilities of U.S. Army 21st Century Control Systems***: Mr. Barry Hatchett, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal
- ***Mobile Ground Targets***: Ms. Robbin Finley, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal
- ***U.S. Navy Seaborne Targets: New Directions in a Time of Change***: Mr. Ken Lyle, Program Manager, Evolving Resources, Inc.
- ***Channel Simulators to Test RF Communication Links for Targets, UAVs and Ranges***: Mr. Steve Williams, Business Area Manager, RT Logic, Inc.

SESSION II: ***NEW TECHNOLOGY***

- ***Conducting Analysis of Alternatives for Directed Energy Systems*:** Mr. Doug Rinell, Team Leader, XXR Directed Energy Weapons
- ***Future Inertial Systems Technology***: Mr. Ralph Hopkins, Principal Member, Technical Staff, Draper Laboratory
- ***Hugh Harris Scholarship Update*:** Mr. Cort Proctor, Consultant, Micro Systems, Inc.
- ***Low Cost Training and T&E Targets***: Mr. Jim Schwierling, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal
- ***Determining Threat Equivalency of Navy Aerial Targets***: Mr. Brian Battaglia, Associate Professional Staff, Johns Hopkins University Applied Physics Laboratory

Friday, 23 October 2009

KEYNOTE ADDRESS

- Maj Gen Blair E. Hansen, USAF, Deputy Commander, Joint Functional Component Command for Intelligence, Surveillance and Reconnaissance; Deputy Director, National Intelligence Coordination Center; Deputy Director, Defense Intelligence Operational Coordination Center

SESSION III: ***CURRENT TRENDS***

- ***Aerial Weapons Scoring System:*** Mr. Derek Foster, Program Director, Meggitt Defense Systems, Inc.
- ***Combat Archer***: Lt Col Peter "Shadow" Ford, USAF, 83rd Fighter Weapons Squadron, Tyndall AFB
- ***TMO Aerial Tow Target Program***: Mr. Tony Still, Project Director, Tow Targets; Engineering Chief, Targets Management Office (TMO), Redstone Arsenal

SESSION IV: ***MILITARY PROGRAMS AND REQUIREMENTS***

- ***Air Force:*** Mr. Mike VandenBoom, Director of Operations, 691st Armament Systems Squadron, Eglin AFB

- ***U.S. Navy:*** CAPT Daniel McNamara, USN, Program Manager, Aerial Target and Decoy Systems, PMA-208, Patuxent River
- ***Office of the Secretary of Defense: Target Investments:*** Mr. Josh Messner, TMI Program - Execution Manager, DOT&E Target Resources

NDIA
National Defense Industrial Association

PROMOTING NATIONAL SECURITY SINCE 1919

47th ANNUAL TARGETS, UAVS & RANGE OPERATIONS SYMPOSIUM & EXHIBITION

"Test and Training in a Time of Change"

ONSITE AGENDA
FLOORPLAN & EXHIBITOR PROFILES
ATTENDEE ROSTER

OCTOBER 21-23, 2009

WWW.NDIA.ORG/MEETINGS/0410 ▸ HYATT REGENCY SAVANNAH ▸ SAVANNAH, GA ▸ EVENT #0410

WILLIS HOWARD AWARD

The Willis Howard Award is presented annually to the person, either corporate or military, who in the view of the Executive Board, has demonstrated both sustained superior service within the communities now represented by the NDIA Targets Division, as well as active service to the Division.

Named after Mr. Willis Howard, one of the founding owners of Cartwright Electronics (now a division of Meggitt Defense Systems, Inc.), it is the highest award presented within the targets community. Willis was also one of the founding corporate members of the NDIA Targets Division, which was originally the Aerial Targets Division of the American Ordnance Association. He was an extremely active member of the Division who presented papers, chaired sessions and was Chairman of the Annual Symposium on two occasions.

Willis was killed in an auto accident while working with the USAF Weapons Evaluation Group at Tyndall Air Force Base. He was so well respected throughout the Targets Community that the Division implemented an award in his honor.

HUGH HARRIS MEMORIAL SCHOLARSHIP & GOLF TOURNAMENT

The Hubert D. Harris Scholarship Program was established in 1991 to memorialize Hugh Harris for his many contributions to the targets community in both government and industry. The Division has been joined by NDIA's Gulf Coast Chapter as a co-sponsor of the scholarship program.

Hugh was a longtime member and leader in various professional organizations including the IEEE, AOC and ADPA (forerunner of the NDIA). He served two years as the national Chairman for the Aerial Targets and RPV Section, working closely with all three military services. Subsequent to his death on June 9, 1991, Hugh was the posthumous winner of the Division's Willis Howard Award for outstanding service.

The Hugh Harris Scholarship is presented annually to a deserving high school senior who will be entering an accredited four-year university in pursuit of a math, engineering or hard science degree. Profits from the Hugh Harris Memorial Golf Tournament supplement the $50,000 base scholarship fund.

SYMPOSIUM AGENDA

WEDNESDAY, OCTOBER 21, 2009

10:00 AM - 6:30 PM	**Registration Open in Ballroom ABC Foyer**
11:00 AM	**Hugh Harris Memorial Golf Tournament at Hunter Golf Club**
5:00 PM - 6:30 PM	**Welcome Reception in Exhibit Hall**

AWARD PRESENTATION

The Willis Howard Award will be presented on Thursday, October 22, 2009.

GOLF COURSE

Hunter Golf Club
Building 8205
South Perimeter Road
Hunter Army Airfield, GA 31409
(912) 315-9115

SYMPOSIUM REGISTRATION

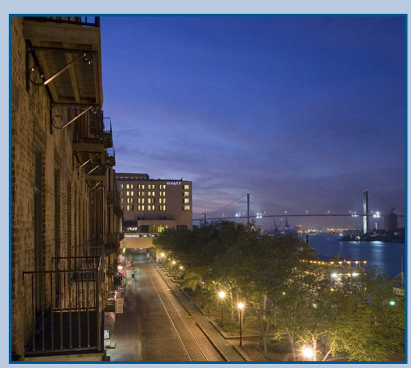
Ballroom ABC Foyer
- Hotel Level 2

GENERAL SESSION

Ballroom ABC
- Hotel Level 2

EXHIBIT HALL

Harborside Center
- Hotel River Street Lower Level



KEYNOTE ADDRESS

Maj Gen David Eichhorn, USAF, is responsible for the development, test and evaluation of manned and unmanned aircraft systems in both experimental and proven aerospace vehicles. He supports the conduct of test and evaluation programs for the Department of Defense, the Defense Advanced Research Project Agency, the National Aeronautics and Space Administration, and the U.S. Air Force, Army, Navy and Marine Corps.

General Eichhorn entered the Air Force as a distinguished graduate through the Reserve Officer Training Corps in 1976. In earlier assignments, he served as an experimental test pilot, and his commands include two flight test squadrons, a test group, a test wing, and the Arnold Engineering Development Center overseeing developmental flight tests on a wide variety of weapon systems. A certified acquisition professional, he served at the Electronic Systems Center as the Vice Commander, where he was previously assigned as Director of Advanced Command, Control and Communications Systems as well as Director of Advanced Aircraft Systems. He has also served as Director of the Aeronautical Enterprise Program Office, Deputy Director of Plans and Programs at Headquarters Air Force Materiel Command, and Deputy Program Executive Officer for Aircraft at Aeronautical Systems Center. Prior to his current assignment, General Eichhorn was the Director of Air, Space and Information Operations, Headquarters Air Force Materiel Command.

THURSDAY, OCTOBER 22, 2009

7:00 AM - 8:00 AM	**Continental Breakfast in Exhibit Hall; Registration Open**
8:00 AM - 8:10 AM	**Welcome Remarks and Keynote Speaker Introduction by Symposium Co-Chairmen** ▶ Mr. David Laird, Director of Programs, Micro Systems, Inc. ▶ Mr. Craig Tangedal, Systems Engineer, 5D Systems
8:10 AM - 8:50 AM	**Keynote Address** ▶ Maj Gen David Eichhorn, USAF, Commander, Air Force Flight Test Center, Edwards AFB

SESSION I: RANGES AND RANGE OPERATIONS

8:50 AM - 9:00 AM	**Introduction by Session Chair** ▶ Ms. Karen Draper, Deputy, Test Management Division, NAVAIR Range Department, Pt. Mugu
9:00 AM - 9:20 AM	**National NAVAIR Range Complex** ▶ Mr. Terrence (Terry) Clark, SES, Director, NAVAIR Range Department, Pt. Mugu
9:20 AM - 9:40 AM	**Targets and Test Platforms** ▶ Mr. Ben Rasnick, Deputy Department Head, Programs, AIR 5.3 (Threat Target Systems Department), Pt. Mugu
9:40 AM - 10:25 AM	**Networking Break in Exhibit Hall**
10:25 AM - 10:45 AM	**Capabilities of U.S. Army 21st Century Control Systems** ▶ Mr. Barry Hatchett, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal
10:45 AM - 11:05 AM	**Mobile Ground Targets** ▶ Ms. Robbin Finley, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal
11:05 AM - 11:25 AM	**Sustainability Issues Facing our Ranges** ▶ Mr. Scott Kiernan, AFFTC Encroachment Lead, R-2508 Complex Sustainability Officer, Edwards AFB
11:25 AM - 11:45 AM	**U.S. Navy Seaborne Targets: New Directions in a Time of Change** ▶ Mr. Ken Lyle, Program Manager, Evolving Resources, Inc.
11:45 AM - 12:05 PM	**Update on Telemetry Systems for Targets and UAVs** ▶ Mr. Allen Wooten, P.E., Chief Hardware Engineer, Dynetics, Inc.
12:05 PM - 12:25 PM	**Channel Simulators to Test RF Communication Links for Targets, UAVs and Ranges** ▶ Mr. Steve Williams, Business Area Manager, RT Logic, Inc.
12:25 PM - 12:35 PM	**Willis Howard Award Presentation by Division Chairman** ▶ Mr. David Miller, Business Development, Meggitt Defense Systems, Inc.
12:35 PM - 1:45 PM	**Networking Lunch in Exhibit Hall**

SESSION II: NEW TECHNOLOGY

1:45 PM - 1:55 PM	**Introduction by Session Chair** ▶ Mr. Milt Cordingly, Special Program Specialist, CEi
1:55 PM - 2:15 PM	**Evolution and Performance of Firejet - Rounding Out the CEi Family of Performance Targets** ▶ Dr. David Langness, VP, Programs and Business Development, CEi
2:15 PM - 2:35 PM	**Conducting Analysis of Alternatives for Directed Energy Systems** ▶ Mr. Doug Rinell, Team Leader, XXR Directed Energy Weapons
2:35 PM - 2:55 PM	**Future Inertial Systems Technology** ▶ Mr. Ralph Hopkins, Principal Member, Technical Staff, Draper Laboratory
2:55 PM - 3:40 PM	**Networking Break in Exhibit Hall**
3:40 PM - 3:55 PM	**Hugh Harris Scholarship Update** ▶ Mr. Cort Proctor, Consultant, Micro Systems, Inc.
3:55 PM - 4:15 PM	**Low Cost Training and T&E Targets** ▶ Mr. Jim Schwierling, Lead Project Director, Targets Management Office (TMO), Redstone Arsenal

KEYNOTE ADDRESS

Maj Gen Blair E. Hansen, USAF, is the Deputy Commander, Joint Functional Component Command for Intelligence Surveillance and Reconnaissance; Deputy Director, National Intelligence Coordination Center; and Deputy Director, Defense Intelligence Operational Coordination Center, Bolling Air Force Base, Washington, DC. General Hansen develops the strategies and plans to integrate, synchronize, and manage full-spectrum defense intelligence operations and capabilities in support of combatant commands to satisfy the priorities of the Department of Defense and the nation.

General Hansen's commands have included a fighter squadron, group and wing to include the 332nd Air Expeditionary Wing at Balad Air Base, Iraq. He held staff assignments at the Combined Forces Command in Seoul, South Korea, the Office of the Secretary of Defense and Headquarters U.S. Air Force, Washington, DC. Prior to assuming his current position, General Hansen was Director of Intelligence, Surveillance and Reconnaissance Capabilities, Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance, Headquarters U.S. Air Force. General Hansen is a command pilot with more than 3,500 hours in fighter aircraft, including 110 combat missions.

4:15 PM - 4:35 PM **Determining Threat Equivalency of Navy Aerial Targets**
- Mr. Brian Battaglia, Associate Professional Staff, Johns Hopkins University Applied Physics Laboratory

4:35 PM - 6:00 PM **Networking Reception in Exhibit Hall**

FRIDAY, OCTOBER 23, 2009

7:00 AM - 8:00 AM **Continental Breakfast in Exhibit Hall; Registration Open**

8:00 AM - 8:15 AM **Welcome Remarks and Keynote Speaker Introduction by Symposium Co-Chairmen**
- Mr. David Laird, Director of Programs, Micro Systems, Inc.
- Mr. Craig Tangedal, Systems Engineer, 5D Systems

8:15 AM - 9:00 AM **Keynote Address**
- Maj Gen Blair E. Hansen, USAF, Deputy Commander, Joint Functional Component Command for Intelligence, Surveillance and Reconnaissance; Deputy Director, National Intelligence Coordination Center; Deputy Director, Defense Intelligence Operational Coordination Center

SESSION III: CURRENT TRENDS

9:00 AM - 9:10 AM **Introduction by Session Chair**
- Mr. Jack Chancellor, Business Development, Meggitt Defense Systems, Inc.

9:10 AM - 9:30 AM **Aerial Weapons Scoring System**
- Mr. Derek Foster, Program Director, Meggitt Defense Systems, Inc.

9:30 AM - 10:15 AM **Networking Break in Exhibit Hall**

10:15 AM - 10:35 AM **Combat Archer**
- Lt Col Peter "Shadow" Ford, USAF, 83rd Fighter Weapons Squadron, Tyndall AFB

10:35 AM - 10:55 AM **TMO Aerial Tow Target Program**
- Mr. Tony Still, Project Director, Tow Targets; Engineering Chief, Targets Management Office (TMO), Redstone Arsenal

10:55 AM - 11:15 AM **Autonomous Cooperative Targets for Air, Land and Sea Operations**
- Mr. Chad Hawthorne, Senior Professional Staff, Johns Hopkins University Applied Physics Laboratory

11:30 AM - 1:30 PM **Networking Lunch in Exhibit Hall (Last Chance to View Exhibits)**

SESSION IV: MILITARY PROGRAMS AND REQUIREMENTS

1:30 PM - 1:40 PM **Introduction by Session Chair**
- Mr. Alvin Brown, Director, Targets Management Office (TMO), Redstone Arsenal

1:40 PM - 2:00 PM **U.S. Air Force**
- Mr. Mike VandenBoom, Director of Operations, 691st Armament Systems Squadron, Eglin AFB

2:00 PM - 2:20 PM **U.S. Army**
- Mr. Alvin Brown, Director, Targets Management Office (TMO), Redstone Arsenal

2:20 PM - 2:40 PM **U.S. Navy**
- CAPT Daniel McNamara, USN, Program Manager, Aerial Target and Decoy Systems, PMA-208, Patuxent River

2:40 PM - 3:00 PM **Office of the Secretary of Defense: Target Investments**
- Mr. Josh Messner, TMI Program - Execution Manager, DOT&E Target Resources

3:00 PM - 3:10 PM **Concluding Remarks by Symposium Co-Chairmen**
- Mr. David Laird, Director of Programs, Micro Systems, Inc.
- Mr. Craig Tangedal, Systems Engineer, 5D Systems

EXHIBITING COMPANIES

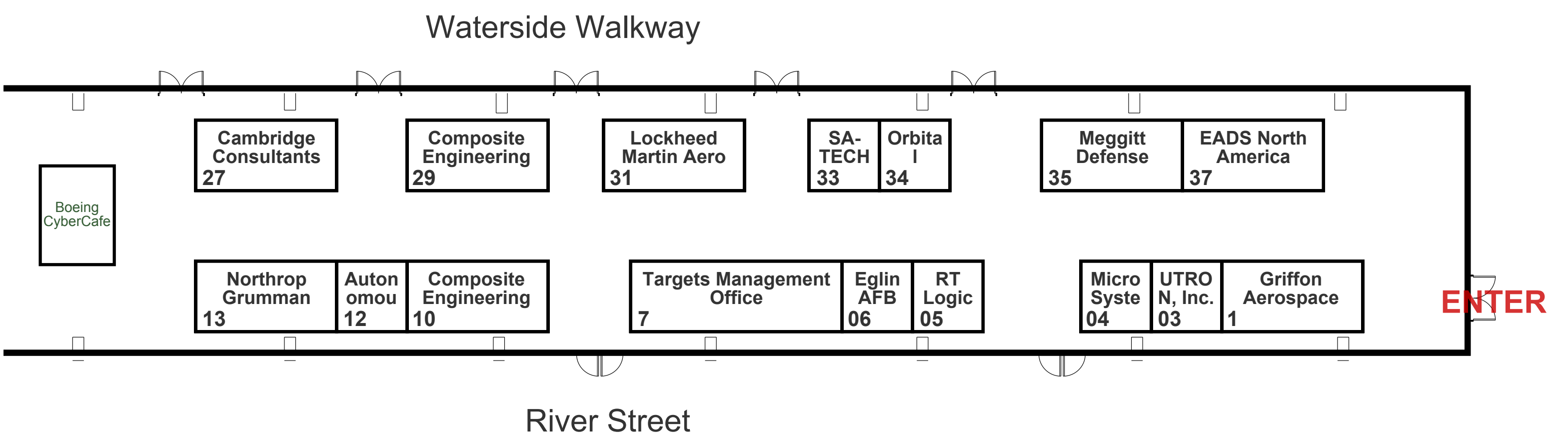
Listed by Name

Name	Booth #
Autonomous Solutions, Inc.	12
Cambridge Consultants	27
Composite Engineering	29
Composite Engineering	10
EADS North America	37
Eglin AFB	6
Griffon Aerospace	1
Lockheed Martin Aero	31
Meggitt Defense Systems	35
Micro Systems, Inc.	4
Northrop Grumman	13
Orbital Sciences Corporation	34
RT Logic	5
SA-TECH	33
Targets Management Office	7
UTRON, Inc.	3

Listed by Booth Number

Name	Booth #
Griffon Aerospace	1
UTRON, Inc.	3
Micro Systems, Inc.	4
RT Logic	5
Eglin AFB	6
Targets Management Office	7
Composite Engineering	10
Autonomous Solutions, Inc.	12
Northrop Grumman	13
Cambridge Consultants	27
Composite Engineering	29
Lockheed Martin Aero	31
SA-TECH	33
Orbital Sciences Corporation	34
Meggitt Defense Systems	35
EADS North America	37

HARBORSIDE CENTER



Autonomous Solutions, Inc.
http://www.autonomoussolutions.com

Autonomous Solutions is a leader in target vehicle automation and multi-vehicle control. We have delivered hundreds of unmanned vehicle systems on 50 different types of vehicles for military and commercial applications. ASI has implemented ground target solutions at Luke AFB, Nellis AFB, and Fort Polk. We currently offer high-precision ground targets and low cost disposable target solutions. Stop by and ask about our ground target solutions.

Cambridge Consultants

Cambridge Consultants develops and manufactures world-leading products and systems, creates and licenses intellectual property and provides technology consultancy. With a team of over 250 engineers, designers and scientists, Cambridge Consultants works across a range of industries including defense, medical technology, industrial and consumer products, transport systems and wireless communications.

Composite Engineering

Composite Engineering Inc. provides high performance aerial targets and target services around the globe. Our platforms include the US Air Force fielded BQM-167A, the BQM-167X and the Firejet target systems. In addition, we provide significant elements of the US Navy GQM-163 and the recently awarded MSST program.

EADS North America
http://www.eadsnorthamerica.com

EADS North America is a major provider of advanced solutions for U.S. defense and homeland security, and is a recognized leader in the design, production, and operation of aerial targets. EADS North America and its parent company, EADS, contribute $11 billion to the U.S. economy and support 200,000 American jobs.

Eglin AFB

Preview the new and improved Gulf Range Drone Control System (GRDCS).

Griffon Aerospace
http://www.griffon-aerospace.com

Griffon is the prime contractor for Air Defense Targets for the US Army Targets Management Office (TMO) and the manufacturer of the MQM-170A Outlaw and MQM-171 BroadSword.

Lockheed Martin Aero

Lockheed Martin (NYSE: LMT) is a global security enterprise engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems.

Meggitt Defense Systems
http://www.meggitt-defense.com

Meggitt Defense Systems is a world-leading designer and producer of sub-scale free flying and towed targets and tow reels with over 140,000 targets delivered. Our motto "Smart engineering for extreme environments" means we take great pride that our equipment will work the first time and every time, wherever deployed.

Micro Systems, Inc.
www.gomicrosystems.com

Micro Systems, Inc. offers turn-key solutions for command/control, instrumentation systems and components for airborne and ground based target applications.
The Company's capabilities encompass all aspects of system development including Systems Engineering, benign and severe environment hardware engineering, high performance, real-time software engineering, and field engineering support.

Northrop Grumman
http://northropgrumman.com

Northrop Grumman enjoys a preeminent legacy of high fidelity aerial target development and production spanning 70 years. The Northrop Grumman team showcases the foundation for the next generation of high performance subsonic target. BQM-74X will meet all of the key performance requirements of the Navy's subsonic aerial target (SSAT) program.

Orbital Sciences Corporation
www.orbital.com

Orbital's Launch Systems Group provides launch vehicle design, development, integration and launch services. Orbital leverages our 46-year history of launch vehicle development for missile defense interceptors, ballistic targets, experimental payloads and satellite launches.

RT Logic
http://www.rtlogic.com

RT Logic, designs, develops, and delivers innovative signal processing systems for the space, flight test and range communications industry. Our Telemetrix® product line is used for flight test, launch vehicle telemetry, on-orbit satellite control, missile and airborne communications, range communications as well as spectrum monitoring/interference detection and training applications. RT Logic is an Integral Systems company.

SA-TECH
www.sa-techinc.com

SA-TECH provides support services to DoD customers in the areas of program management, operations and maintenance, engineering services, and logistics. Our specialty is test/training ranges and targets.

Targets Management Office
http://www.peostri.army.mil/PMITTS/TMO

The Targets Management Office provides technically advanced target system development, target system procurement and life-cycle target operations and sustainment support in live and virtual environments for US and allied clients. The targets systems encompass 3 domains: Aerial, Ground and Virtual.

UTRON, Inc.
http://www.utroninc.com

UTRON is an award winning R&D Company with an exemplary history of providing advanced technological innovations in the areas of high velocity gun launch and novel materials. UTRON's defense division operates a new 300-acre high-energy test facility in West Virginia, which is certified as an IED/EFP test center.

ATTENDEE ROSTER

MR. SAMI ADLAY
NAVAIR WEAPONS DIVISION

CDR PETE ALEXANDER, USN
L-3 RUGGEDIZED COMMAND & CONTROL SOLUTIONS

MR. JOHN ALLEN
U.S. ARMY PEO STRI

MR. PAUL BAITER
ANALYTICAL SERVICES, INC.

MS. KATY BALL
WEBER

MR. BRAD BARE
TYBRIN CORPORATION

MR. ROBERT BARRETO
AIRBORNE THREAT SIMULATION

MR. BILL BARSBY
ZODIAC DATA SYSTEMS

MR. BRIAN BATTAGLIA
JOHNS HOPKINS UNIVERSITY APL

MR. ROB BELKNAP
BAE SYSTEMS AEROSPACE SOLUTIONS

MR. STEVE BELOW
J B MANAGEMENT

MR. STEVE BERKEL
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION

MR. JOHN BRADDY
PEO STRI TARGETS MANAGMENT OFFICE

MR. ALVIN BROWN
PEO STRI TARGETS MANAGEMENT OFFICE

MR. LARRY BROWN
THE BOEING COMPANY

CAPT ED CAFFREY, USN (RET)
ENGINEERED ARRESTING SYSTEMS CORP.

MR. ROGER CALDOW
THE JOHNS HOPKINS UNIVERSITY APL

MR. RON CARTER
UTAH CENTER FOR AERONAUTICAL INNOVATION & DESIGN

MR. PETER CASTRILLI
RAYTHEON TECHNICAL SERVICES COMPANY, LLC

MR. JACK CHANCELLOR
MEGGITT DEFENSE SYSTEMS, INC.

MS. KAREN CHERGOSKI
SYSTEMS APPLICATION & TECHNOLOGIES, INC.

MR. TERRY CLARK
NAVAIR

MRS. DEBBIE CLEGG
ARGON ST

MR. MILT CORDINGLY
CEI

MAJ CLEVELAND DARGAN, USA
U.S. ARMY ARDEC

MR. THOMAS DOWD
NAVAIR

MS. KAREN DRAPER
NAVAIR

MR. SCOTT DUFFY
PEO IWS ITE

MR. JIM DUNCAN
RAYTHEON COMPANY

MAJ GEN DAVE EICHHORN, USAF
AIR FORCE FLIGHT TEST CENTER, EDWARDS AFB

MR. ALAN EVANS
SOFTWARE ENGINEERING INSTITUTE

MR. DIK FARHALL
AIRBORNE SYSTEMS N.A.

MR. DON FERGUSON, JR.
U.S. ARMY MISSILE COMMAND

MR. KEVIN FERGUSON
MICRO SYSTEMS, INC.

MS. ROBBIN FINLEY
TARGETS MANAGEMENT OFFICE

MR. ERIC FINN
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION

LCDR JIM FLEMING, USN
OPNAV N091

LT COL SHADOW FORD, USAF
83RD FIGHTER WEAPONS SQUADRON

MR. DEREK FOSTER
MEGGITT DEFENSE SYSTEMS, INC.

MR. MICHAEL FRANCIS
TARGETS MANAGMENT OFFICE

MR. MIKE FUKUDA
ADVANCED TECHNOLOGY ASSOCIATES, INC.

MR. BOB GRAHAM
ATLANTIC TARGETS & MARINE OPERATIONS

MR. SAM GRIFFITH
NAVAIR

MR. JIM GRUENBERG
WRIGHT STATE UNIVERSITY - NATIONAL CENTER FOR MEDICAL READINESS

MR. RICH HADDAD
MEGGITT TRAINING SYSTEMS, INC.

CDR BILL HALL, USN (RET)
C-PORT MARINE SERVICES, LLC

MAJ GEN BLAIR HANSEN, USAF
JOINT FUNCTIONAL COMPONENT COMMAND

MR. BARRY HATCHETT
PEO STRI PM ITTSW TARGETS MANAGEMENT OFFICE

MR. CHAD HAWTHORN
THE JOHNS HOPKINS UNIVERSITY APL

MR. MICHAEL HELKE
AEROMECH ENGINEERING, INC.

MR. JEFF HERRO
CEI

MR. JIM HOBSON
ARGON ST

MR. TODD HONDA
ATK ADVANCED WEAPONS DIVISION

MR. RALPH HOPKINS
DRAPER LABORATORY

MR. ERIC HUFFMAN
TARGETS MANAGEMENT OFFICE

MR. RENYA INAGAKI
C3I SYSTEMS CORPORATION

MR. BOB INSINNA
THE BOEING COMPANY

COL WES JARMULOWICZ, USMC (RET)
NORTHROP GRUMMAN CORPORATION

MR. RANDY JEFFREYS
ONR

MR. ALLAN JOHNSON
GATECH RESEARCH INSTITUTE

MR. DARREN JOHNSON
5-D SYSTEMS, INC.

MR. SCOTT KIERNAN
AFFTC

MSGT RYAN KILIAN, USAF
U.S. AIR FORCE

MAJ PATTY KIM, USAF
HEADQUARTERS AIR COMBAT COMMAND

MR. LARRY KINCANNON
EADS NORTH AMERICA

MR. ANDY KRISTOVICH
OSD/DOT&E

MR. DAVID LAIRD
MICRO SYSTEMS, INC.

MR. MIKE LAROSE
U.S. ARMY

MR. JOHN LATIMER
LOCKHEED MARTIN INFORMATION SYSTEMS

MR. RAY LOWMAN, II
U.S. ARMY VIRTUAL TARGETS CENTER

MR. KEN LYLE
EVOLVING RESOURCES, INC.

MR. JAMES MAYBURY
APPLIED RESOURCES, INC.

CAPT DANIEL MCNAMARA, USN
PMA-208 NAVY AERIAL TARGETS & DECOY SYSTEMS

MR. RICH MEINERS
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION

MR. JOHN MENDES
TARGETS MANAGEMENT OFFICE

MR. BOB MENDEZ
AIR CRUISERS COMPANY

MR. JOSHUA MESSNER
OFFICE OF THE SECRETATRY OF DEFENSE, DOT&E

MR. MATT METCALF, III
TUG HILL CONSTRUCTION, INC.

MR. DAVE MILLER
MEGGITT DEFENSE SYSTEMS, INC.

LT COL STUFF MILLER, USAF
TYNDALL AFB

MR. MATT MILLIGAN
SOUTHERN CALIFORNIA OFFSHORE RANGE

MR. JUHA MOISIO
ROBONIC, LTD, OY

MR. JIM MOORE, JR.
53RD TEST SUPPORT SQUADRON

BG STEPHEN MUNDT, USA (RET)
EADS NORTH AMERICA

MR. BRIAN NALLEY
TARGETS MANAGEMENT OFFICE

LT COL MICHAEL NEEMAN, USAF
86TH FIGHTER WEAPONS SQUADRON

MR. DICK NIEHAUS
THE BOEING COMPANY

MR. DOC O'CONNELL
SYNECTIC SOLUTIONS, INC.

MR. DAVE ORMSBEE
MICRO SYSTEMS, INC.

MR. BOB PALMER
MEGGITT DEFENCE SYSTEMS, INC. - CANADA

MAJ BERNIE PETERS, USA
CAMP GRAYLING JOINT MANEUVER TRAINING CENTER

MR. KARL POULSEN
MICROTURBO, INC.

MR. CORT PROCTOR
MICRO SYSTEMS, INC.

MR. DAVID PURDY
NAVAL AIR WARFARE CENTER, WEAPONS DIVISION

MR. BEN RASNICK
AIR 5.3, NAVAIR

MR. JIM RENSHAW
APPLIED RESOURCES, INC.

MR. CHARLIE RICH
TARGETS MANAGEMENT OFFICE

MR. REINHARD RICHTER
E.I.S. AIRCRAFT GMBH

MR. DOUG RINELL
DIRECTED ENERGY, AAC

COL KEVIN RUMSEY, USAF (RET)
FLUOR GOVERNMENT GROUP

MR. SANDY SANFORD, JR.
APPLIED RESOURCES, INC.

CAPT JOHN SCHWERING, JR., USN (RET)
THE BOEING COMPANY

MR. JIM SCHWIERLING
TARGETS MANAGEMENT OFFICE

MR. ERAN SHANI
ISRAEL MILITARY INDUSTRIES

CAPT STEVE SHEGRUD, USN (RET)
WHITNEY, BRADLEY & BROWN

MS. APRIL SIBISKI
THE GAMMON GROUP, LLC

MR. CHUCK SLEEPER
UBC, INC.

MR. JERRY SMAILES
U.S. AIR FORCE

MR. BRENT SMITH
JACOBS ENGINEERING GROUP, INC.

COL CYRIL SOCHA, USAF
308TH ARMAMENT SYSTEMS WING

MR. WALT SPENCE
HONEYWELL CORP

MR. TONY STILL
TARGETS MANAGEMENTS OFFICE

MR. STEVE STREIGHTIFF
COMPUTER SCIENCES CORPORATION

MR. BRADLEY STRINGER
WEBER

MR. TIM STRUSZ
ATK ADVANCED WEAPONS

MR. MARK SYDENHAM
QINETIQ, LTD.

MR. DENNIS TACKETT
MODERN TECHNOLOGY SOLUTIONS, INC.

MR. CRAIG TANGEDAL
5-D SYSTEMS, INC.

COL PK TANGUAY, USA (RET)
COMMUTER AIR TECHNOLOGY

MR. RAINER TELLINGHUSEN
E.I.S. AIRCRAFT GMBH

COL BRUCE TRUOG, USA
PEO STRI TARGETS MANAGEMENT OFFICE

MR. DOUG TYLER
NORTHROP GRUMMAN CORPORATION

MR. GREGG VAN SPLINTER
ATSO

MR. MIKE VANDENBOOM
691ST ARMAMENT SYSTEMS SQUADRON

MR. PAUL VANDRUNEN
TYBRIN CORPORATION

COL ROD WALSH, USA (RET)
EADS NORTH AMERICA

MS. JANE WARRINER
TYBRIN CORPORATION

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PROCEEDINGS

Proceedings will be available on the web through the Defense Technical Information Center (DTIC) two weeks after the symposium. All registered attendees will receive an email notification once the proceedings are available.

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During symposium registration and check-in, each attendee will be issued an identification badge. Please be prepared to present a valid picture ID. Your badge must be worn at all symposium functions.

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MDS' other technologies include airborne countermeasure systems, ammunition handling systems and environmental control systems. Our Training Systems group in Atlanta, Georgia specializes in live-fire range Targetry, control and instrumentation for various weapon types ranging from small arms through full tank rounds and virtual training ranges utilizing the latest in computer generated graphics for full immersion scenarios from individual weapons to full combat unit engagements including calls for fire and air strikes.

Our company's goal is to support our armed forces with the best training and combat systems possible so the soldiers can train like they fight and fight like they train. We take pride in our combat systems' reliability from towed countermeasures to ammunition handling systems – all proven in combat in the harshest environments in the world. Our motto, "Smart engineering for extreme environments," means we take great pride that our equipment will work the first time and every time, wherever deployed.

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Headquarters USAF Warfare Center

Testing - Tactics - Training

83d FWS
NDIA Brief

Lt Col Pete "Shadow" Ford

83 FWS/CC

23 Oct 09

This Briefing is:
UNCLASSIFIED

Overview

- WEG & 83 FWS Mission
- Targets
- Air-to-Air Engagements
- Results
- Future

53 WEG Mission

Provide senior leaders an annual assessment of weapon system effectiveness & suitability through kill chain evaluations on all combinations of fighter, bomber, and remotely piloted aircraft employing both air-to-air & air-to-ground weapons in realistic scenarios that enhance training

Provide threat representative aerial targets for WSEP, DoD, and FMS weapons testing programs

***Weapons-Build Through Impact Analysis* of the A/A and A/G Kill Chains**
***Aerial Target Systems* for WSEP, DoD and FMS Test Programs**

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Aerial Target Systems **for WSEP, DoD and FMS Test Programs**

83 FWS Mission

Provide a Tailored Force Development Evaluation on the overall effectiveness & reliability of DOD air-to-air weapons systems

Validate & expand air-to-air tactics, techniques, and procedures

Provide air-to-air missile experience to participating units

Targets

- Adaptive Full Spectrum Threat-Realistic Expendable Target

- 3-Dimensional
  - Low OR High
  - Slow OR Fast
  - Level OR Highly Maneuvering
  - RCS/RF/EA/IR/Easily Seen

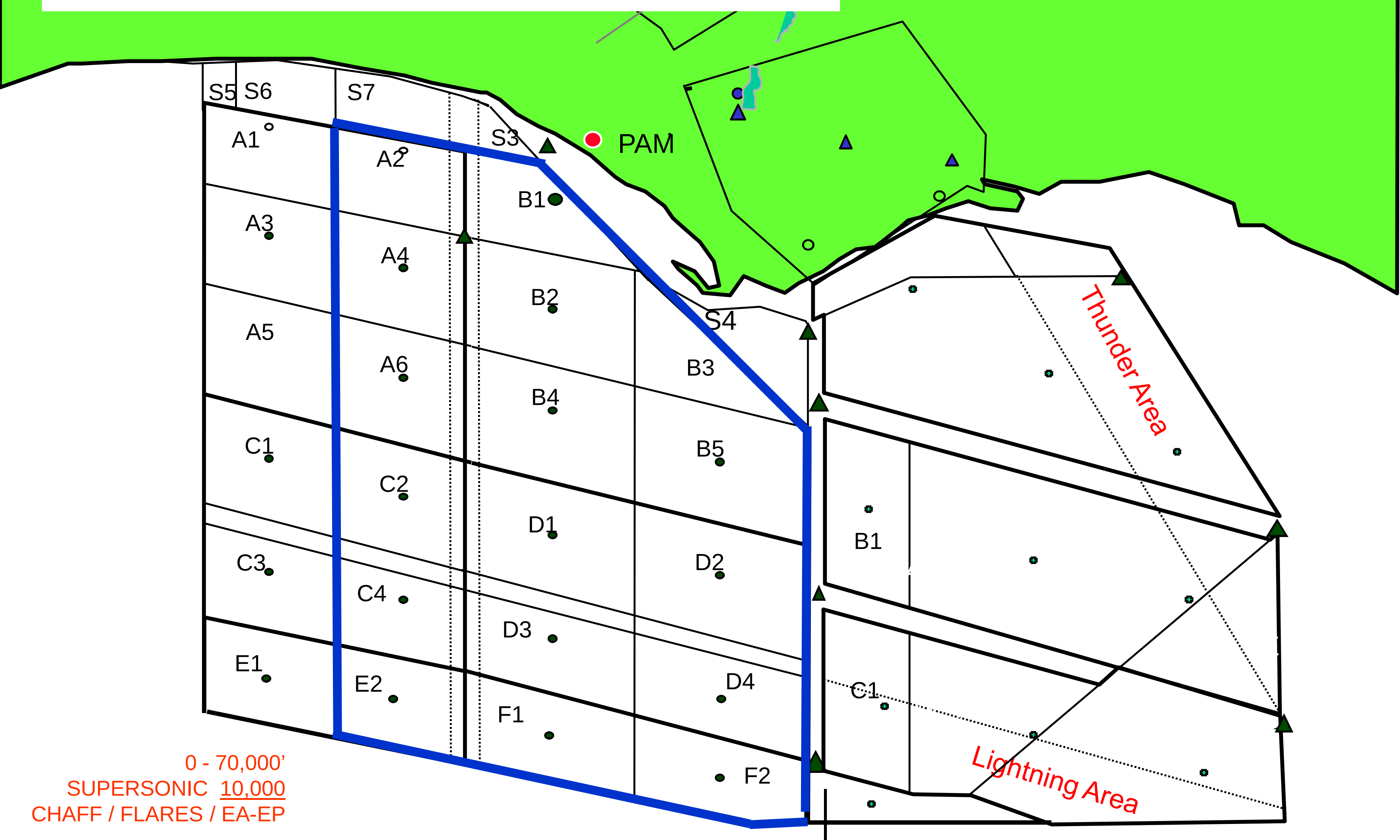
- Roles…
  - Fighter
  - Cruise Missile/UAS
  - Plus…Airliner, Cessna, Helo

Air-to-Air Engagement

- **<u>COMBAT</u>**
  - **Fluid, Dynamic, Un-constrained, Dangerous and Expensive!**
- **<u>TRAINING</u>**
  - **Ideally, similar w/o real death & danger**
  - **…Fluid ~ Structured**
  - **…Dynamic ~ Repetitive**
  - **…Un-constrained ~ Bounded**
  - **…Expensive ~ Affordable**
- **<u>VALID</u>**
  - **Validated as we gather quantifiable data/info for analysis**
- **<u>CUSTOMER</u> - Can I have it ready yesterday and again tomorrow?**

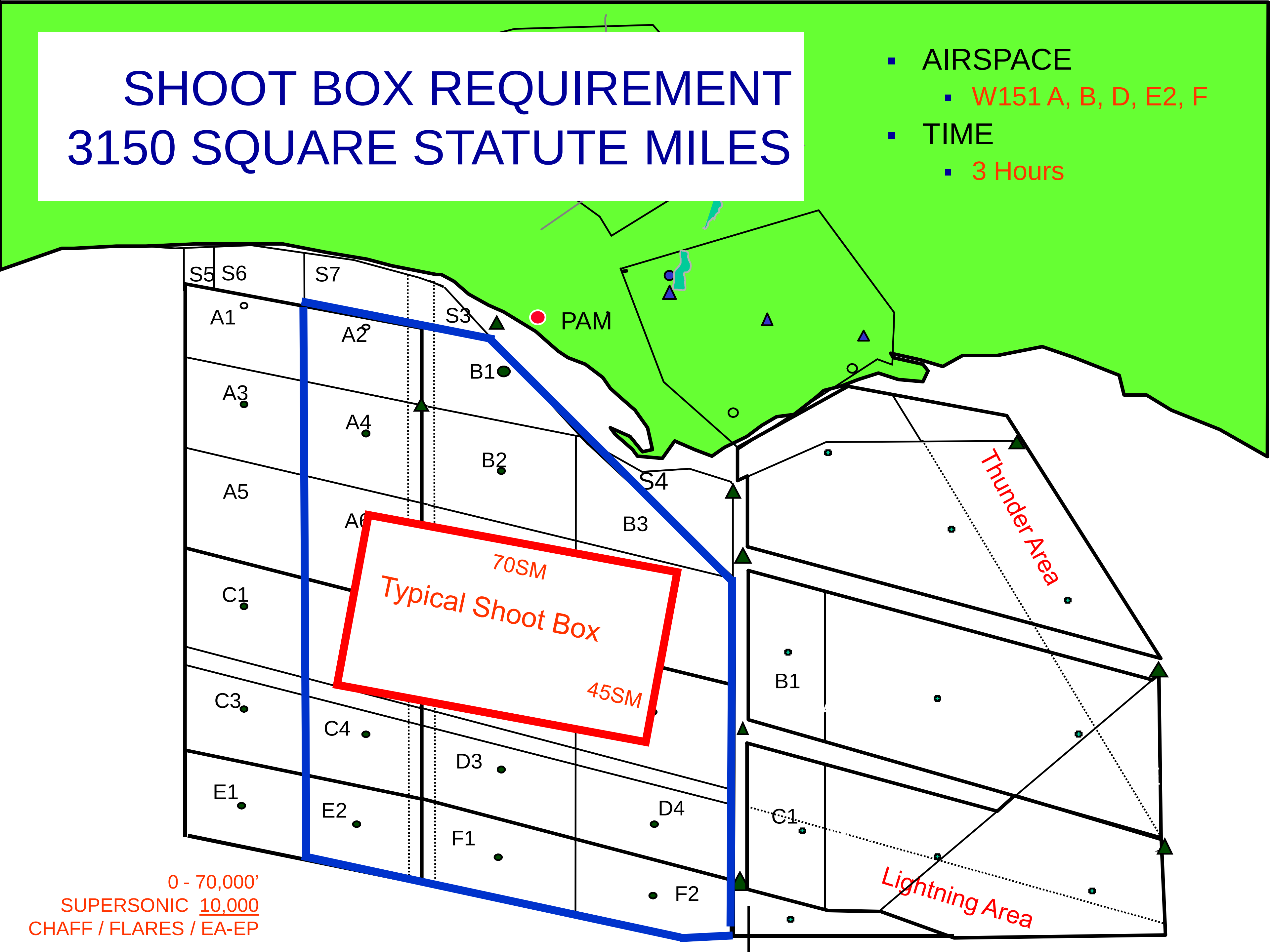
TYPICAL COMBAT ARCHER SCHEDULED RANGES

- AIRSPACE
  - W151 A, B, D, E2, F
- TIME
  - 3 Hours



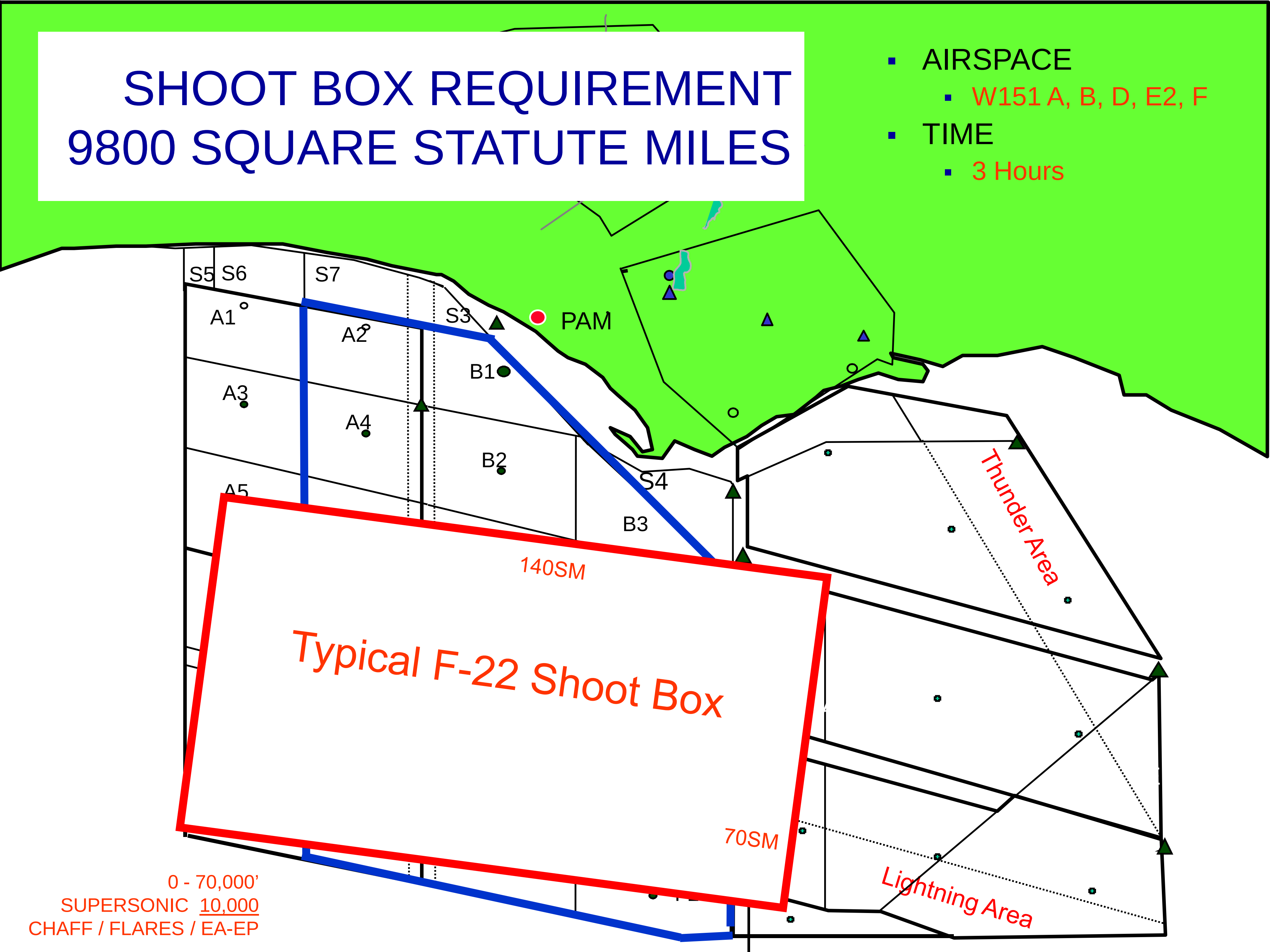
SHOOT BOX REQUIREMENT
3150 SQUARE STATUTE MILES

- AIRSPACE
  - W151 A, B, D, E2, F
- TIME
  - 3 Hours



SHOOT BOX REQUIREMENT
9800 SQUARE STATUTE MILES

- AIRSPACE
  - W151 A, B, D, E2, F
- TIME
  - 3 Hours



RESULTS

- **TACTICAL**
  - **3-1, TTPs, SHOT-KILL**
- **OPERATIONAL**
  - **OPLANS**
  - **IN-THEATER WEAPONS EFFECTS**
- **STRATEGIC**
  - **TO CSAF ANNUALLY – FILTER TO OSD**
  - **CNO GROWTH**
- **DEFENSE INDUSTRY**
  - **WEAPONS – WPNS SYSTEMS - TARGETS**

NDIA TAKE-AWAYS

- TARGETS
  - Evaluate Multi-Role Platforms (Combined WSEPs)
  - Target Set Expansion!
  - Incorporate New Weapons Systems (F22/F35/UAS)
  - Incorporate New Weapons

- RANGES
  - Optimize Efficient Use across Users…Joint Ops
  - Optimize Growth (Higher, Faster, Farther, +Data Fidelity)
  - Play Well with others…
    - Civilian use…Business use…
    - Gov't (FAA) use…
    - Continued Military use

Headquarters USAF Warfare Center

Testing - Tactics - Training

QUESTIONS?

PETER.FORD@TYNDALL.AF.MIL
83 FWS/CC
DSN 523-4039
COMM 850-283-4039

Keeping a Razor Sharp Edge for America…

Aerial Weapons Scoring System (AWSS)

Presented
at
NDIA 47th Annual Targets, UAVs and Range Operations Symposium
10/23/09
by

Derek Foster
Program Director, Electronic Systems
Meggitt Defense Systems Inc.
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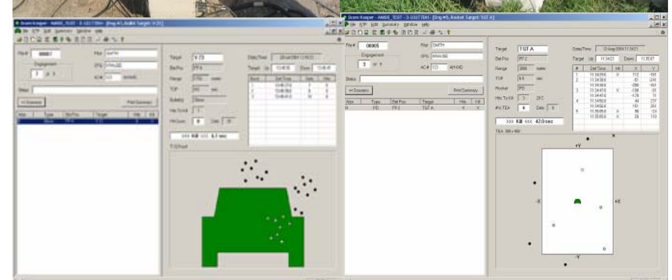
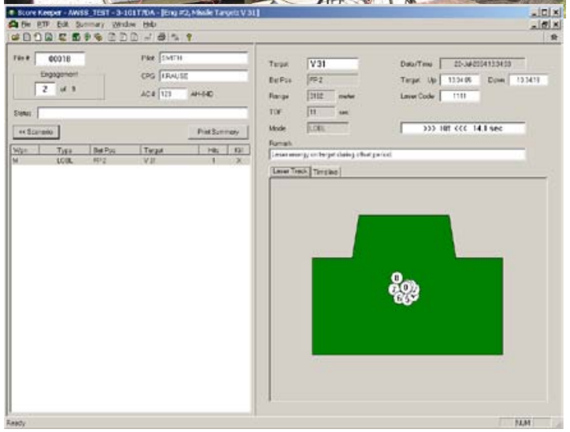
What is AWSS?

- **Scalable & portable system of computer controlled sensors used to score live-fire helicopter gunnery for evaluation of crew & weapons performance.** This objective scoring system allows the commander to validate training standards, ensure training effectiveness, and substantiate training ammunition requirement levels.
- Consists of:
  - Acoustic sensors for 2.75” rocket impact location
  - Radar sensors for cannon/machine gun scoring
  - IR/Optical sensors for laser designator detection & tracking when used with the Hellfire Captive Training missile
- Six fully portable systems delivered to the US Army for crew qualification gunnery training
- Only fielded system worldwide for Attack Helicopter live fire training



AWSS Required Operational Capability

- **AWSS is the standard objective scoring method for all US Army AH-64 & OH-5 crew qualification gunnery tables (6-)**
- Provide Commander with objective feedback of target effect for all Attack Helicopter weapons engagements
- Operate Day and Night with no degradation or limitation due to environmental conditions that would not preclude training
- Detect and score > 90% of all projectiles (rockets and bullets) in the target effect area (scored zone)
- Maintain > 95% equipment availability rate
- Sustain NO damage from environmental / EMI standard conditions for Army ranges & training devices



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AWSS Background

Original Requirement	1984
Prototype Operations (Ft Hood, TX)	1986-90
Production Deliveries	1991
ECPs Incorporated	1995-99
Upgrades Funded	2000
Production Start	2003
Fielding	2004-07
Continuous System Enhancements	2007-present

Currently there are (4) Systems based at Ft. Hood, TX that are utilized for all US Army Attack Helicopter live-fire gunnery operations in North America. There is (1) System permanently based at Grafenwoehr, Germany and another (1) System at Camp Casey, South Korea.

System Packaging for Portability

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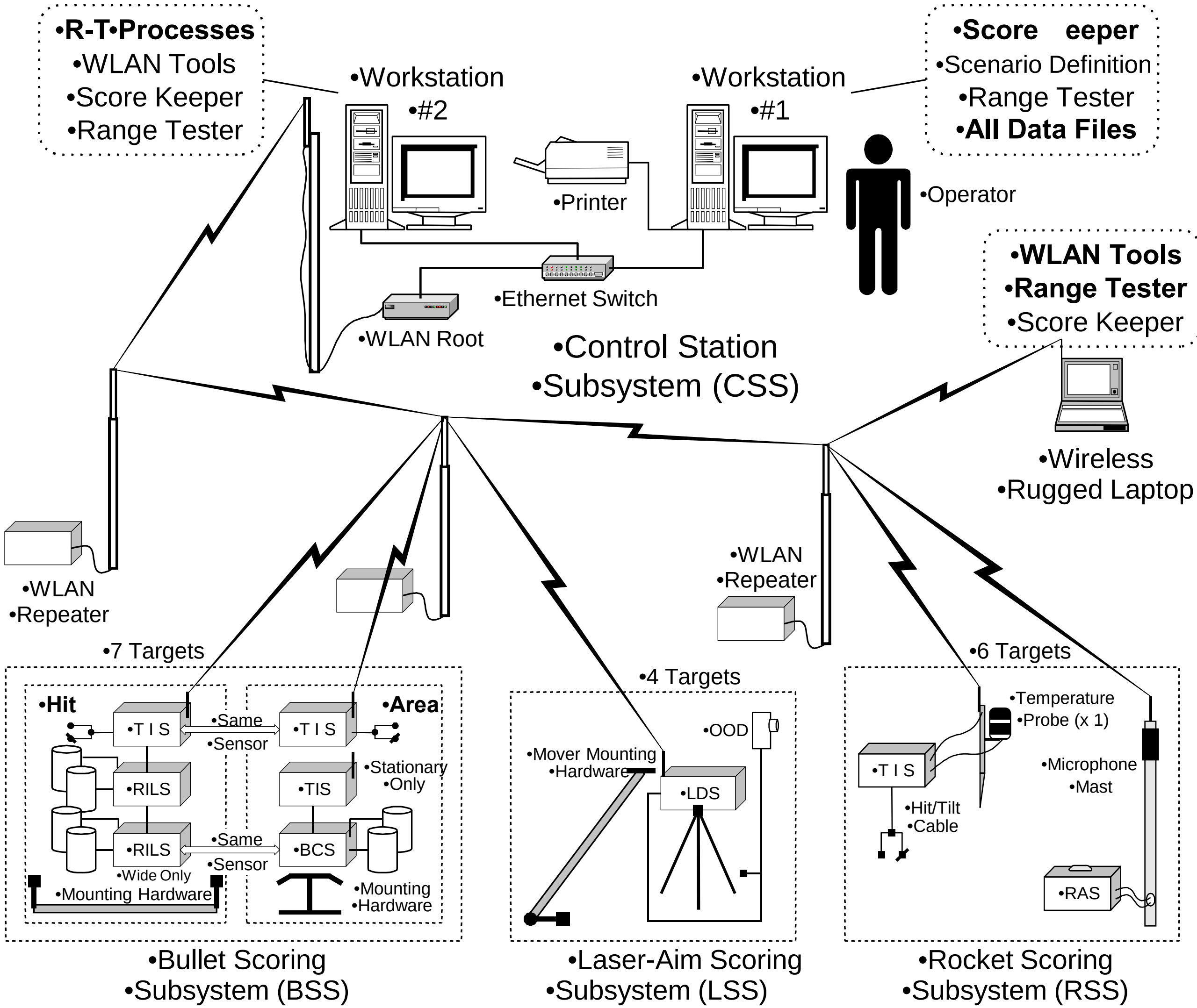
AWSS Benefits

- Every Weapon Engagement is scored to same standard
- Target Effect of every Weapon Engagement is provided in near REAL-TIME
- Every Weapon Engagement is documented
- TTPs can be validated and standardized
- Crew Performance Improves Dramatically
- Training Resource Utilization is captured
- Performance can be tracked
- Crew Errors are separated from Bias Errors
  - Both can be identified and tracked
  - Weapons maintenance / boresight accuracy improved
- OBJECTIVE MEASUREMENT OF COMBAT READINESS!

AWSS Subsystems

- Control Station Subsystem (CSS)
  - (CSS) Computers, Printer, WLAN Data Link, System Software
- Bullet Scoring Subsystem (BSS)
  - 7.62mm, .50 cal, 20mm, 30mm, 40mm
  - Real-Time Hit Scoring (98% Detection/Location On-Target)
  - Area Scoring (98% Detection within 50X20 meters area)
- Laser-Aim Scoring Subsystem (LSS)
  - LOAL and LOBL Missile Launch Modes
  - Real-Time Hit Indication
- Rocket Scoring Subsystem (RSS)
  - PD (M274) and MPSM (M267) Rockets (90% Detection/Location within the TEA)
  - Real-Time Scoring with Target Effect (90% Detection/Location within the TEA)

Subsystems and Components



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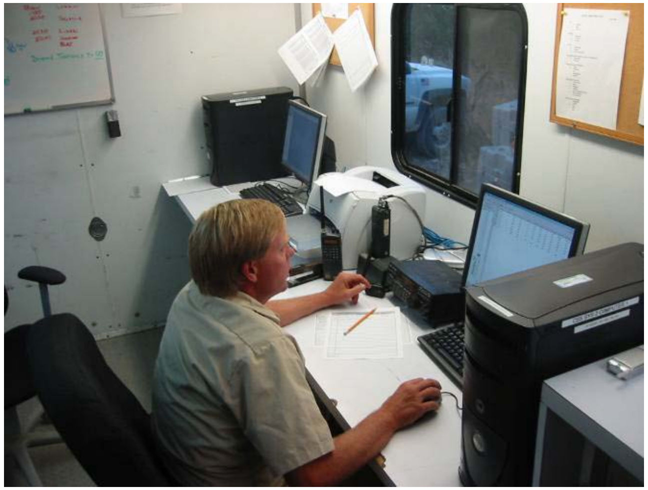
Control Station Subsystem (CSS)

- Workstation #1
  - Primary Control Station for scoring engagements
  - Holds all shared data including score files
  - Only station requiring data back up
- Workstation #2
  - Runs Real-Time Processes automatically
  - Performs sensor communication and rocket scoring
  - Secondary scoring station (backup)
- Rugged Laptop
  - Supports downrange operations (setup/BIT)
  - Remote scoring station
  - **May be used to observe engagement results in real time at remote location (tower)**



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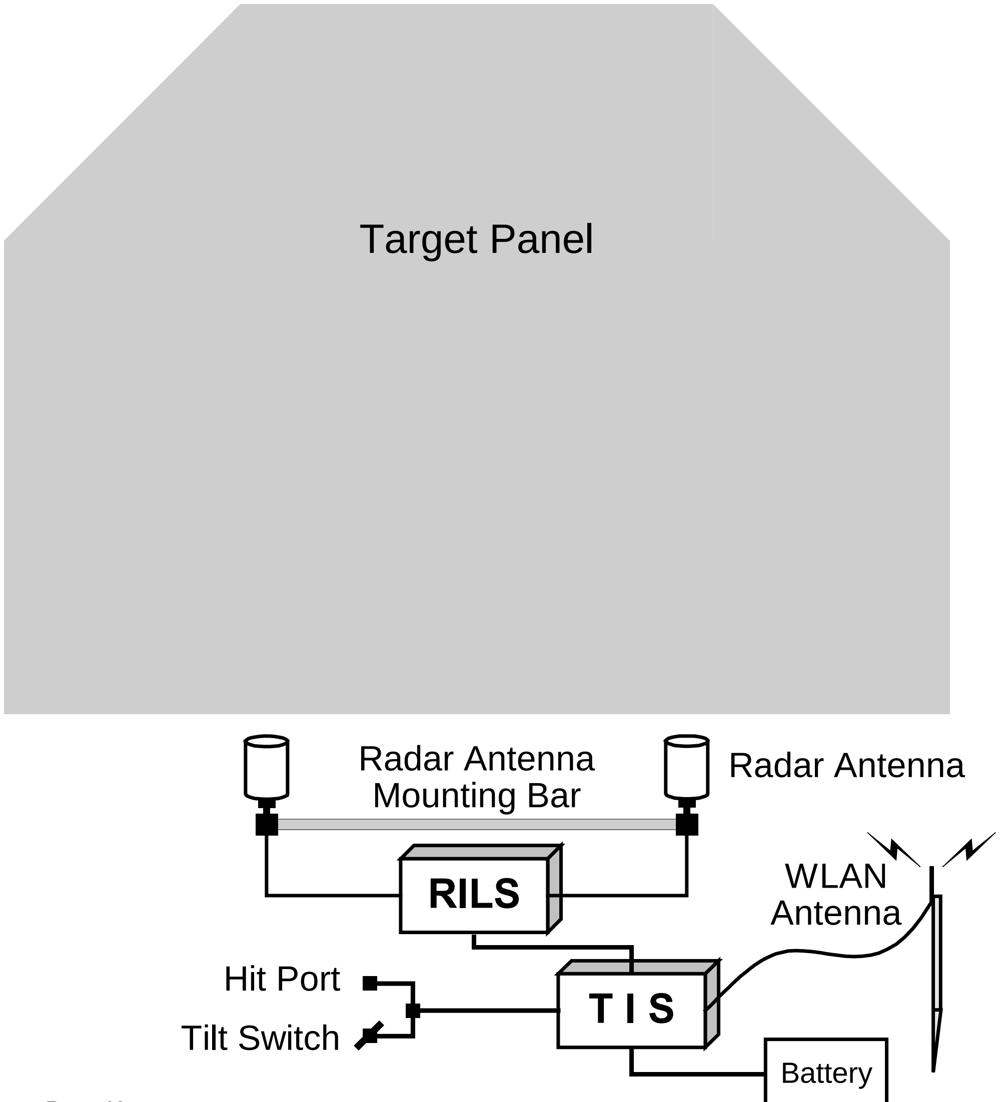
Bullet Hit Scoring Stationary Target



Round
Identification
Location
System

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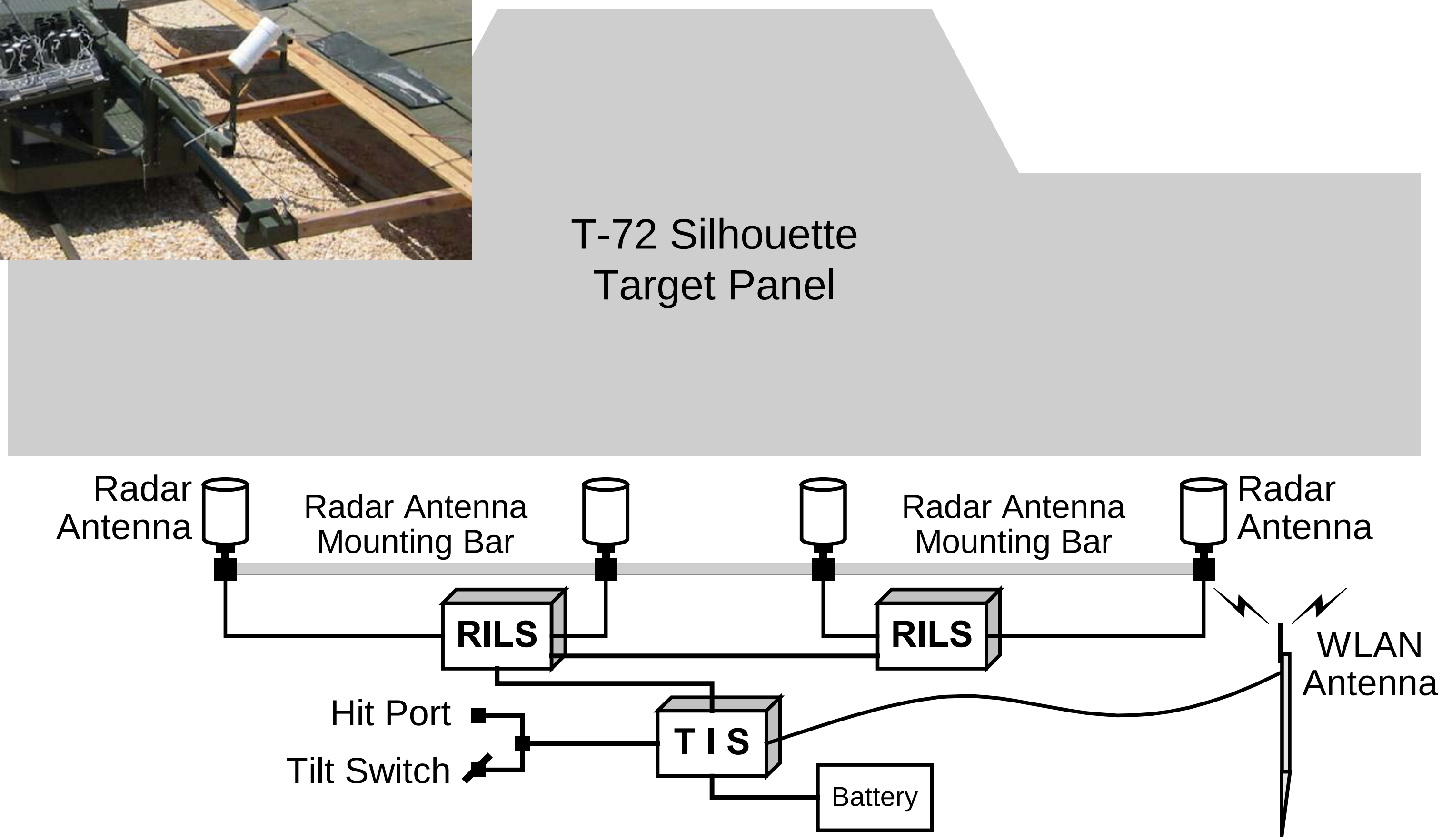
Bullet Hit Scoring Moving Target



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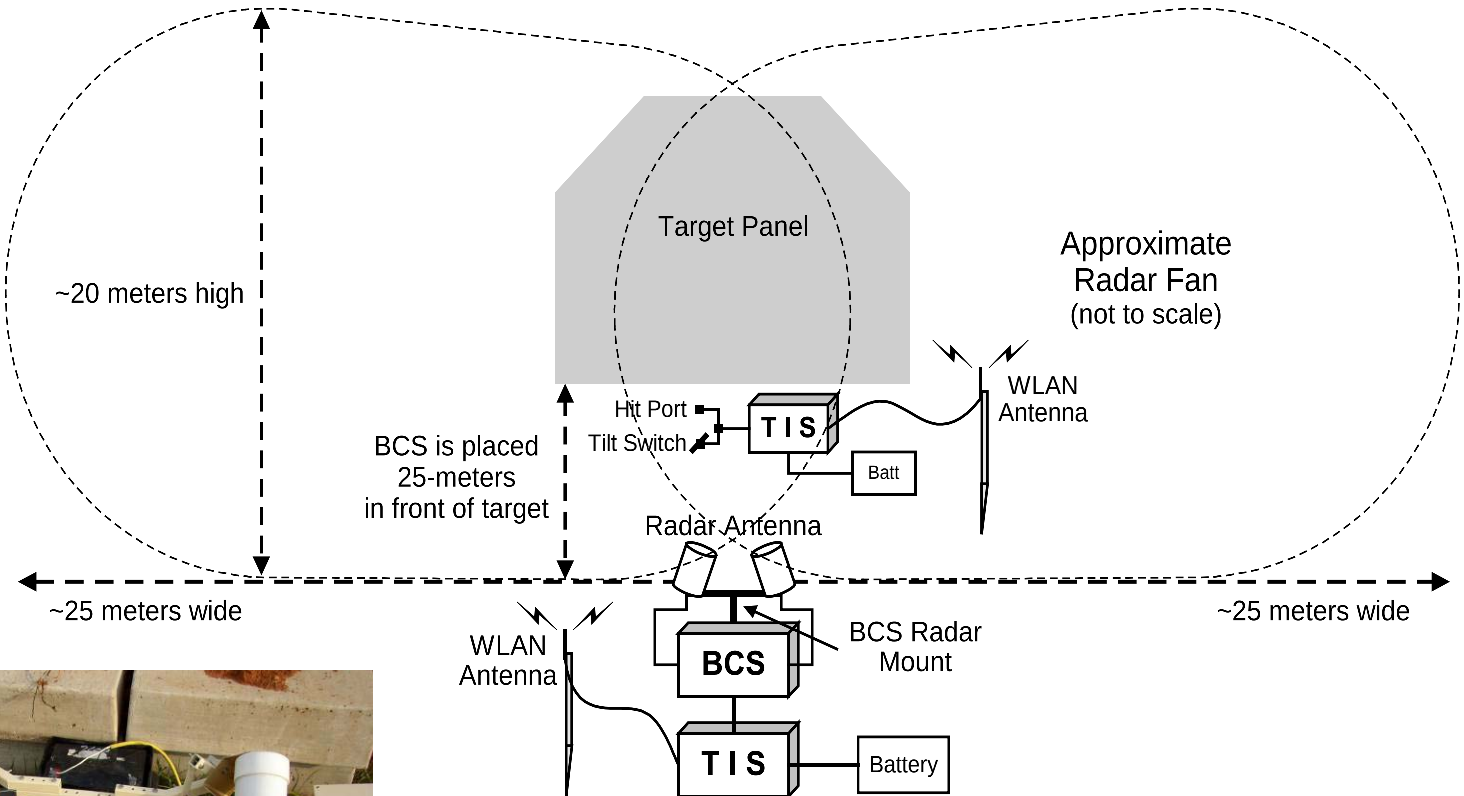
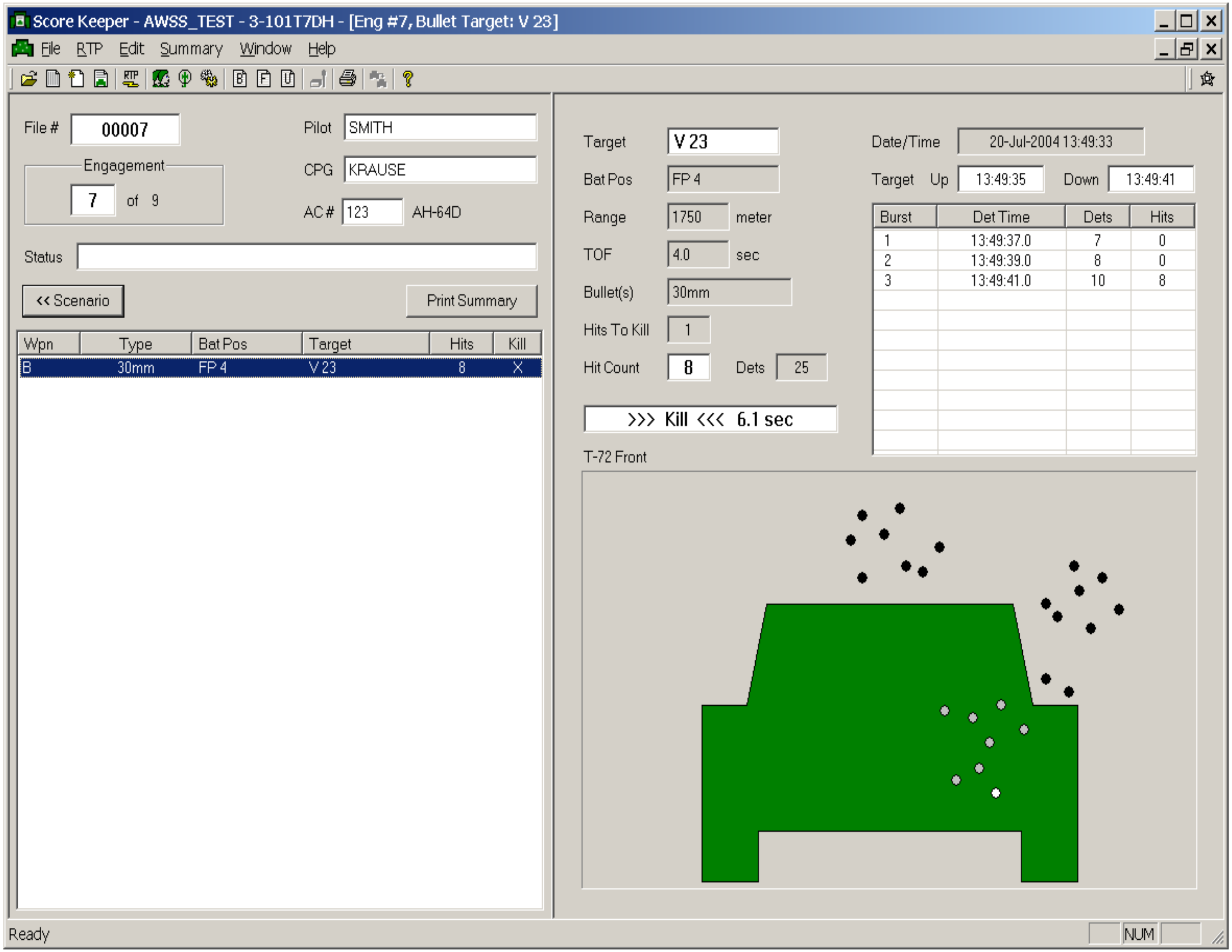
Bullet Area Scoring



Bullet Hit Scoring Display



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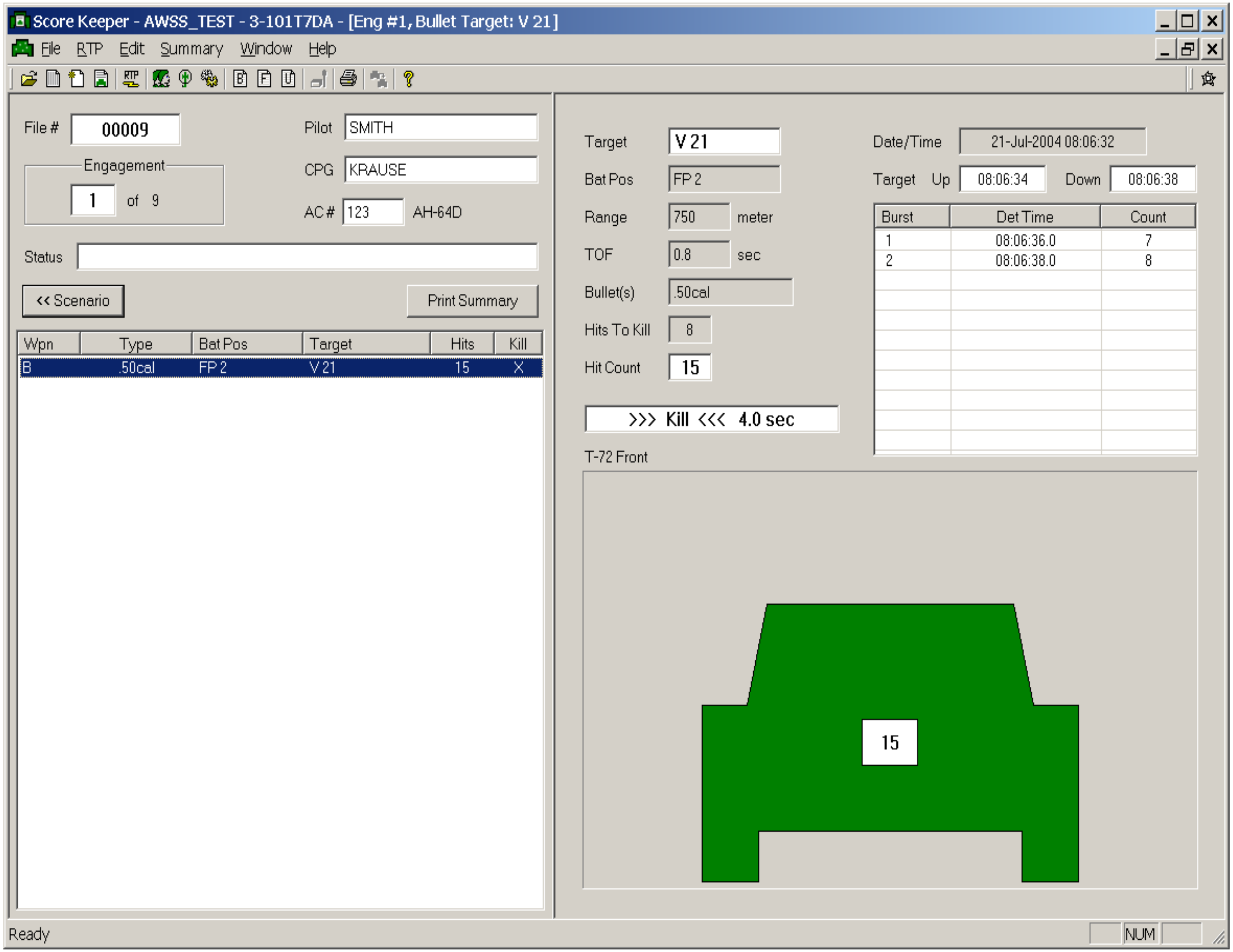
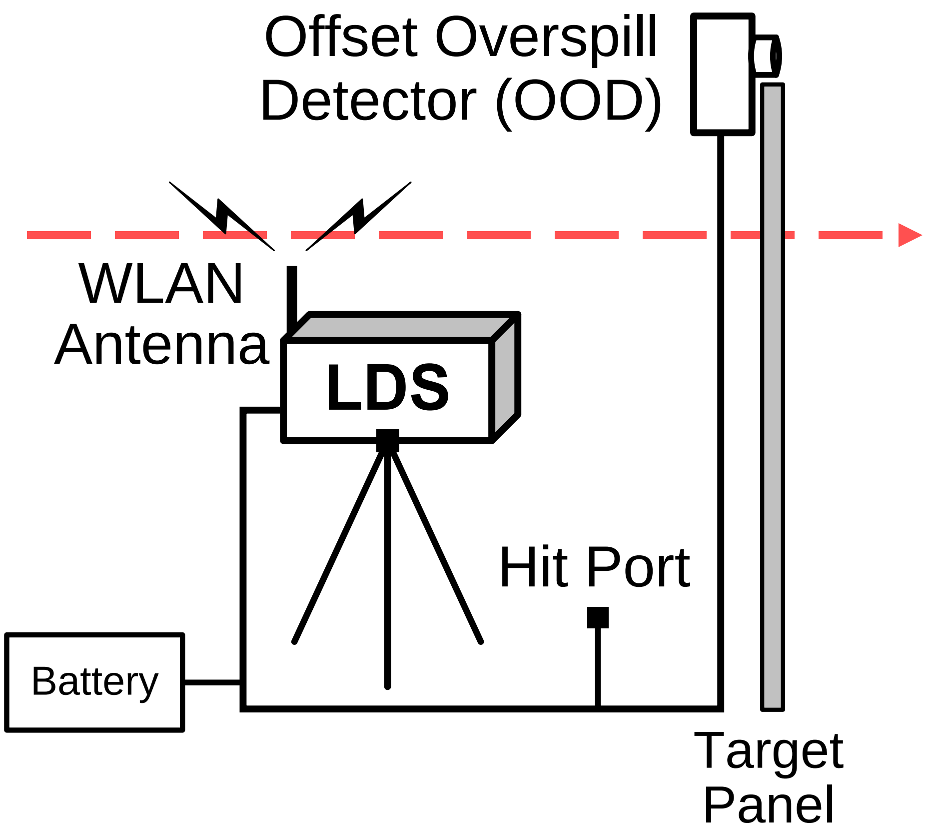
Bullet Area Scoring Display



Laser Scoring Subsystem (LSS)



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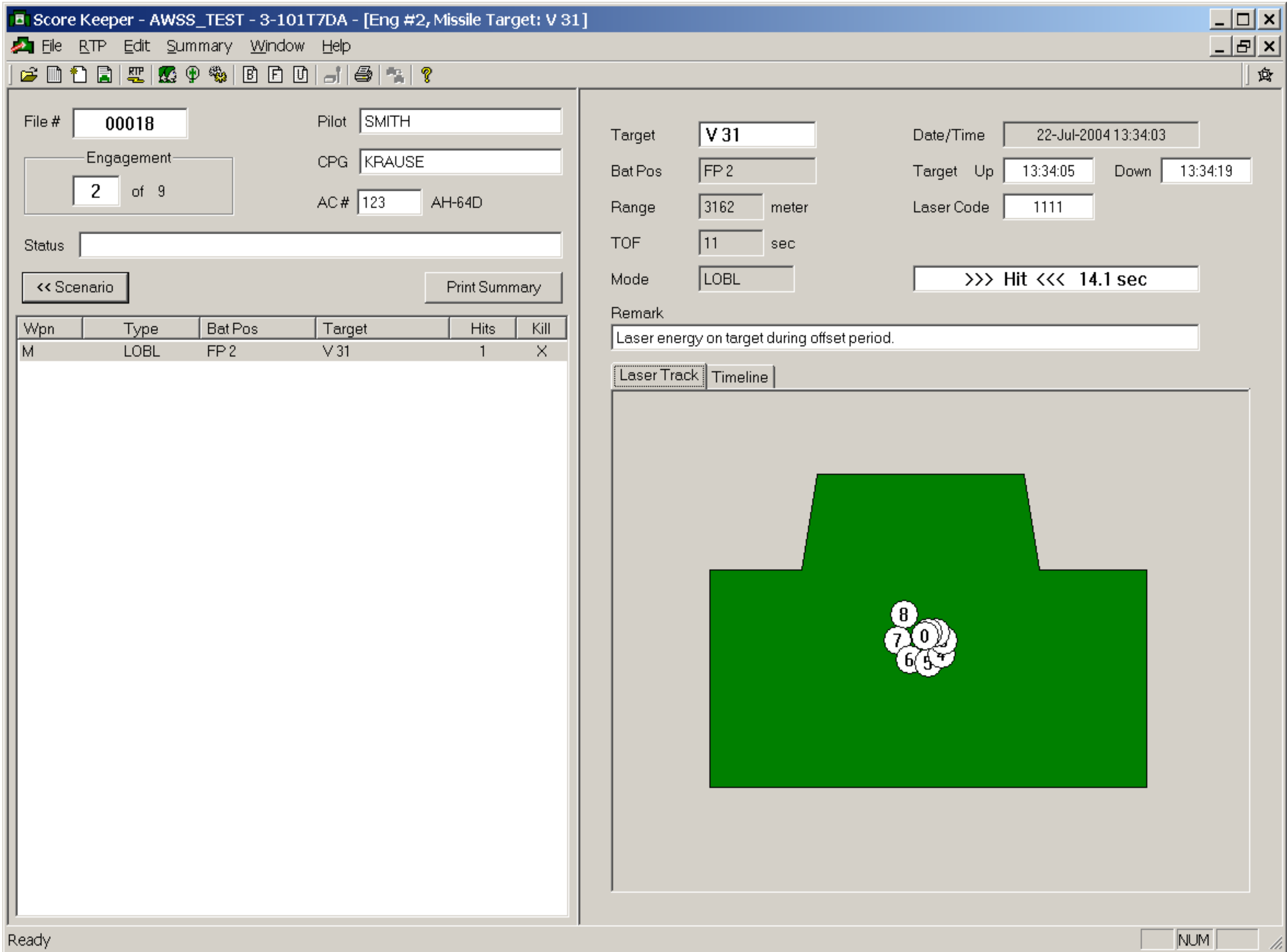
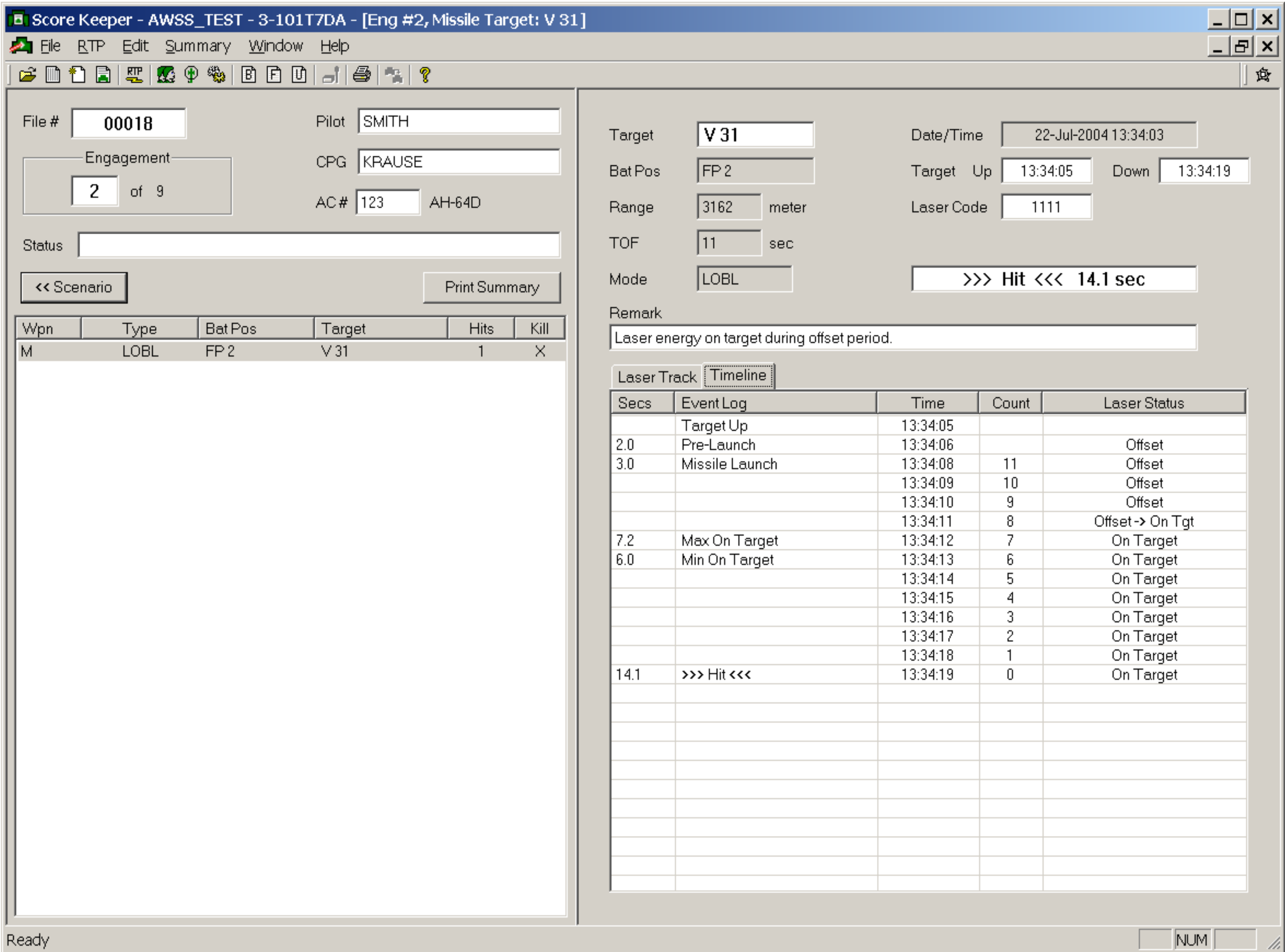
Missile Laser Track Display



Missile Timeline Display



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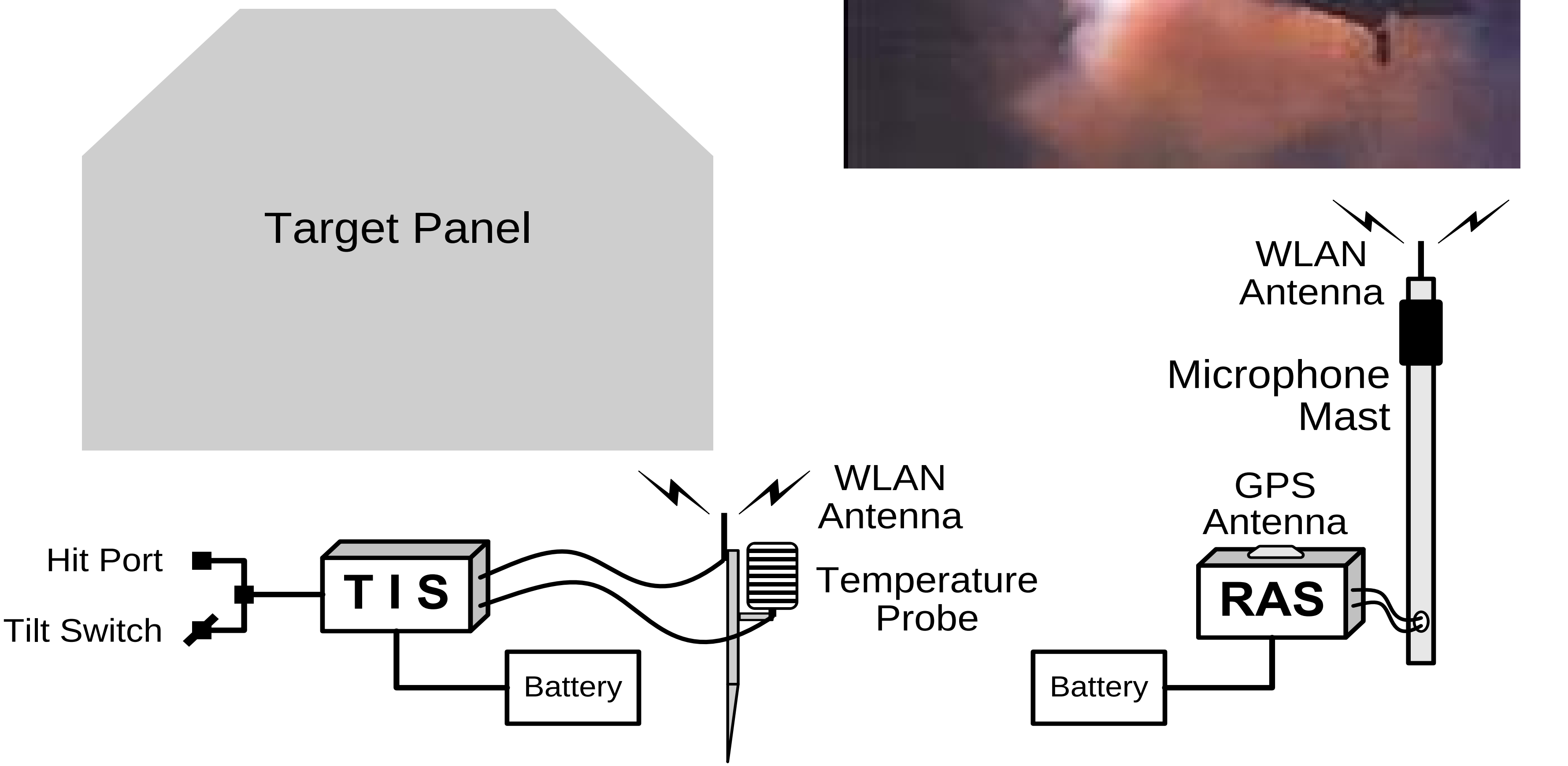
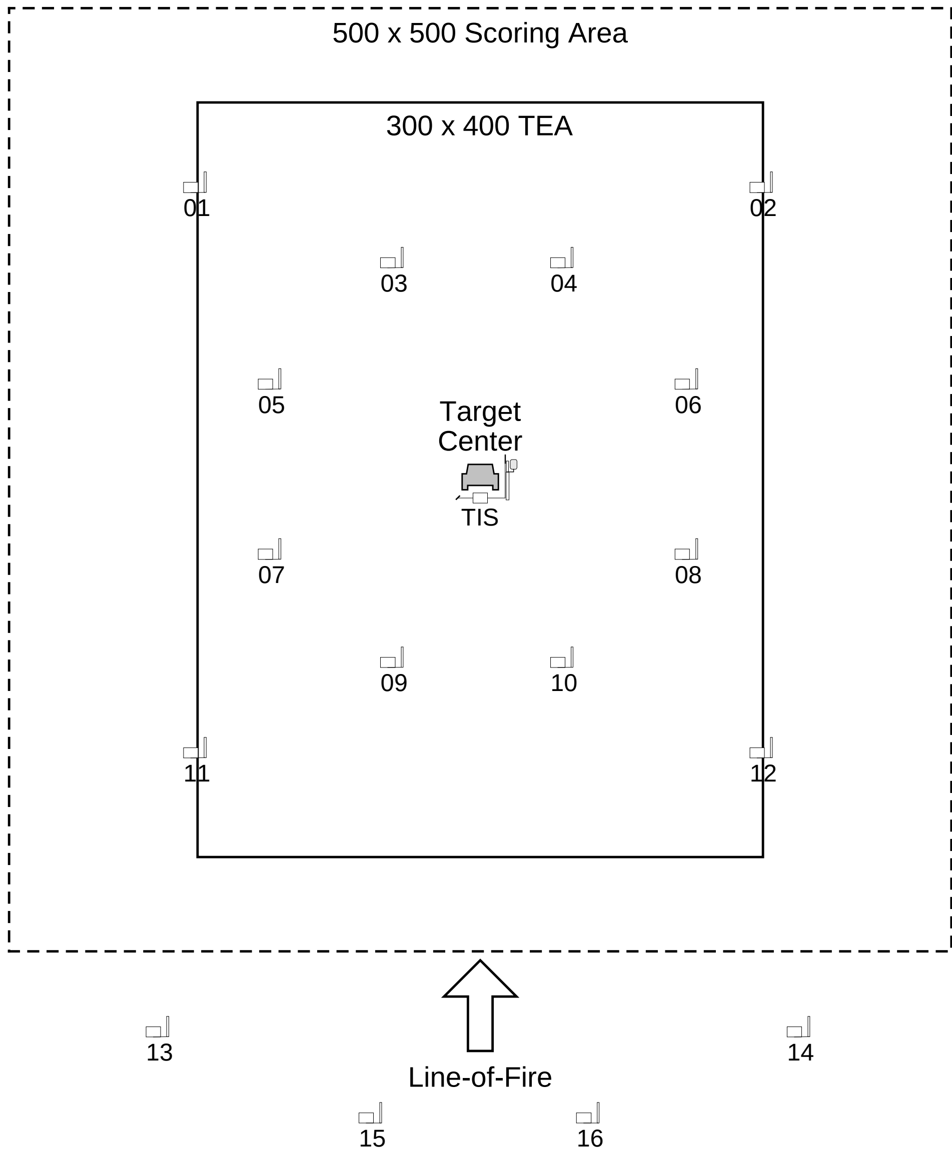
Rocket Scoring Subsystem



Rocket Scoring Area

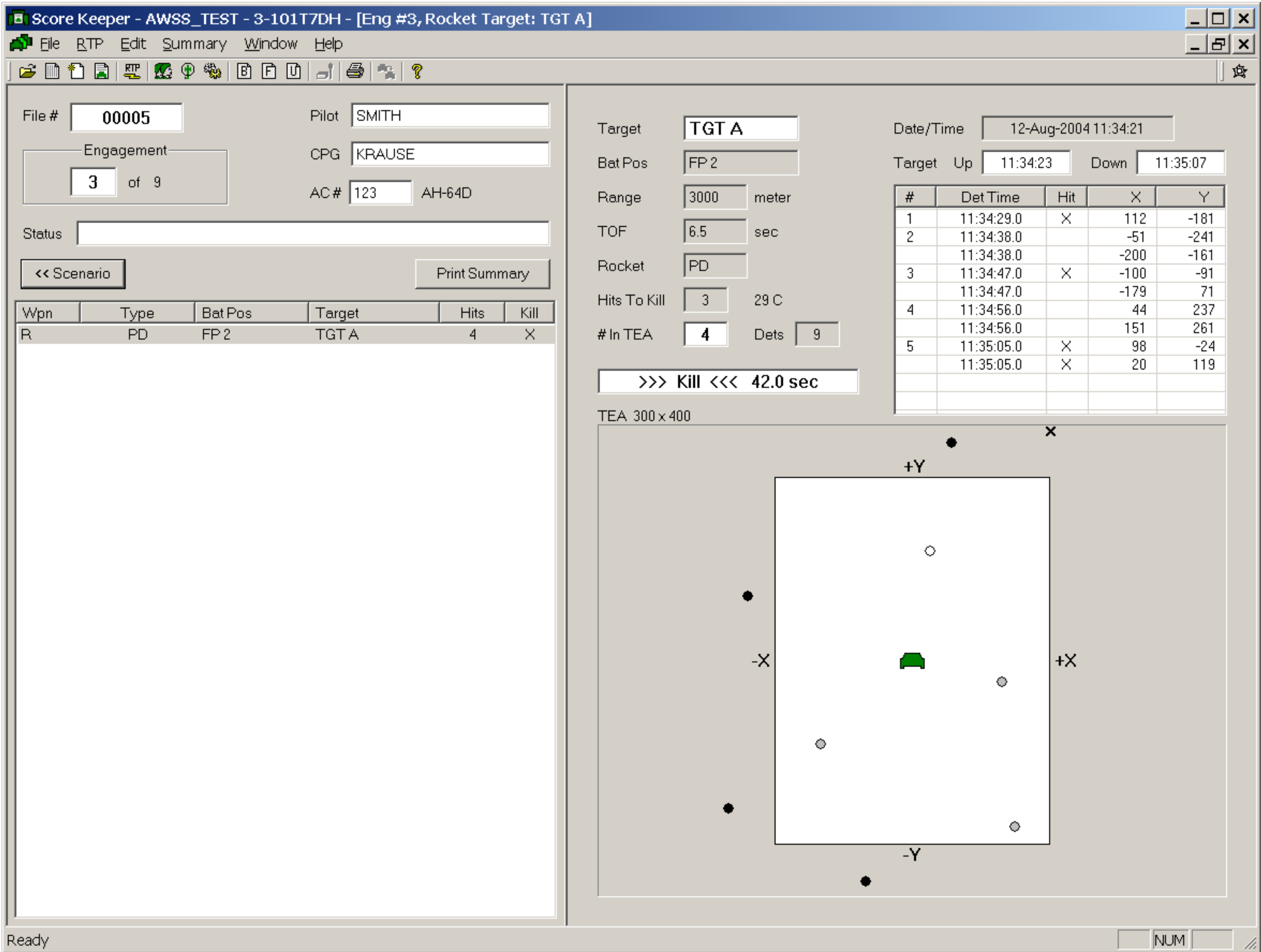


Impacts are accurately located within 500m X 500m zone.

Impacts within user defined Target Effect Area (TEA) area are indicated as target hits.

All impacts detected and resolved are indicated on score sheet for each target.

Rocket Scoring Display



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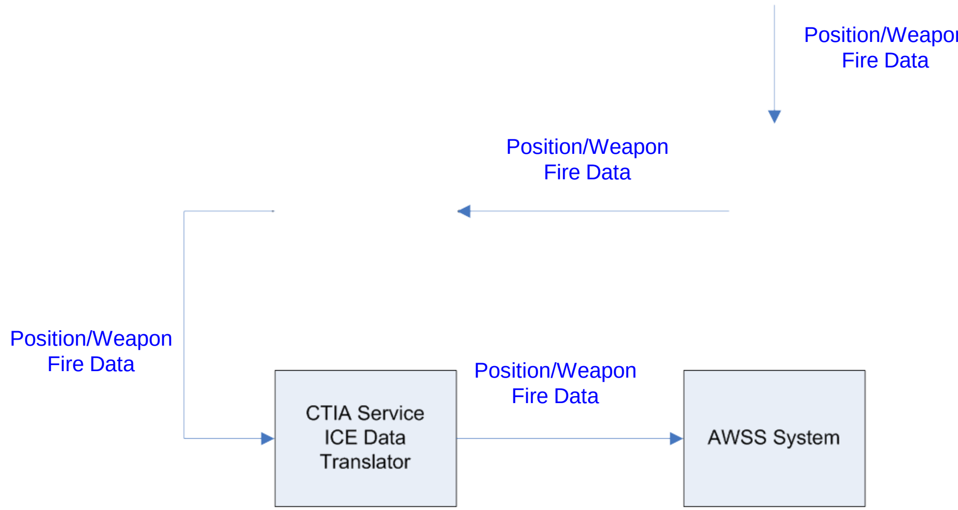
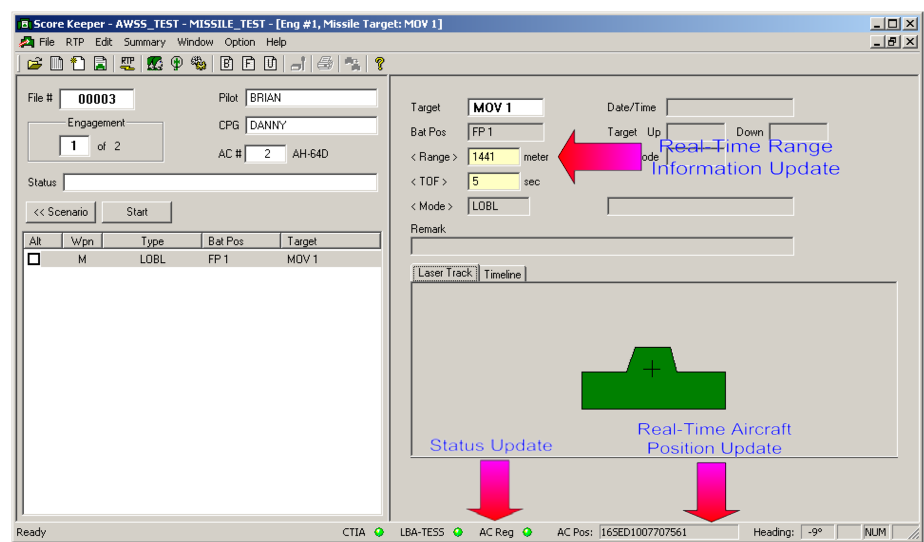
Current System Upgrade Efforts

- Integration of AWSS Control Station Subsystem with Aviation Tactical Engagement Simulation System (TESS)
  - Pulls A/C status & weapons data from the 1553 bus into the AWSS Control Station for improved scoring via the TESS, Smart Onboard Data Interface Module (SMODIM)
  - Automates the scoring process for the Hellfire Missile Engagements (using the Captive Training Missile) & eliminates the need for Pilot shot call
  - Provides a common GPS time base to sync the A/C weapon firing events to the AWSS score reporting





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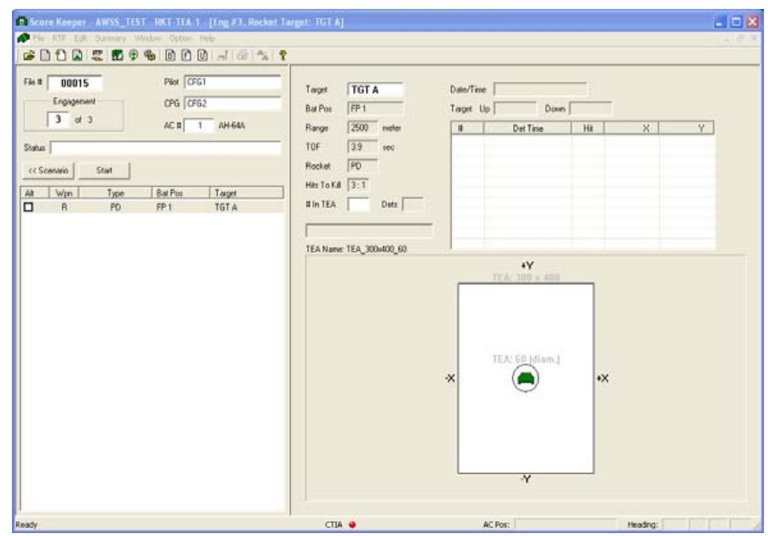
Current System Upgrade Efforts cont.

- Evaluation of Radar for Short range, Rapid Fire Rocket Scoring
  - NAWC/WD Targets System Division, Point Mugu/Port Hueneme is cooperating with multiservice Army (PM ITTS, TMO) and Air Force (86th FWS/ACC) evaluations of the Surface Target Vector Scorer (STVS) for data collection and proof of concept
    - NAWC/WD Targets System Division
    - POC: Mr. Dae Hong 805-989-5996 dae.hong@navy.mil
  - STVS was recently developed for the US Navy for enhanced fleet training capabilities during gun weapon system & missile firing
  - Goal is to enable the AWSS to provide accurate scoring of single, pairs & ripple fire M274 Point Detonation 2.75” Training Rockets when fired at range to target of less than 1500 meters



Government & Service Contractor POC's

- **Training Requirements/Doctrine:**
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  - CW4 Ed King – USAACE, Gunnery Branch, Ft. Rucker
    334-255-2693, edward.d.king@us.army.mil
  - Mr. Ron Moring – Army Aviation Training Specialist - ATSC, TCM-Live, LTD
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  - Mr. Troy Stevens – AWSS Operations Manager – Warrior Training Alliance, CSC
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Questions / Comments?

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Unmanned Aircraft Systems Present & Future Capabilities

Major General Blair Hansen

23 October 2009

This briefing is classified

UNCLASSIFIED

Overview

- Why Unmanned Aircraft Systems
- Evolution of Capabilities
- Growing Demand
- Emerging Missions
- Challenges
- Vision

Why Unmanned Aircraft Systems?

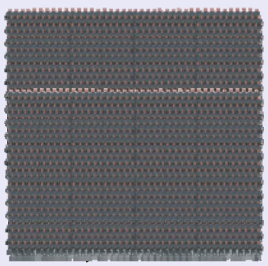
- Persistence - ability to loiter over a target for long time periods for ISR and/or opportunity to strike enemy target
- Undetected penetration / operation
- Operations in dangerous environments
- Can be operated remotely, so fewer personnel in combat zones - projects power without projecting vulnerability
- Integrates “find, fix, finish” sensor and shooter capabilities on one platform

RQ-11 Raven

Reaper

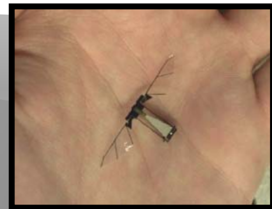
RQ-8 Fire Scout

Evolution of Capabilities

	WWII	Vietnam	Gulf War	OIF/OEF	Near Future	Distant Future
Planes	 **1,000 planes** (B-17)	 **30 planes** (F-4)	 **1 plane** (F-117)	 **1 plane** (F-16)	 **4 planes** (MQ-)	 **Swarm** (Autonomous UAS)
People		 **60 crew**	 **1 crew**	 **1 crew**	 **1 crew**	 **Mission Commander**
Targets	**1 Target**	**1 Target**	**2 Targets**	**6 Targets**	**32 Targets**	**??? Targets**
Tech	**Mass Aircraft**	**Tactical Strike**	**Laser Munitions**	**GPS Munitions**	**MAC**	**Collaboration**
C2	**In-the-Loop**	**In-the-Loop**	**In-the-Loop**	**In-the-Loop**	**On-the-Loop**	**Out-of-the-Loop**
Mgmt	**Active**	**Active**	**Active**	**Active**	**Responsive**	**Passive**

Family of Systems

Nano
Navigate / communicate inside buildings

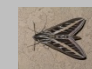


Nano

Micro
Close-in reconnaissance & situational awareness

Wasp III

Bio-Mechanicals
- Indoor Reconnaissance
- Indoor Lethal/Non-lethal
- Indoor Comm
- Cyber attack
- Swarming



"SUAS Family of Transformers"
- Personal ISR
- Lethal
- SIGINT
- Cyber/EW
- Counter-UAV
- AutoSentries

Lite Machine's Conceptual SUAS

Man-portable
- ISR
- Time-Sensitive
- Lethal

Raven B

Irregular Warfare

Increasing across all mission sets

Switchblade SUAS
Technical Demonstration

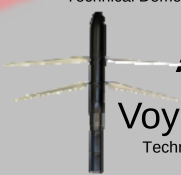
Family of Expendables
- Close-In ISR
- Expendable Jammers
- Lethal
- Counter Air
- Precision Clandestine Resupply
- Cyber attack

Artist Conception Future AL-SUAS

Air-Launched
- Close-in ISR
- Lethal
- SIGINT/DF

Finder SUAS

Anti-Access Support



Voyeur SUAS
Technical Demonstration

Multi-Mission
- ISR
- Force protection
- FID

Scan Eagle

Tier II Joint
- ISR
- Comm Relay
- Lethal
- SIGINT

GT Aero Conceptual Bandit SUAS

Next Gen Multi-Mission
- ISR
- Communications Relay
- Lethal / Non-lethal
- Electronic/Cyber Attack/SEAD
- SIGINT/Low Altitude Pseudo-Sats
- = New Mission areas

Now → **Future**

We must take a joint approach to:

Get the <u>most</u> out of UAS to <u>increase</u> joint warfighting capability, while promoting service interdependency and the wisest use of tax dollars

Requires:

- Optimal joint concept of operations (CONOPS)
- Airspace control resulting in safe / effective UAS operations
- Air defense architecture to achieve security w/o fratricide
- Acquisition effectiveness, efficiency, standardization

Principles of UAS Evolution

- Automation is key
- Modularity = flexibility
- UAS is compelling where the human is a limitation to mission success
- Seamless manned and unmanned systems integration
- “Integrated Systems” approach
- Robust, agile, redundant C2 enables supervisory control (“man on the loop”)
- Solutions are linked and must be synchronized

Autonomy

Conventional Harbor

- 4 operators per crane
- Manpower-centric system
  - Legacy system
  - Manpower dependant
  - Manual Operation

"Multi-Crane Control"

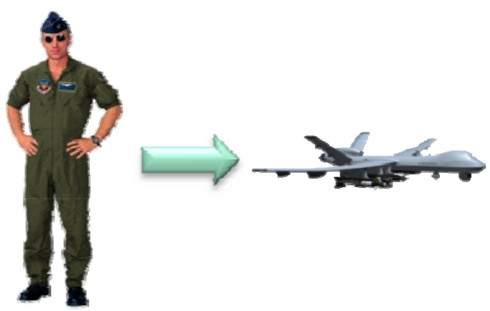
- 1 operator per 6 cranes
  - 24x increase in efficiency
- Tech-centric system
  - Multi-crane Control
  - Automation (cranes and AGV)
    - DGPS
    - Algorithms

Autonomy – Multi-Aircraft Control Potential Manpower Savings

2011
(Current system)

- **50 CAPs**
  - **50 MQ-9 CAPs**
  - **7 a/c in constant transit**
- **10 pilots per CAP**
  - **500 pilots required**
  - **70 pilots to transit a/c**

570 Total Pilots

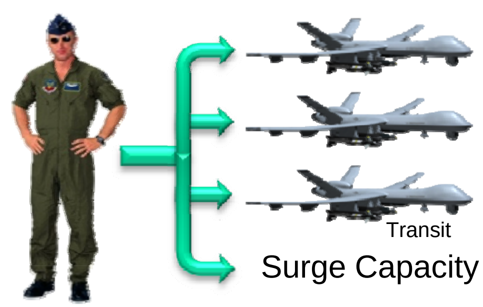


2012
(MAC)

- **50 CAPs**
  - **50 MQ-9 CAPs**
  - **2 CAPs per MAC GCS**
  - **1 transit per MAC GCS**
- **5 pilots per CAP**
  - **250 Pilots required**
  - **0 to transit aircraft**

250 Total Pilots

56 Manpower Savings



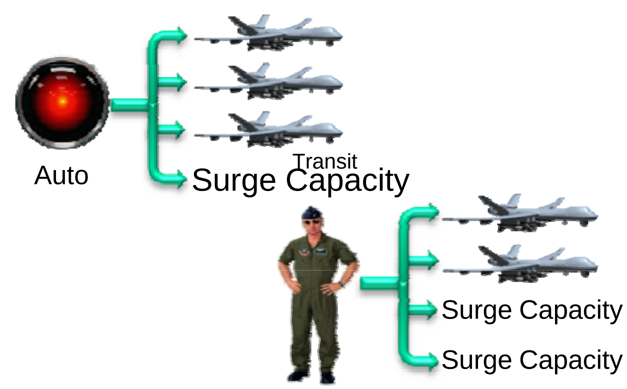
MAC = 1 pilot can fly up to 4 a/c

TBD
(MAC + 50% auto)

- **50 CAPs**
  - **50 MQ-9 CAPs on orbit**
- **25 CAPs automated**
- **25 CAPs in MAC (5 pilots/CAP)**
  - **125 pilots required**
  - **25 auto-msn monitor pilots**
  - **0 to transit aircraft**

150 Total Pilots

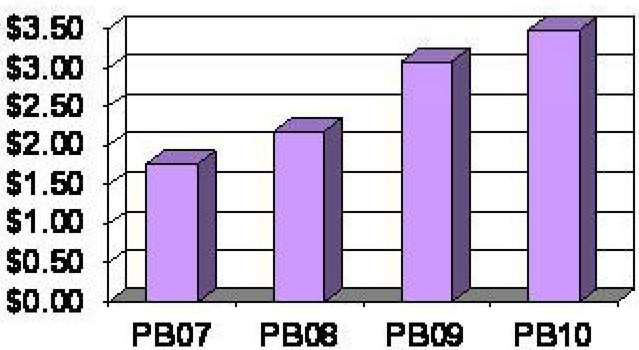
64 Manpower Savings



Unmanned Aerial Systems Growth

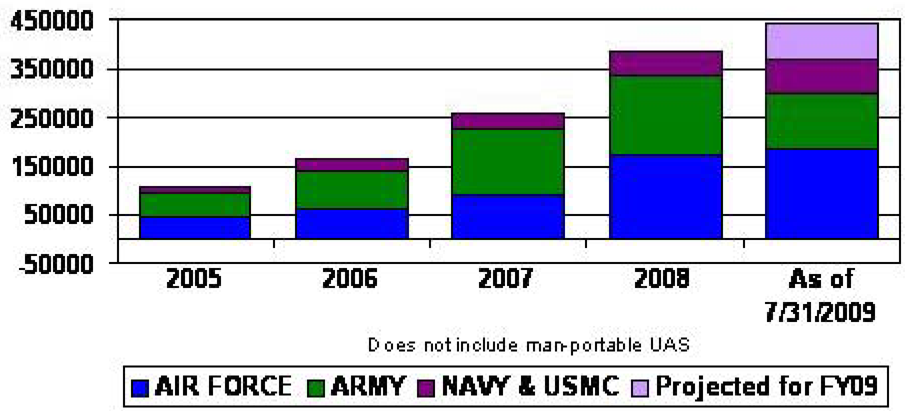
- Overwhelming demand for persistent ISR has driven significant DoD investment in UAS
  - Over 2,000 UAS aircraft deployed to Iraq and Afghanistan
  - $ 3.5B investment in PB10
  - Over 450K flight hours in FY09
  - Light-weight, low altitude UAS account for preponderance of growth

UAS Investment



Does not include Overseas Contingency Operations funding

DoD UAS Flight Hours



Does not include man-portable UAS

Anticipated growth within CONUS

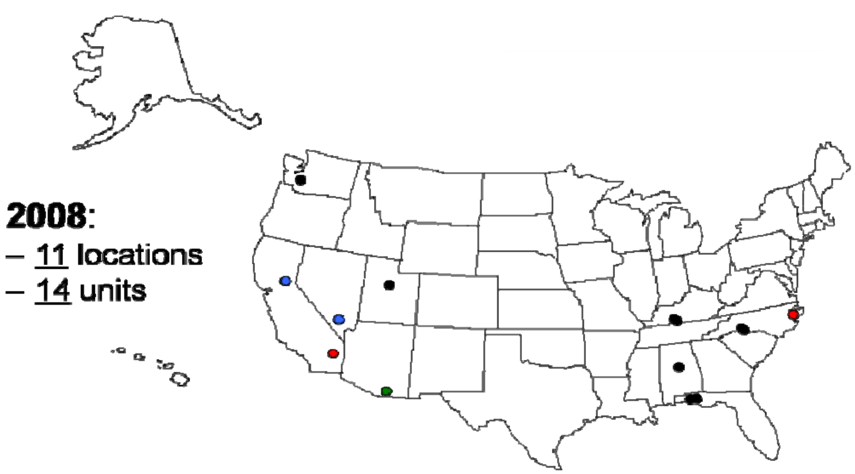
Planned **2013** DOD UAS bed down

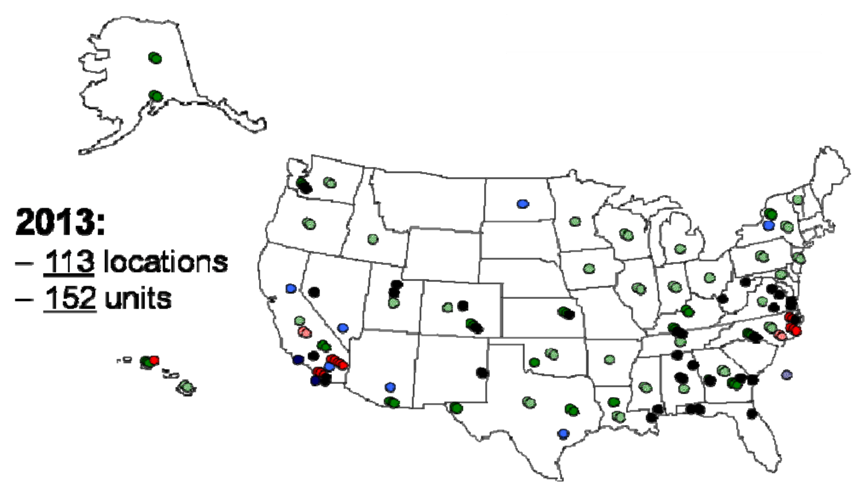
- **113 CONUS locations**
- **1.1 million UAS flight hrs for** *initial/continuation training*
- **91** of airspace is **Class E&G**

Service	# Base/ Posts	# UA	# Troops	Airspace Class (1000 Hrs/Yr) A	B	C	D	E	G	Rest-ricted	Total
Army	4	4066	3521	0	0	0	17.1	110.8	284.6	5.2	417.7
Air Force	9	96	1140	51.8	0	1.6	4.4	17.3	0	5.1	80.2
Navy	0	9	24	0	0	0	0	0	0	0	0
Marine Corps	1	1401	1134	0	0	0	2.1	10.3	67.1	0.8	80.3
SOCOM	41	1364	4465	9.9	0	0	4.7	25.9	499.6	7.4	547.5
Total:	152	6936	102 4	61.7	0	1.6	28.3	164.3	851.3	18.5	1.1M Hrs
of Use:				5	0	0	2	15	76	2	
Navy Programs of Record still in Development and Test phases in 2013											

Manned Aircraft Annual Training Hours (Worldwide in FY07):

Army	..	405 Hrs
Air Force	...	1,700 Hrs
Navy / Marine Corps	..	1,167 Hrs
SOCOM	..	103 Hrs
TOTAL		3.3M Hrs

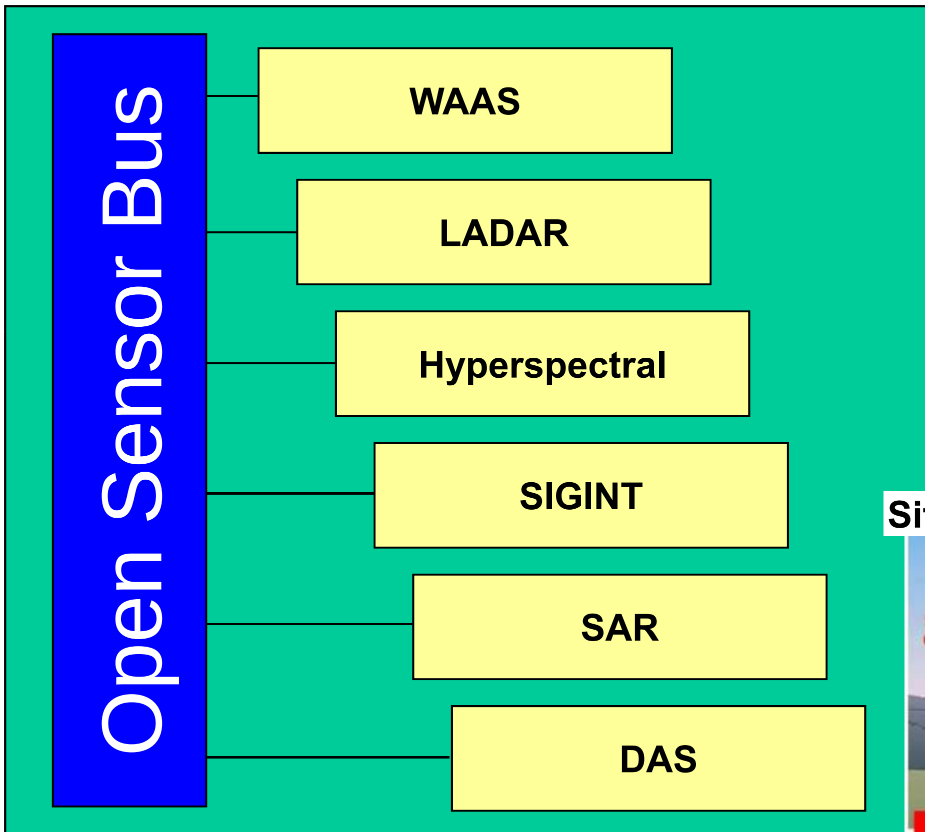


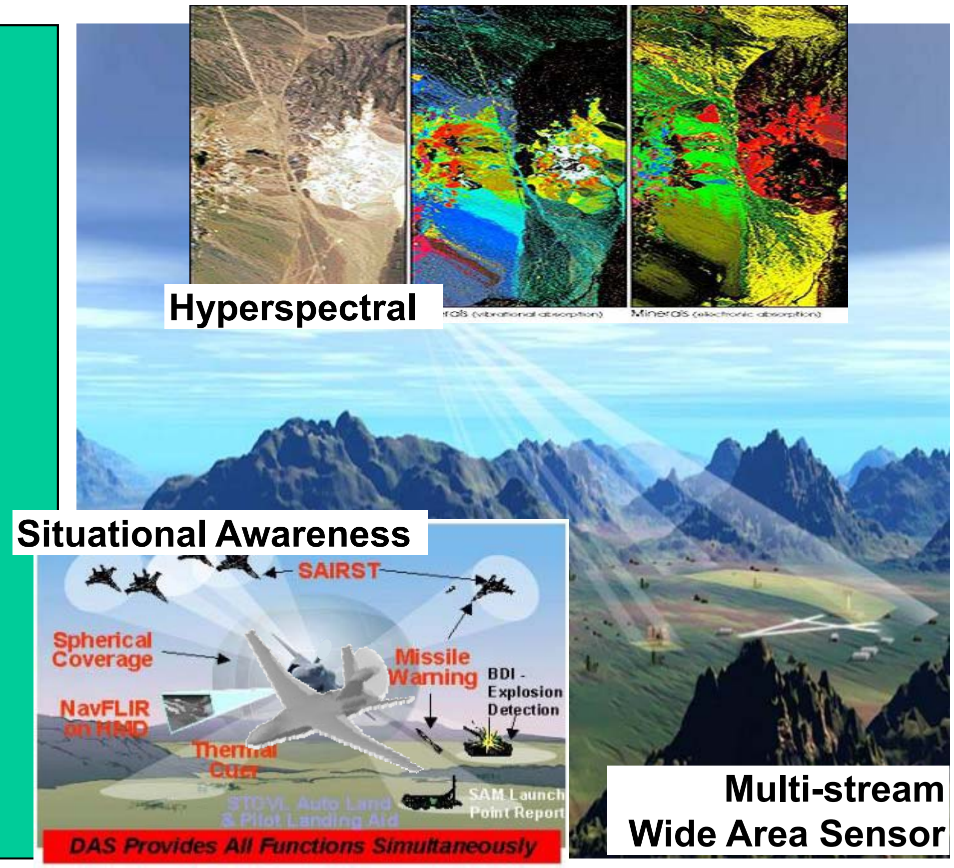


Army   Air Force   Navy   Marines   SOCOM   State ID'd but Post TBD

Emerging UAS Missions - Advanced ISR Capabilities

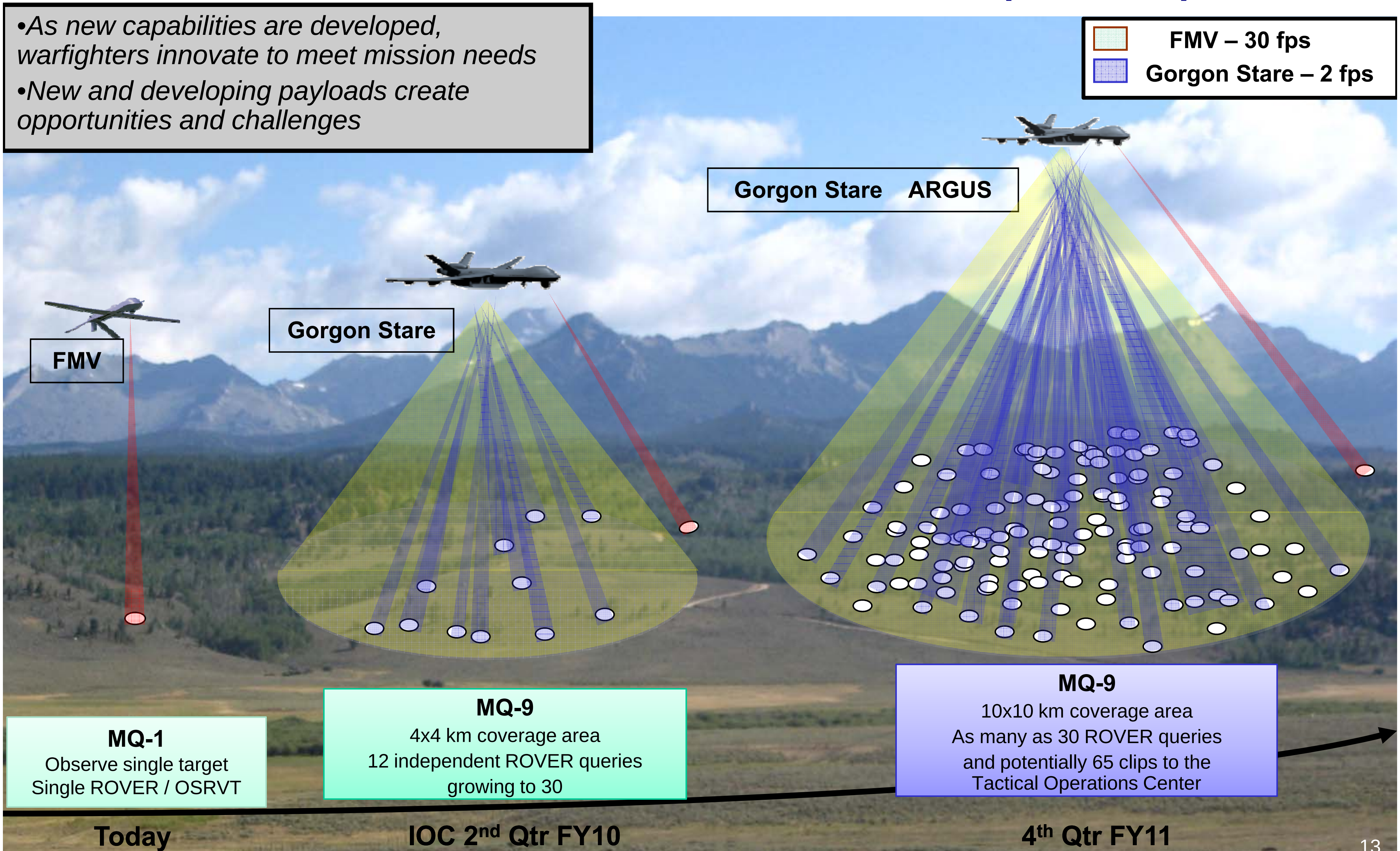
Open architecture allowing modular sensors to be integrated quickly and inexpensively





Wide Area Airborne Surveillance (WAAS)

- *As new capabilities are developed, warfighters innovate to meet mission needs*
- *New and developing payloads create opportunities and challenges*



Analytical Challenges – Data ≠ nowledge

- Tasking Processing, Exploitation and Dissemination (TPED)
  - Capabilities have not kept pace with platform growth
- Data Standards and Interoperability
  - Sufficient interoperability does not exist between platforms and TPED architectures
- Communications Architectures
  - Growth of UAS platforms and intelligence capabilities has driven significant frequency spectrum demand

Vision for an unmanned future

- Automated control and modular "plug-and-play" payloads
- Airspace integration/deconfliction – addressing both cultural and technical challenges
- Joint UAS solutions and teaming
- Automated exploitation capabilities
- Technology to address bandwidth concerns
- An informed industry and academia – knowing where we are going and what technologies to invest in ….

Today s UAS deliver a game-changing capability

A single air vehicle provides the ability to find, fix, and finish targets

Unmanned Aircraft Systems Present & Future Capabilities

Major General Blair Hansen

23 October 2009

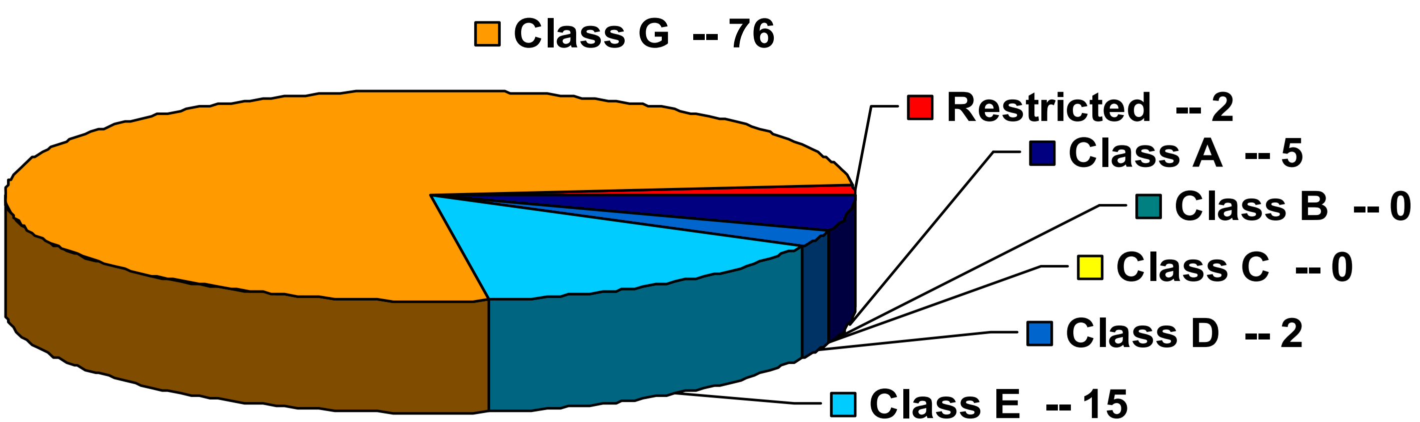
This briefing is classified

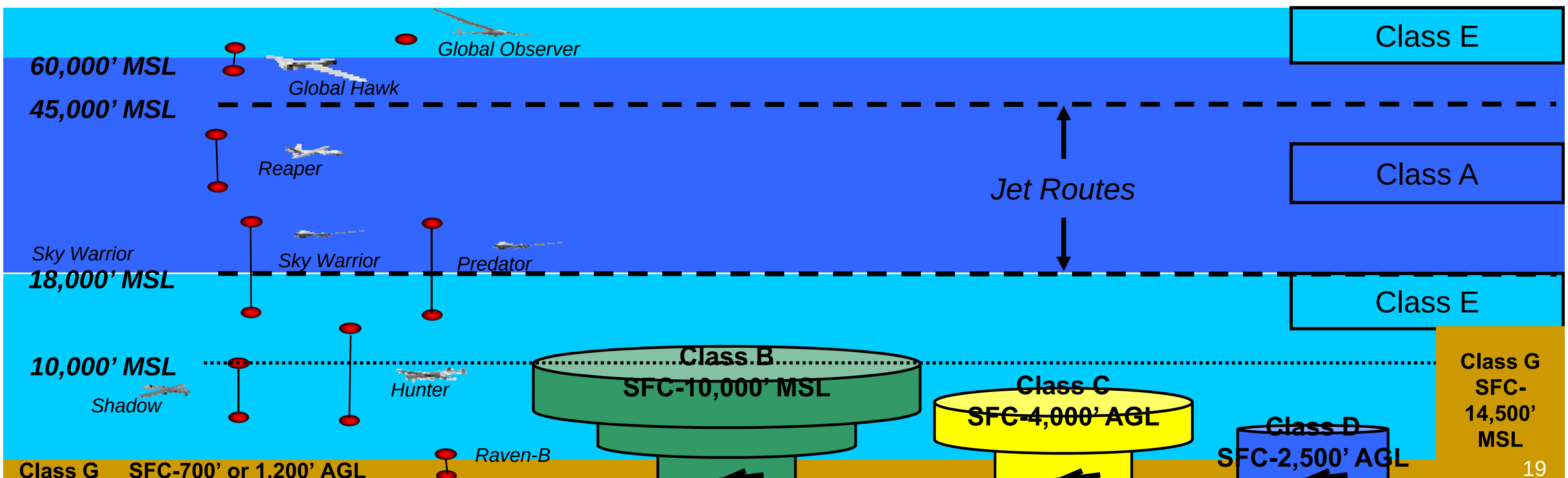
UNCLASSIFIED

Back up slides

The Operational Demand
by Airspace Class

Percent of 1.1M Hours





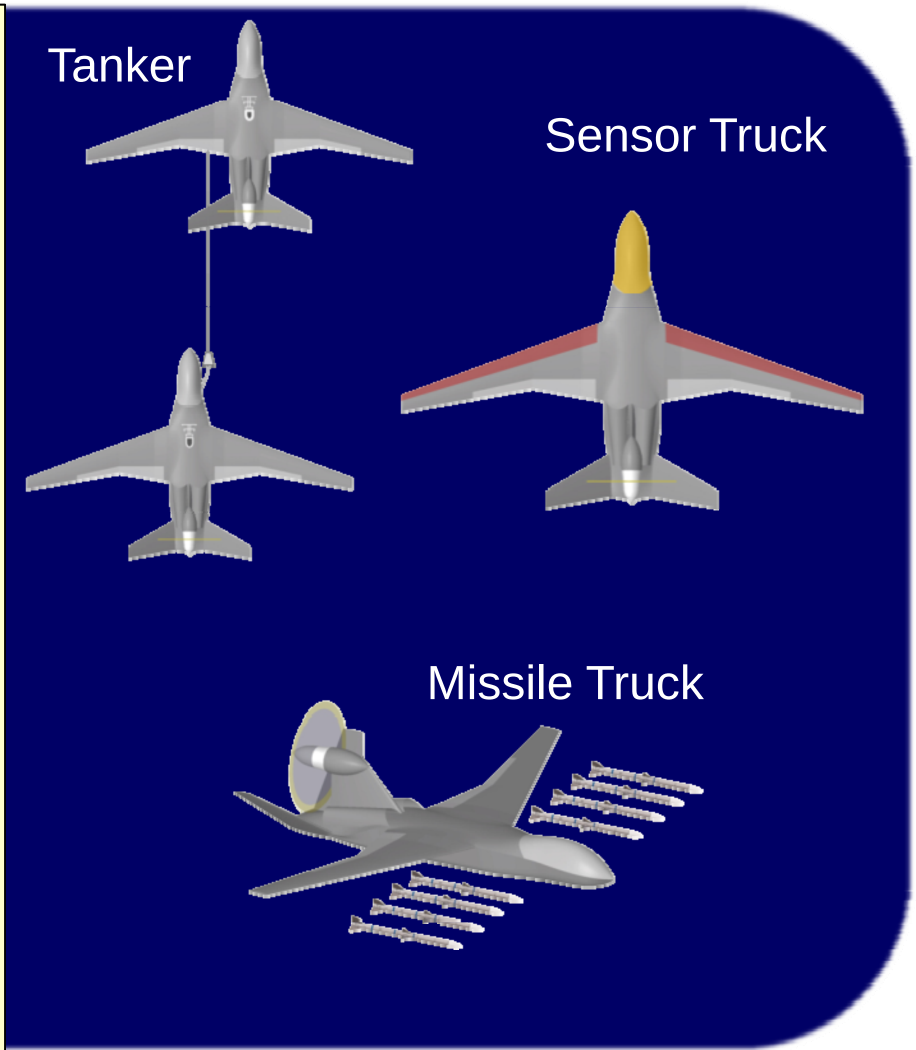
UAS Classification

- **Joint Classification scheme developed to facilitate consensus on regulations, standards and certification**
- **Utilized at all echelons and levels within combat theaters**

UAS Category	Maximum Weight (lbs) (MGTOW)	Normal Operating Altitude	Speed (KIAS)	Current/Future Representative UAS
Group 1	**0-20**	**1,200 AGL**	**250**	**WASP III, BATCAM, Raven, Dragon Eye**
Group 2	**21-55**	**3,500 AGL**		**Scan Eagle**
Group 3	**1320**	**1 ,000 MSL**		**Silver Fox, Shadow, Neptune,**
Group 4	**1320**		**Any Airspeed**	**Predator, Sky Warrior, Hunter, Fire Scout**
Group 5		**1 ,000 MSL**		**Global Hawk, Reaper, BAMS, Global Observer, N-UCAS**

UAS – an alternative to a range of traditionally manned systems

- Deeply modular and upgradable
  - Support future roles and mission needs
- Size, Weight and Power
  - Maximize sensor & weapons flexibility
- High subsonic dash
  - Force packaging and responsiveness
- Target area persistence
- Survivable in contested environment



U.S. Navy Aerial Target Systems

Presented to 47th Annual NDIA Symposium

23 October 2009

Savannah, GA

Captain Dan McNamara
Program Manager
PMA-208, Navy Aerial Target & Decoy Systems

Outline

- Product Line
- Operating Sites
- Supersonic Targets
- Subsonic Targets
- Full Scale Targets
- Target Control System
- Foreign Military Sales
- Challenges

PMA-208 Target Product Lines

Supersonic

GQM-163A

AQM-37C

ZGQM-173A Multi-Stage Supersonic Target (MSST) (development)

Subsonic

BQM-34S

BQM-74E

Sub-Sonic Aerial Target (SSAT) (development)

Full Scale

QF-4

QF-16

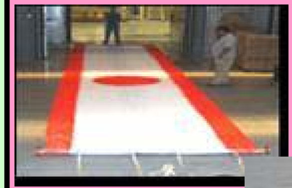
Mobile Land Target (MLT) (development)

Other/Support

Tactical Air Launched Decoys

Common Equipment / Augmentation

Threat Simulation



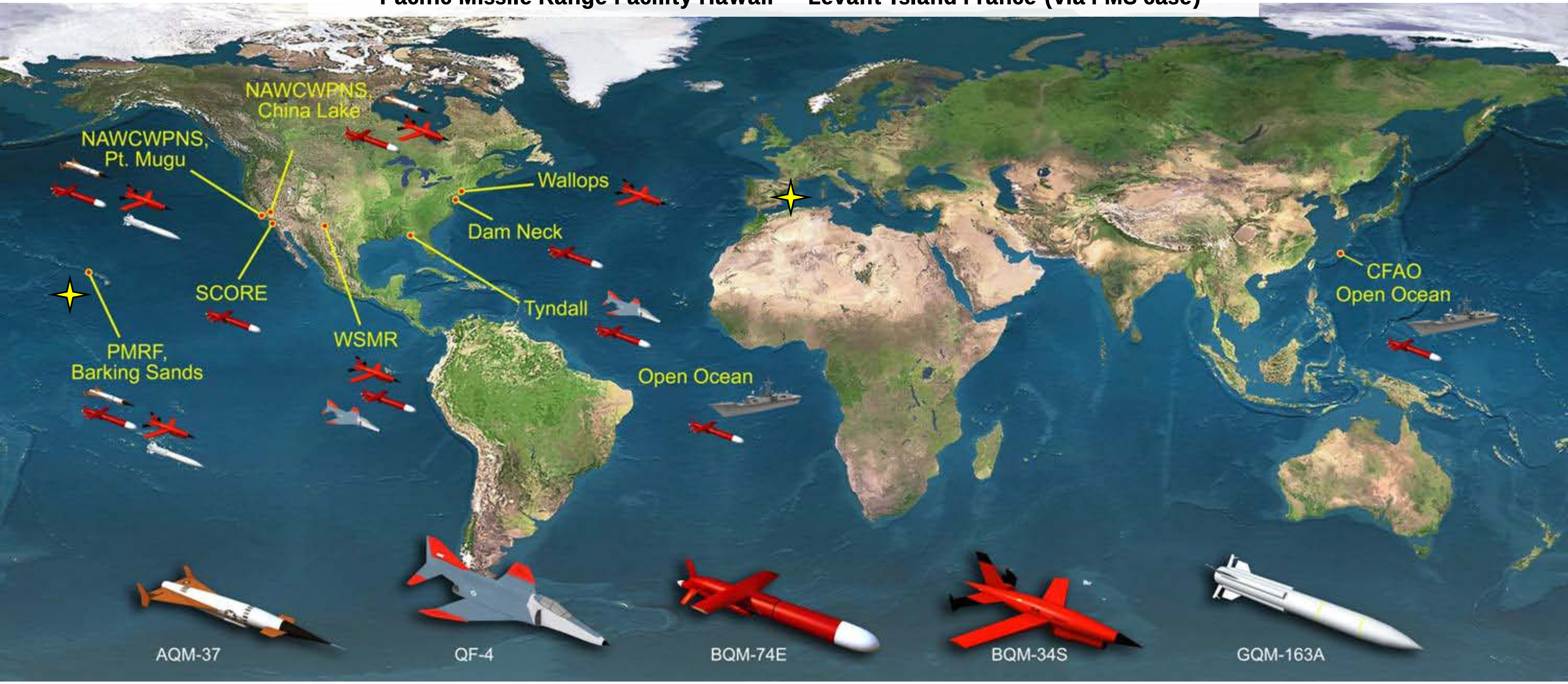
Banners

System for Naval Target Control (SNTC)

Operating Sites

GQM-163 capability scheduled to stand up in2010 on the following ranges:

- Pacific Missile Range Facility Hawaii - Levant Island France (via FMS case)



Air Launch:

BQM-34

AQM-37

BQM-74

SSAT (objective)

Ground Launch:

BQM-34

BQM-74

SSAT (threshold)

GQM-163

ZGQM-173 (threshold)

Ship Launch:

BQM-34

BQM-74

SSAT (threshold)

GQM-163A Supersonic Sea Skimming Target

- Prime Contractor: Orbital Sciences Corporation
  - 180 targets total
- Operations to date: 5 (Targets Expended: 8)
  - 6 October 2005 (1)
  - 12 and 13 June 2007 (2)
  - 12 December 2007 (2 as stream raid)
  - 3 December 2008 (1)
  - 18 December 2008 (2 as stream raid)

  *** Next operation anticipated December 2009 (2 as stream raid)
- Developing augmentation to current flight termination system
- Developing Orbital Front End Subsystem (OFES)
- Pacific Missile Range Facility (PMRF) Stand-up (FY10)

GQM-163A meets most Supersonic Sea Skimming test requirements

ZGQM-173A
Multi-Stage Supersonic Target (MSST)

- Prime Contractor: Alliant Techsystems Inc (ATK)
- MSST's purpose is to emulate advanced two-stage ASCMs in support of Air Defense Weapons/Combat Systems T&E events, to include:
  - AEGIS CG Mods, AEGIS DDG Mods, LHA-6, DDG-1000, CVN-21, SSDS, CIWS, RAM Blk 2, SM-6 ERAM, ESSM, SM-2, and JSF
- ACAT IVM Program that directly impacts ACAT I programs
  - The Preliminary Design Review is planned for 2nd quarter 2010
  - The Critical Design Review is planned for 2nd quarter 2011
  - Flight Test commencement is planned for 2nd quarter 2012
- Development effort will lead to follow-on contract for Low Rate Initial Production and Full Rate Production
- Initial Operational Capability planned for 2014

MSST will satisfy the remaining Supersonic Sea Skimming test requirements

BQM-34S

- Prime contractor – Northrop Grumman
- Sustainment
- Missions
  - Low fidelity A/C simulator
  - T&E workhorse – special configurations
    - Open Loop Seeker (OLS) integration
  - Launch: ground, ship, air
- Product Improvements
  - UIAU integration fielded Oct 09:
    - Replace existing autopilots with UIAU from BQM-74
    - Common avionics, radar altimeter, Support Equipment with current production BQM-74E
    - Address obsolescence issues
    - Reduced logistics
    - Allows for performance growth if required
    - 25 retrofits planned to support expected operations

Current Inventory ~ 204
FY06 Ops/Expenditures - 19/2
FY07 Ops/Expenditures - 14/3
FY08 Ops/Expenditures - 12/0
FY09 Ops/Expenditures - 4/1

Great T&E "Truck" but does not adequately represent many of today's threat ASCMs

BQM-74E

- Prime Contractor: – Northrop Grumman
- Production
  - Training and T&E workhorse
  - Final procurement FY09

Current Inventory ~ 276
FY06 Ops/Expenditures - 235/62
FY07 Ops/Expenditures - 158/52
FY08 Ops/Expenditures - 231/68
FY09 Ops/Expenditures - 207/46

- Missions:
  - High fidelity Anti-Ship Cruise Missile (ASCM) Surrogate
  - Low-fidelity A/C simulator
  - Launch: ground, ship, air
- Product improvements
  - Programmable semi-autonomous navigation
    - Selectable Lost Carrier Sensitivity from waypoint to waypoint
    - Return to Recovery Area
    - Planned fielding FY10

Target still adequately represents many but not all threat ASCMs

Requirement for New Subsonic Target

- BQM-34 and BQM-74 no longer represent all modern subsonic threats
- Both targets will be out of production, potential target gap
- Previous attempts to replace were unsuccessful (1999-2007)
- JHU/APL Sensitivity Study completed Apr 2008
  - Identified key performance attributes required for combat systems testing
  - Determined threat equivalency boundaries for key performance attributes
  - Determined that existing Navy subsonic targets could not be modified to achieve needed performance attributes
- Study accepted by stakeholders (OSD(DOT&E), ASN(IWS), PEO(IWS), and OPNAV N43/N91 sponsors as Analysis of Alternatives (AoA)

SSAT Capabilities Development Document (CDD) to be approved Nov 2009

Subsonic Aerial Target (SSAT) Acquisition Approach

- Strategy is to have industry modify an existing subsonic target to achieve Navy SSAT requirements rather than develop from scratch
- Request For Information (RFI) for Development released Jun 2008 to gain insight into industry perspective
- Industry Day conducted Oct 2008
- Draft RFP released Jul 2009
- Pre-solicitation conference 8 Oct 2009
- Final RFP ready for release (after CDD approval) for full and open competition to support contract award in 4th quarter FY10
- Contract for engineering/manufacturing development, two priced production options and contractor logistics support options

Full and Open Competition

Full Scale QF-4/QF-16

- QF-4 - Air Force led program
  - Operating at Tyndall & White Sands Test Ranges
  - Air Force existing contract runs thru Lot 15 (FY09)
    - Navy procures 5 FY09, 3 FY10
  - Air Force plans to award new contract in FY10
  - Procurements from FY10 will deliver FY12

- AST QF-16 Air Force led program
  - Replacement for the QF-4
  - Navy providing requirement inputs and funding to Air Force
  - Navy participating in TEMP development and Source Selection
  - Contract Award anticipated 3rd quarter FY10
  - IOC 3rd quarter FY15

Source Selection process in-work

Navy Moving Land Target (MLT)

- Navy identified need for a threat representative training MLT to replace QLT-1C
- MLT program transferred from PMA-205 to PMA-208 2007
- Navy leveraged the Shootable Remote Threat Ground Target (SRTGT) OSD T&E demonstration initiative to refine requirements, prototypes filling gap until MLTs procured competitively
- MLT acquisition approach:
  - Planning for full and open competition to purchase commercial system
  - Completed a requirements study Jun 09
  - RFI released Aug 09 (solicitation #N00019-09-RFI-0235)
  - Requirement defined in Target Capability Document (TCD) signed Sep 09
  - Designated as Abbreviated Acquisition Program (AAP) in Sep 09
  - Draft RFP planned release late CY09
  - Contract award expected 3rd quarter FY10 for 60-120 targets

Planning to release a draft RFP late 2009

System for Naval Target Control (SNTC)

- SNTC
  - Prime Micro Systems, Inc
  - Controls BQM-74/34 aerial targets & seaborne targets
  - UHF 435–450 MHz
  - 200 nmi line of sight
  - 330 nmi via Relay
  - Supports Training and T&E

- Next Target Control System
  - Draft Initial Capabilities Document (ICD) complete
  - Analysis of Alternatives in progress

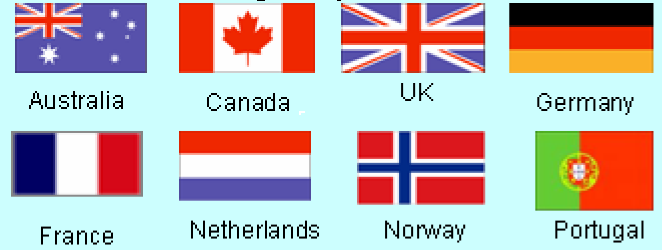
Requirements analysis effort in work to document long term target control needs

Foreign Military Sales

Description

- PMA-208 Hardware Case
  - USN is reimbursed for Targets & Equipment expended from USN inventory in support of international operations on US ranges
- Range Services Case
  - Separate FMS Case to fund target presentation at US Range
- Presentations on OCONUS Ranges
  - Target presentations performed on foreign range
  - France: GQM-163A

FMS Cases managed by PMA-208



Other international funding of target operations

Background

- PMA-208 manages 8 active cases / 1 Lease Agreement
  - 8 countries / Case Values Total: $ 33M
- OCONUS FMS deliveries:
  - FR-P-LGV; 1 GQM-163A to France in CY10
- Typical FMS Range Sites
  - NAWCWD Pt. Mugu/China Lake, CA
  - PMRF Barking Sands, HI
  - NAWCAD Wallops Island, VA

Country / Cases	Total Case Value	Product (Quantity)
Australia / AT-P-LAH	pending case closure	
Canada / CN-P-LFG	pending case closure	
/ CN-P-LIH	$ 6,809,638	BQM-74E/34 (10-15)
France / FR-P-LGV	$12,105,299	GQM-163A (1)
/ FR-P-ZAI	$ 73,616	MK7 lease (1)
Germany / GY-P-LFJ	$ 1,763,630	BQM-74E/34 (4-5)
Netherlands /NE-P-LGA	$ 2,970,090	BQM-74E/34 (5-7)
Norway / NO-P-LAU	$ 3,605,000	BQM-74E (5-7)
Portugal / PT-P-LCO	$ 1,200,000	BQM-74E (3-4)
UK / UK-P-LIV	$ 4,936,394	AQM-37C (5)
	$33,463,667	

8 active cases valued at over $33M

Target System Challenges

Evolution of the threats

- Supersonic dive
- Anti-ship ballistic cruise missile
- Asymmetric threats
- Enhanced threat capability
- Constant formal coordination with Operational and Intelligence communities

Programmatic

- Meeting evolving requirements - more extensive and accurate representation of threat
- Reconfiguration, reuse, and versatility
- Cost control – acquisition & operations
- Obsolescence
- Inventory management

A critical enabler to the successful development & fielding of future Naval combatants and their associated defensive weapons systems . . .

"Just Targets"

Questions?

U.S. Navy Aerial Target Systems

Contact:
Captain Dan McNamara
Program Manager
PMA-208, Navy Aerial Target & Decoy Systems
daniel.mcnamara@navy.mil
301-757-6129

…ARGET MANAGEMENT INITIATIVE

Office of the Secretary of Defense - Director Operational Test & Evaluation: Target Investments

Josh Messner - DOT&E TMI Execution Manager

'We're with OSD…
we're here to help!"

47th Annual
Targets, UAVs &
Range Operations Symposium
Savannah, GA
October 21-23, 2009

Outline

Å Changes at DOT&E
Å Supporting DOT&Eôs Mission
Å Target Management Initiative
Å Submitting Proposals
Å FY09 Recap
Å FY10 Program
Å FY11 Focus Areas

DOT&Eôs Target Resources Staff:

Å Dennis Mischel: TMI Program Manager / Targets Lead
Å Pat Burris: 5th Gen. FSAT Project Manager / Aerial Targets
Å James Maybury: Target Control Systems / C^2 Interfaces
Å Josh Messner: TMI Execution Manager / Mobile Ground Targets

Changes at DOT&E

Director, Operational Test & Evaluation

Dr. Charles McQueary

Principal Deputy

Mr. David Duma

Mr. Steve Daly

Land & Expeditionary Warfare

Mr. Richard Sayre

Live Fire T&E

Mr. Bill McCarthy

Missile Defense

Net-Centric and Space Systems

Mr. Mike Crisp

Air Warfare

Mr. Tom Blann

RETIRED

Naval Warfare

Changes at DOT&E

Dr. J. Michael Gilmore ï Director, Operational Test & Evaluation

- Sworn in on 9/23/2009
- Formerly the Assistant Director for National Security at the Congressional Budget Office (CBO) and Deputy Director of General Purpose Programs within Program Analysis and Evaluation (PA&E)
- B.S. in Physics from M.I.T.
- M.S. and Ph.D in Nuclear Engineering from University of Wisconsin

pporting DOT&E’s Mission

http://www.dote.osd.mil/about.html

“The Director, Operational Test & Evaluation (DOT&E)… … making **budgetary and financial recommendations to the SecDef regarding OT&E**; and **oversight to ensure OT&E for major DoD acquisition programs is adequate to confirm operational effectiveness and suitability of the defense system in combat use.”**

Targets Staff supports DOT&E by:

- Annual monitoring of Services targets budgets for potential impacts to OT&E
- Make Investments that:
  - Help to ensure Targets are Threat Representative and Cost Effective
  - Help promote interoperability between Services and Ranges
  - Help to ensure Target Systems (C^2, Scoring, Launch) are adequate to support Testing

DOT&E's Target Management Initiative

Objective

- Improve threat realism, increase interoperability, and reduce test costs.

Projects

- TMI projects include ***studies, standards developments, target system prototypes, and proof of concept demonstrations***.

Selection

- Supported by Target Investment Working Group (TIWG)
- Criteria Include: Importance to Operational Testing, Improvement to the Threat Realism, Benefit vs. Cost, Multi-Program Applicability, Potential for Successful Execution
- DOT&E Deputies are briefed on prioritized project list

Execution

- Projects are typically 1-3 years in length
- $50K Studies to $3M Prototypes
- Project Execution is Managed by the Services
- Minimum deliverables include: Monthly reporting, Bi-annual briefings, Final Report

Prime consideration is given to projects that address Operational Testing (OT) requirements and DOT&E resource concerns.

nal Upcoming Dates

Å**16 November** ï Release Call for Proposals & FY11 Focus Areas

  ÅInitial proposal format will be 1 page white paper

Å**21 December** ï White paper proposals due

Å**0   January** ï DOT&E releases response to white papers and detailed proposals are requested.

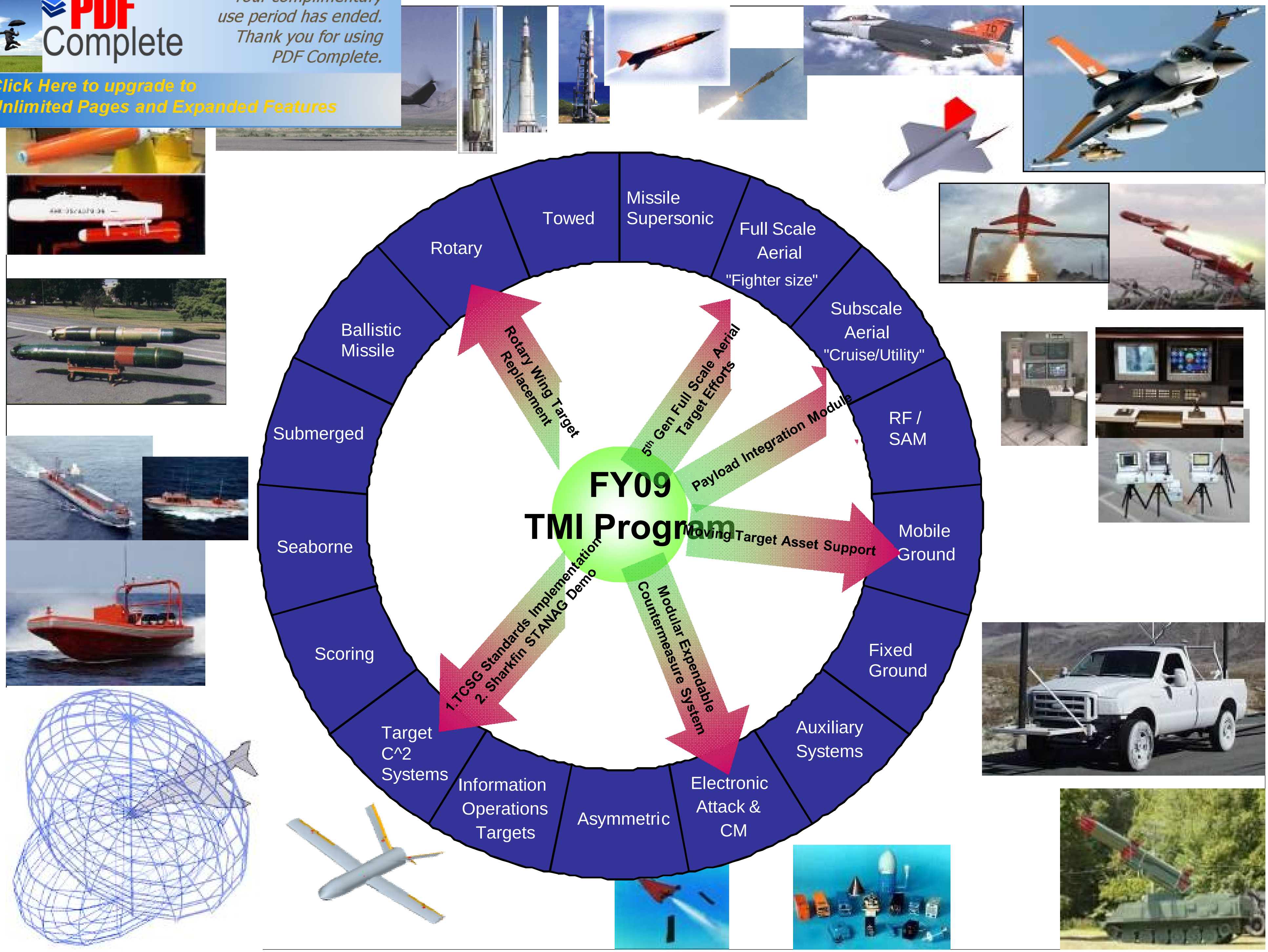
Å**05 February** ï Detailed proposals due.

Å**12 February** ï TMI sends detailed questions to proposal authors.

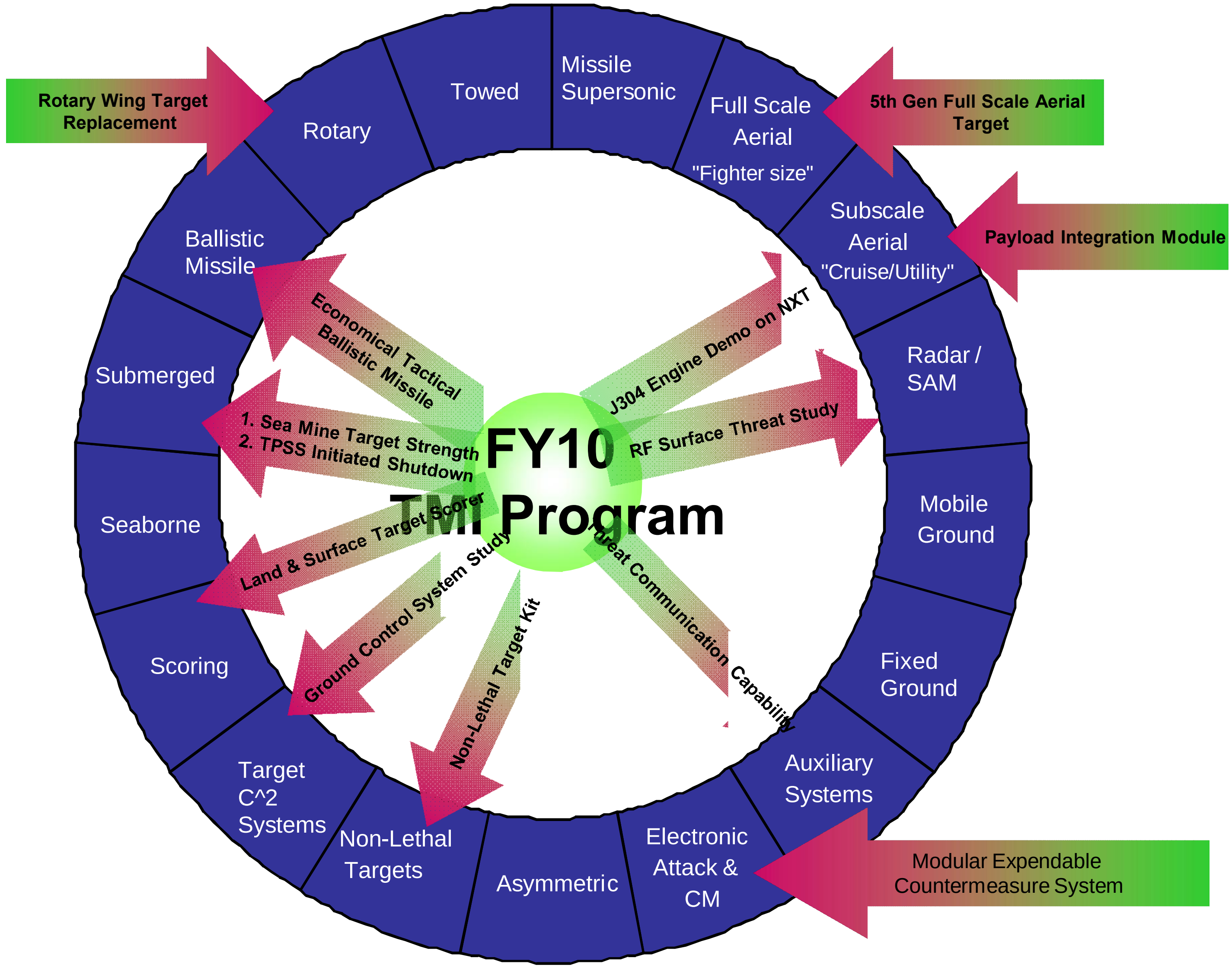
Å**Early March** ï New Start Reviews

Submitting Proposals

- Project proposals can be submitted via the TMI website: www.tmi.osd.mil
- We recommend industry and academia work with Service partners when submitting proposals.
- Please follow-up submittals with a call to 703-681-5502


FY09
TMI Program
Towed
Missile Supersonic
Full Scale Aerial "Fighter size"
Subscale Aerial "Cruise/Utility"
RF / SAM
Mobile Ground
Fixed Ground
Auxiliary Systems
Electronic Attack & CM
Asymmetric
Information Operations Targets
Target C^2 Systems
Scoring
Seaborne
Submerged
Ballistic Missile
Rotary
Rotary Wing Target Replacement
5th Gen Full Scale Aerial Target Efforts
Payload Integration Module
Moving Target Asset Support
Modular Expendable Countermeasure System
1.TCSG Standards Implementation
2. Sharkfin STANAG Demo

10 TMI Program



FY11 Focus Areas

ity

Have an Explosive Year

TMO

Targets Management Office

U.S. Army TMO's Towed Targets Program

47th Annual Targets, UAVs and Range Operations Symposium
Oct 2009

Briefer:
Tony Still
Targets Management Office
Tech Mgt Div
SFAE-STRI-PM ITTS-QE
256-842-0377
tony.still@us.army.mil

T
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PM-ITTS

FALSE IMPRESSION CAVEAT

It should be explicitly noted that the U.S. Government makes no official commitment nor obligation to provide any additional detailed information or an agreement of sale on any of the systems/capabilities portrayed during this presentation that have not been authorized for release.

OUTLINE

- Towed Target Platforms (droned/manned)
- Various Towed Targets
- TMO Towed Target Simulation Capabilities
- R&D Efforts
- Future Efforts
- Summary

BLUF

- Towed Targets can inexpensively emulate airborne threats
- TMO has a “basket” of various towed targets
- Performance envelope very similar to drone or aircraft towed from (except Gs)
- Less Costly Acquisition & Tracking Testing
- Less Costly Live-Fire Testing/Training (typically ≤ 1/25th cost of towing drone)
- TMO has in-house/ and contract capability to design/fab proto-type towed targets to meet customer testing requirements.

Typical TMO MQM-107 Tow Target Mission

Manned Aircraft Towing Platforms

Manned Aircraft used during developmental flight testing (not used during live-fire)

RM-30B Reeling Machine

Lear 36 during development of TAPS

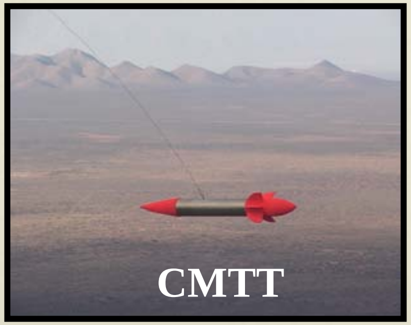
Cruise Missile Tow Target deploying from F-16/RM-30

T-38 during development of JCHAAT (simulates MQM-107 type launch)

TMO Towed Targets

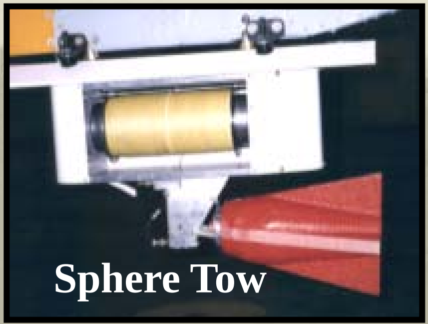

Snatch Banner


TRX-4A


CMTT


JCHAAT


Aerial Gunnery Tow


Sphere Tow


POTA-Tow


RRTT


TIX-4 (3 versions)


TIX-MARS-888

Simulations

MISSILE DATCOM

Aerodynamic prediction code. Input the Geometry of the flight vehicle, body configuration, surface roughness Control surfaces, etc……….out put is aero coefficients and derivatives, center of pressure, etc

CBAS

Cable Body Aero Simulation: Computes the dynamic motions of a tow body and tow cable behind the towing aircraft, given the dynamic movement of the towing aircraft.

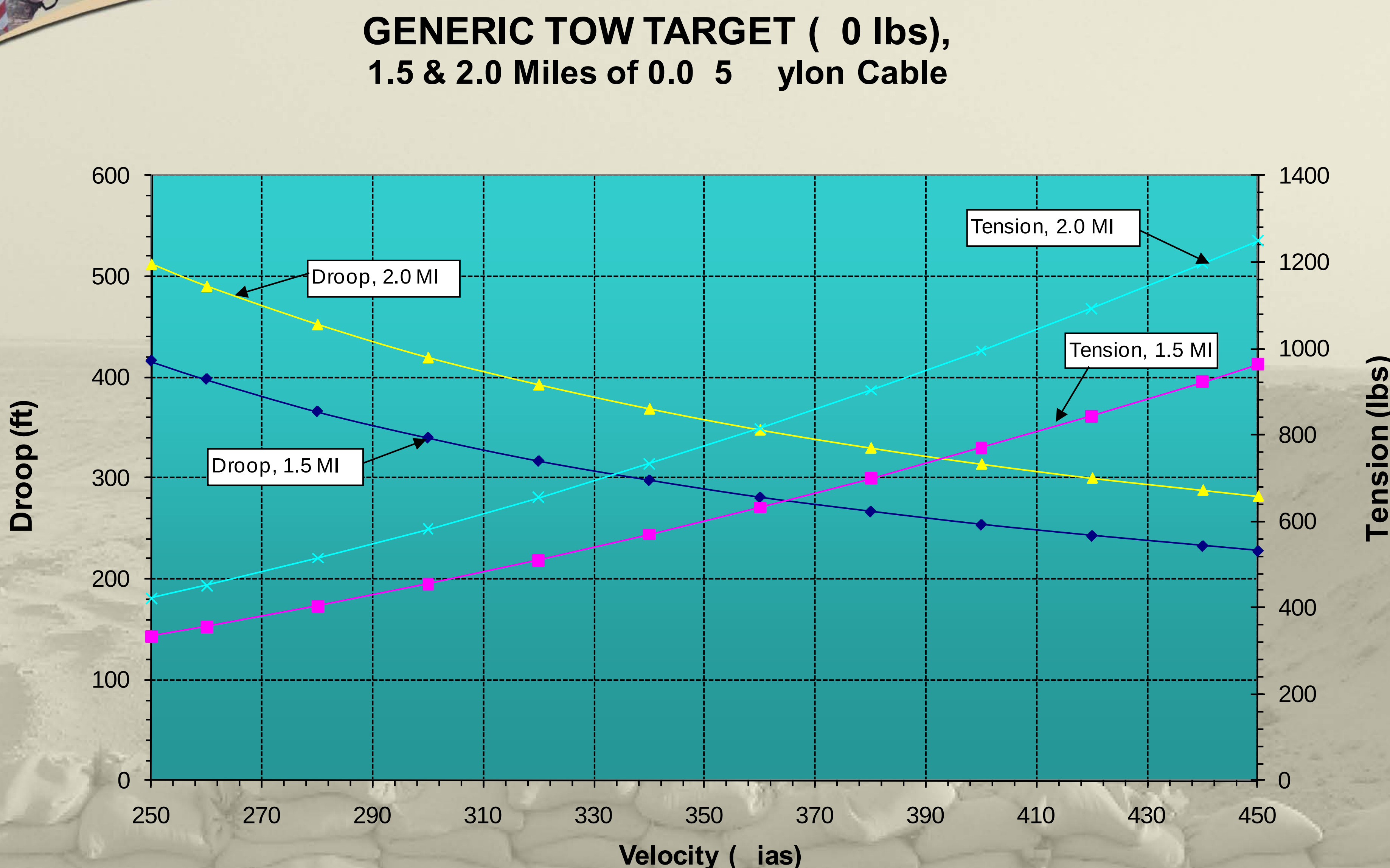
CBAS- Jr

Cable Body Aero Simulation: Static version used for "steady state" flight. Easy to use, (XCEL version). Predicts towline tension, angle, droop, etc.

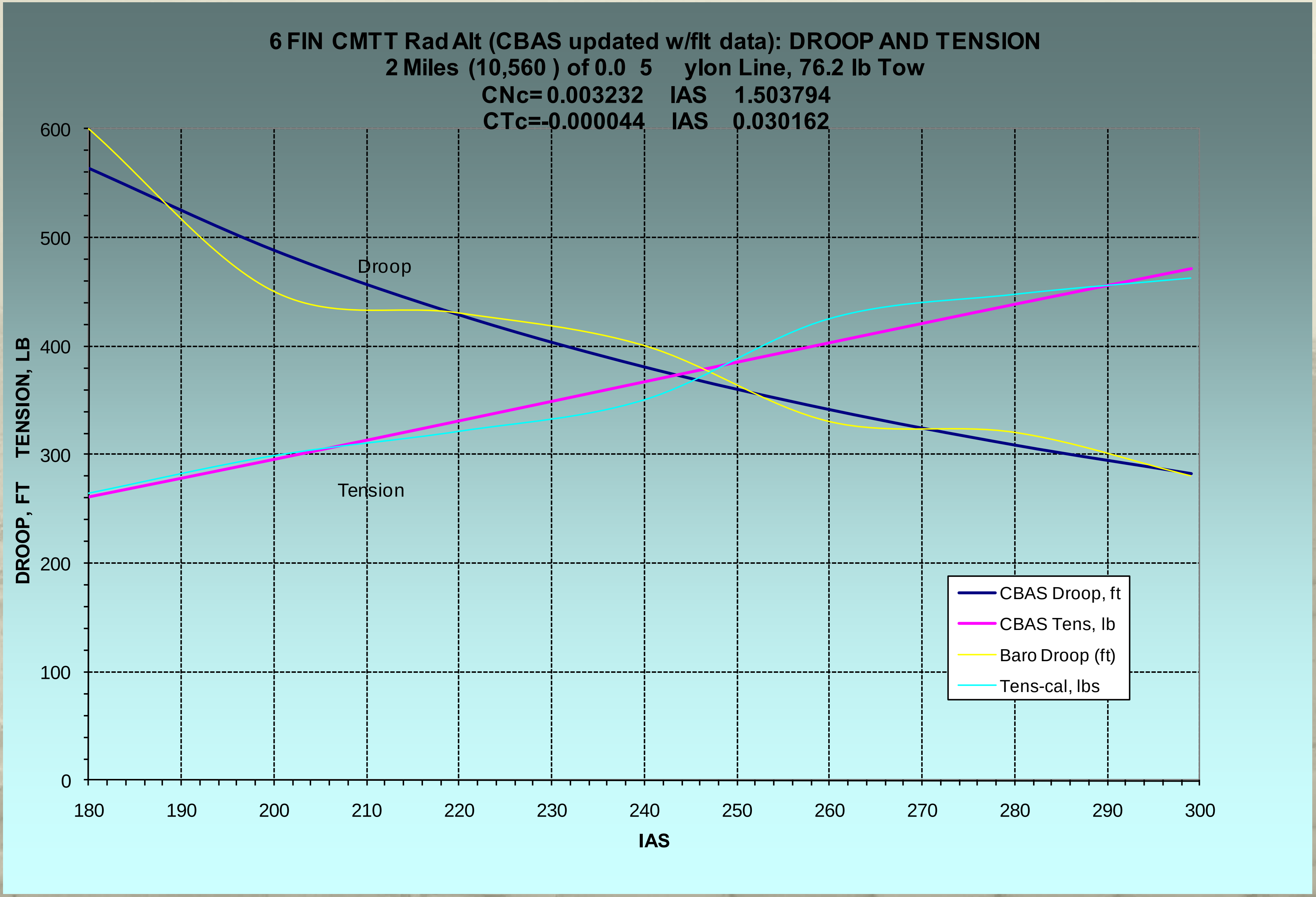
XPATCH

Enter tow target geometry and materials, predicts RCS signature as a function of frequency, polarization & and aspect angle.

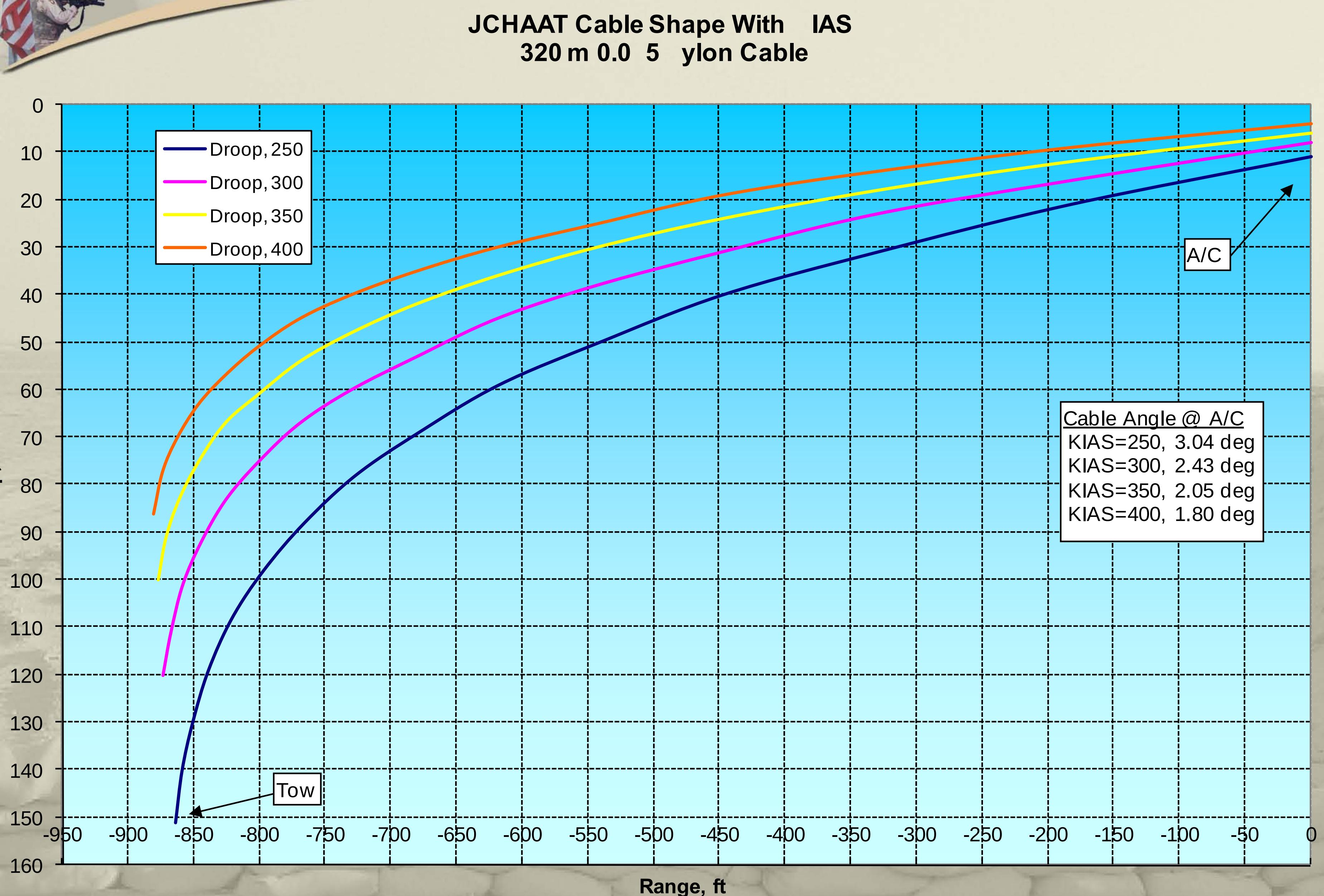
Static Droop/Tension Plot From CBAS



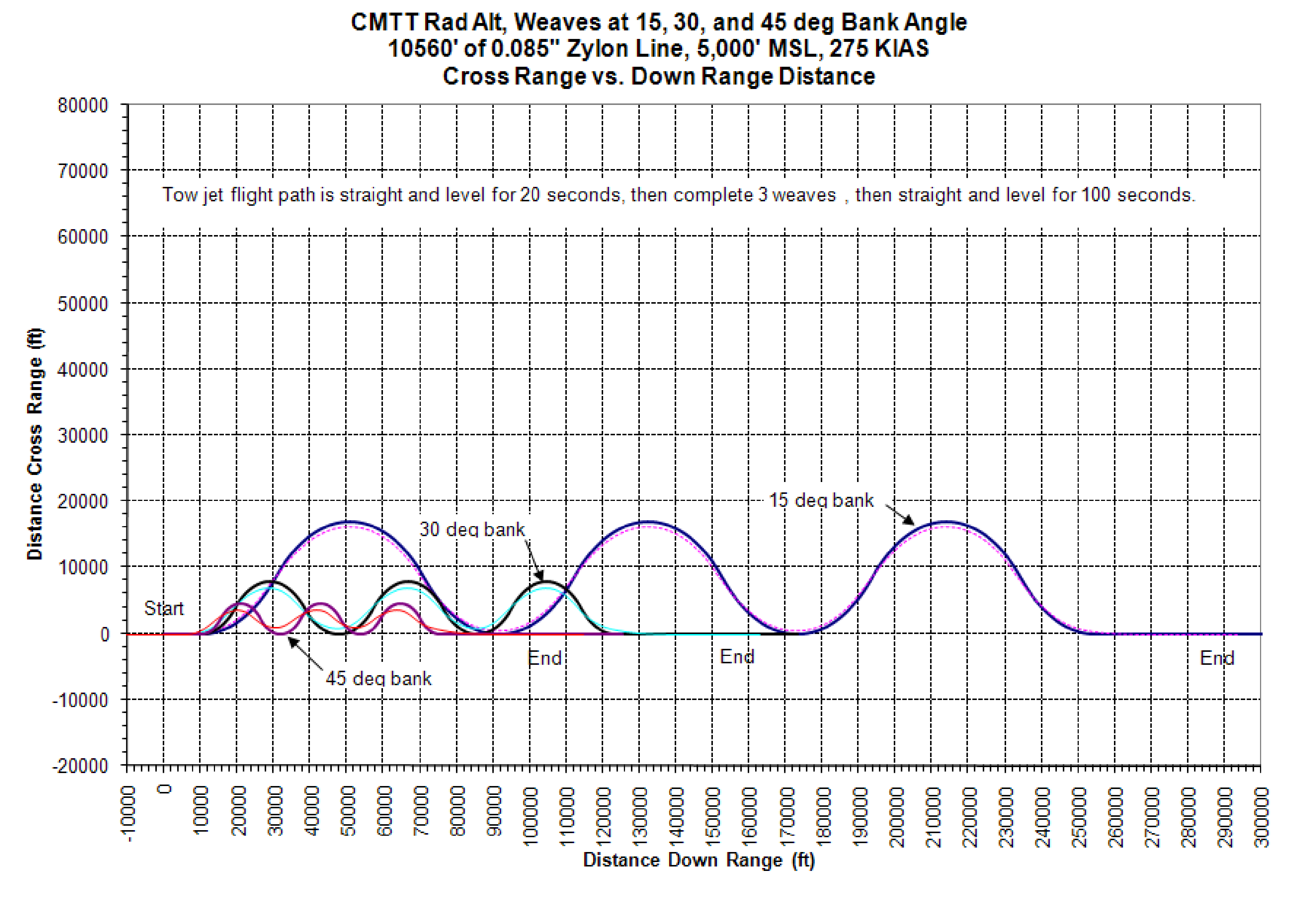
CBAS Predicted vs Actual Flight Data



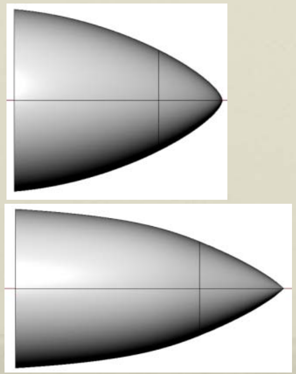
CBAS Predicted vs Actual Flight Data



CBAS Sr. Dynamic Prediction Code



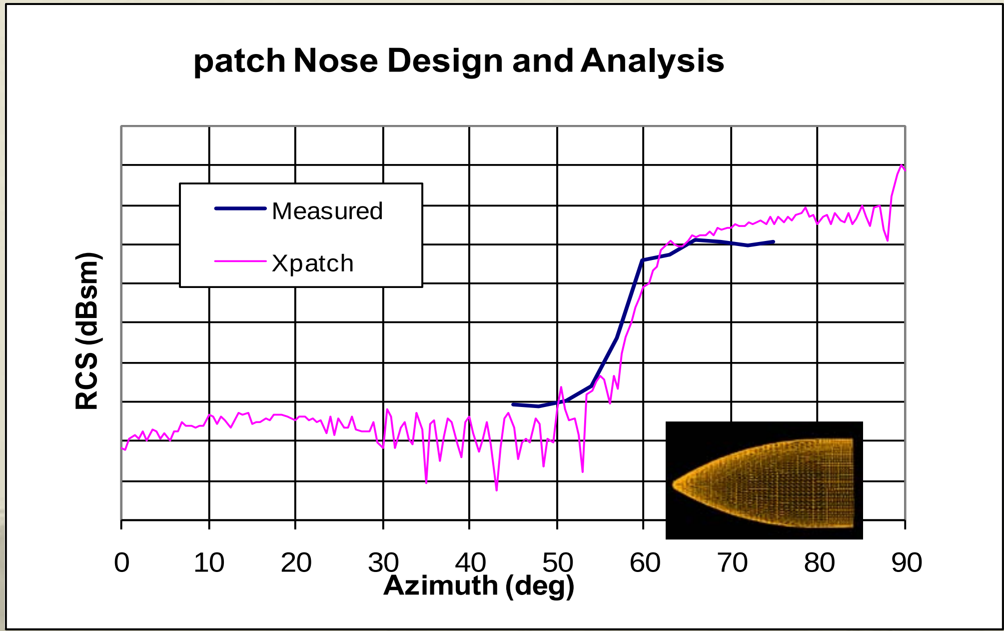
X-Patch RCS Signature Prediction Code



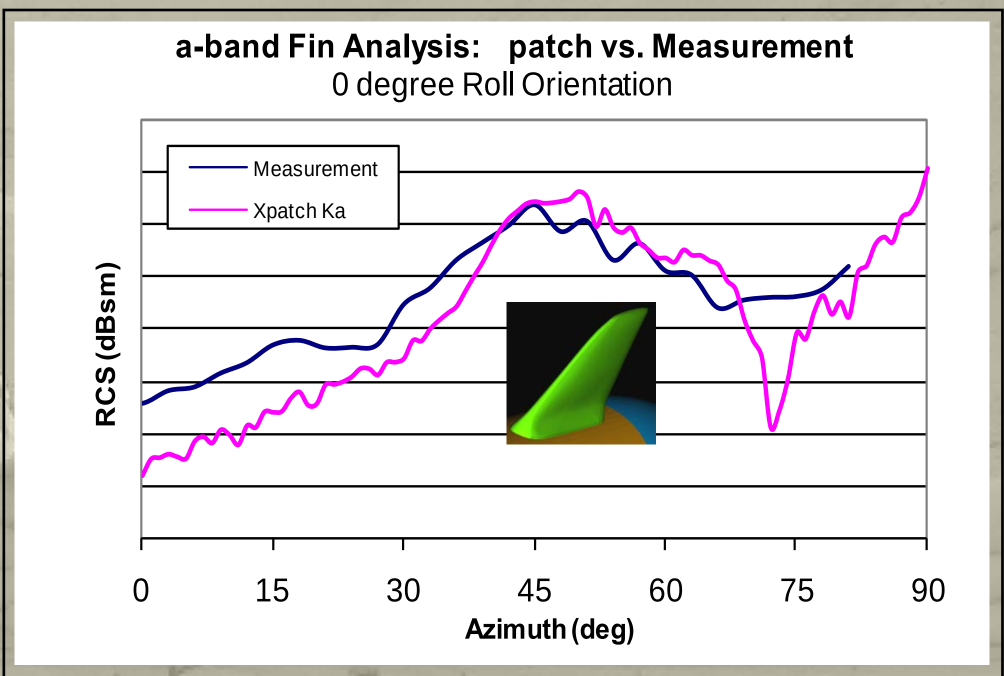
Which nose-cone provides the best signature for my application?

What is the RCS of each nose-cone?

What should the nose look like as part of my signature budget?



- Use RCS prediction codes to prototype target parts prior to fabrication
- Xpatch
  - ➢DoD state-of-the-art code
  - ➢High frequency
  - ➢Based on Physical Optics and Shoot-and-Bounce Ray Theory
- Generate RCS as a function of look-angle
- Analyze scattering features
- Coordinate RCS requirements with aerodynamic design and manufacturing trade-offs



TMO R&D Efforts

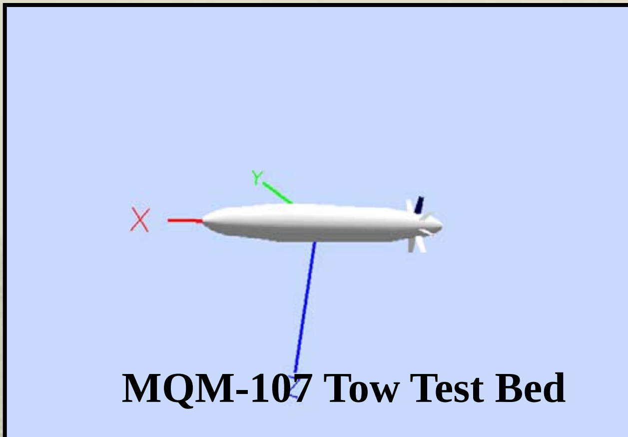
Tow Reel on Manned AC

AT-38 with MQM-107 Tow Launcher

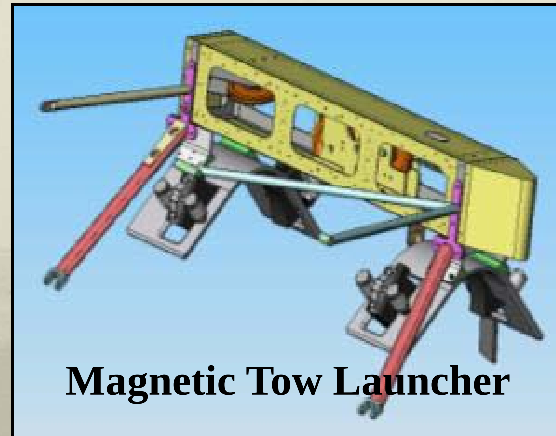
RM-30B tow reel integration
40th FLTS, Eglin

Recent/ Ongoing Developmental Efforts

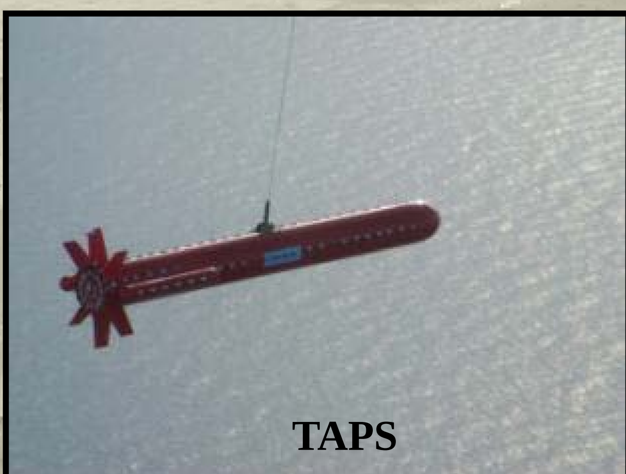
Reduced Radar Tow Target (RRTT)
Magnetic Tow Launcher
Low Observable Instrumented Tow (LOIT) – USAF funded
Towed Airborne Plume Simulator (TAPS) – USAF funded
Camera Kit for Two-way Tow Reel
MQM-107 Tow Test Bed



MQM-107 Tow Test Bed


Magnetic Tow Launcher


Reduced RCS Tow Target & GPS


TAPS

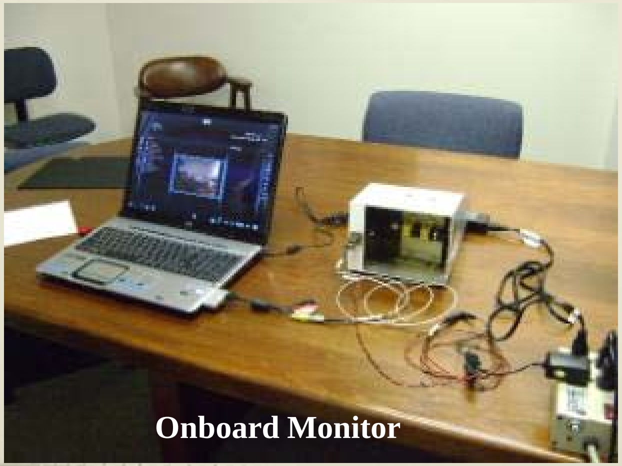

LOIT


Camera Kit for Two-Way Reel

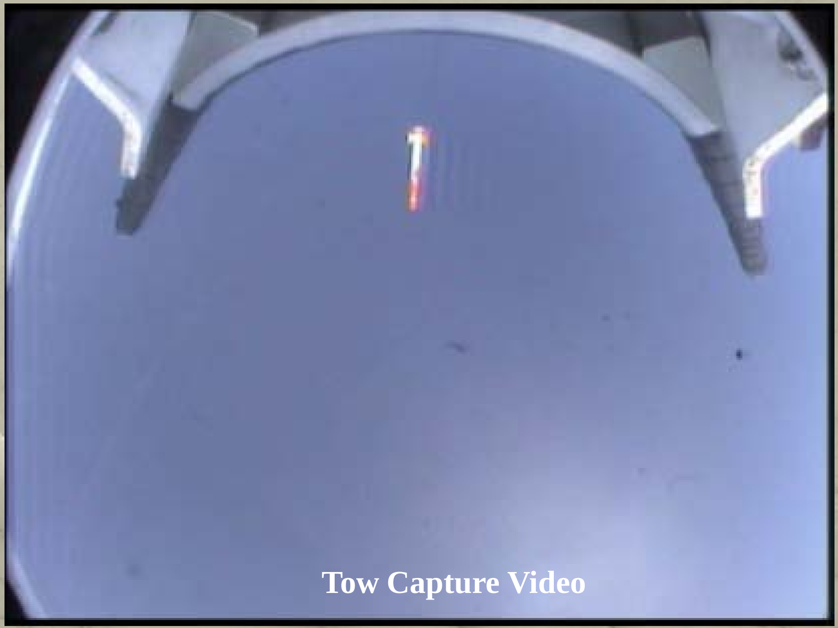
Radar Altimeter Tow Target Flight Test

Onboard Video Camera for Tow Reel

Video Camera fits on nose of launcher



Onboard Monitor



Tow Capture Video

Tow GPS Efforts

High Accuracy GPS Data Logger

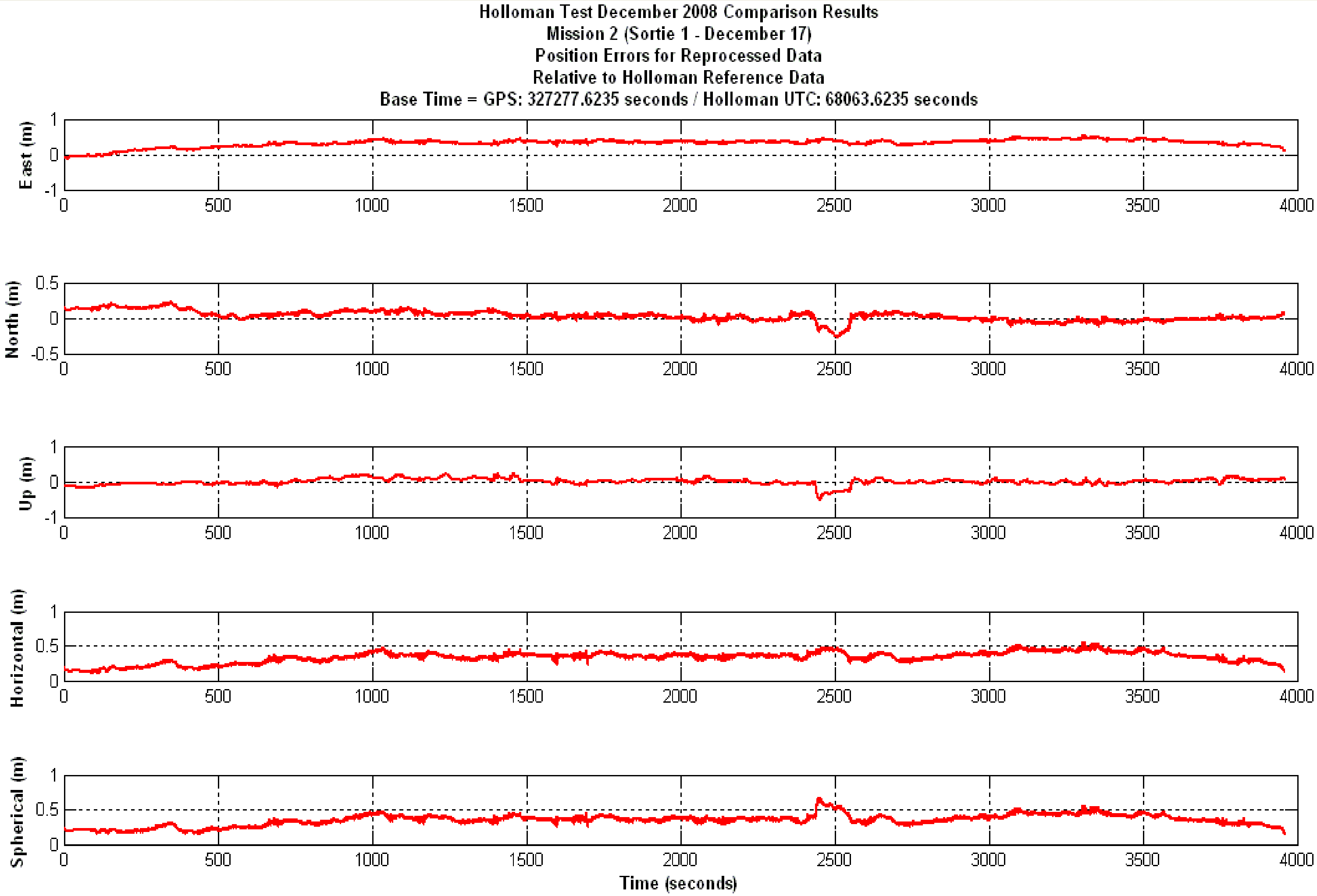

Installed in Tow Target


Tow/GPS under wing of launcher


Over water flight testing

GPS Accuracy Testing

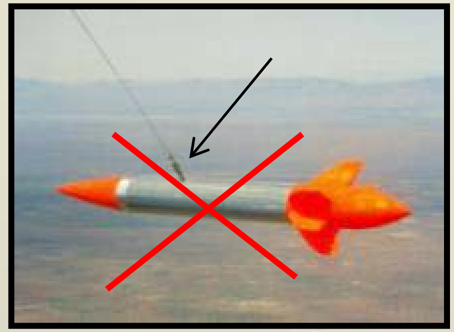
Holloman AFB, NM



X,Y,Z Accuracy vs Truth Position Data

Magnetic Tow Launcher Testing

Targets Management Office

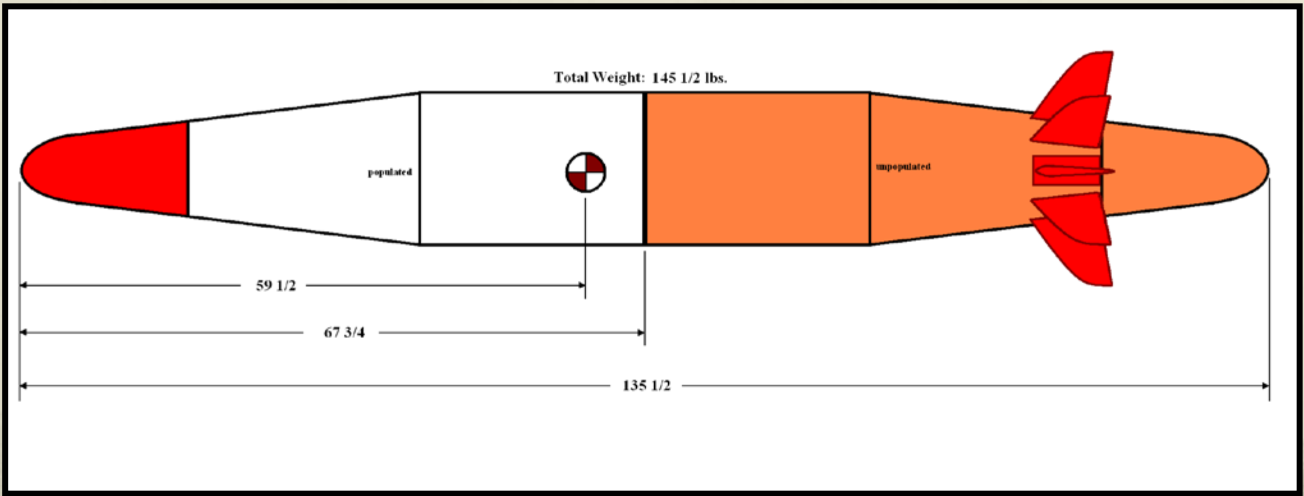


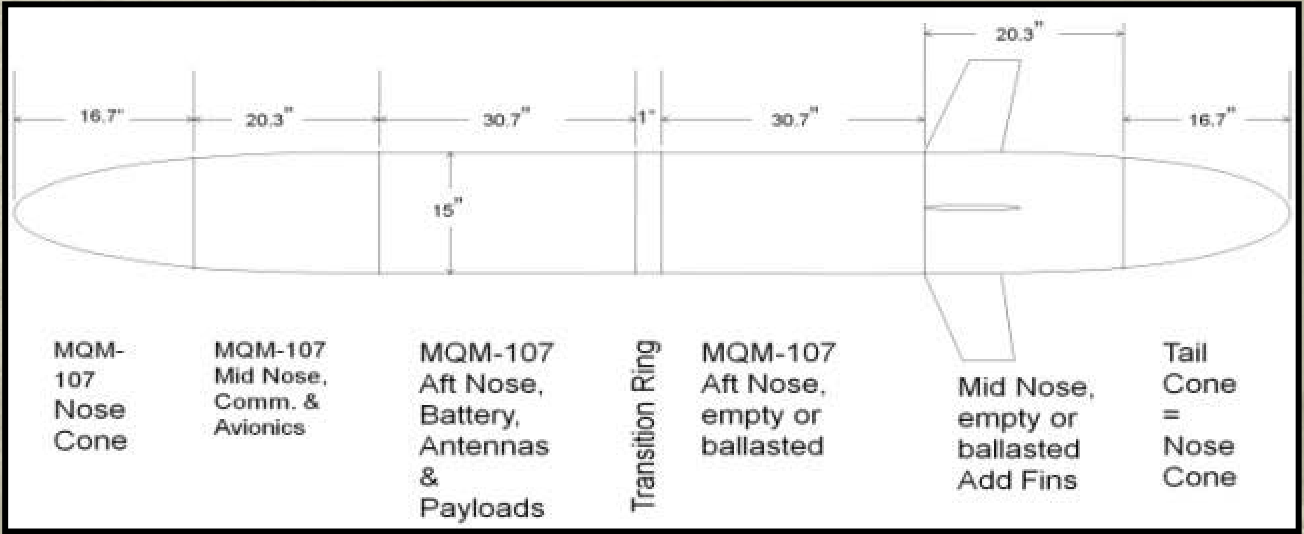
T
M
O

PM-ITTS

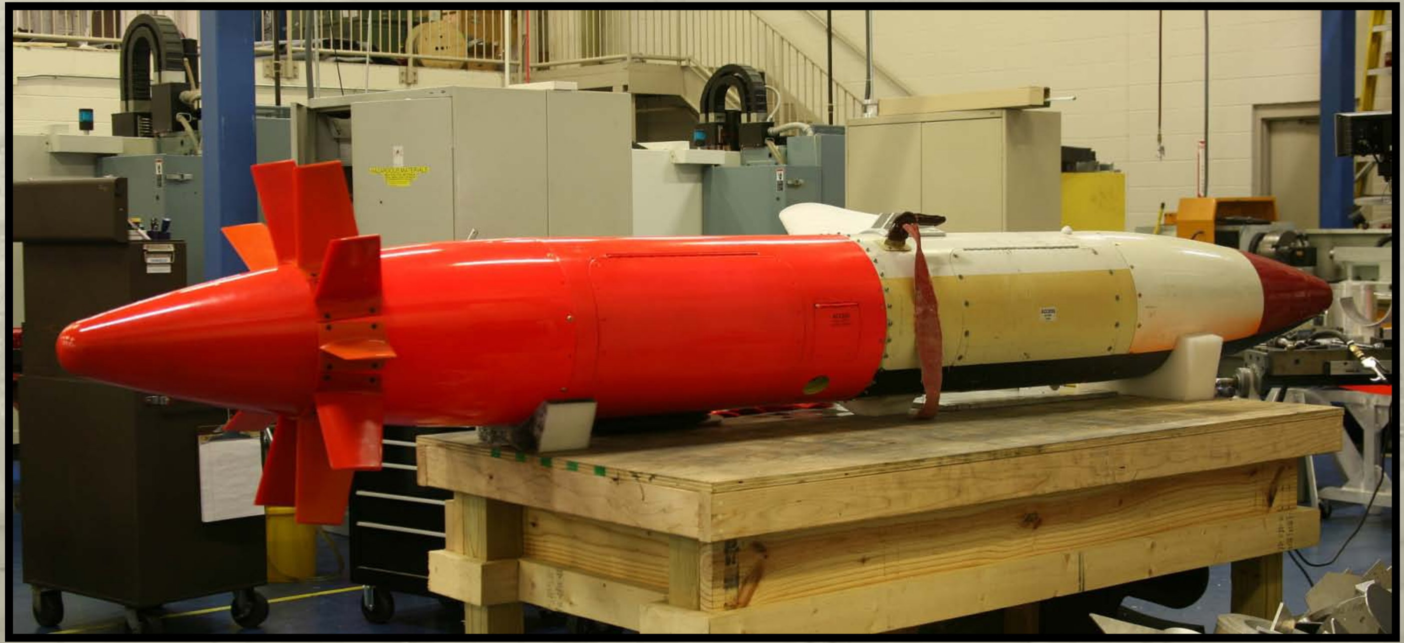

1st Deploy

MQM-107 Tow Test Bed





MQM-107 Tow Test Bed



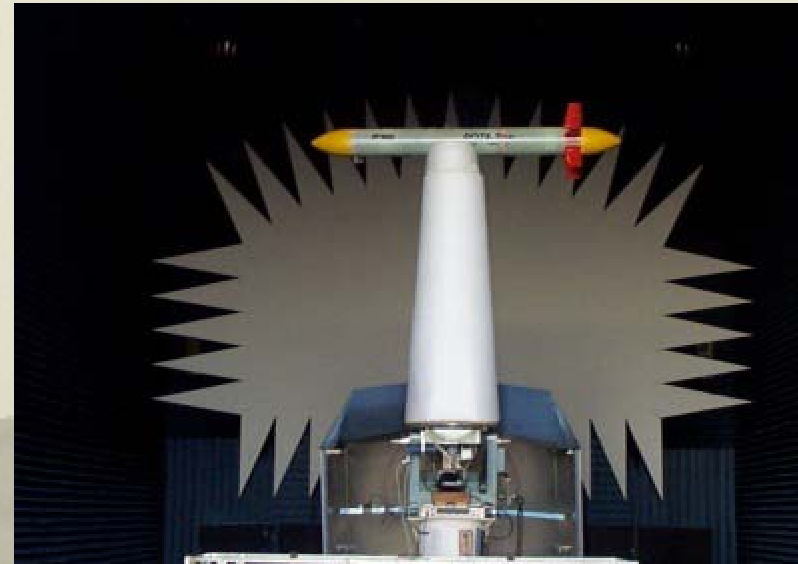
Towed Airborne Plume Simulator (TAPS)

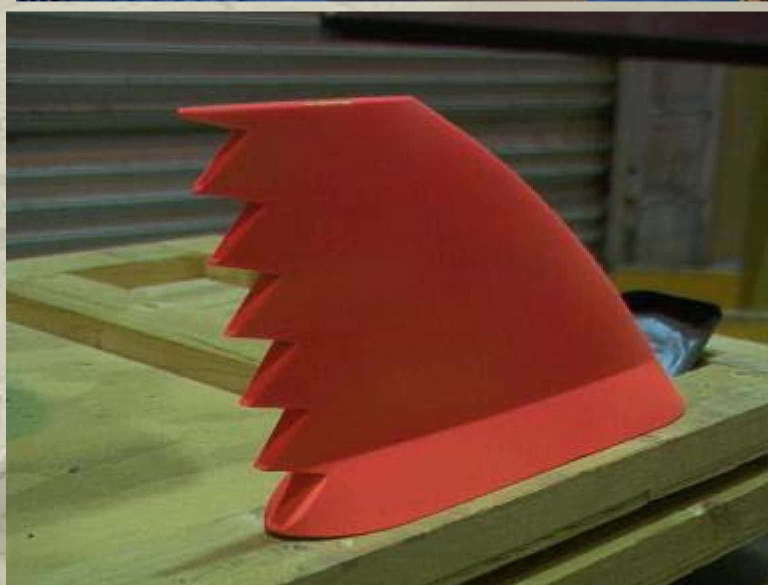
Support to Center for Countermeasures (CCM)

Tandem Towed Targets

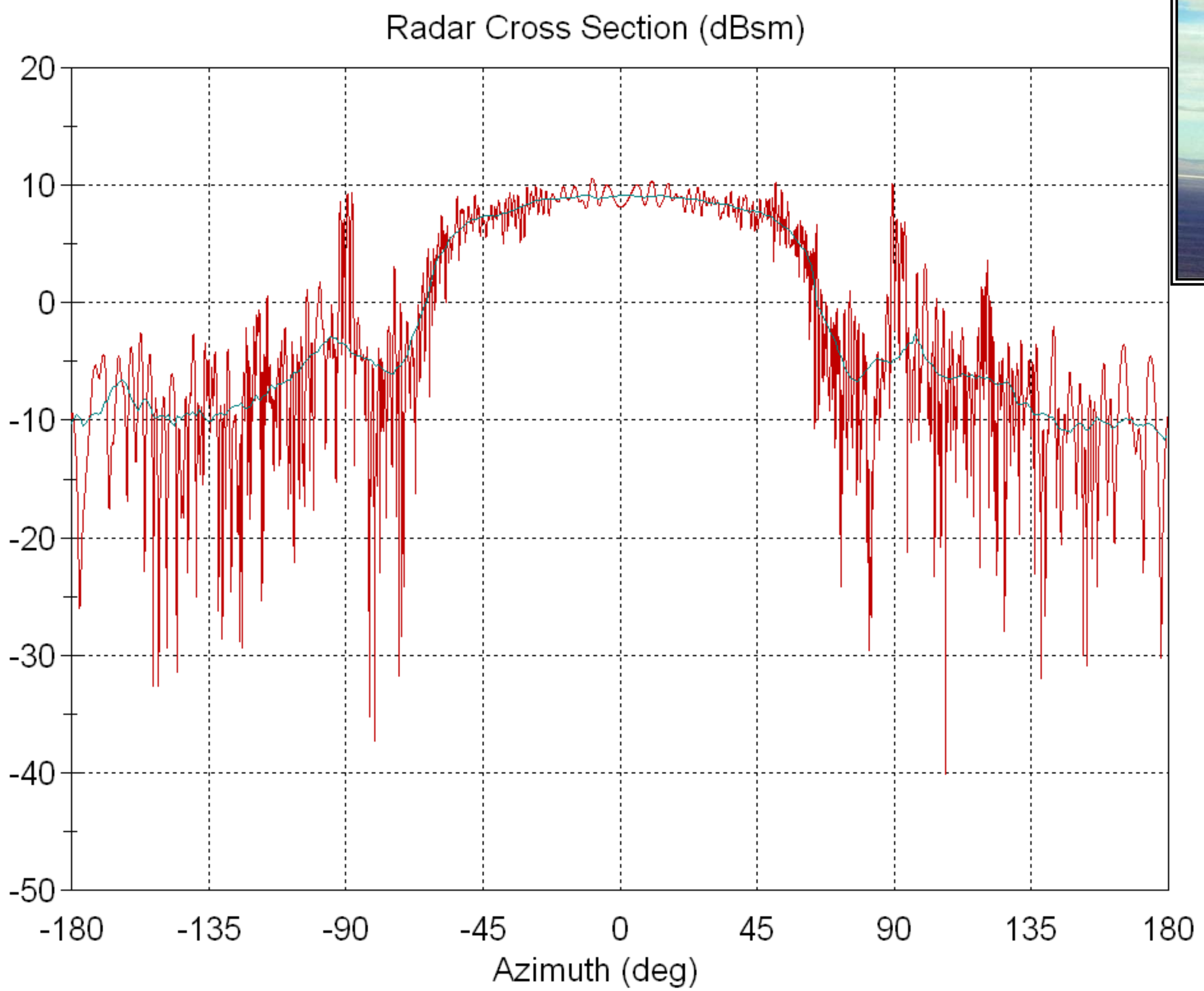
Tandem Towed Targets

Radar Cross Section (RCS) Measurement at Pt. Mugu





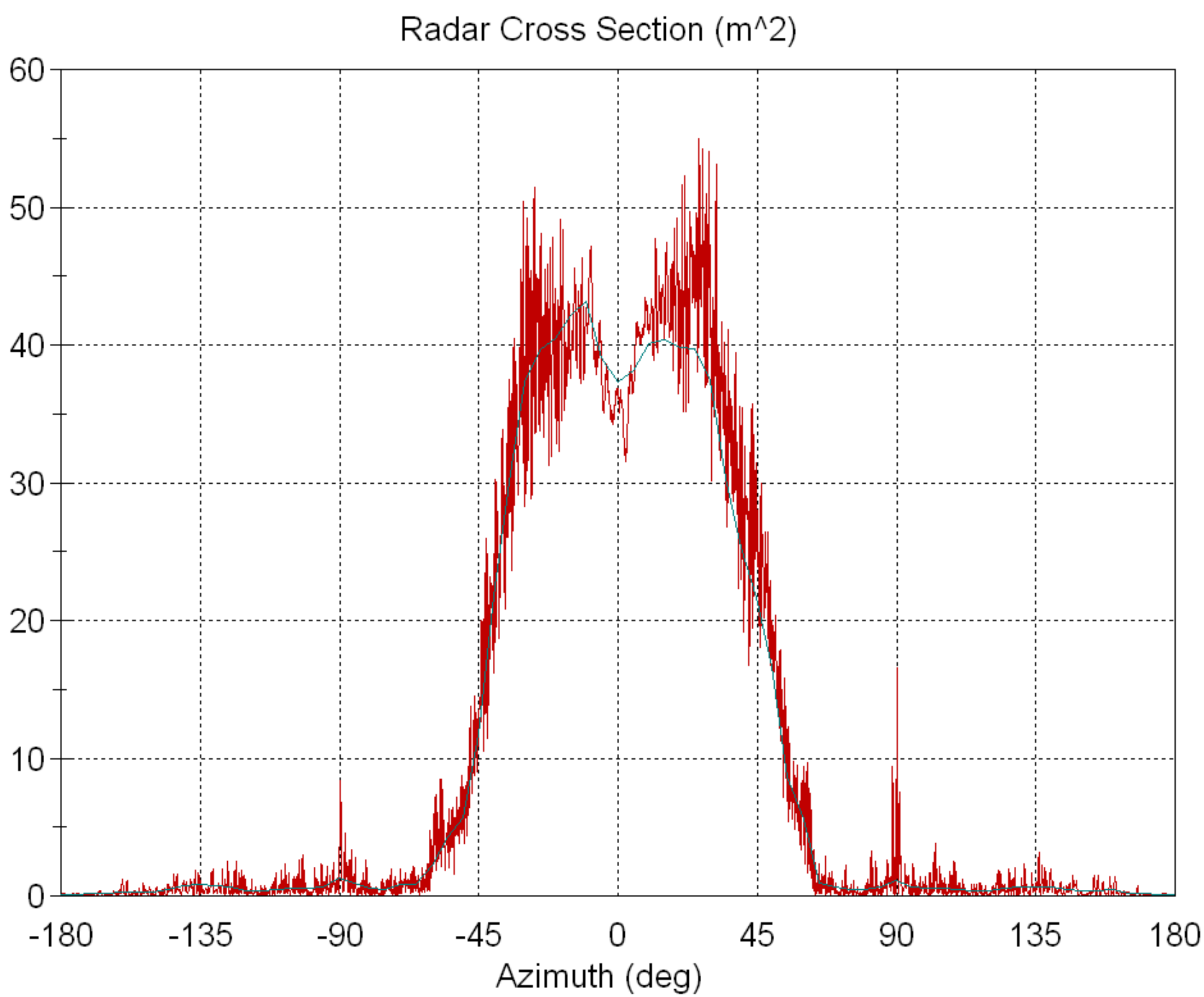
Radar Cross Section (RCS) Sample



Roll:	0
Tilt:	0
Pitch:	0
Pol:	HH
Freq:	6.2023
Window:	20
Slide:	1
Start Az:	-60
Stop Az:	79
Mean:	8.09286
St. Dev.:	1.27677
Max:	9.14087
Min:	3.4341

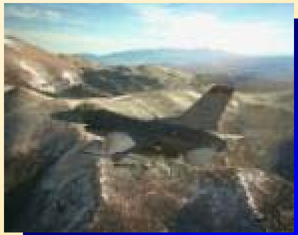
ALL TMO TOWED TARGETS HAVE BEEN MEASURED AT MUGU

X-Target RCS (plotted in M^2)



Roll:	0
Tilt:	0
Pitch:	0
Pol:	HH
Freq:	15.02
Avg Start:	14
Avg Stop:	16
Avg BW:	2
Window:	10
Slide:	5
Start Az:	-40
Stop Az:	45
Mean:	36.5415
St. Dev.:	5.86588
Max:	43.0823
Min:	21.7052

Cruise Missile Tow Target (CMTT)



Cruise Missile Tow Target

USERS / CUSTOMERS

deleted

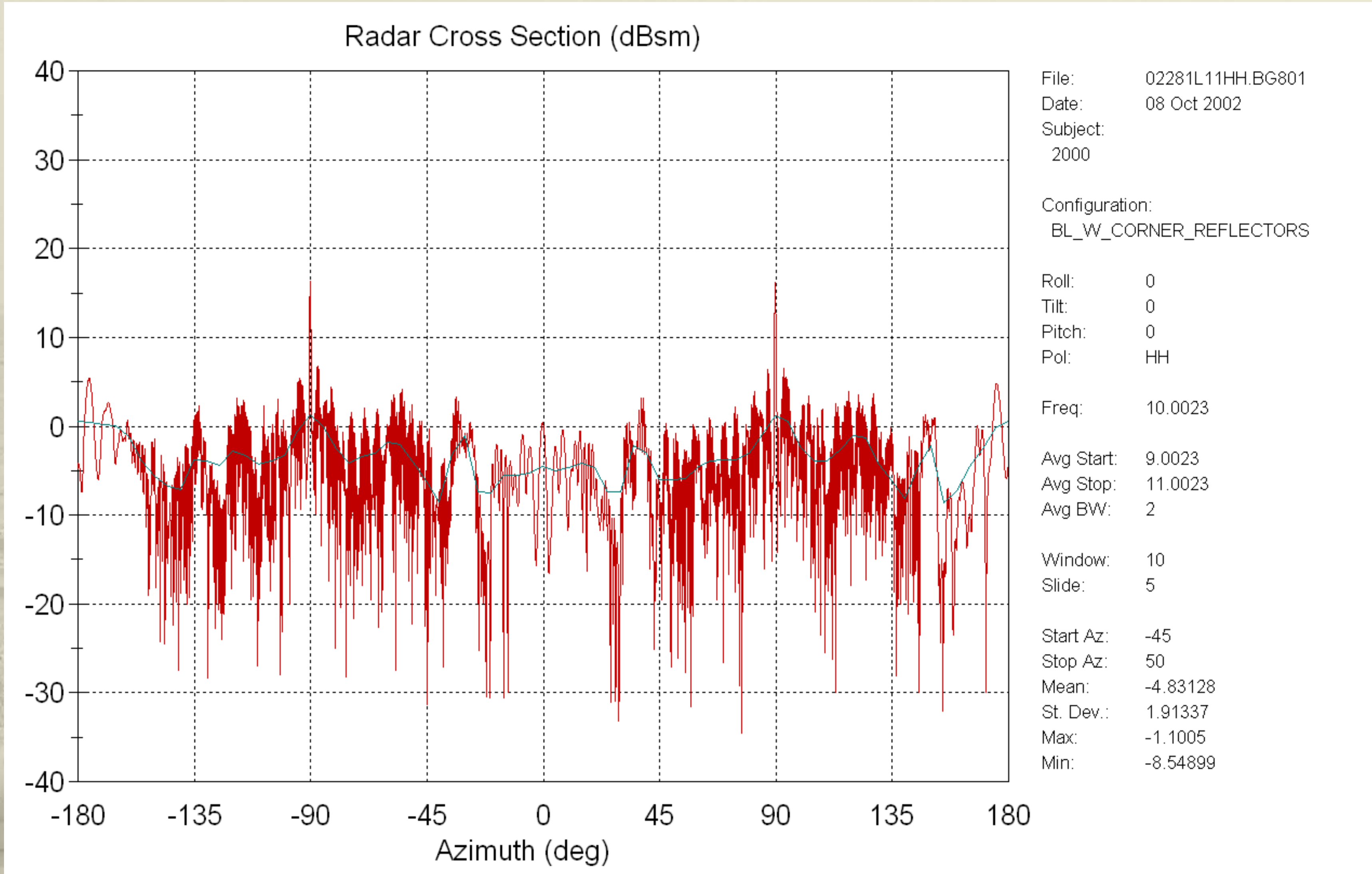
DESCRIPTION

- **TOWED BY F-16 OR T-38 FOR SEARCH/TRACK MISSION. TOWED BY MQM-107 FOR SEARCH/TRACK/ LIVE-FIRE.**
- **TOWED ON 5700 FEET OF RADAR TRANSPARENT .065" DIAMETER "ZYLON" TOWLINE**
- **LOW RADAR CROSS SECTION**
- **CAPABLE OF AIRSPEEDS UP TO 450 KNOTS**
- **CAPABLE OF ALTITUDES AS LOW AS 175 FEET ABOVE THE GROUND**
- **DEVELOPED BY TMO**

FUNCTIONAL DATA

LENGTH	96 INCHES
WEIGHT	60 POUNDS FOR MANNED AIRCRAFT VERSION 76 POUNDS FOR DRONED VERSION
MATERIALS	ALUMINUM FUSELAGE POLYSTYRENE FINS & TAILCONE
TOWLINE	.065" DIAMETER (15X1000 BRAID) ZYLON
ALTITUDE	DROOP UNDER TOWING CRAFT VERIFIED AS FUNCTION OF AIRSPEED/MACH NUMBER
RADAR CROSS SECTION	MEASURED FROM 2-18 GHz

CMTT (7.5 CR) RCS



Future Potential R&D Efforts

Glide Tow

Height Keeping Tow

Summary

- TMO can develop “user specific” tow targets
- Low Radar Cross Sections can be achieved
- Tow Targets save money

Interested in Tow Target Support?

TMO

Contact Info:

Tony Still
SFAE-STRI-PM ITTS-QE
Targets Management Office
Redstone Arsenal, Al
256-842-0377w
tony.still@us.army.mil

Air Force Aerial Targets

October 2009 NDIA Brief

Savannah, GA

Mr. Mike VandenBoom, Deputy Director
691st Armament Systems Squadron
Eglin AFB, FL

Overall Classification of This Briefing is Unclassified and Cleared by AAC/PA No. xx-xx-xx-xxx

Overview

- **Purpose**
- **System Description**
- **Organizational Structure**
- **Product Groups**
  - **Full-scale Aerial Targets**
  - **Subscale Aerial Targets**
- **Summary**

Purpose

- Provide “Presentations” of Realistic Threat Representative Systems (Aircraft and Cruise Missiles) in Support of the Following:
  - Lethality Testing Required for New or Improved Weapon Systems Prior to Production (10 USC 2366)
  - USAF Air-to-Air Weapon System Evaluation Program
- Validate Performance Of DoD Surface-to-Air and Air-to-Air Missiles and Aircraft Systems
  - Emulates Performance, Signatures and Countermeasures (Infrared and Electronic Attack)

Overview

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- Summary

System Description

- Aerial Target "Presentations" Include:
  - The Target Itself
  - Target Control System
    - Gulf Range Drone Control System (GRDCS)
  - Missile Scoring
  - Launch, Recovery, Maintenance & Repair of Target

Overview

- Purpose
- System Description
- **Organizational Structure**
- Product Groups
  - Full Scale Aerial Targets
  - Subscale Aerial Targets
- Summary

691 ARSS Staff


MS. MICHELE BRAZEL
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MR. ALLAN PIXLEY
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SUBSCALE FLT LEAD &
AFSAT PM


MS. HOLLY REEDY
FULLSCALE FLT LEAD


MR. KEN HISLOP
QF-16 PM


MS. LEE NEUGIN
QF-4 PM

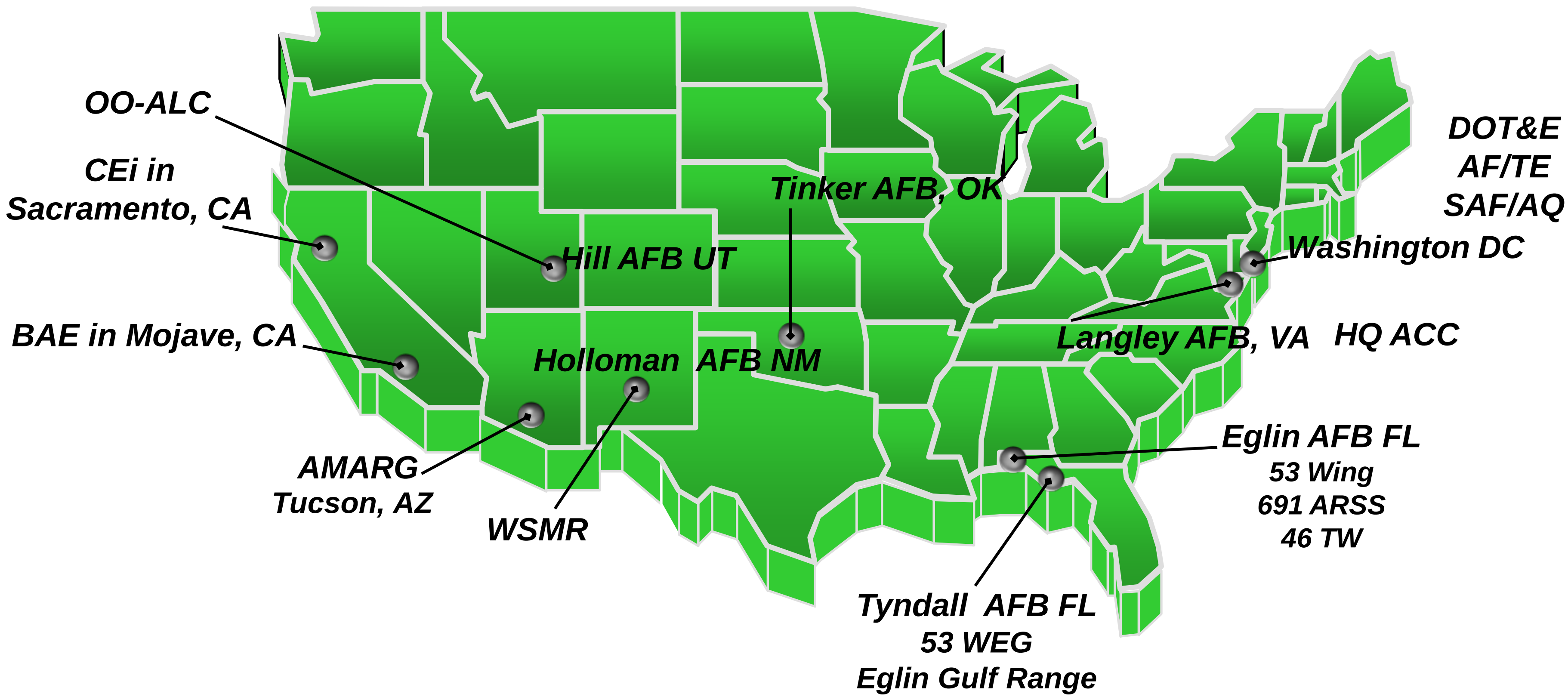
96ABW-2009-0432

Where We Fit In

Organization	Leadership
Air Force Headquarters	
Air Force Materiel Command	
Air Armament Center	Maj Gen CR Davis, Commander
308th Armament Systems Wing	Mr. Randy Brown, Director
728th Armament Systems Group	Col Cyril Socha, Commander
691 Armament Systems Squadron	Ms. Michele Brazel, Director

96ABW-2009-0432

USAF Aerial Targets Stakeholders



Click Middle of Screen to Start Movie

Overview

- Purpose
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QF-4 Full Scale Aerial Target

Description

- Full Scale Aerial Target for Threat-Representative Weapon System Evaluation
- Meets USAF, Army, Navy, Allied Test Requirements
- Droned, Refurbished F-4 Aircraft Out of AMARG
- Program in Full Rate Production
- Prime Contractor is BAE Systems, Mojave, CA

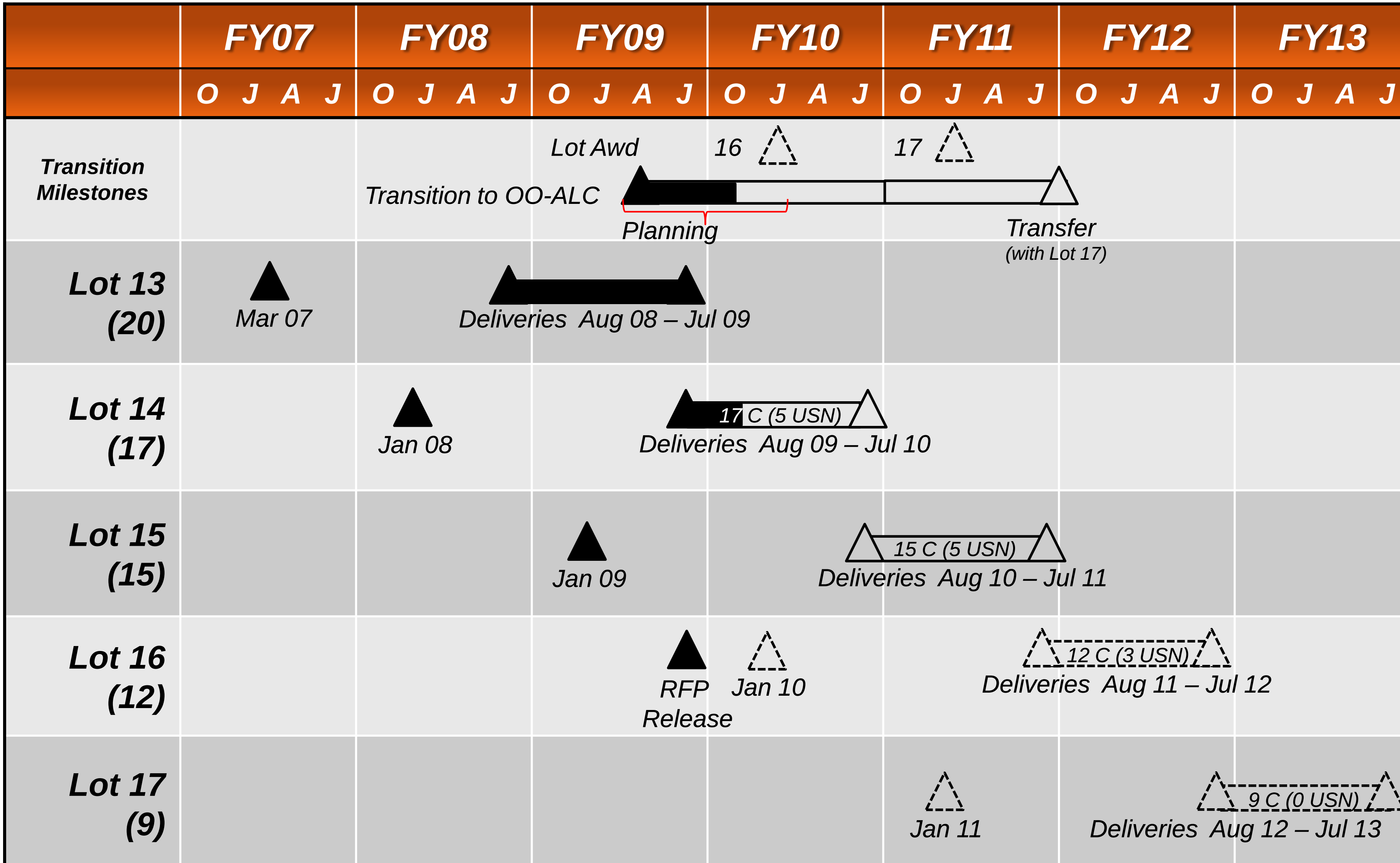
Key Features

- Satisfies Title 10 "Live Fire/Lethality"
- Operates via Ground-Based Target Control System
- Supersonic, High-G, Heavy Payload Capability
- Provides 3rd Generation Threat Representation

QF-4 2009 Accomplishments

- **Completed Lot 13 and Began Lot 14 Deliveries Oct 09**
  - **Total of 256 QF-4s Delivered to Date**
- **Transitioned from F-4E to RF-4C Production in July 08**
  - **Provides Three Additional Years of Full Scale Capability**
  - **Lot 15 on Contract with 2 Additional Planned (Lots 16 & 17)**
- **FY09 Supported Live Fire and WSEP Test Missions**
  - **52 NULLO**
  - **113 Missiles Fired**
  - **22 Kills**

QF-4 Master Schedule



The Future of QF-4

- **Last QF-4 Delivery Planned FY13**
- **Sufficient Inventory Through FY15**
  - **Assumes 16 to 20 QF-4 Kills Per Year**
  - **Assumes Current Production Plan**
  - **Maintains Full Scale Operational Capability Until Planned QF-16 Deliveries**

QF-16 Full Scale Aerial Target

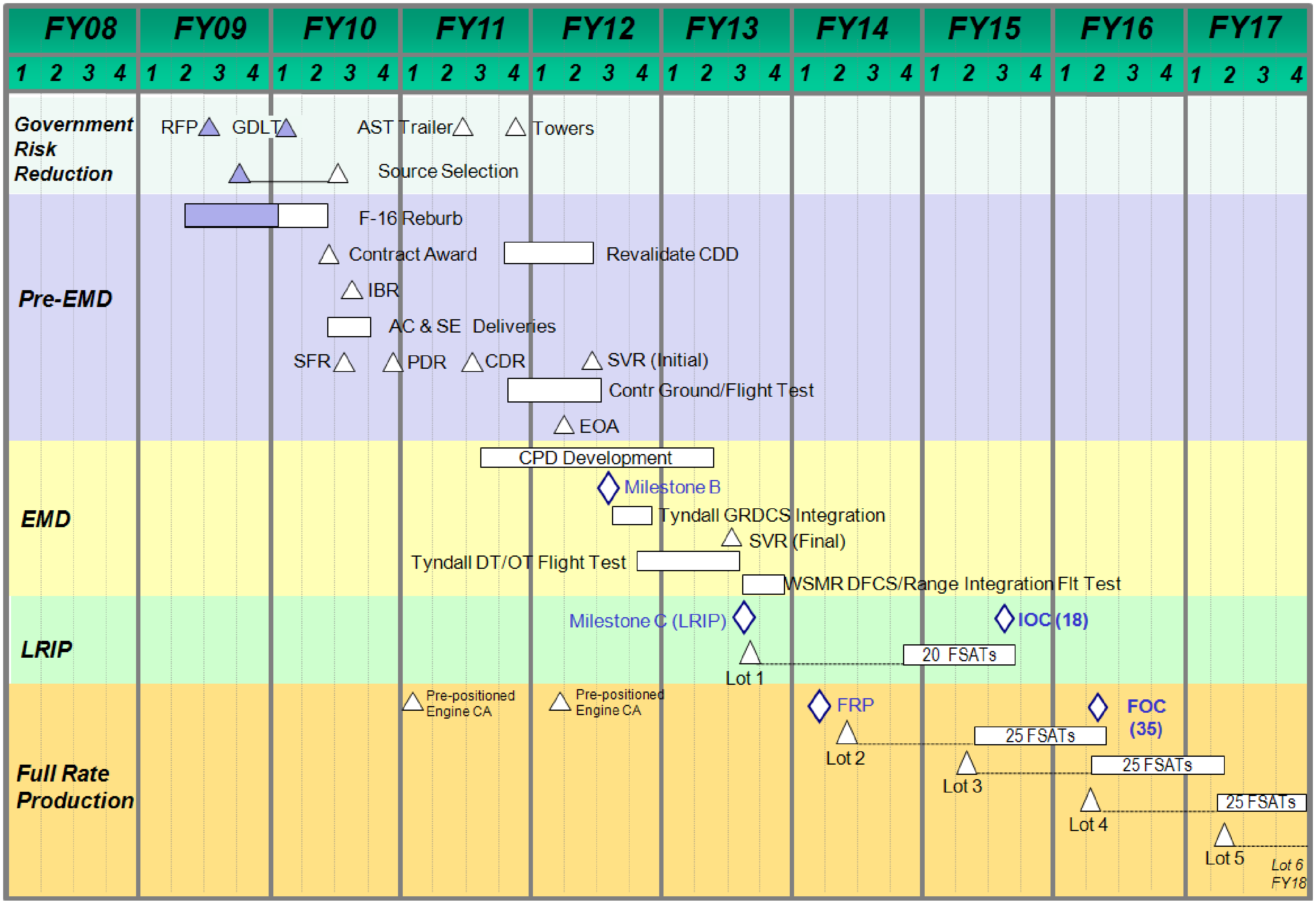
Description

- **Fullscale Target for Threat-Representative Weapon System Evaluation**
- **Meets USAF, Army, Navy, Allied Test Requirements**
- **Program in Source Selection Phase**
- **Refurbished F-16 Aircraft With Drone Modification Installed**
- **Risk Reduction in Progress: Airframes, Engines & Target Control System**

Key Features

- **Follow on for QF-4 Program: Supersonic, High-G, Heavy Payload Capability**
- **Satisfies Title 10 "Live Fire/Lethality"**
- **Provides 4th Generation Threat Representation**

Program Schedule



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QF-16 Risk Reduction

- Risk Reduction Activities: FY07-09
  - Focus on Government Furnished Equipment
- F-16 Airframe Study
  - Assess Condition and Availability of Block 15s, 25s and 30s
  - Cost of Refurbishment
- Engine Study
  - OSS&E Impacts to Manned and Unmanned Capability
  - Assesses Multiple F100 Engine Configurations
- Target Control System (TCS)
  - Data Link Tester Development
    - Integrate GFI Ground S/W with Contractor-Developed Airborne S/W
  - Portable TCS For Contractor Development Support

QF-16 Status

- Industry Days Complete (2 Events)
  - 63 Industry Attendees Representing 23 Companies
- Acquisition Strategy Panel Approved 21 Nov 08
- Draft RFP Released 29 Jan 09
  - Received Industry Comments
  - Refined Final RFP
- RFP Released on 25 Jun 09
- Source Selection in Progress
- Contract Award in 2Q FY10

Overview

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AFSAT Subscale Aerial Target

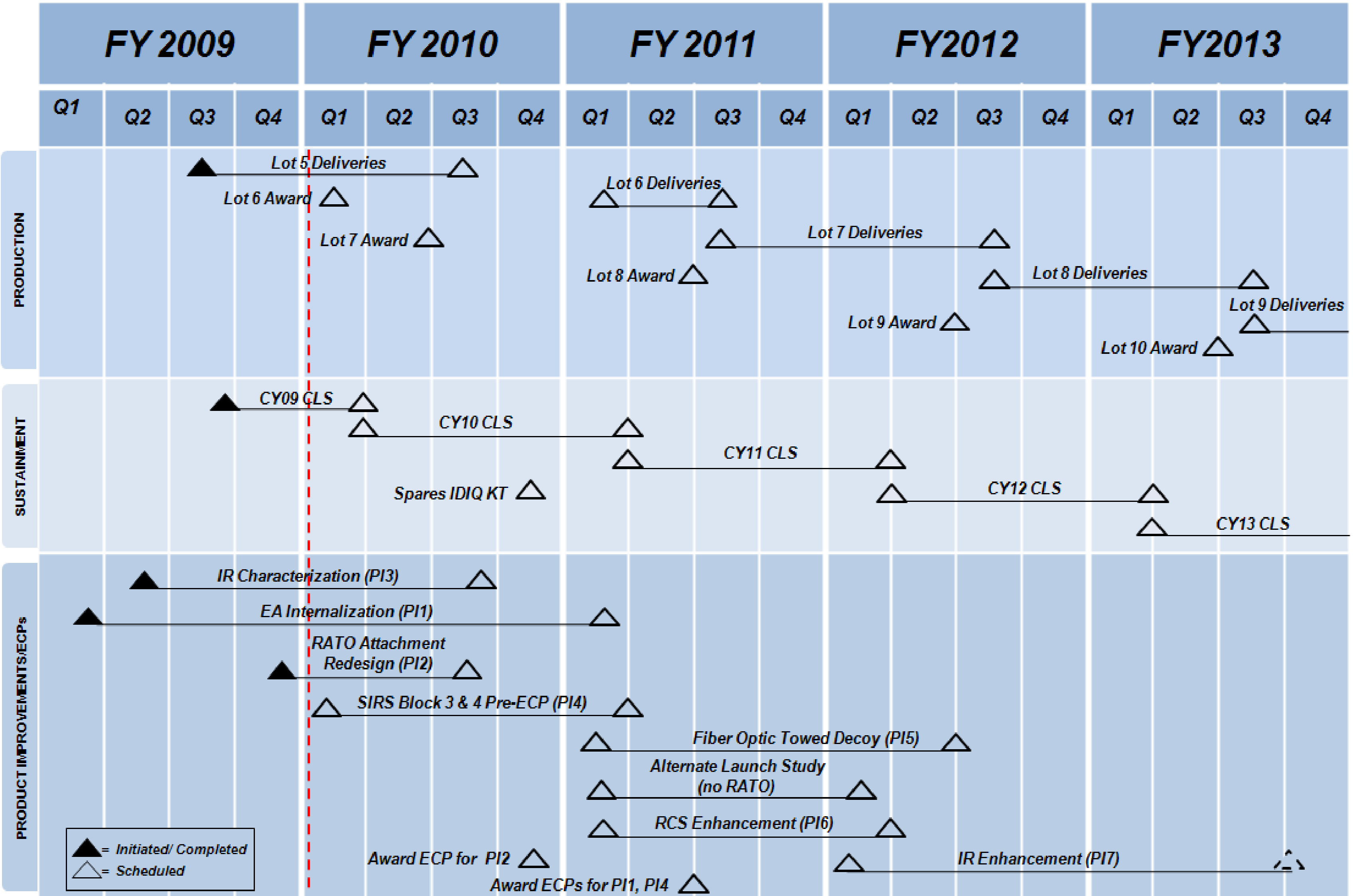
Description

- An Affordable, All-Composite Airframe
- Flies Faster/Slower, Higher/Lower, and Provides 3x+ More Presentations Than Legacy Subscale Targets
- Program in Production Phase
- Prime Contractor is CEi, Sacramento, CA

Key Features

- Supports Title 10 "Live Fire/Lethality"
- Operates via Ground Based Target Control System
- Subsonic, Relatively Heavy Payload Capability

Program Schedule



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AFSAT FY09 Accomplishments

- Completed First Year of Standard Ops
- 148th Target Delivered
- 40 WEG Operational "Hot" Missions Supported
  - 72 Launches
  - 240 Presentations
  - 214 Missile Shots
- Demonstrated Operational Capability at UTTR

Overview

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Summary

- QF-4 Production Planned Through FY13
  - Using RF-4E Model
  - Inventory Expected to Be Depleted in FY15
- QF-16 Pre-EMD Underway
  - Request for Proposal (RFP) Released
  - Production Deliveries Planned to Begin in FY15
- AFSAT Supporting Operational Missions
  - Next Step to Award Lot 6-10 in 2QFY09
  - Award Product Improvement Efforts in FY09

Determining Threat Equivalency of Navy Aerial Targets

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brian.battaglia@jhuapl.edu
240-228-9487

47th Annual Targets, UAVs & Range Operations Symposium & Exhibition

National Defense Industrial Association

The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Threat Equivalency

- Representative aerial targets are needed to show that ship combat systems meet their requirement to defeat specified missile threats.
- To do this, a target must be similar enough to the threat so that performance of all aspects of the combat system are equivalent against the threat and the target.
  - e.g. Sensor tracking, engagement timelines, interceptor P_K

The Importance of Threat Identification

- **Previously, threat ID was nothing more than "subsonic" or "supersonic."**
- **Today, combat systems are relying more heavily on identifying the incoming threats in order to plan and carrying out engagements.**
  - **Matching speed, signatures, RF emissions, etc. become more important to differentiate between similar systems**
- **Failure of a target to be identified as the threat it is emulating could result in unrepresentative engagements**

However…

- **A target does not need to match the performance parameters of the threat if the combat system responds the same way as it would to the threat.**

However…

- **A target does not need to match the performance parameters of the threat if the combat system responds the same way as it would to the threat.**

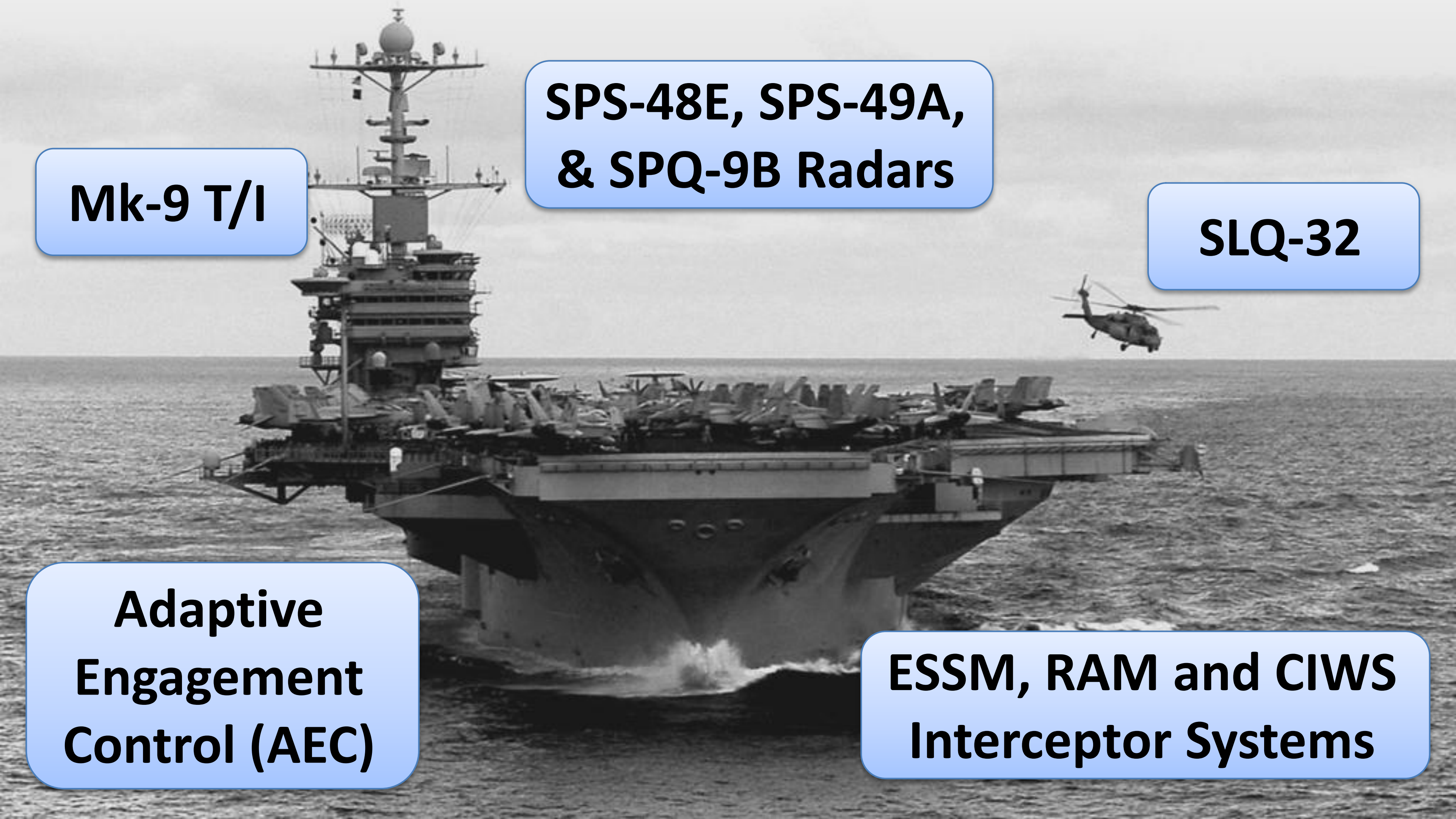
How close to each threat does the target need to be for it to be threat representative?

The Analysis

- **Through simulation, we determine the response of combat system elements to the threat and the notional targets for a range of target performance parameters.**
  - **Speeds, altitudes, radar and IR signatures, etc.**

Representative Aegis Combat System

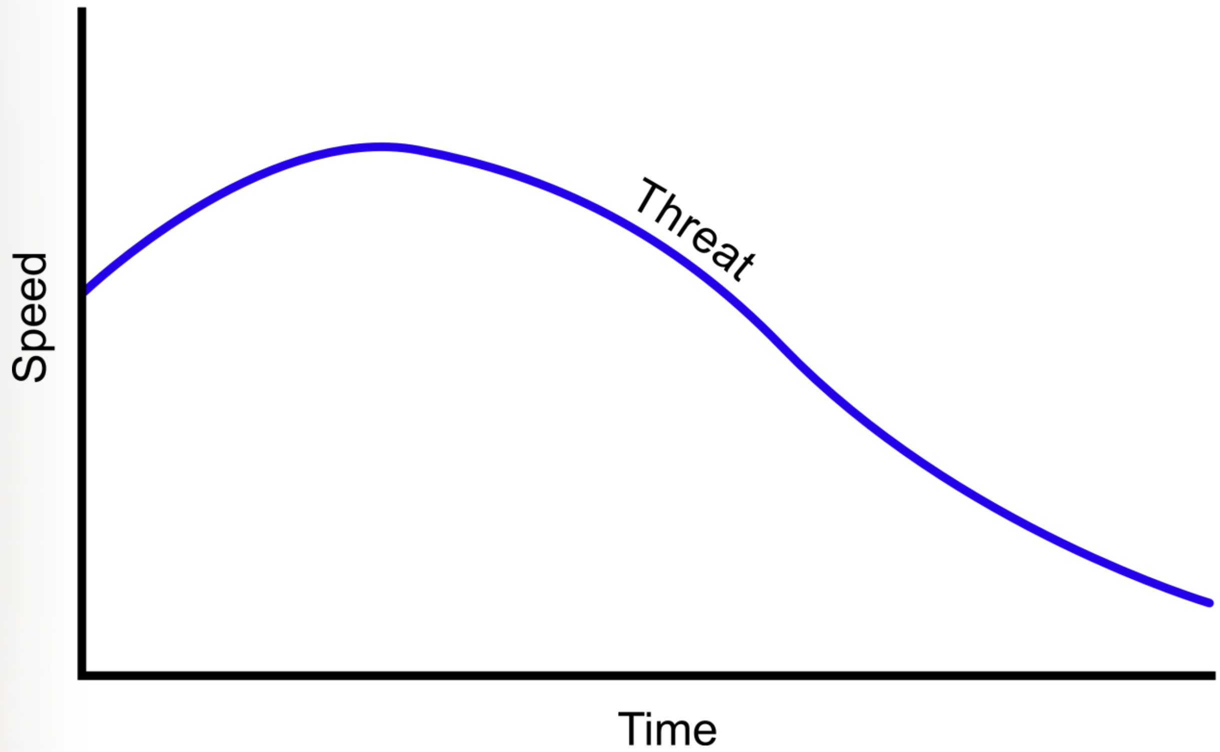
Representative Ship Self Defense System



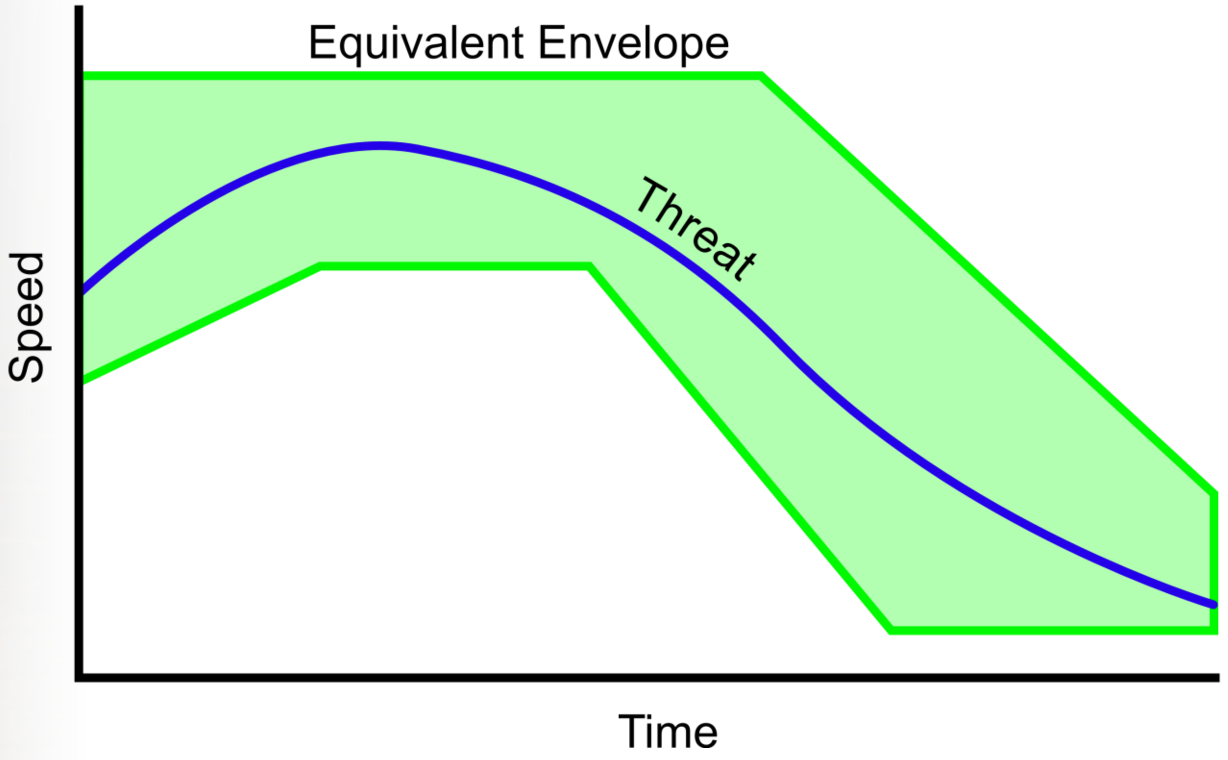
The Process

- Compare output of simulations for each metric
  - Target ID
  - Probability of detection
  - FirmTrack range
  - Interceptor probability of kill
- Make determination of threat equivalency boundaries
- Identify target systems that satisfy these boundaries
  - If none exist, use results to identify requirements for new system

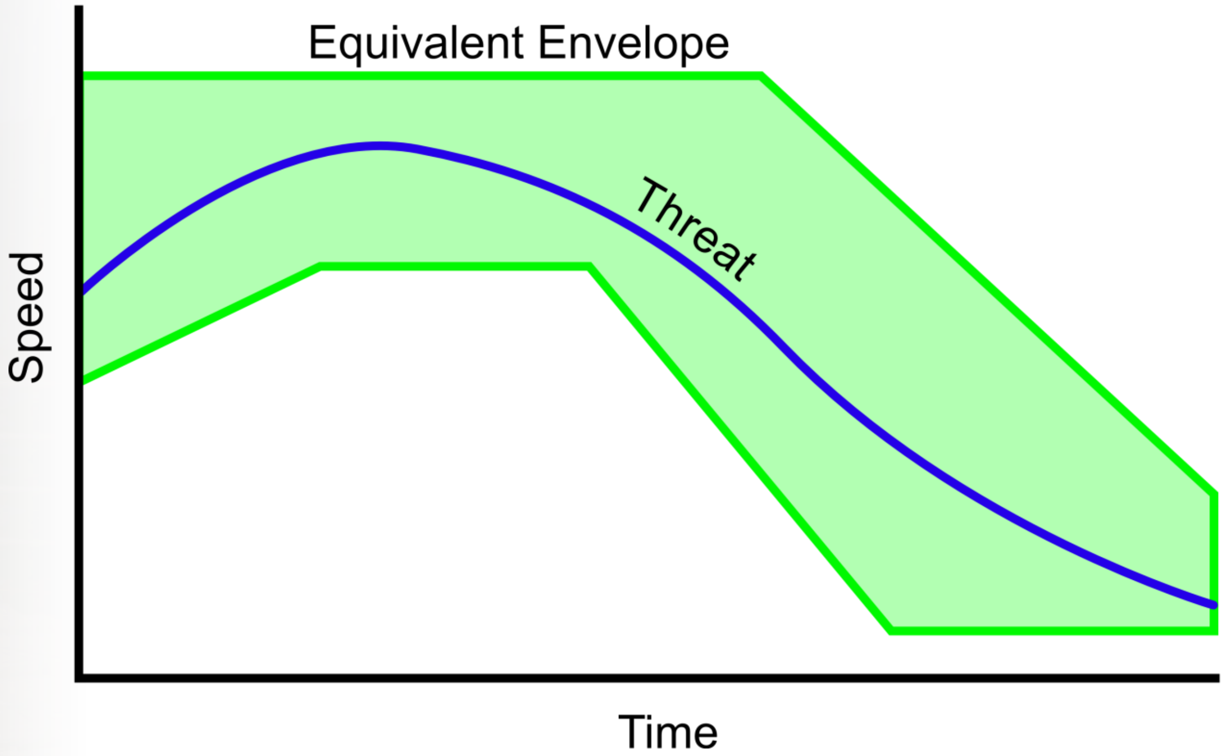
Performance Boundary Example



Performance Boundary Example



Performance Boundary Example



Target is equivalent to threat inside of envelope.

The Studies

- **Studies can be done for each class of weapon system.**
  - **e.g. Subsonic threats, supersonic sea-skimming threats, high diving threats**
- **APL has conducted a study for the Multi-Stage Supersonic Target, the Subsonic Aerial Target, and is currently conducting a high diving equivalency study.**

Conclusion

- **Combat system simulations can be used to assess how well aerial targets emulate missile threats and to identify target performance requirements.**
- **These equivalency studies ensure that the Navy's defense systems are tested against threat representative targets.**

NAVAIR Range Complex

Presented to

NDIA Conference

22 October 2009

Terry Clark
Director, NAVAIR Ranges

Naval Air Systems Command

NAVAIR RANGES

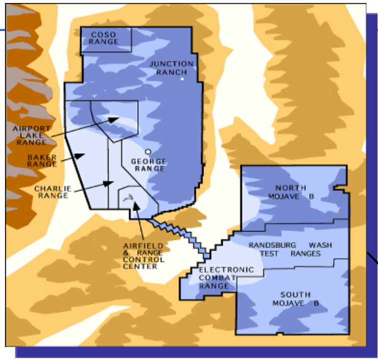
Weapons Division
China Lake
Point Mugu

Aircraft Division
Lakehurst
Patuxent River
Orlando

FRCs
Cherry Point
Jacksonville
North Island

NAVAIR Ranges

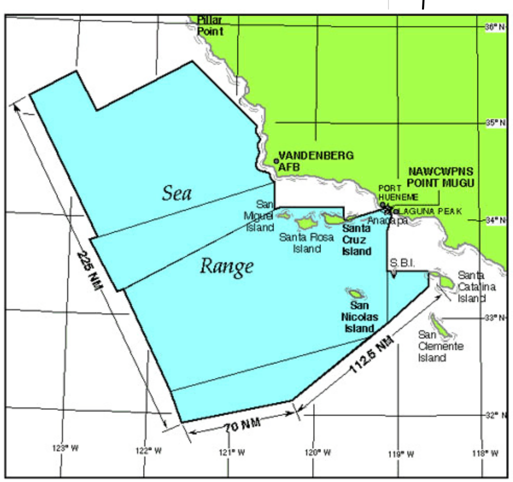
NAVAIR RANGES



China Lake

Aircraft Division

Weapons Division

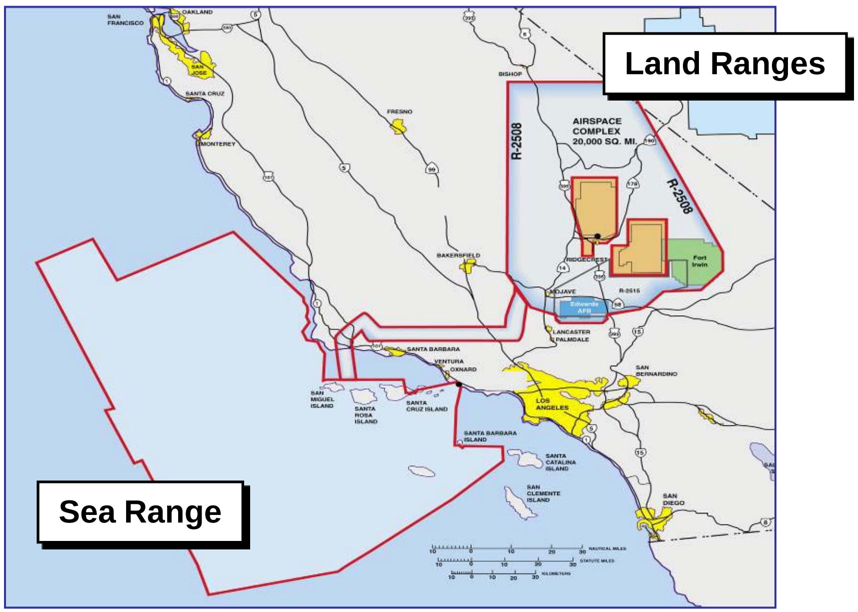


Point Mugu

Patuxent River

NAVAIR Ranges

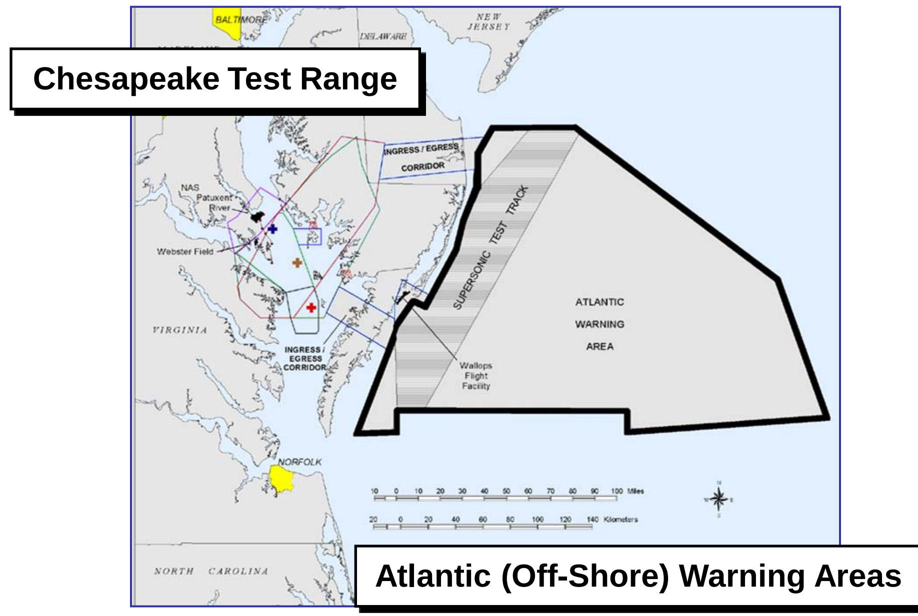
Pacific Ranges



36,000 sq mi controlled sea/airspace
125,000 sq mi instrumented

>1M acres land space
17,000 sq mi restricted airspace

Atlantic Ranges



2,700 sq mi restricted airspace

Access to 30,000 sq miles of warning area

NAVAIR Ranges Mission

Provide for the safe and secure collection of *decision-quality* data. We…

• Develop, operate, manage and sustain interoperable, *MRTFB* open air, land and sea ranges for Fleet, NAE acquisition programs, DoD, and strategic allied partners' T&E and training events.

• Provide air vehicle and weapons systems modification and instrumentation.

• Schedule and control air, land, sea space and associated range operating areas.

The Concept

NAVAIR RANGES

- Evolve the separate ranges into a single Range Complex
  - Resulting in:
    - Transparency of test options to customers
    - Secure remote test data review
    - More flexible use of resources and resource sharing
    - Greater sharing of knowledge and capabilities across ranges

The Approach

- A Strategic Roadmap with Initiatives to provide:
  - Increased knowledge and awareness of total range capabilities
    - Must penetrate further down in the organization
  - Common systems and families of systems
  - Inter-range connectivity with known attributes
  - Strong decisions on leader/follower capabilities
  - Single, open investment strategy
  - Common business practices

Change the culture from Competition to Cooperation

NAVAIR RANGES

Where are we?

- Leveraging current strengths
  - Connection and leadership at West coast ranges
    - Positive impact to other service programs realized
  - Innovative culture at Atlantic Test Range
  - Cohesive Senior leadership team across all Range activities
  - Strong culture of continuous improvement
    - Naturally looking for “Best of Breed”

Our Goal

Provide Decision Quality Data to our customers as effectively, efficiently, and flexibly as possible in a resource constrained environment

Questions?

TMO

Targets Management Office

Mobile Ground Targets & Virtual Targets

47th Annual Targets, UAVs and Range Operations Symposium

Robbin Finley
(256) 842-6459
PEO STRI, PMITTS, Targets Management Office
Lead Project Director for Ground & Virtual Targets
robbin.finley@us.army.mil

22 October 2009

AGENDA

- Mobile Ground Targets Components
    - ➢ Operational Threat Vehicle Company
    - ➢ Mobile Ground Target Hardware
        - – Actual Hardware
        - – Surrogate Hardware
        - – Technical Vehicles
    - ➢ Mobile Ground Target Operations
- Virtual Targets
- Summary

Mobile Ground Targets Components

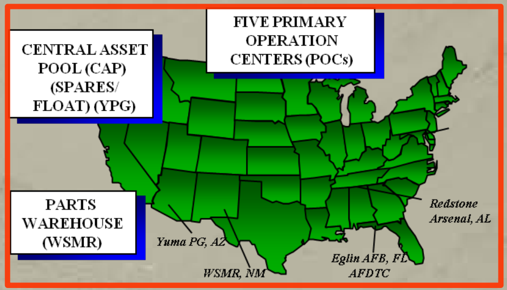
Operational Threat Company

Fully Mission Capable Systems for use in Force-on Force Exercises

Mobile Ground Target Hardware

Fleet of Foreign Threat Systems With Multiple Operational and Mobility Capabilities

Mobile Ground Target Operations



Maintains and Operates All Systems In The Mobile Ground Target Fleet

Operational Threat Vehicle Company



- Operational Turrets
- Communications
- Operational Sights
- Smoke (VEESS, launchers)
- Ancillary Equip

STATUS:

- Four T-72 MBTs delivered to WSMR; currently undergoing acceptance testing
- Three BMP-2 IFVs and Two BTR-80 APCs are on contract for delivery
- One BMP-2 and Two BTR-80s to be procured next year

MBT - Main Battle Tank
IFV – Infantry Fighting Vehicle
APC – Armored Personnel Carrier

DESCRIPTION:

- Acquire and field fully mission capable Foreign Threat representative Mobile Ground Targets (MTB, IFV, and APC) to meet emerging requirements
- To provide realistic threat capable targets for use in force-on force exercises to challenge Blue Forces to adapt to the changing battle dynamic as it unfolds to properly test Blue systems
- Targets to be certified following DA approved process

Mobile Ground Target Hardware

STATUS:

Recent Additions:	**Coming Soon:**
ZPU-1	**URAL 375**
ZPU-2	**BMP-3**
KAMAZ 4310 Trucks	**ZSU 23/4**
Technical Vehicles	**SA-9**

DESCRIPTION:

- Provide optimized mix of varying fidelity surrogate and/or actual targets to cost effectively meet the requirements of the objective force
- The systems will be validated and/or certified following the U.S. Army Validation and/or Certification Process
- Provide surrogates and/or actuals such as 5-Ton Truck Variants, BMP-3 Infantry Fighting Vehicle, D30 Towed Artillery, ZSU-23-4, SA-9, and Technical Vehicles with Gun Mounts

Mobile Ground Target Hardware (Surrogate Targets)

BMP-3 Surrogate (BMP3-S)

The BMP3-S emulates the threat infrared (IR), millimeter wave (MMW) radar and visual signatures of the threat within a wide range of environmental conditions.

SMERCH Multiple Rocket Launcher

Actual SMERCH MRL MAZ-543 chassis with fabricated firing cab and rocket launcher

Mobile Ground Target Hardware (Surrogate Targets)

Reconfigurable Electro-optical and Magnetic Expendable Target (REMET)

Low Cost Mover (LCM)

Baseline Evaluation & Augmentation of MMGTS RCS (BEAMR)

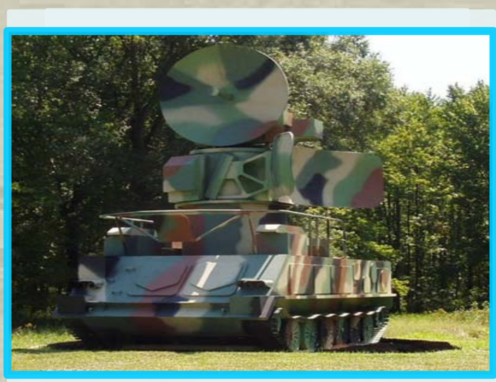
A full-scale, validated, plastic surrogate target that replicates a T-80 Main Battle Tank in its magnetic and electro-optical signature

LCM consists of an unmanned host chassis integrated with a full-scale plastic target façade. The common support structure supports a variety of full-scale plastic surrogate targets.

Evaluation and Validation of Radar Signature Fidelity of Plastic Facades (ZSU 23/4 and 2S6)

Mobile Ground Target Hardware (Surrogate Targets)

Metal Target Surrogate Analysis and Validation (MT-SAV)

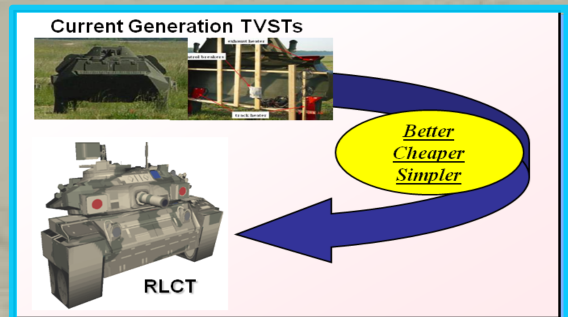


Validation of Metal Target and Evaluation of Data Collection Processes

Threat Vehicle Surrogate Target (TVST)

A 2 ½ dimensional plastic targets that represent the BMD-2, BMP-2, BTR-70 and BRDM-2 vehicles.

Realistic Low Cost Target (RLCT)



Improve IR signature of 2-D and 2 ½-D targets for gunnery ranges

Mobile Ground Target Hardware (Technical Vehicles)

STATUS:

<u>Assets Available</u>

- CUCV Truck (27)
- CUCV Blazer (4)
- HMMVV (6)
- Civilian Trucks (10)
  - Mitsubishi
  - Nissan
  - Toyota

<u>Items Available</u>

- 7.62mm
- 12.7 mm
- ZPU-1
- ZPU-2
- ZPU-4
- Netting

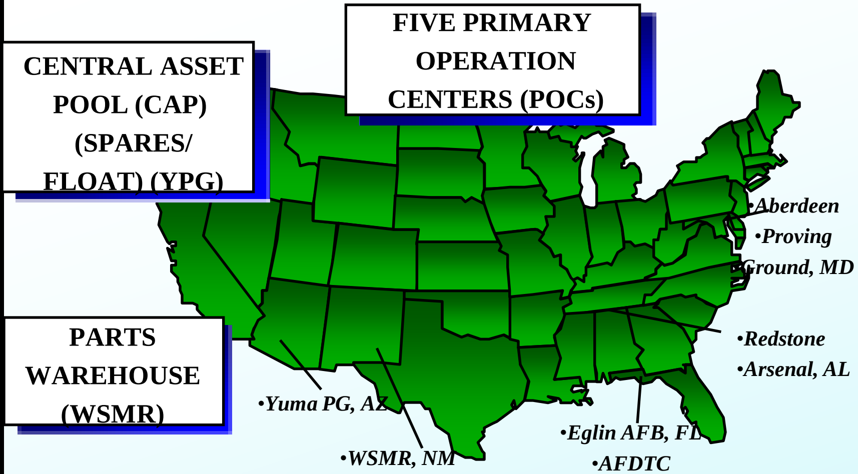
DESCRIPTION:

- Technical Vehicles are commercial vehicles modified to carry a wide array of weaponry or to be utilized as troop carriers
- These assets operate in a multitude of environments
- Variations are unlimited and can mount or transport almost any crew-served weapon

TMO

Targets Management Office

Mobile Ground Target Operations



STATUS:

- Supported 30 Customer Tests YTD
- Completed Residual Risk Acceptance Inspections at each POC
- Support Requirements Analysis
- Currently Supporting Multiple customers to Include:
  - Weapon System Developers
  - Test Ranges
  - Intelligence Centers

DESCRIPTION:

- TMO Allocates Assets Provides Targets From Nearest POC To Support Tests
- TMO Initiates Loan Agreement And Funding With User
- POCs Store And Maintain Assets; Maintain Accountability; Cm Control; Provide Daily Scheduling; And Operate Assets For User

Virtual Targets

STATUS:

- Delivered 3215 simulation models to 101 simulation developers during FY09
- Validated ZSU 23/4, T-90 Surrogate, BM-21, BTR-70 & T-72M1 radar models
- Validated T-72M1, 2S3, & BTR-70 IR analysis models

DESCRIPTION:

- The Virtual Targets project creates Computer Aided Design (CAD) geometry models
- The Targets Generation Laboratory supports transformation of CAD models, model from other sources, or field data into inputs for simulation
- The Targets Generation Laboratory also supports verification and validation of simulation models in accordance with AR 5-11 and DA PAM 73-1
- The Army Model Exchange provides a distribution point for simulation target models to support T&E modeling and simulation requirements

Summary

- **Multiple Ground Targets**
  - Multiple Variants Currently Available
  - Surrogate Develop Capabilities Exist
  - Contract in Place for Foreign Military Procurements
- **Virtual Targets**
  - Thousands of Models Available
  - New Model Development and Validation Efforts Underway
  - Models Available Online Thru Army Model Exchange

For More Information
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TMO

Targets Management Office

Capabilities of U.S. Army 21st Century Control Systems

47th Annual Targets, UAVs and Range Operations Symposium

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TMO Lead Project Director
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PM-ITTS

22 October 2009

Outline

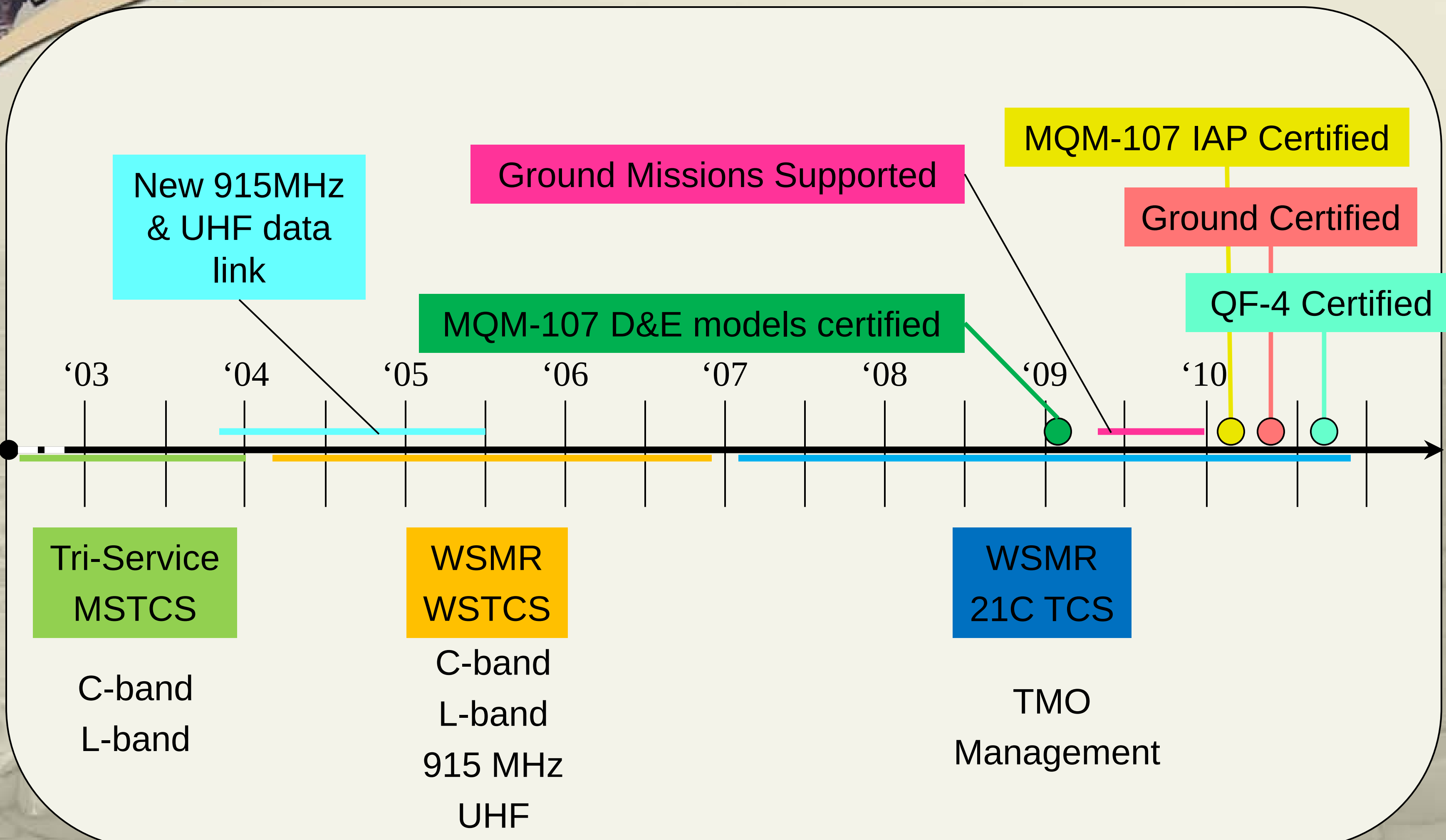
- Need
- History
- Description and Highlights
  - Aerial
  - Ground
- Summary and Path Forward
- Questions/Comments

Need

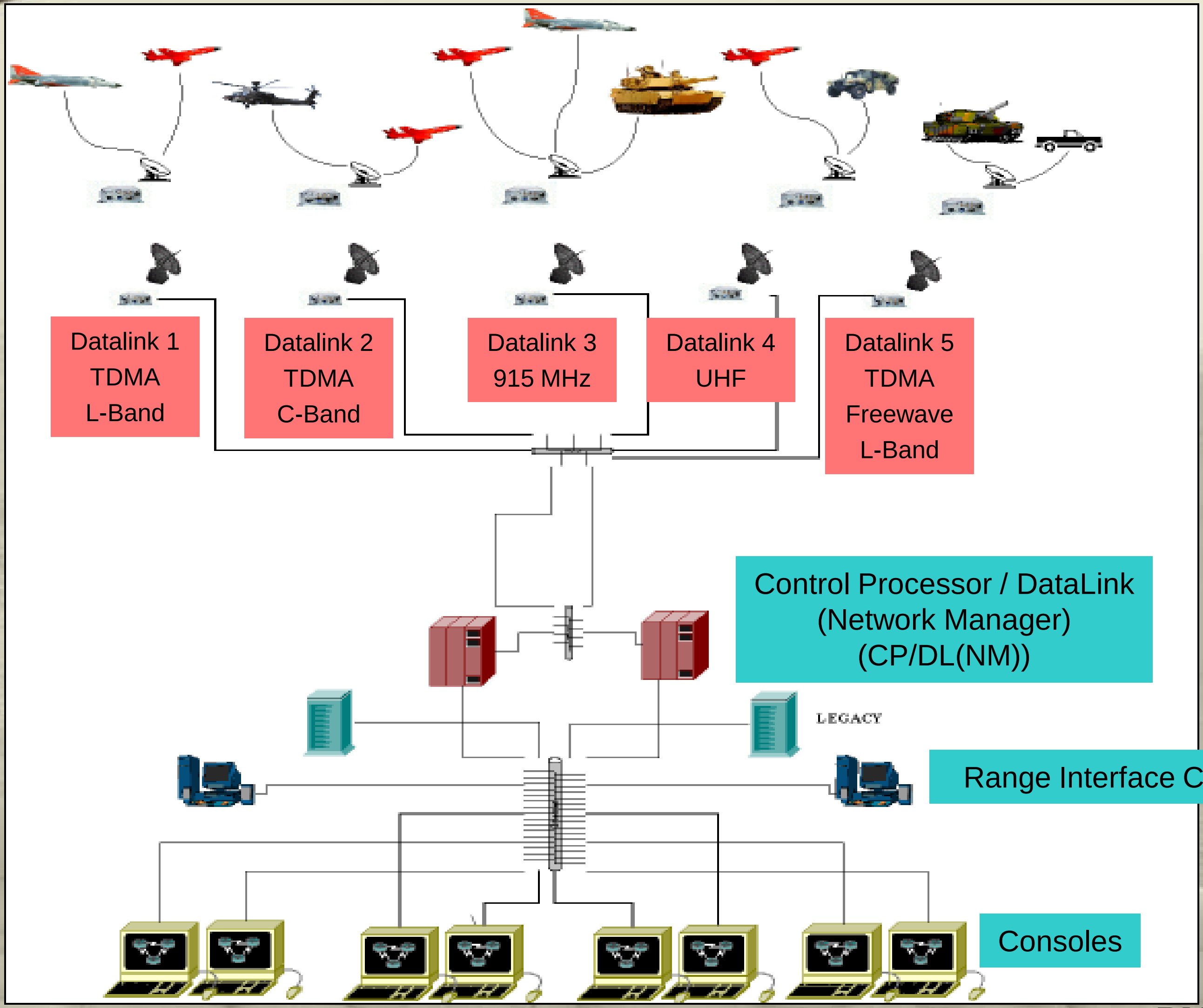
- WSMR requires a remote control system for testing with both aerial and ground targets
- The existing control system, Drone Formation Control System (DFCS) developed in the early 70's using 70's technology
- Existing WSMR legacy remote ground control system is obsolete
- Upgrade to modular control system utilizing state-of-the-art technology

History

Targets Management Office



Description



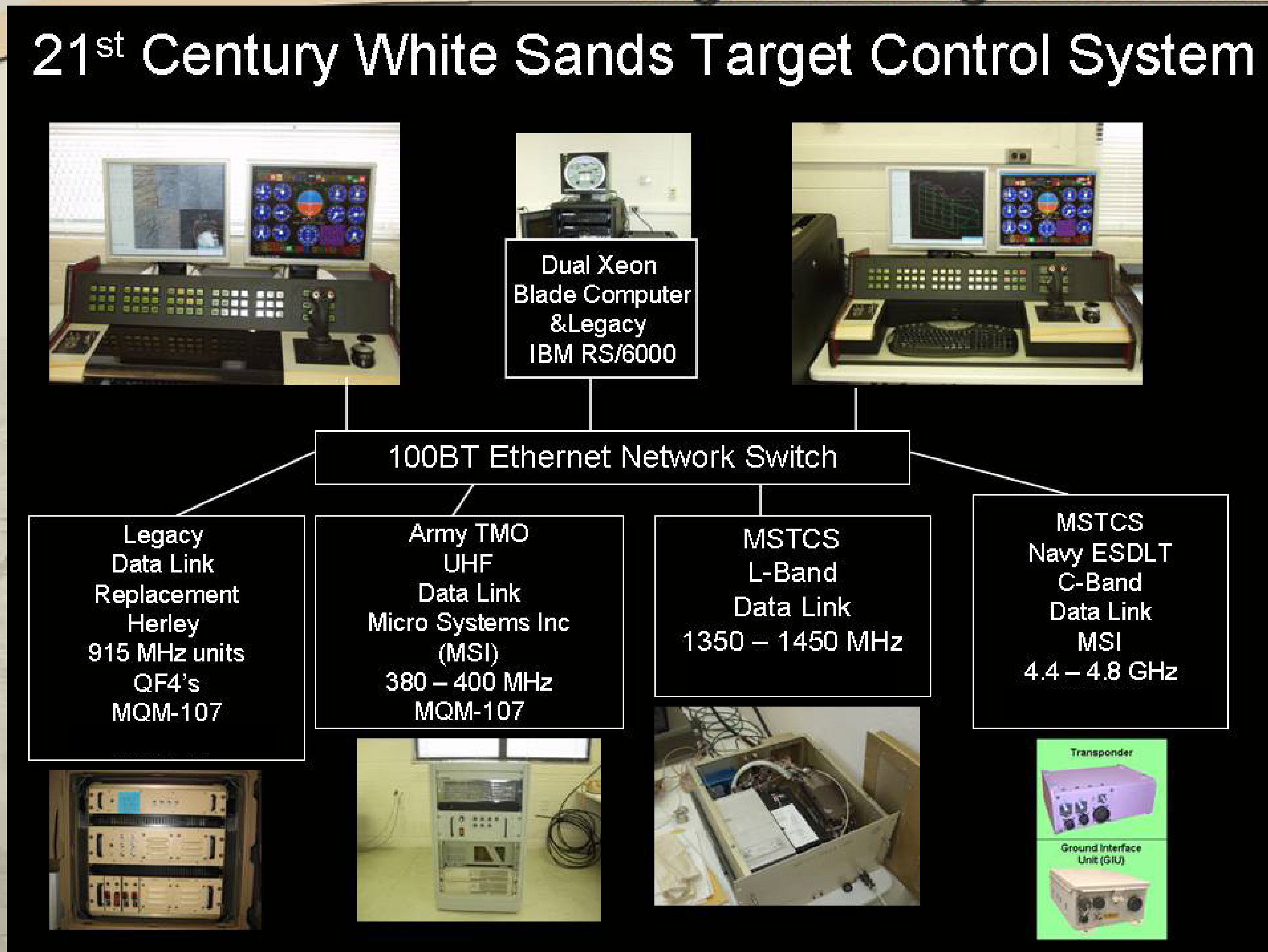
Description: *Consoles*

Heads Down Display Console

Description : *Datalink*

TMO

Targets Management Office



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PM-ITTS

Description: *Aerial Target Control*

Targets to be certified for flight:

MQM-107

Models: D*, E*, IAP
Datalink: UHF

QF-4

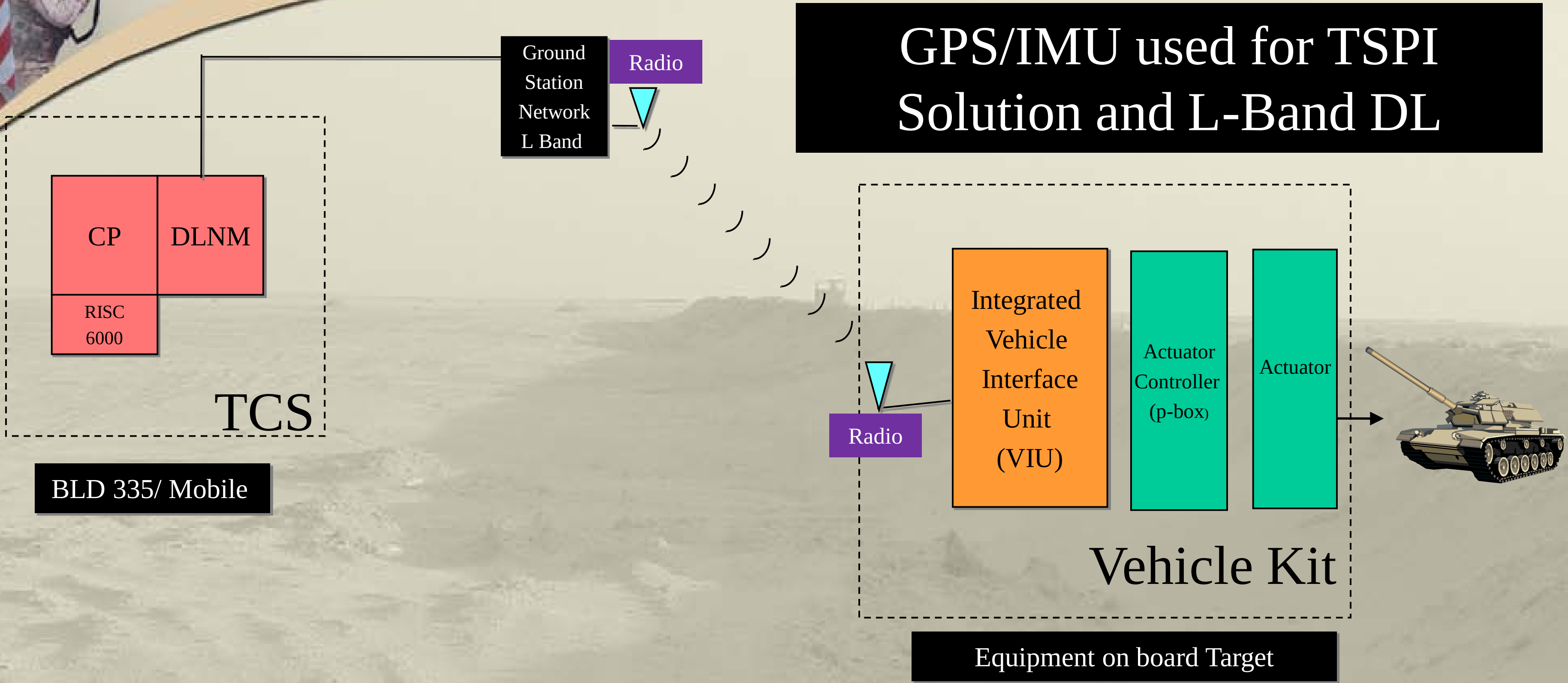
Datalink: 915MHz

* MQM-107 D and MQM-107 E have been certified

Highlights: *Aerial Target Control*

- Certified UHF MQM-107 D & E Fall of '08*
  - Dual Formation
- Scheduled UHF MQM-107 Integrated Avionics Package (IAP) flights within next 6 months
- QF-4 testing FY10

Description: *Ground Target Control*

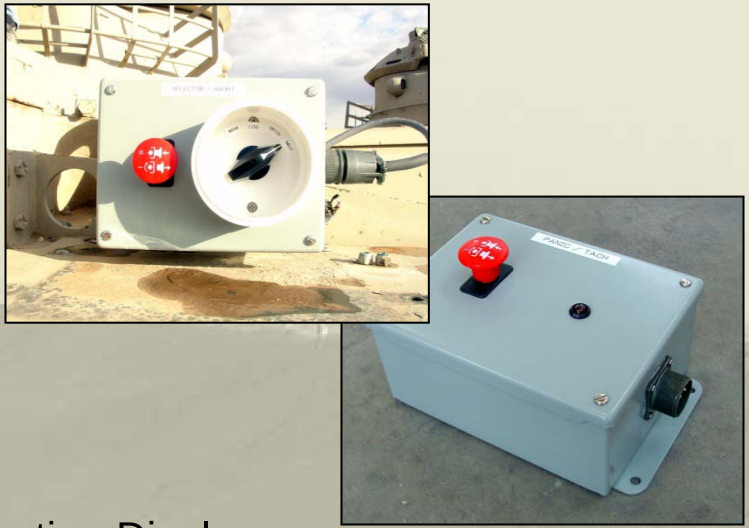


- **GPS/IMU based instead of legacy multi-lateration**
- **Radio Agnostic (L-band instead of 915 Mhz) based Solution**

(From legacy VBS to state-of-the-art VIU)

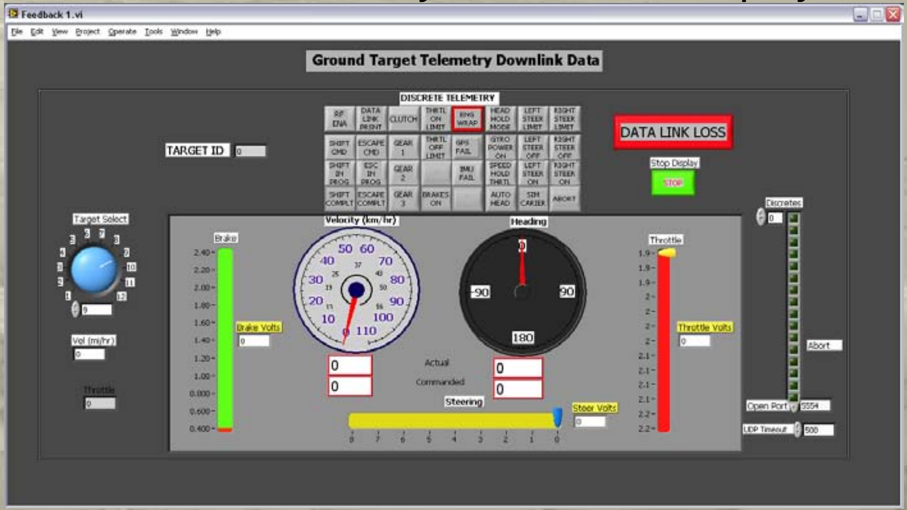
Description: *Ground Target Control*

New Control System Architecture



Compact Design

Vehicle Telemetry Information Display



Description: *Ground Target Control*

Vehicles Currently Configured


T-72


5-ton Truck


Light Truck

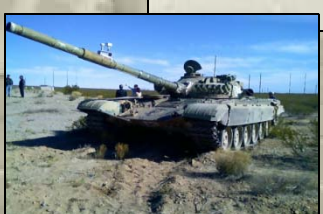

BMP


2S3


Sedan

Highlights: *Ground Target Control*

- Demonstrated in Dec 2007 control of actuators for truck using older Vehicle Control Module (VCM) and 915MHz Vehicle Bourne Subsystem (VBS) on an M-60 tank.
- Demonstrated remote control of BMP and T-72 using updated Vehicle Remote Control (VRC) with 915MHz radio local/manual Line Of Sight (LOS) control with mobile van.
- Supported and continue to support testing missions:
  - Single target, dual target, formation control
  - 3-vehicle convoys – BMP and T-72



Summary

- Multiple datalinks supported
- Both ground and aerial control
- Currently supporting ground missions
- MQM-107 D & E models flight certified

Path Forward

- Complete Console Integration
- MQM-107 IAP Certification Flights
- Ground Target Certification
  - T-72, BMP, 2S3, 5 Ton, Pickup
- QF-4 Certification Flights

Questions/Comments

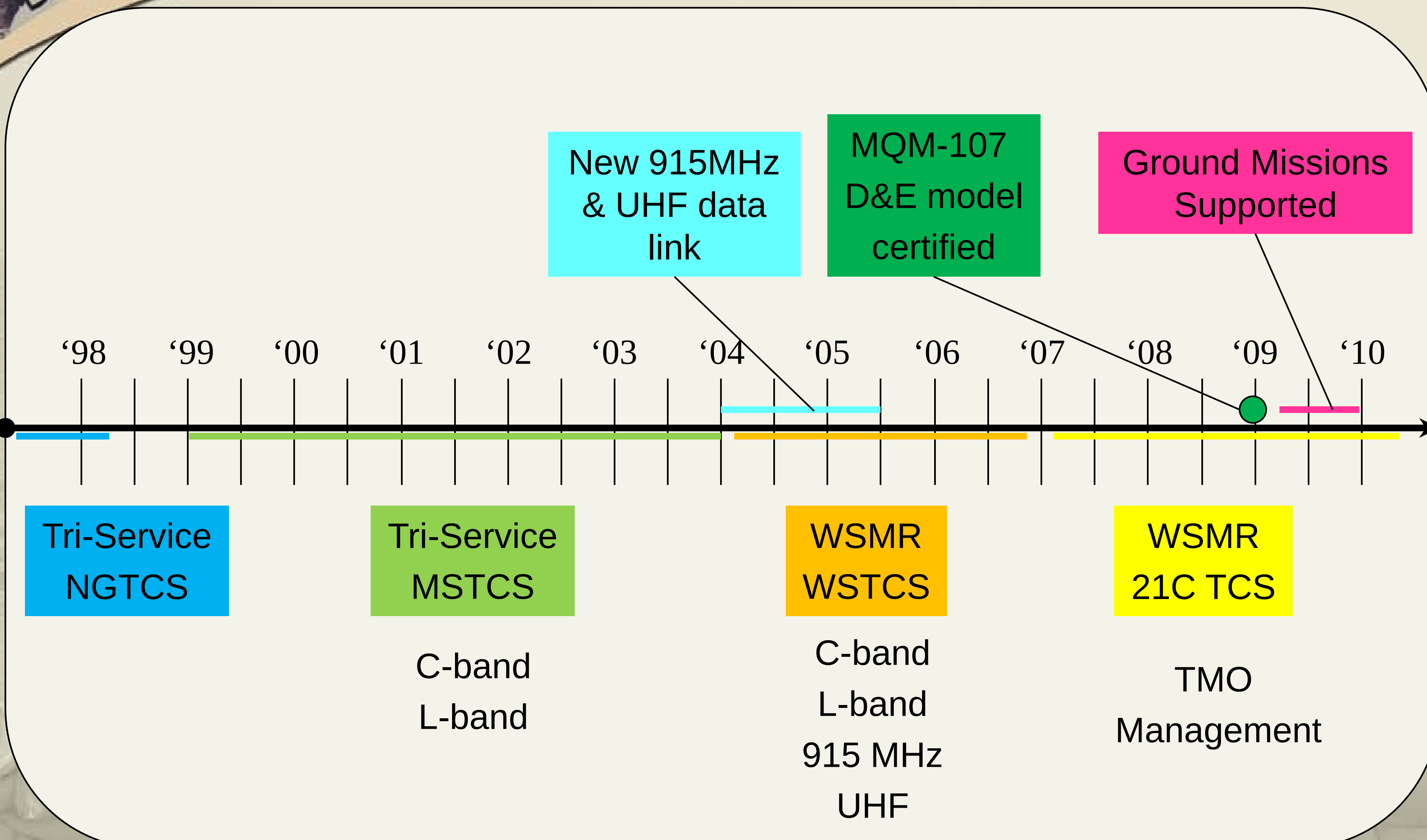
Questions???

Backup Charts

TMO

Targets Management Office

History



Future Inertial Systems Technology

Presented at NDIA 47th Annual Targets, UAVS & Range Operations Symposium & Exhibition

October 21-23, 2009
Savannah, GA

Anthony Kourepenis

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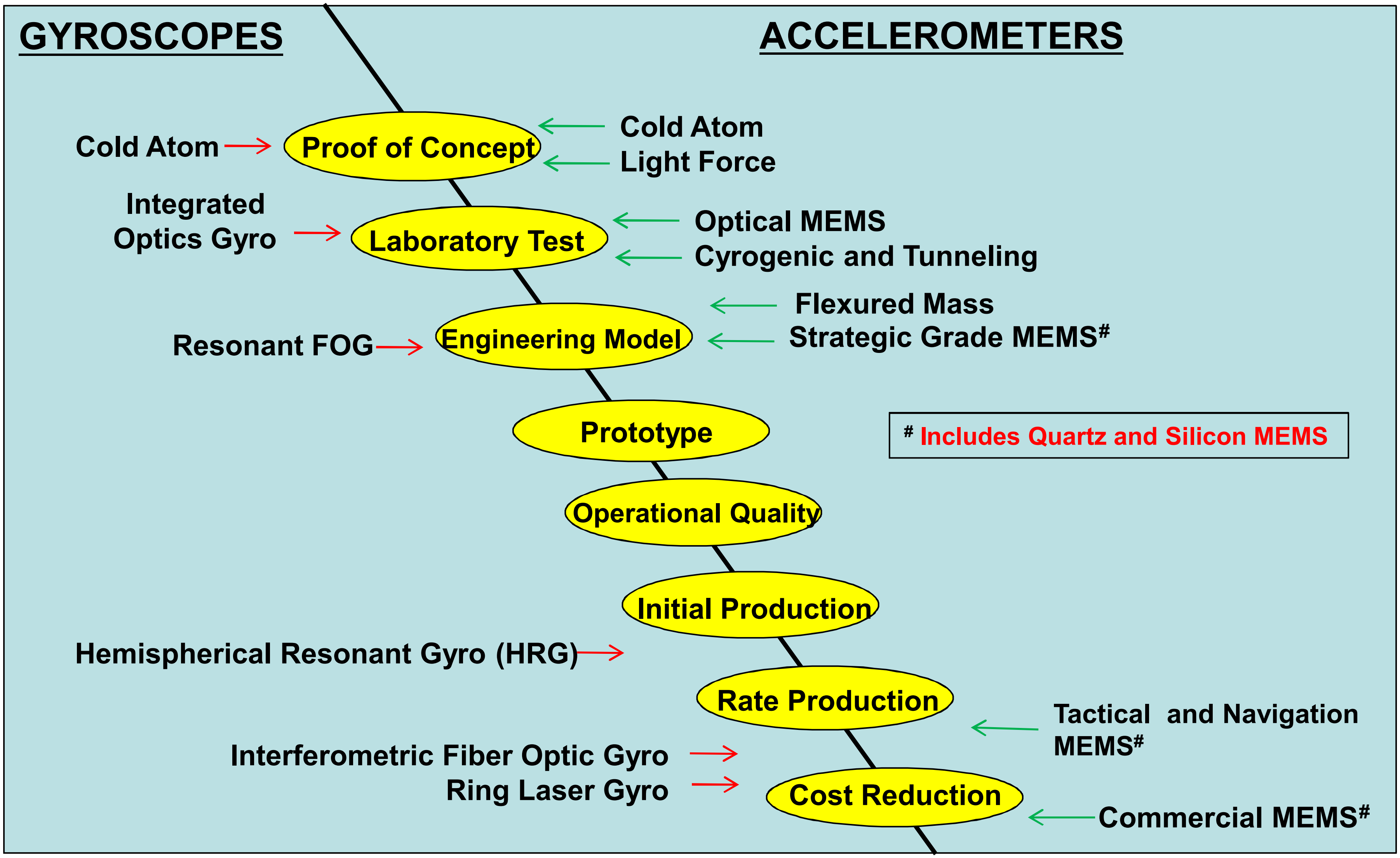
Outline

- Current State of the Art
- MEMS Inertial Developments
- Emerging Solid State Optical Technologies
- Cold Atom Interferometery
- Conclusion

ate Inertial Technology Maturity



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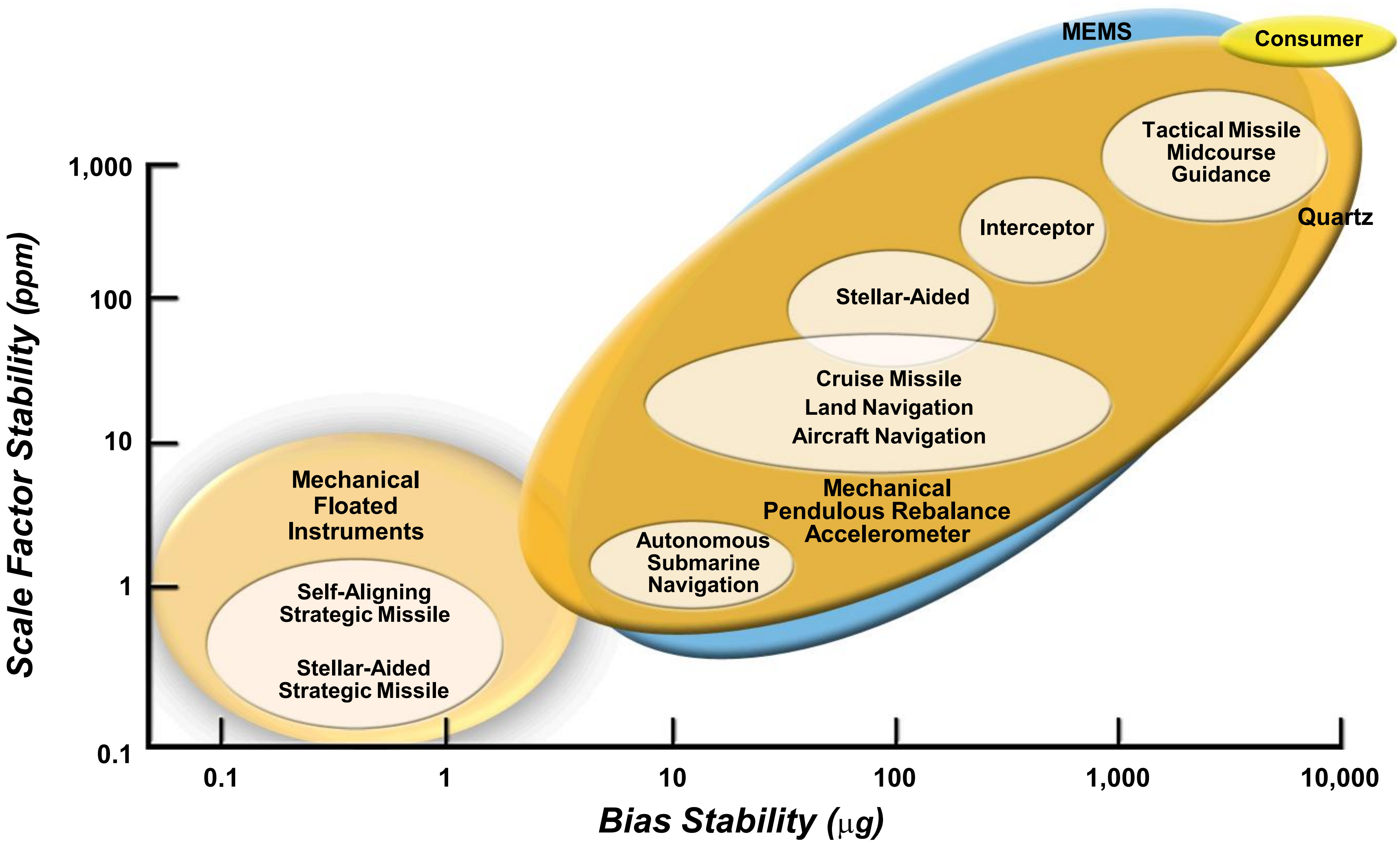
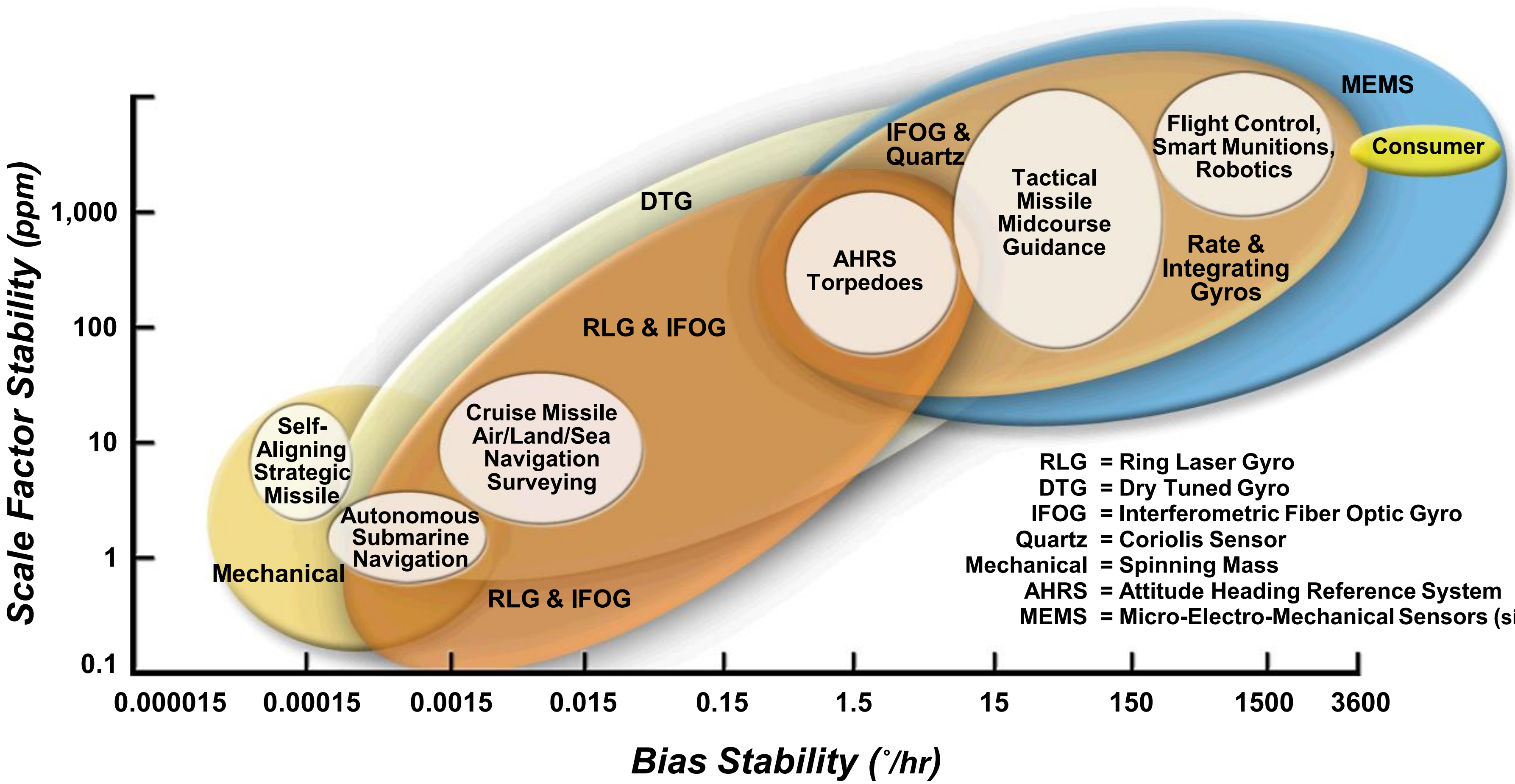
lerometer Technology Applications



Gyro Technology Applications

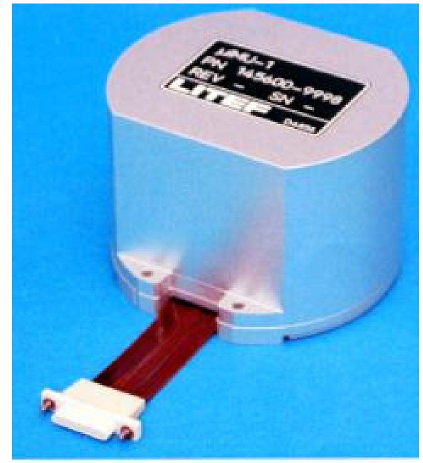


RLG = Ring Laser Gyro
DTG = Dry Tuned Gyro
IFOG = Interferometric Fiber Optic Gyro
Quartz = Coriolis Sensor
Mechanical = Spinning Mass
AHRS = Attitude Heading Reference System
MEMS = Micro-Electro-Mechanical Sensors (silicon)

Solid State MEMS IMUs

AIS - SiIMU02

HI- HG1930



Litef- μIMU-1

AIS - SiNav

IGS – 202/250

SD - SDI500

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MS Performance Limiters

Å Signal to noise

Å Parasitic capacitance

Å Electronics gain, phase, offset limitations

Å Packaging materials

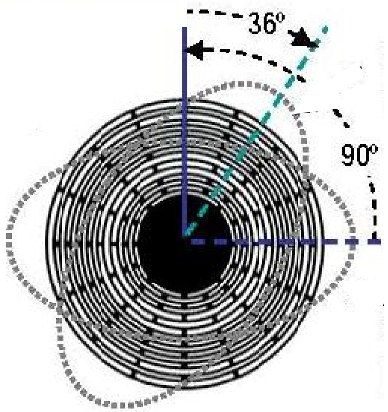
Å MEMS fabrication tolerances

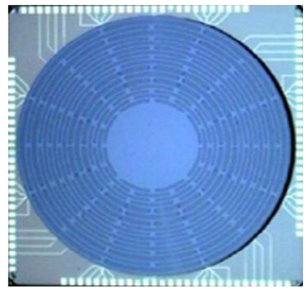
"It's hard to design an inertial instrument with a sensor element that has no inertia"

ature Navigation Grade R&D

BOEING

DARPA NGIMG

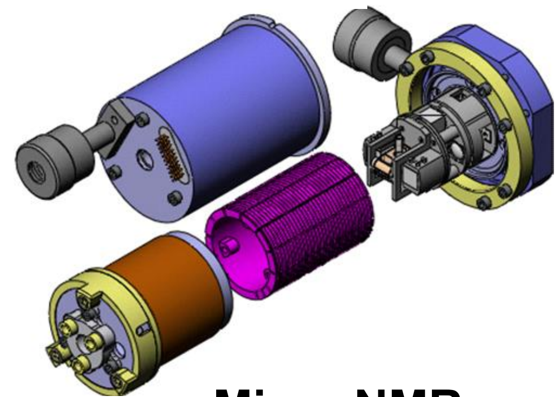




Quartz Disc Resonator

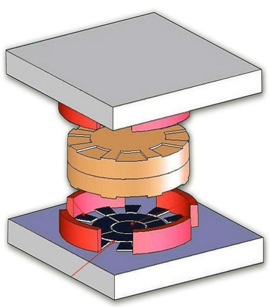
NORTHROP GRUMMAN

DARPA NGIMG



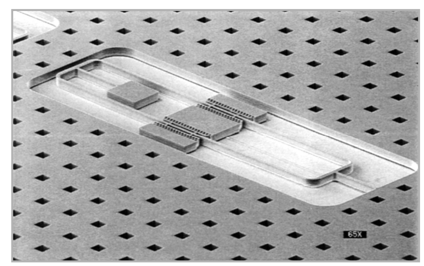
Micro NMR

DARPA NGIMG



Archangel SYSTEMS INC

Levitated Spinning Mass



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SF (1σ) $\cong$ 1-10 PPM

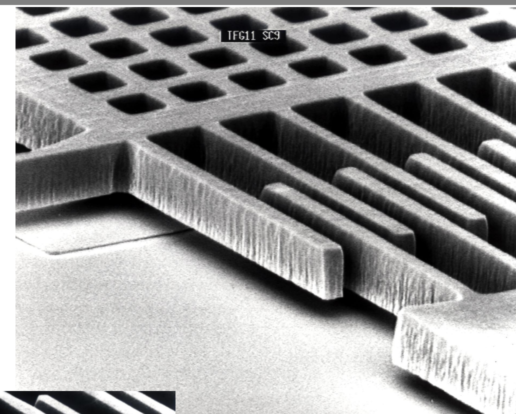
Bias (1σ) $\cong$ 1-10 micro-g

Silicon Oscillating Accelerometer

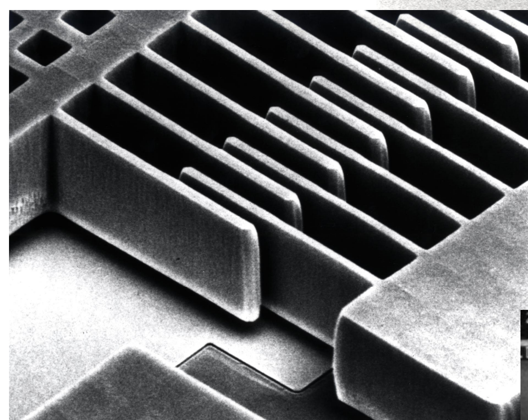
MS Fabrication Precision

- Fabrication is continually improving because of focused process development and the evolution of new machinery
  - Better definition
  - Thicker parts

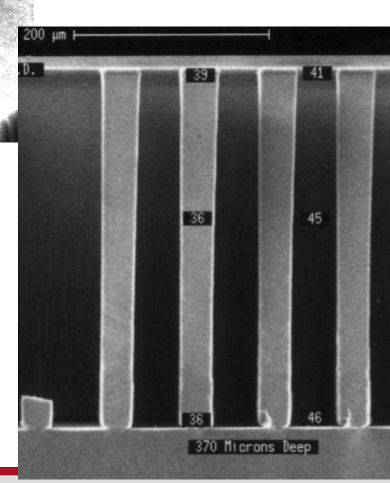
- New processes enable tighter tolerances and greater precision to be obtained in fabricated devices
  - Increased design flexibility
  - Better performance
  - Higher yield
  - Lower cost



1992
5 microns



1996
20 microns



1999
400 microns

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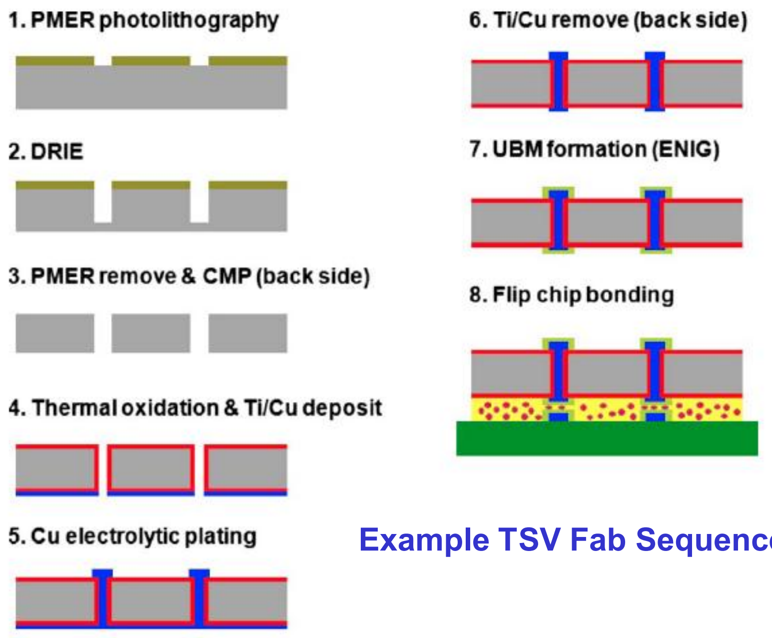
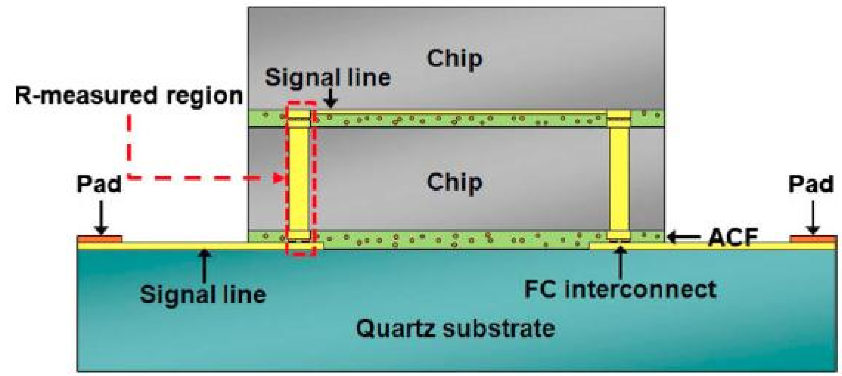
ckaging: Thru-Silicon Vias (TSVs)



Example TSV Fab Sequence



Example Stacked Chip Test Cell w/ TSVs

Å Merging of front-end (litho., etch) and back-end (die attach, packaging) processes

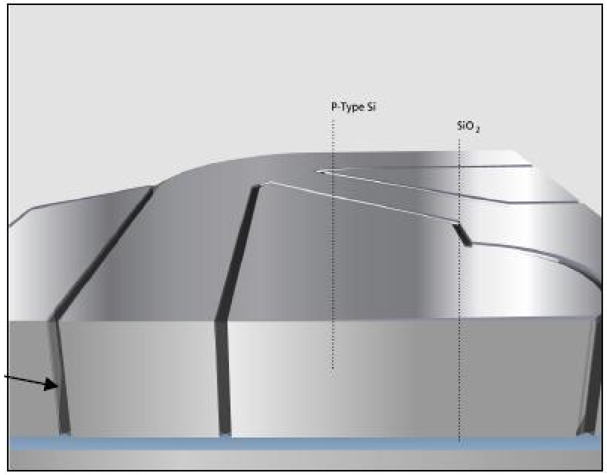
Å Shortened chip-to-chip interconnects and reduced parasitics

Å Improves chip speed, reduces power, reduces noise

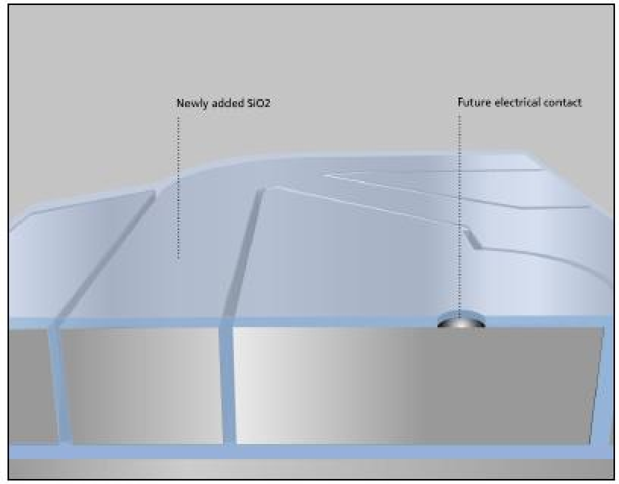
REF: Kim, Jung, *Fabrication and electrical characterization of through-Si-via interconnect for 3-D packaging*, J. Micro/Nanolith, MEMS MOEMS 8(1), 013040 (Jan- Mar 2009)

n-Chip Hermetic Vacuum Encapsulation

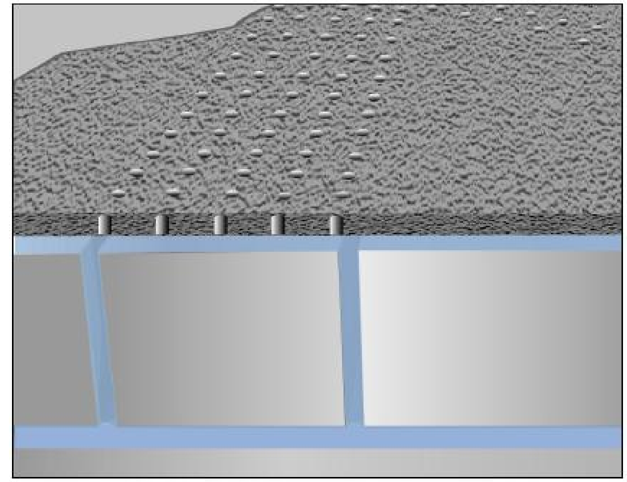
1. SOI Wafer DRIE



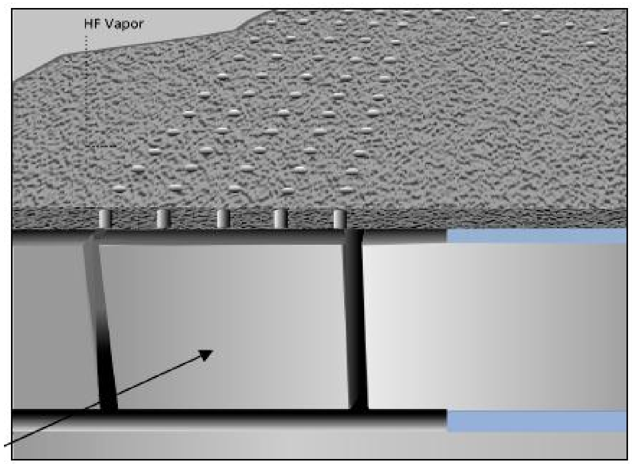
2. Oxide Fill



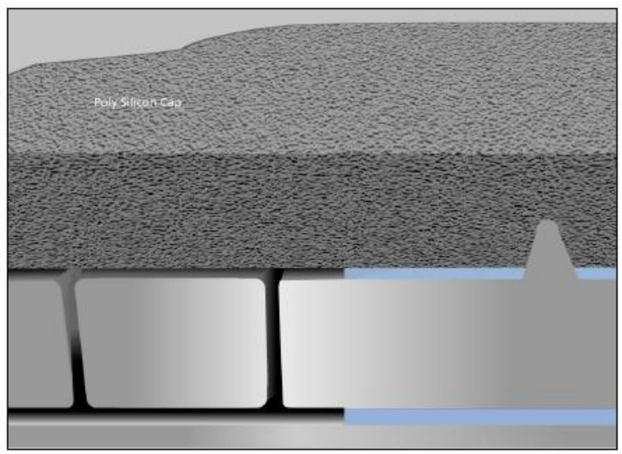
3. Vent Formation



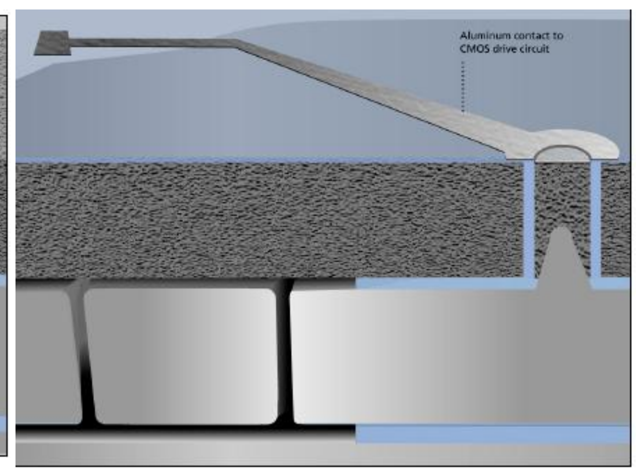
4. HF Release Etch



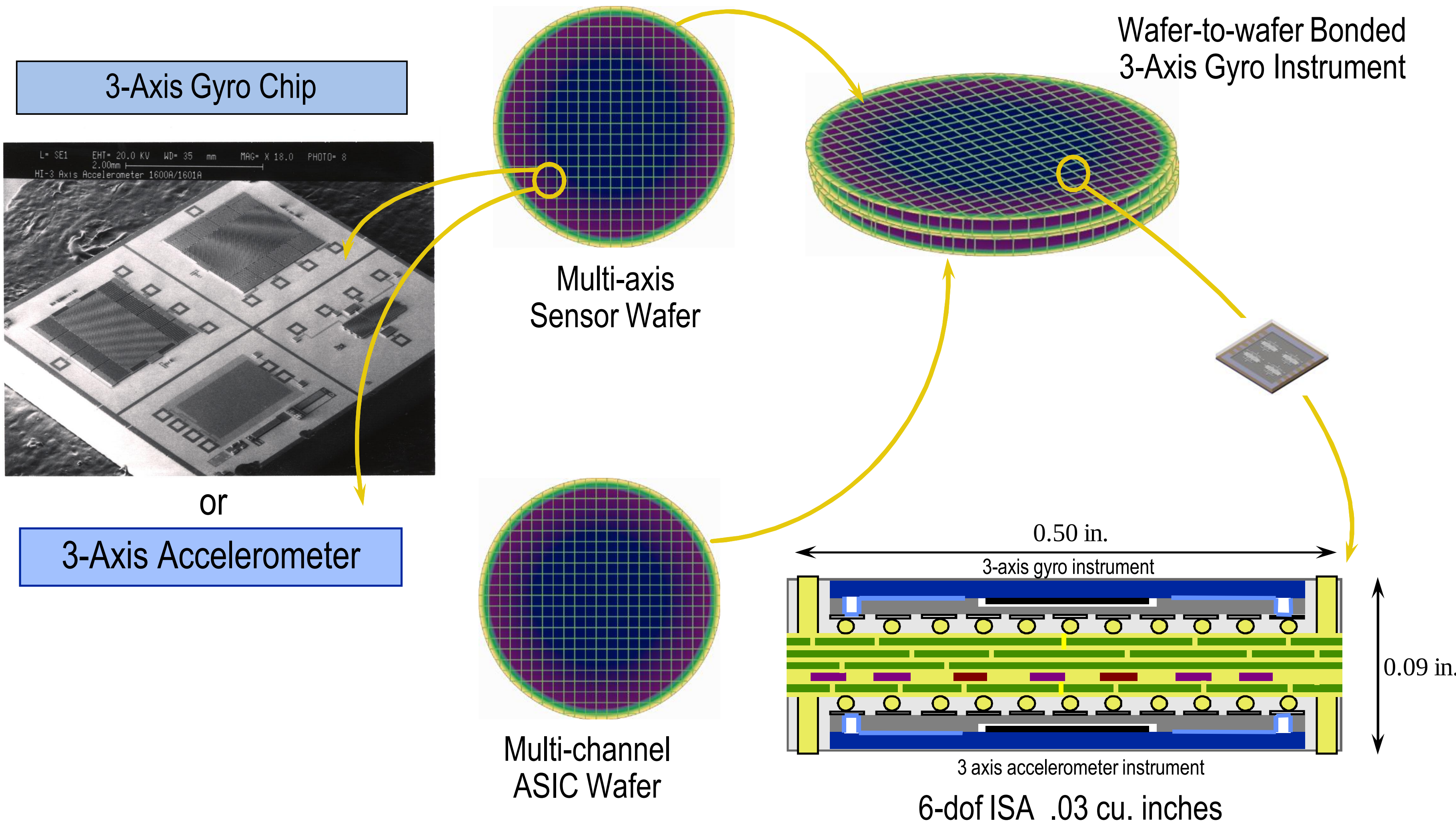
5. Epi Encapsulation



6. Via and Metalization



e MEMS Inertial Chipset



REF: J. Connelly et al, *A Micromechanical Inertial Measurement Unit (MMIMU) for Tactical Applications, AIAA GN&C*, Monterey, CA, Aug. 2002

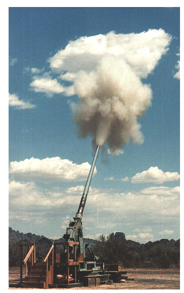
Inertial MEMS

Today:

Å MEMS sensors are an enabling technology for a broad range of new GN&C systems and mass-market consumer products

Å **Low-cost inertial systems are <u>the</u> technology for the integrated battlefield**

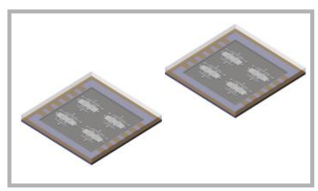
- ï **High A/J GPS**
- ï **Precision-guided munitions**
- ï **Autonomous vehicles**
- ï **Tagging/Tracking**
- ï **Personal navigation**



Soon:

Å Inertial MEMS will be a commodity item: value lies in GN&C system and integrated product

High Performance G-hard, Digital INS Chip Set



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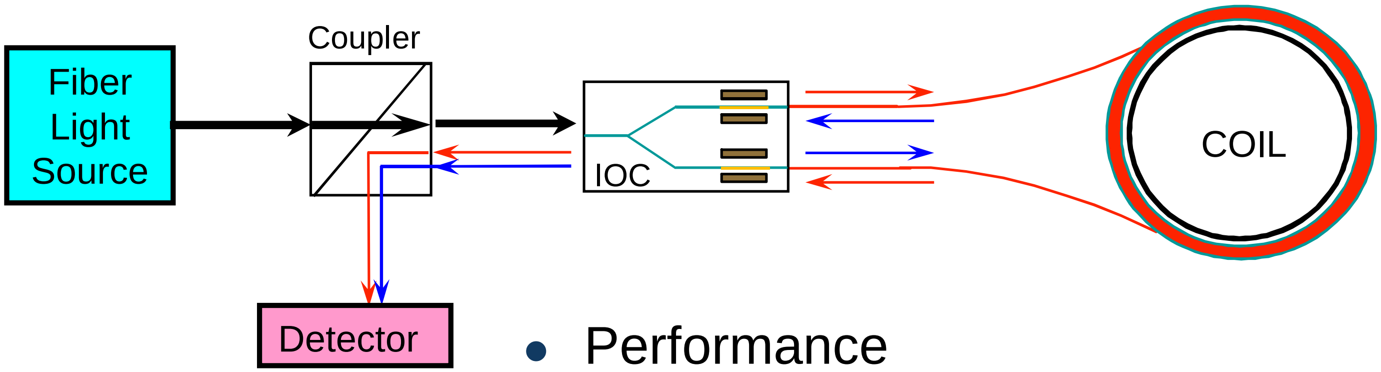
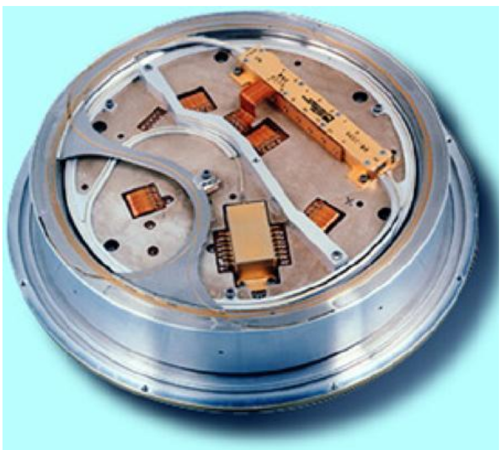
Fiber Optic Gyros



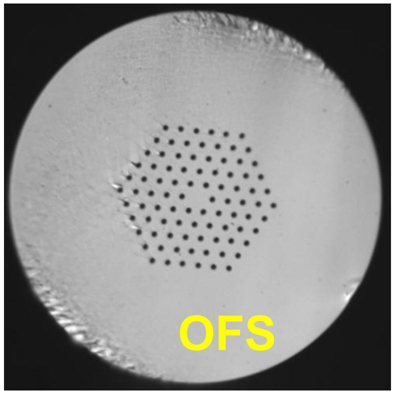


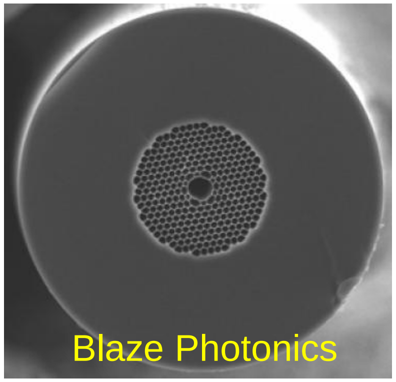
- Performance
  - Light source noise
  - Fiber performance limits (e.g. scattering)
  - Commercial optical part stability
- Size
  - Performance proportional to L*D
- Cost
  - Commercial TELCOM components

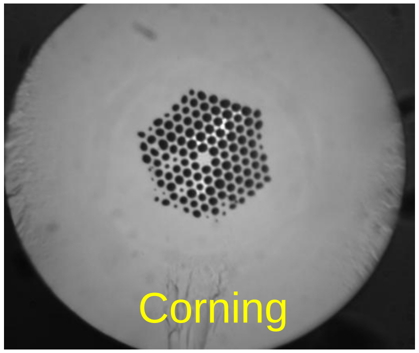
otonic Crystal Fiber IFOG

Å Reduce IFOG size while maintaining performance

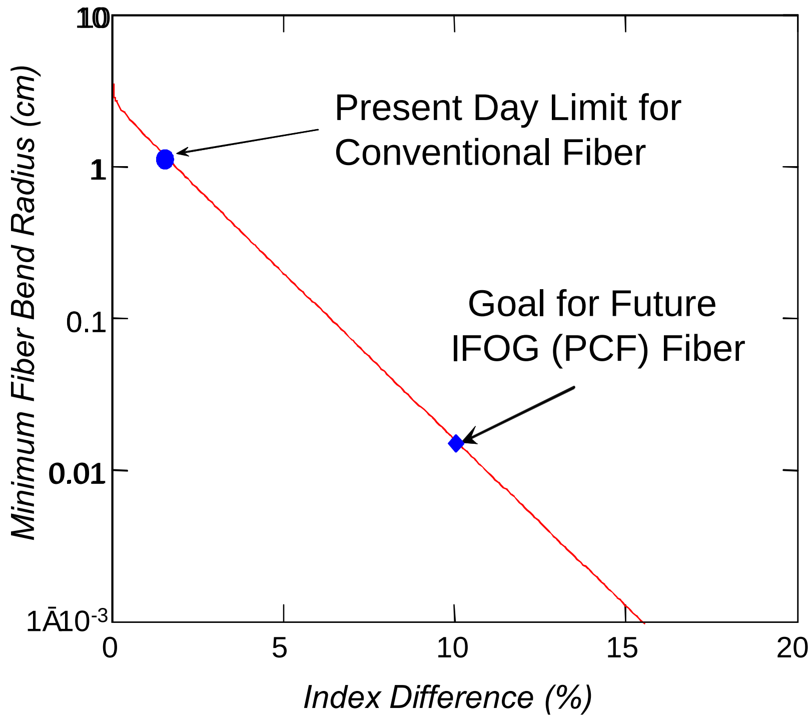
- Å High birefringence
- Å Low bend losses
- Å Less cladding
- Å Less dispersion
- Å Lower wavelength



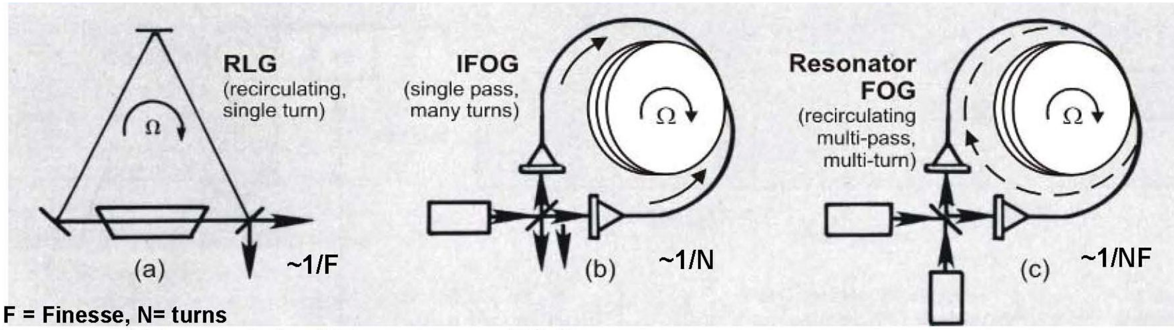




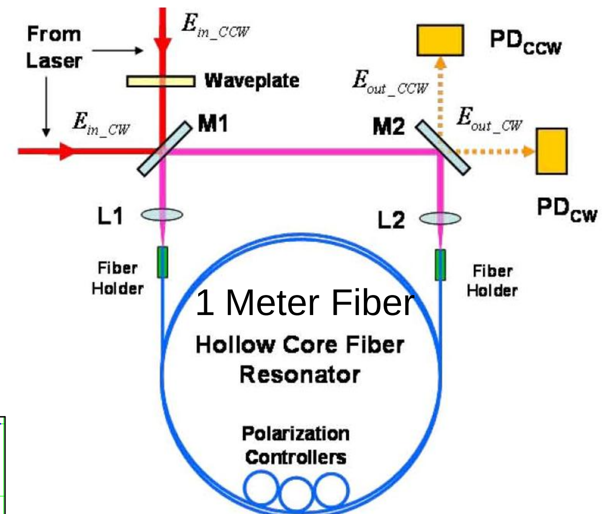
PCF Bending Limit



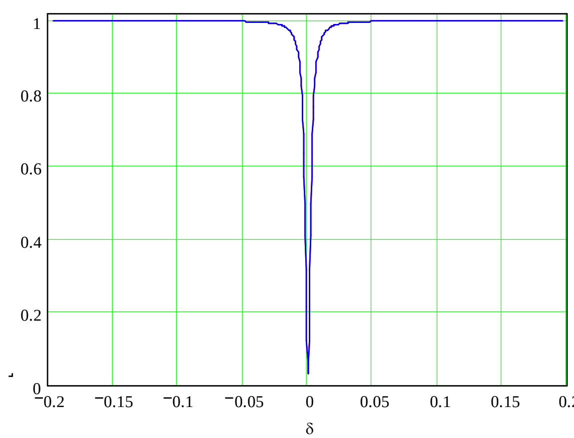
ction: Honeywell PC Fiber RFOG

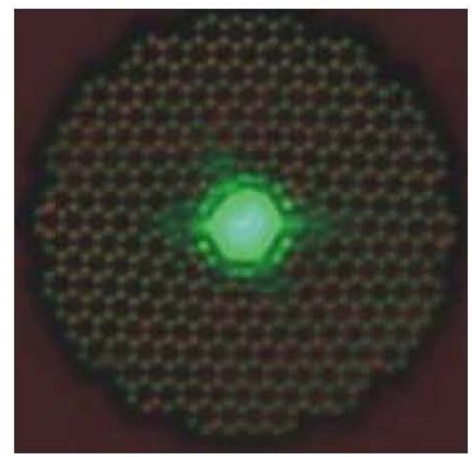


F = Finesse, N= turns



- RFOG performance driven by resonator quality:
  - Previous RFOGS limited by errors due to high intensity in glass core & backscatter
  - Hollow core PC fiber- bulk of light (99%) travels in AIR not Glass

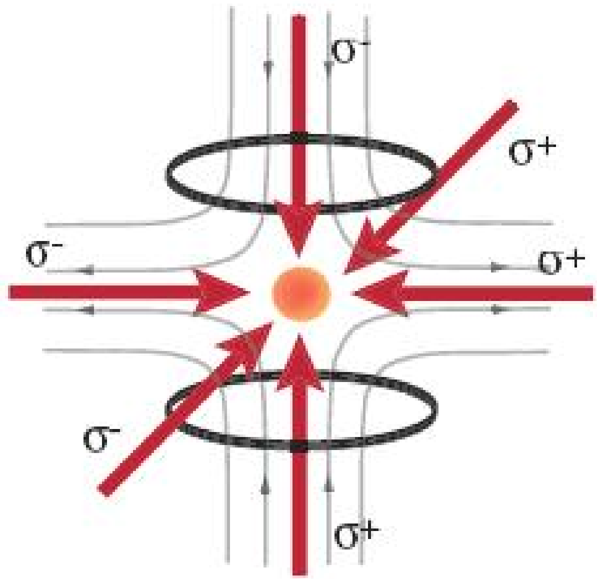




- Optical Component development required
  - Hollow core couplers, etc.

Honeywell

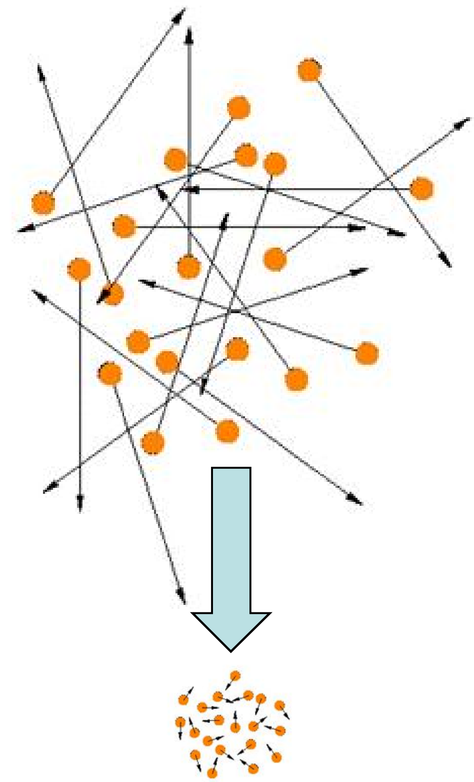
oling and Trapping Atoms



- Magneto-optic Trap (MOT)
  - Laser frequency tuned to atomic resonance
  - Absorption = momentum kick
  - Magnetic field confinement
  - Hard vacuum

Warm = 300 °K

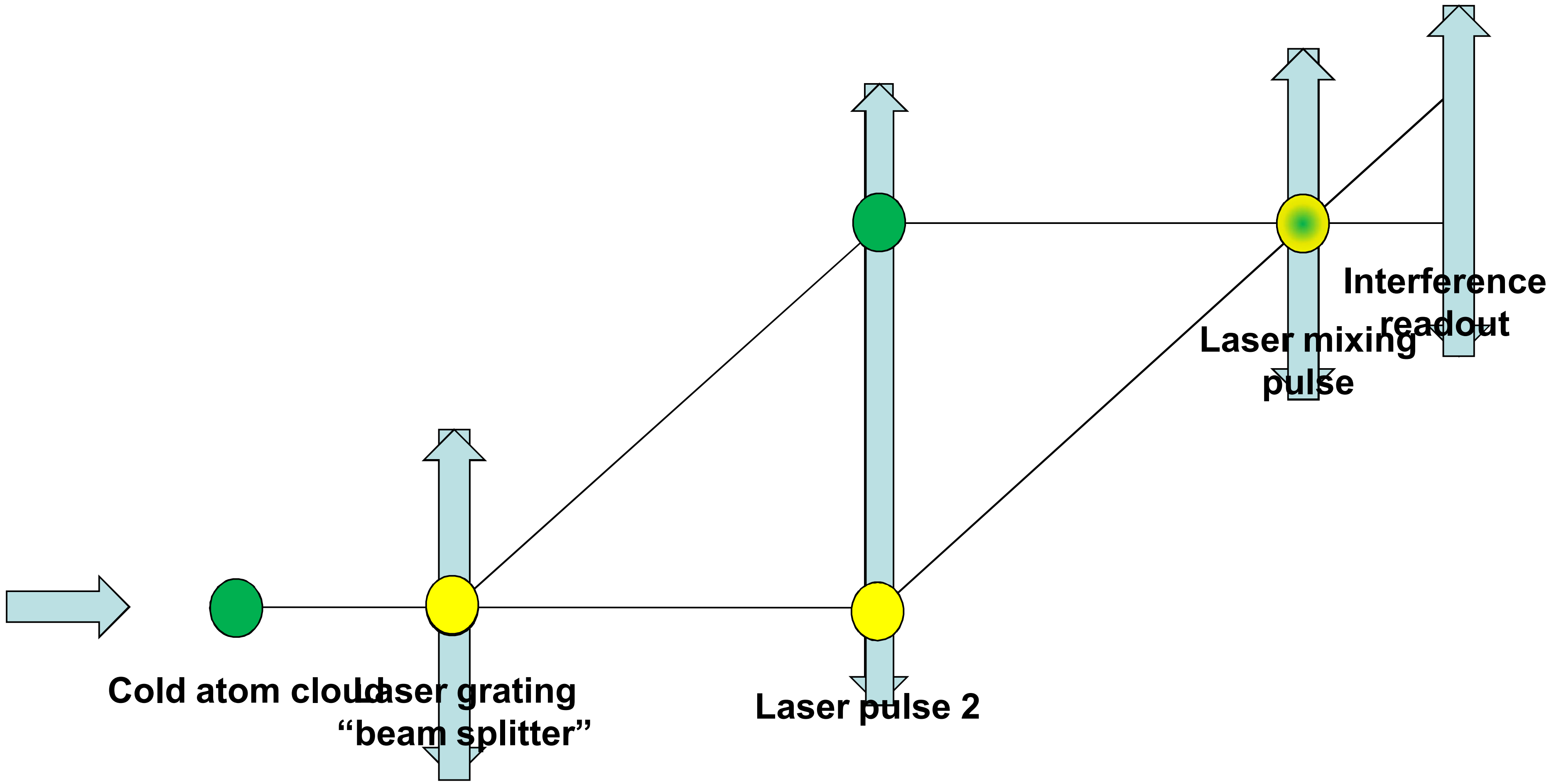
1 msec => 0.5 m dia



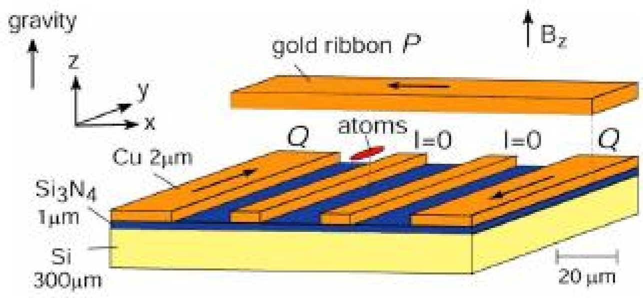
Cold = 2 μ°K

1 msec => 30 μm dia

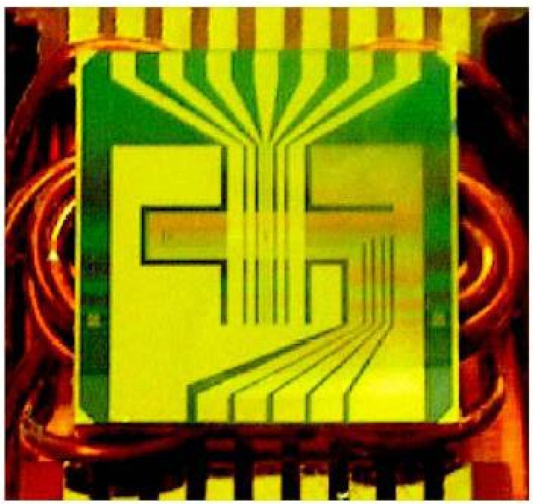
Atom Interferometry



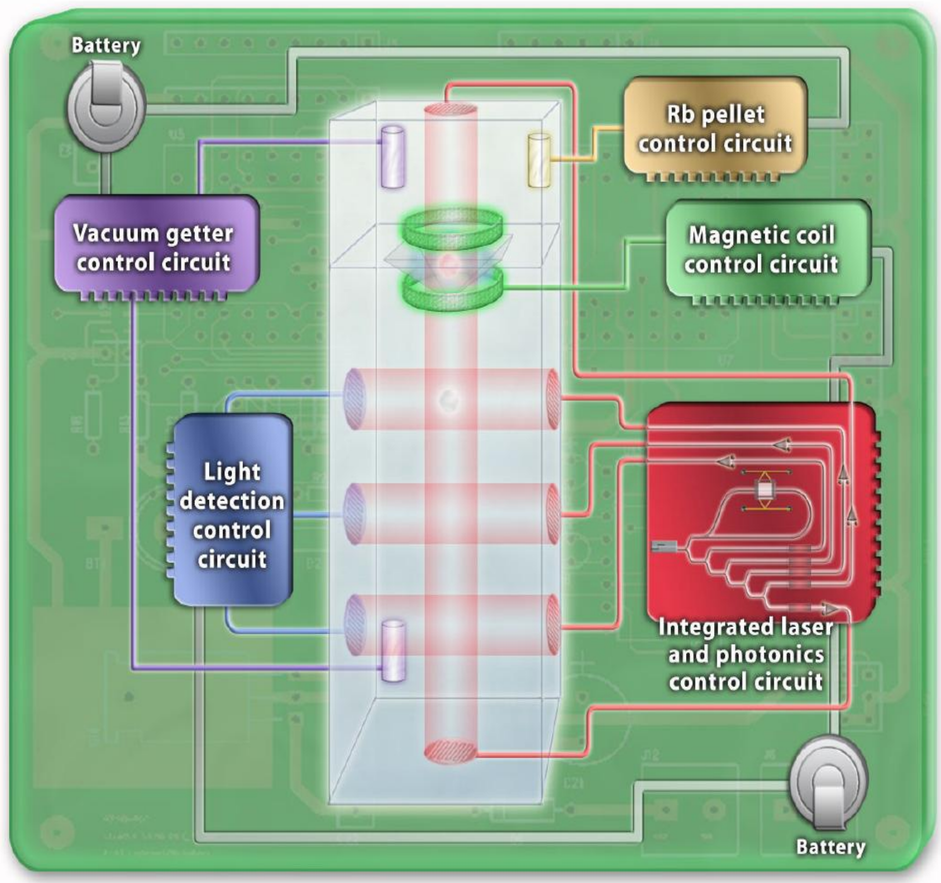
...tion: Cold Atom Interferometery



MEMS Atom Trap Microchip Schematic



MEMS Atom Trap Microchip (1.27 cm x 1.27 cm)



Notional Tactical-Sized Atom Force Sensor Ref: DARPA DSO

REF: Zatezalo, et. al, Bose-Einstein Interferometry and its Applications to Precision Undersea Navigation, IEEE 2008

www.darpa.mil/dso

…chnology: Where do we go from here?

- **Many organizations throughout the world are developing MEMS gyros and accels:**
  - ï **Commercial applications require very low cost – payback will be from quantity sold.**
  - ï **Military applications require very low to low cost – payback will be from providing the entire GN&C system, not just the sensors.**
- **Ongoing development activities are:**
  - ï **Improve manufacturing efficiency – reduce cost and size.**
  - ï **Improve performance to compete with RLG/FOG – performance for reduced cost.**
- **Photonic crystal/Advanced optical technologies:**
  - ï **Potential low cost, solid state alternative to MEMS**
  - ï **Competitive discriminator v. MEMS?**

Å **Nanotech will be used as a fabrication process for instrument components, won't have nano-inertial instruments per se**

Å **Cold Atom technology very developmental, but has pathway to tactical size form factor – i.e. parallels RLG development**

U. S. NAVY SEABORNE TARGETS

New Directions in a Time of Change

Jeffrey L. Blume, P.E.

Head, Surface Targets Team
Naval Air Warfare Center Weapons Division
Pt. Mugu, California

jeffrey.blume navy.mil

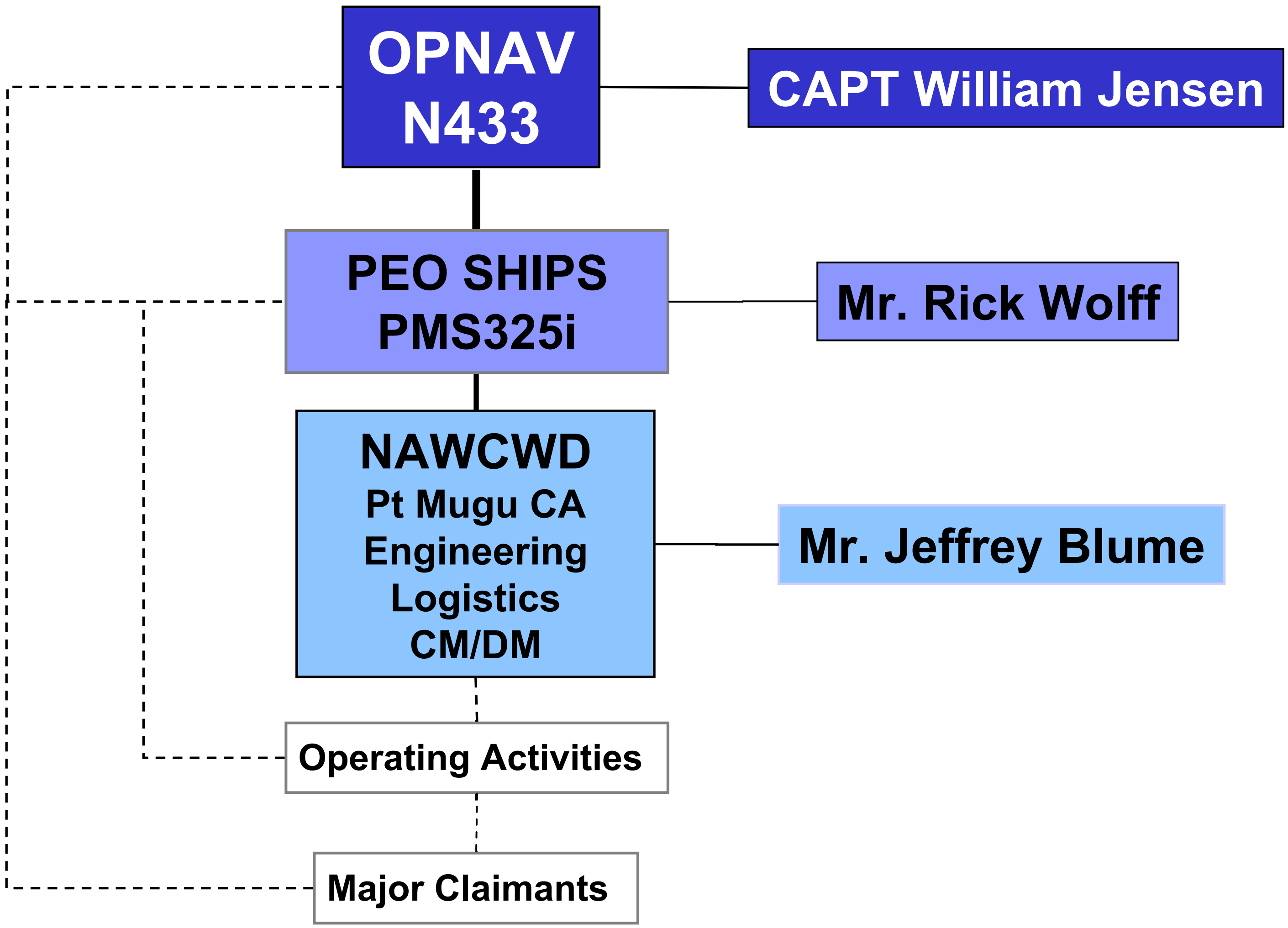
47th Annual NDIA
Targets, UAV's & Range Operations
Symposium and Exhibition

Unclassified

NAVAIR

New Challenges = New Capabilities

Seaborne Targets Structure



Surface Targets Team

Mission

- Navy life-cycle lead for Seaborne Targets and augmentation systems
- Tri-Service Lead for Seaborne Targets
- Seaborne target services to the Fleet, DoD, and Foreign Military Customers in support of weapon system T&E and Fleet Training

Surface Targets Team

Who we support

- SEABORNE TARGET DEVELOPMENT AND PRODUCTION
  - OSD
  - Chief of Naval Operations
  - PEO Ships
  - Army and Air Force

- OPERATIONS
  - Navy Weapon System T & E
  - Naval Fleet Training
  - USAF Test and Evaluation
  - Foreign Military Customers

Changes

- Powered targets
- Towed targets
- Control System
- Augmentation
- New roles

Seaborne Target Resources

Powered Targets

Generic threat. Also tow tractor

High-speed terrorist threat

Self-propelled ship simulator

Ship deployable for at-sea training.

Fast-Attack Craft Target

Powered Targets

- QST-35A to QST-35B
  - Tow tractor and manned harassment
- Sinkable HSMST
  - Increased use of HE
- Production FACT
  - Missile-capable FIAC threat

Fast-Attack Craft Target
FACT

Towed Targets

- Low-Cost Modular Target (LCMT)
  - Single platform with mission kits for HARM, Gunnery, Hellfire, and Harpoon
  - Lower cost, increased survivability, and reduced inventory
  - Some current targets will phase out

Seaborne Target Resources

Towed Targets

Multi-purpose tow used with QST-35

Low cost tow for use with HSMST & SDST

Ship gunnery target

LCMT will Replace ISTT, Williams Sled, HARM Barge

HARM target

SEABORNE TOW TARGET MATRI

Mission	Hellfire	Gunnery	HARM
MODULAR TARGET			
HULL TYPE	PONTOONS		
HULL MATERIAL	PLASTIC		
L W	25' X 12'		
WEIGHT, Lbs	2700		
PAYLOAD, Lbs	3000		
TOW SPEED UP TO, ts	25-30		
TOW VESSEL	HSMST		
E ISTING TARGET	ISTT	Williams Sled	HARM Barge
			
HULL TYPE	MONO	PONTOONS	PONTOONS
HULL MATERIAL	GLASS	STEEL	STEEL
L W	28' X 8'	30' X 14'	45' X 20'
WEIGHT, Lbs	2,500	4,200	37,000
PAYLOAD, Lbs	400	300	3,000
TOW SPEED UP TO, ts	25	6-8	6-8
TOW VESSEL	QST-35 preferred - HSMST marginal	Tug	Tug

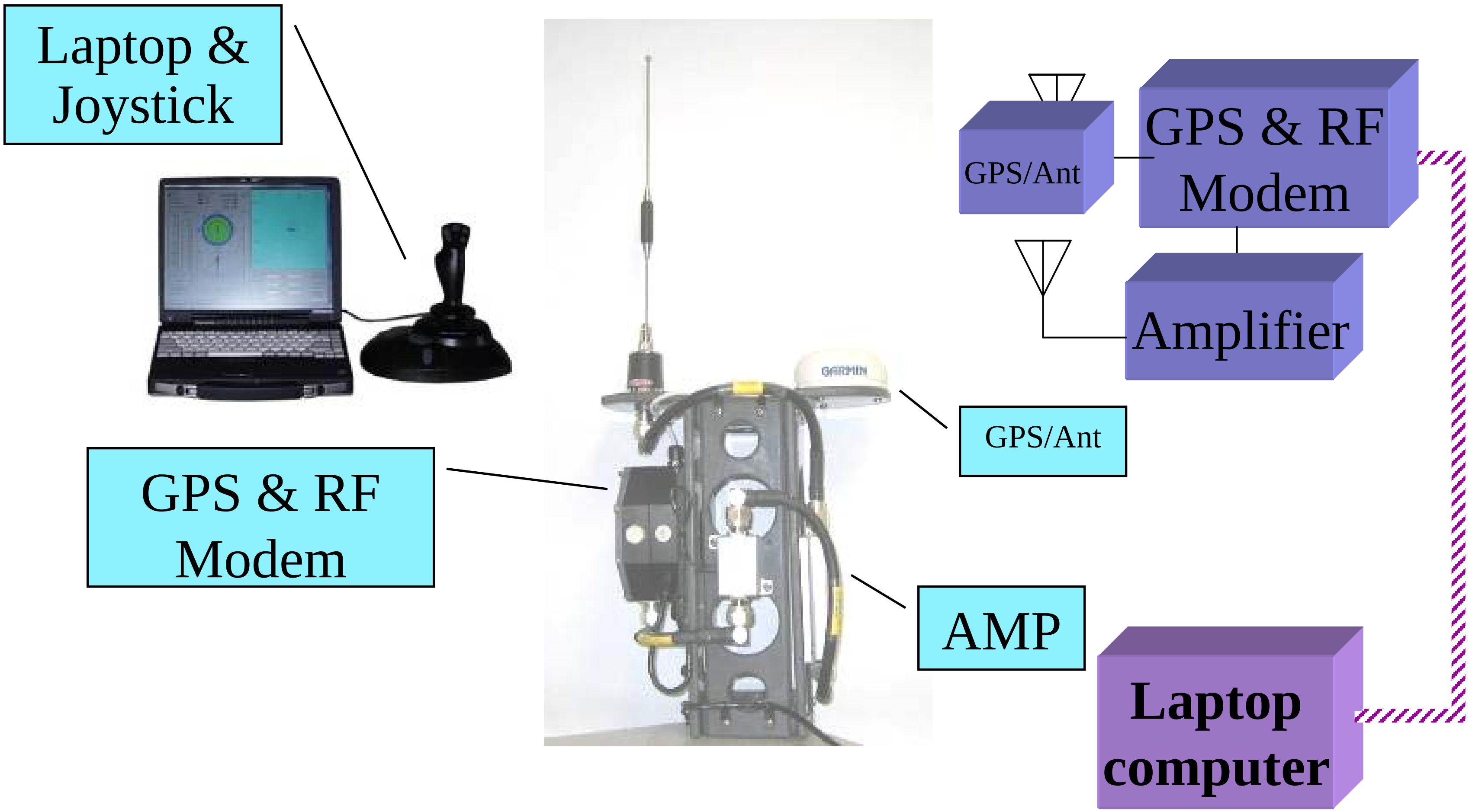
NAVAIR

Control Systems

- SeaCAN (Seaborne Controller Area Network)
  - A singular solution
    - Common architecture and hardware for ***ALL*** Seaborne powered targets
    - Operates with ***ALL*** Navy command links

- PCCU upgrades
  - Added PCCU data logging capability, user select PC time or GPS time to be recorded.
  - Updated drivers for Windows XP and Vista
  - Updated software for PCCU used as Tracker.

PCCU Block Diagram



Augmentation

- Focus on realistic and repeatable IR and RF signatures
  - Developing compendium of signature data for all POR targets
- Humannequin
  - Mannequin with realistic human features including IR signature characteristics
  - Instrumented to assess vulnerability

Humannequin

- Threat surface craft can be disabled by rendering either propulsion systems or the craft operator inoperative. Currently there is no real-time means to assess whether operator has been incapacitated.

- Commercially-available mannequins will be outfitted with heat sources and sensors to provide realistic human signatures and vulnerability measurements.

NAVAIR

New Roles

- Seaborne targets as USV surrogates
  - Targets can be configured to execute other USV missions either operationally or as developmental prototypes
- Seaborne targets as UAV surrogate test beds
  - Good payload test beds
  - Impervious to traditional flight risks
  - Long endurance

Planned Procurements

- Focus on Program-of-Record Targets
  – HSMST, SDST, FACT, LCMT, and LCTT

- Adjust quantities annually based on requirements and budget.

Operating Sites and Resources

U. S. Navy Seaborne Targets											
Operating Activity	Powered						Towed / Static				
	MST	QST-35	FACT	HSMST	SDST	ATLS	HARM Barge	Williams Sled	ISTT	LCTT	LCMT
NAWCWD, Point Mugu, CA											
NAWCAD, Pax River, MD											
NAWCAD Det, Norfolk, VA											
CFAO, Okinawa											
PMRF, auai, HI											
SCORE, San Diego, CA											
MCAS, Cherry Point, NC											
ATGL, Norfolk. VA											
ATGM, Mayport, FL											

Questions?

Seabornetargets.org

ugh Harris Scholarsh

rpose

de annual update to the members

w/Inform membership on applic

dures

t your continued support by

ntifying qualified applicants

viding continued financial support

urpose of Scholarship

lize Hugh Harris

Financial Assistance to Eligi

ge Interest in Engineering/Sc

Educational Crisis

ars US Public Education Dro
1 in the World to No. 29

nce Degrees (% of total awa

37.8%

: 28.1%

17.6% (Engineering 6.7%)

Scholarship Status

ed in 1991: Goal $50K, to be self sus
dministered by NDIA HQ.
olarship Awarded in 1992
000 Award in '92
d to seven in 2000
d $49K to date
's winners
Needleman: Univ. of FL, Engineering
Fitzgerald: Univ. of FL, Aerospace Engine
Draper: CalPoly Univ., Mechanical Engine

Scholarship Schedule

- y: Members identify applicants
- y: Mail info packets to applicants
- : Applications to Scholarship Comm
- cholarship Committee ranks applica
- Executive Committee determines nu ships
- ust: NDIA issues scholarship grants

Eligibility

or or graduate

ed in accredited 4 year college

al career

rospace, Chemical, Electrical, Civil, Comp

al, Mechanical

l fields: Physics, Chemistry, Mathematics,

ering

Eligibility (continued)

d by Targets/Ranges/UAV Division n
al or corporate)

d by Gulf Coast Chapter

s of full scholarships (military acader
neligible

nts in 2-year community colleges are

by-laws are available upon request

Your Responsibilities

otential Applicants

holarship Committee

Proctor

Glenlake Circle

ille FL 32578

: cortp@aol.com

ntinued donations (corporate/individ

2009 Contributors

ulf Coast Chapter: $3000

THANKS

Questions

?

Conducting Analysis of Alternatives for Directed Energy Systems

Doug Rinell

Approved for Public Release

Distribution A

96ABW-2009-0433

Conducting Analysis of Alternatives for Directed Energy Systems

Counter-Electronics Program

Objectives:
Support the Counter-Electronics program in supporting an Analysis of Alternatives to produce the most effective CE solution

Evaluation Factors

- Functional Defeat Effectiveness
- Non-Lethal
- Assurance of Kill /BDA
- Collateral Effects
- Mission Survivability

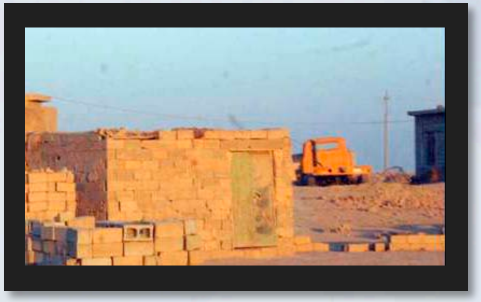
Example Study Approach

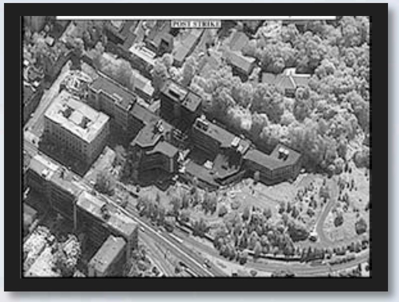
1. Define and Characterize Operational Target Set

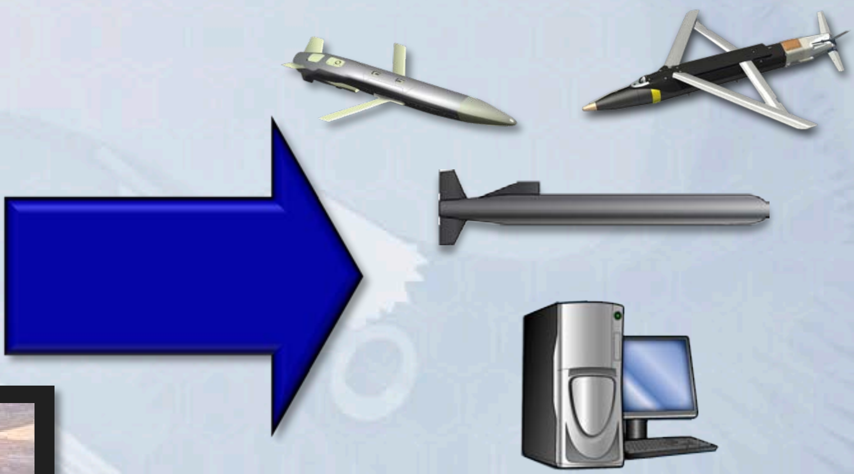
- Buildings
- Bunkers
- WMD
- Power Distribution / Transmission
- POL Facilities
- Vehicles
- Etc…

2. Define Weapon System Concepts

- CE Missile
- CE Bomb
- CE UAS
- Kinetic Weapon Systems
- IO Technique
- Etc…







Example Study Approach

3. Define Criteria, Tactical Considerations and Measures of Effectiveness

- **Effectiveness**. What is P_K? P_{degrdn}
- **Assurance**. How do you know its dead / Damage Assessments
- **Collateral Damage**. What are effects on Schools/Hospitals – Reconstruction Costs
- **Mission Survivability**. Will the platform get to the target range?
- **Environment.** What happens in weather?
- **Target Uncertainty** – What happens if we are unsure of where key components /target properties are?

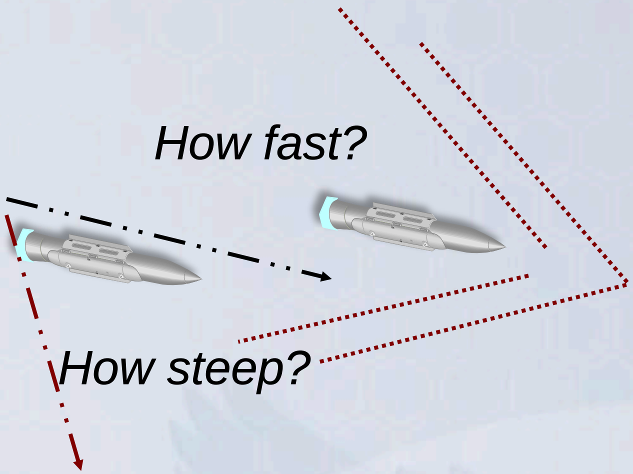
4. Sensitivity Analysis

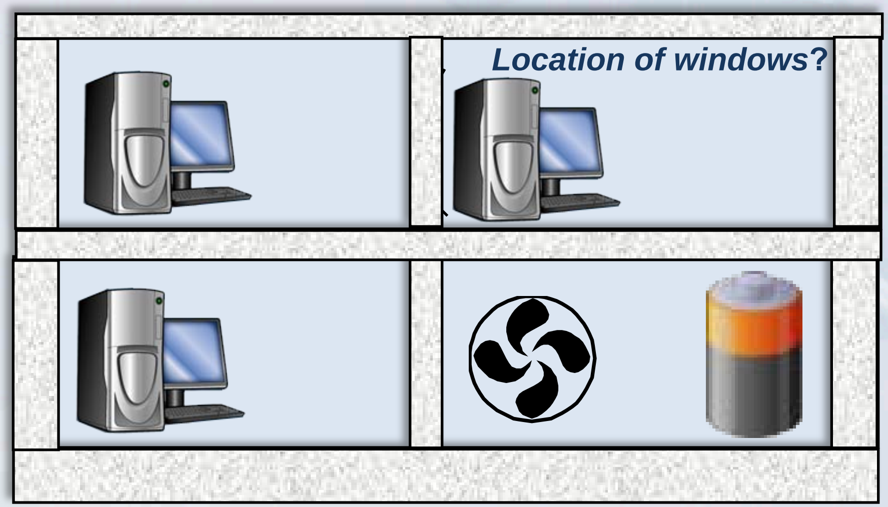
- Range to target – How close do we need to get?
- Attack geometry – Azimuth, etc
- Target Construct – Materials, Rebar,
- Target Layout – Windows, Doors, Computer, C2 , power, HVAC location
- Environment – Humidity, rain, temperature, etc

5. Summarize Results & Analyze

Weapon & Building Characteristics

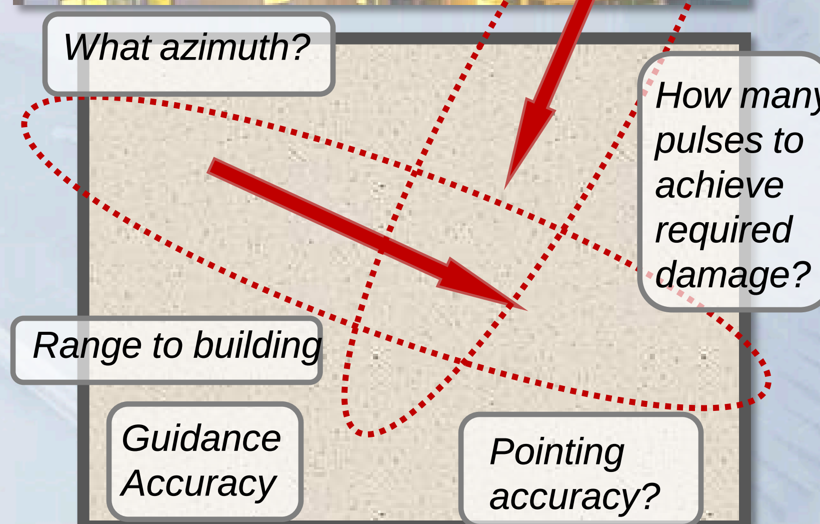
Construction Practices





How Compartmented?
Internal Structure?

Side View

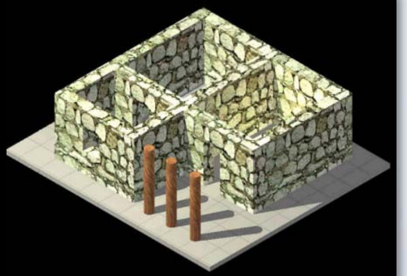


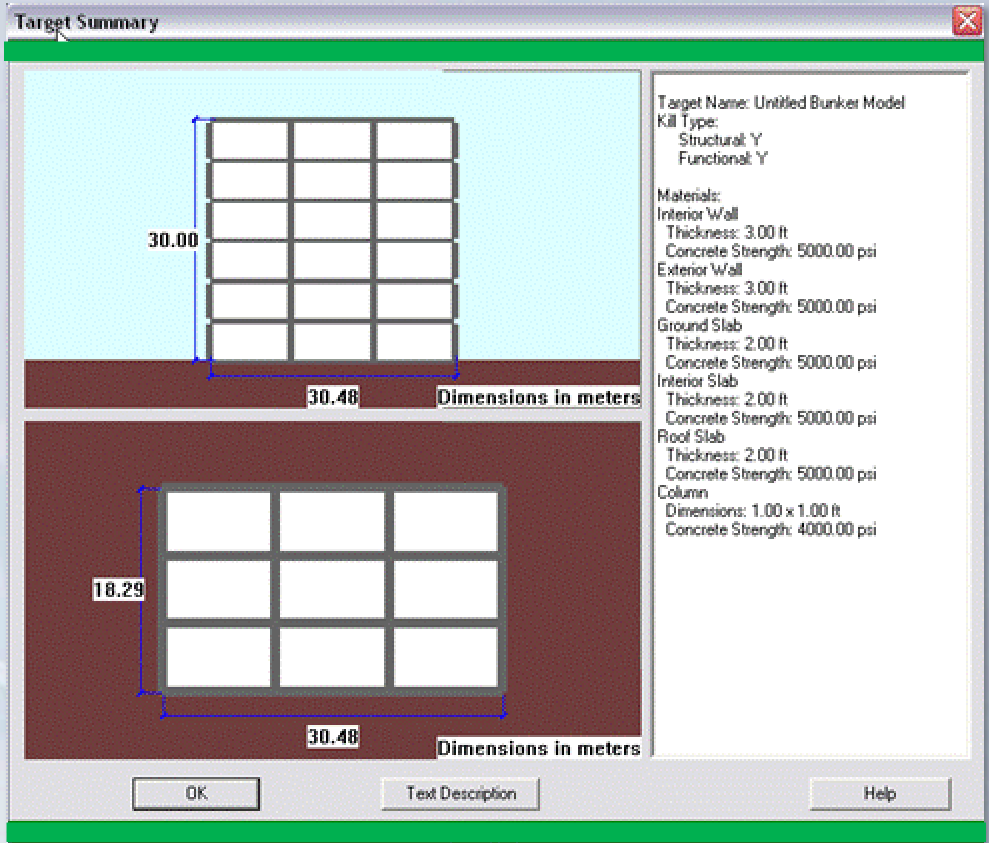
Top View

Detailed Target Information

Detailed target models :

- Window/Doors Location
- Computers Type / Layout
- Communications Type / Layout
- HVAC Type / Layout
- Power Type / Layout
- Wall Materials
- Roof Materials
- Rebar Configuration
- etc



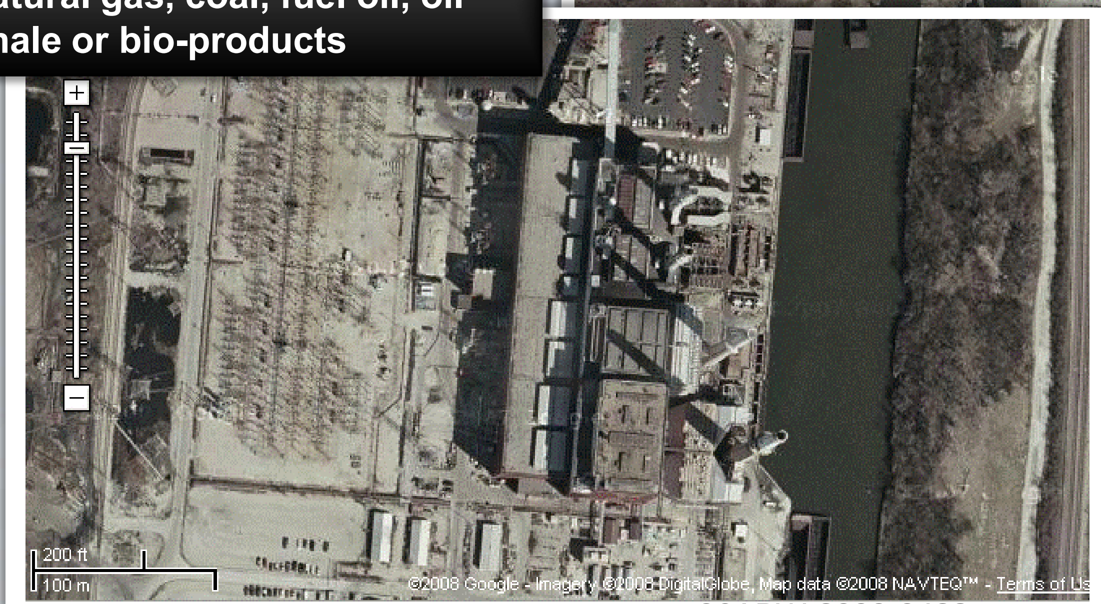


Models to Accommodate Needed Details

Example Power Plants

Description:

We will need to know much detail about target construction and functionality. Power plants (or power stations) such as the coal firing plant shown here are numerous. Different types of these electricity production facilities include: nuclear, natural gas, coal, fuel oil, oil shale or bio-products

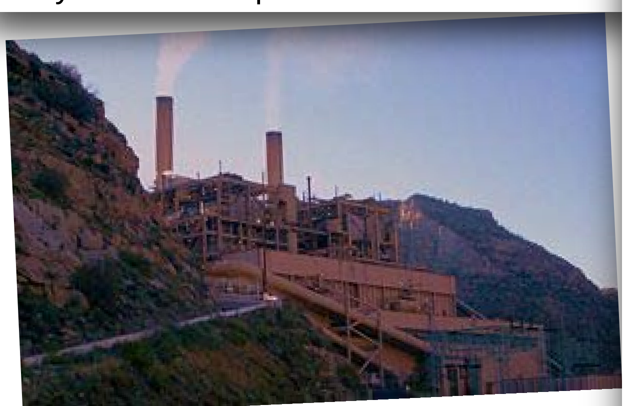


Power Plant Types

Currant Creek Power Plant near Mona, Utah is a natural gas fired combined cycle electrical plant.

Oil Power Plant in Iraq

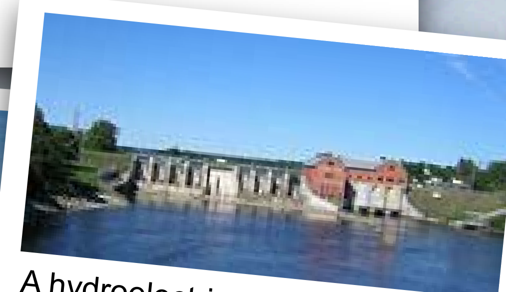
Flue gas stack at GRES-2 Power Station in Ekibastus, Kazakhstan



This is the Castle Gate Coal Plant near Helper, Utah.

Wind turbine in front of a thermal power station in Amsterdam, Netherlands

The Susquehanna Steam Electric Station, a boiling water reactor



A hydroelectric dam and plant on the Muskegon river in Michigan

Coal Plant System

Inflow

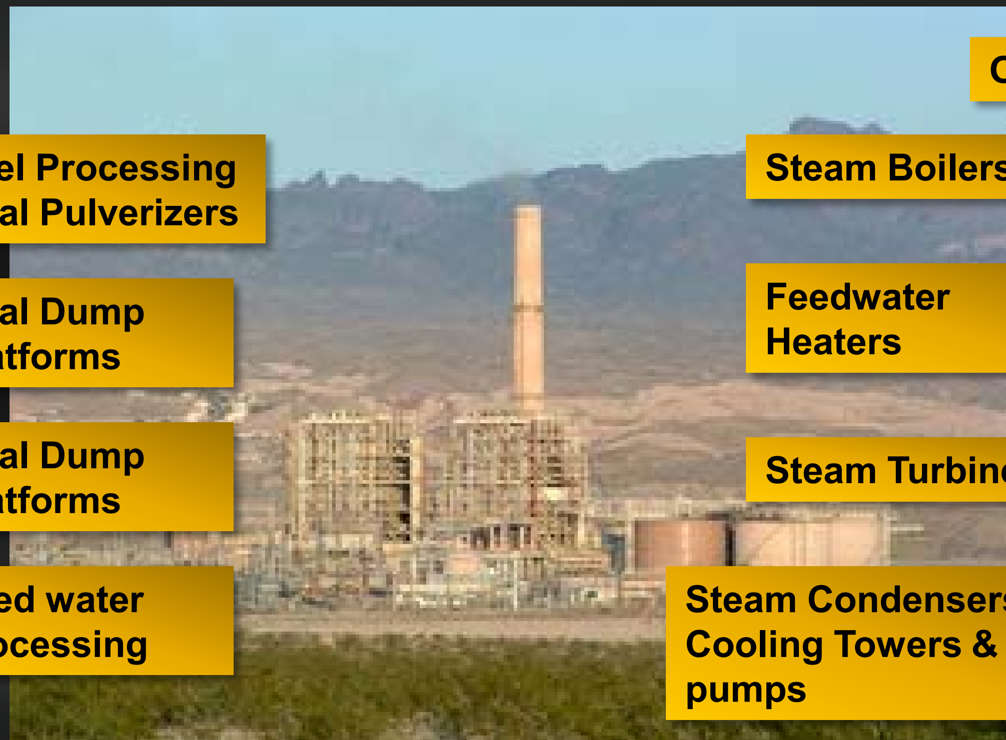
Coal by:
- Rail
- Barge
- Truck
- May use Fuel Oil for start-up
- Pipe
- Truck
- Tank Cars

Fuel Processing Coal Pulverizers

Coal Dump Platforms

Coal Dump Platforms

Feed water processing



Outflow

Steam Boilers

Feedwater Heaters

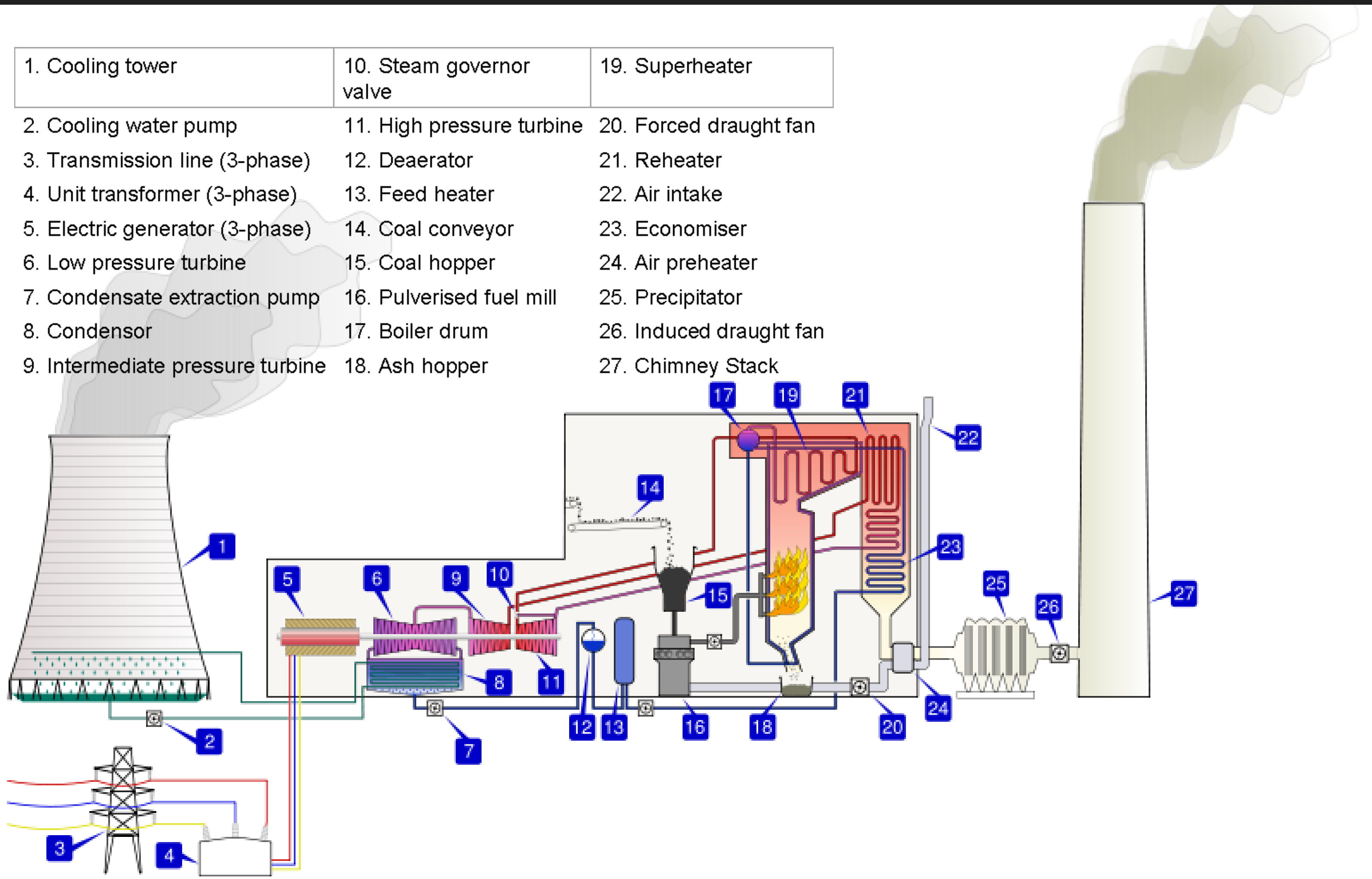
Steam Turbines

Steam Condensers, Cooling Towers & pumps

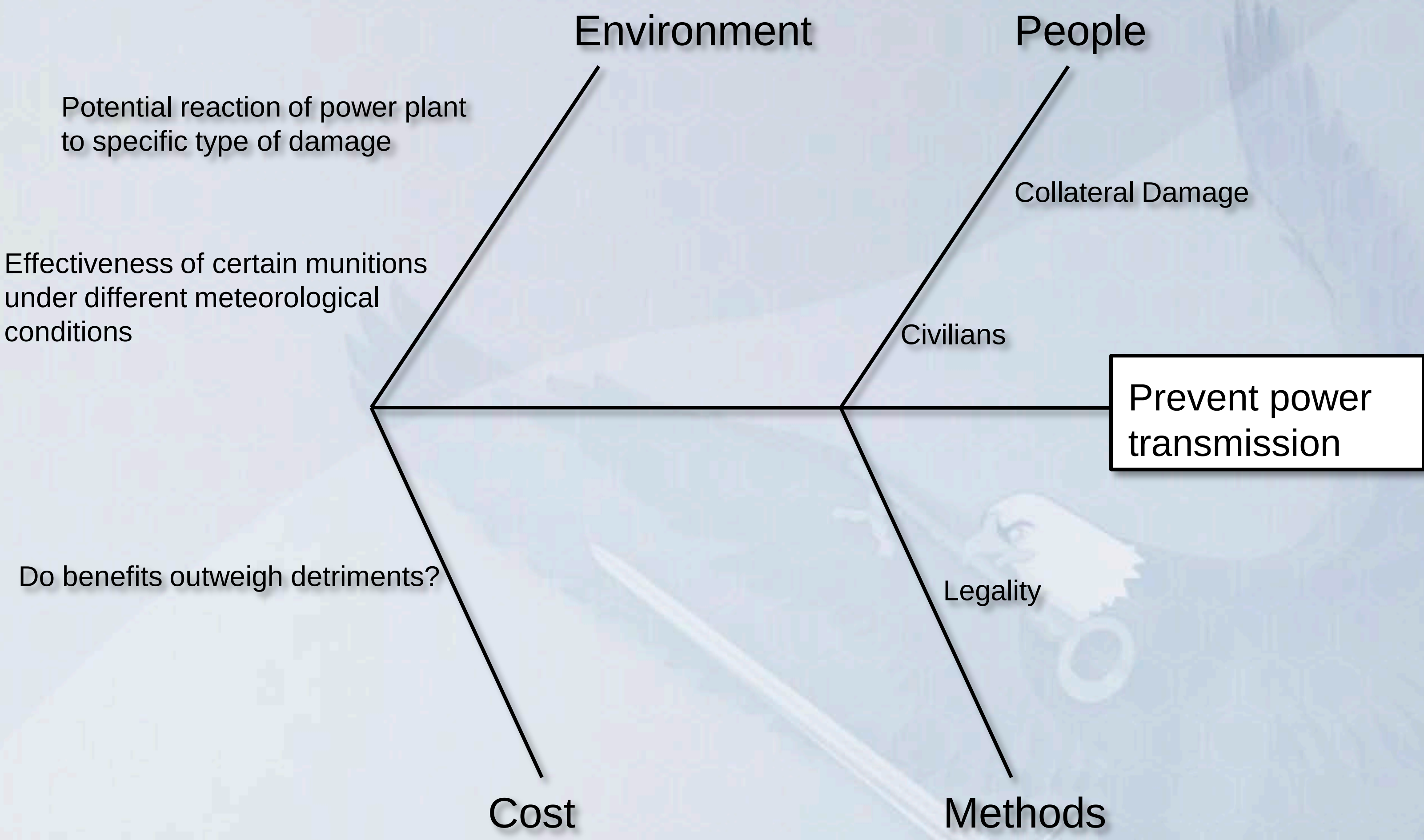
Measures of Operational Effectiveness
- Deny Fuel Flow for x time
- Destroy Fuel Storage for x time
- Disable output for x time
- Destroy Permanently

Key Characteristics

1. Cooling tower	10. Steam governor valve	19. Superheater
2. Cooling water pump	11. High pressure turbine	20. Forced draught fan
3. Transmission line (3-phase)	12. Deaerator	21. Reheater
4. Unit transformer (3-phase)	13. Feed heater	22. Air intake
5. Electric generator (3-phase)	14. Coal conveyor	23. Economiser
6. Low pressure turbine	15. Coal hopper	24. Air preheater
7. Condensate extraction pump	16. Pulverised fuel mill	25. Precipitator
8. Condensor	17. Boiler drum	26. Induced draught fan
9. Intermediate pressure turbine	18. Ash hopper	27. Chimney Stack



Power Transmission

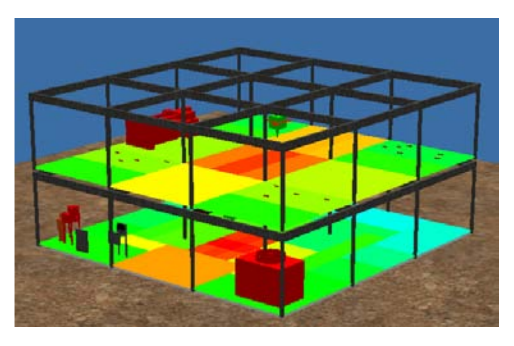


Conclusions/Summary

Targets will need to be very detailed

Instrumentation will need to be netted across the target and non-intrusive/non-influencial

Target Construction will require Homework



LOW COST
T&E AND TRAINING
TARGETS

BRIEFER:

Jim Schwierling
Lead Project Director
256-876-3451 DSN: 746-3451
E-MAIL: jim.schwierling@us.army.mil

Low Cost
Training and T&E Targets

TMO
Targets Management Office

Outline

- Precision Target Signatures
  - Program Description
  - Purpose of the Program
  - History of Development
  - Scope
  - Technical Status
- Precision Scoring Ranges
- Summary

Precision Target Signatures (PTS)

The Precision Target Signatures (PTS) project is an evolution of low cost decoys/surrogates created to develop a Full-Scale, 3-D decoy that emulates the visual and electromagnetic signatures of "Actual" Threat Vehicles

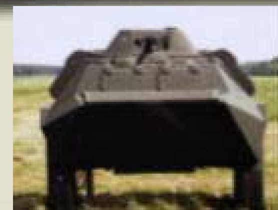
(T-72M, BMP-2, BTR-80)

Precision Target Signatures

- PTS supports multiple T&E and Training programs
- Real threat vehicles are expensive
- Multiple targets are needed for IOT&E in FY 11
- Cannot afford multiple real threat vehicles
- Funding has limited actual threat vehicles to (3 each T-72, BMP-2, and BTR-80)

Precision Target Signatures
Design Evolution

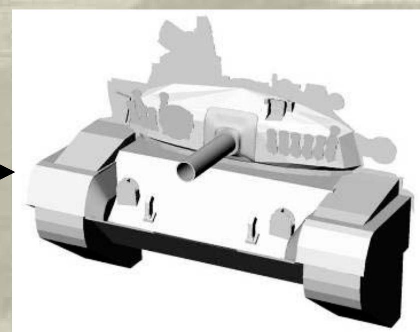
TMO
Targets Management Office



TVST 2 ½-D

MBT-S

RLCT Concept



PTS 2.5-D Design

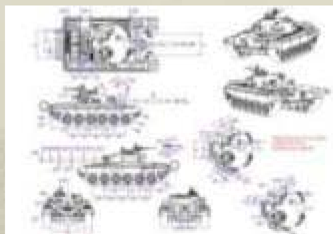
PTS 2.5-D
Full-Scale Prototype

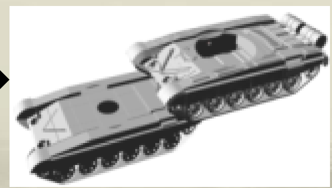
PTS 3-D Design

Full Scale T-72M

Precision Target Signatures
Process

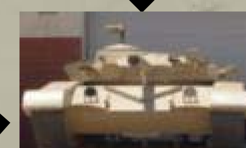
TMO
Targets Management Office


Validated Model


3-D CAD Design


1/5th Scale Prototype


Full Scale Prototype


Paint
Desert Tan
OD Green


Trailer Mounted


Skid-Pulled


IR Kit

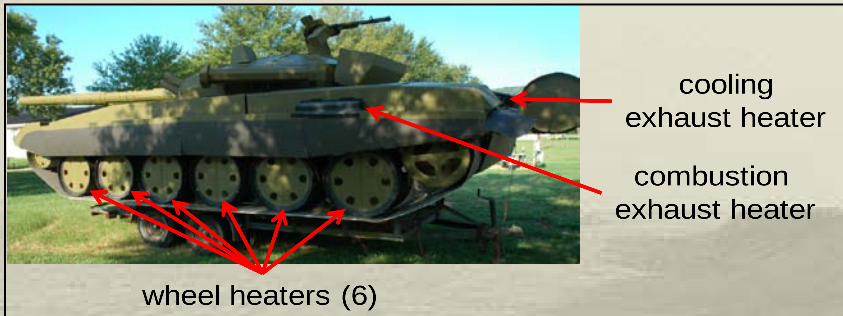
Minimal Logistical Footprint

Three PTS Full-Scale T-72s Ready for Shipment

T-72 Design

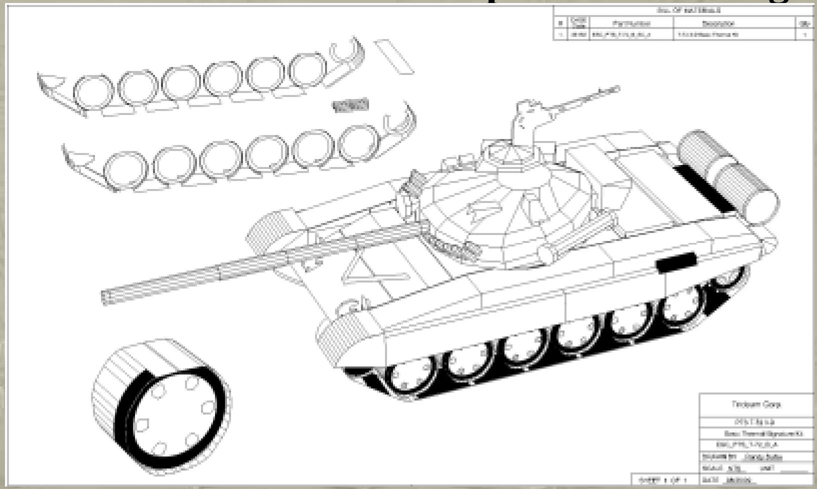
TMO
Targets Management Office

PTS T-72 on Trailer with Thermal Kit



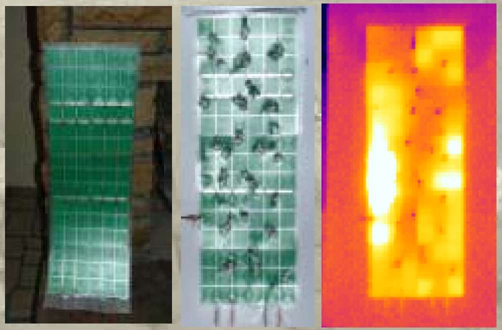
Target at RTTC Pre-Test

PTS T-72 Thermal Kit Top Level Drawing



- 60 individual heaters total on five independently adjustable circuits.

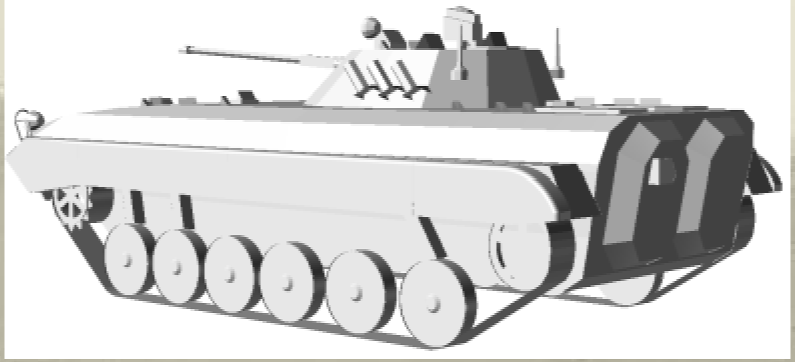
Thermal Imagery



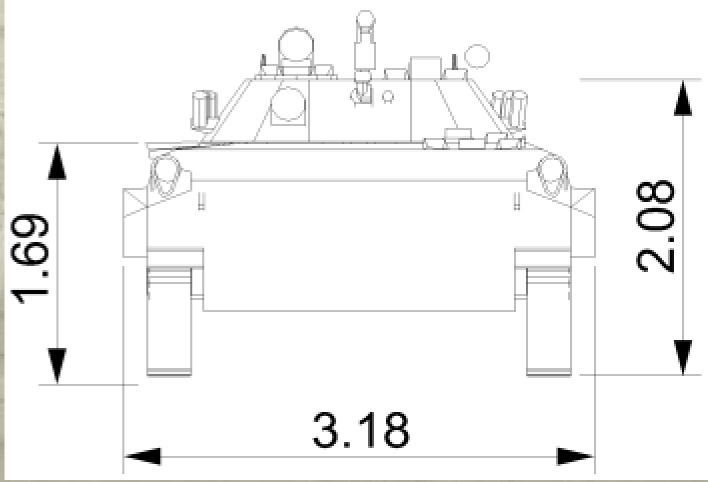
38 Hits

BMP-2 Concept Design

- 3-D model of BMP-2 concept design is shown below.
- Geometry is based off of approved model, extensive measurements, and verified data.



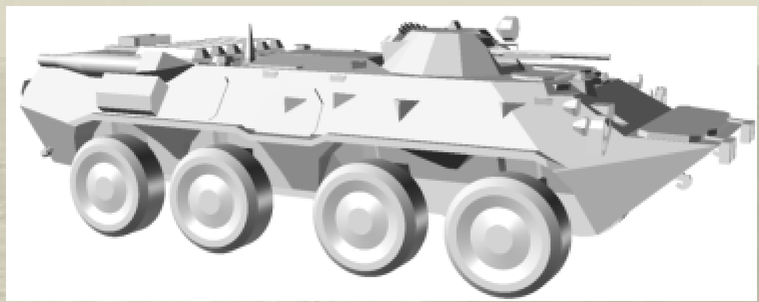
PTS BMP-2 Concept Dimensions

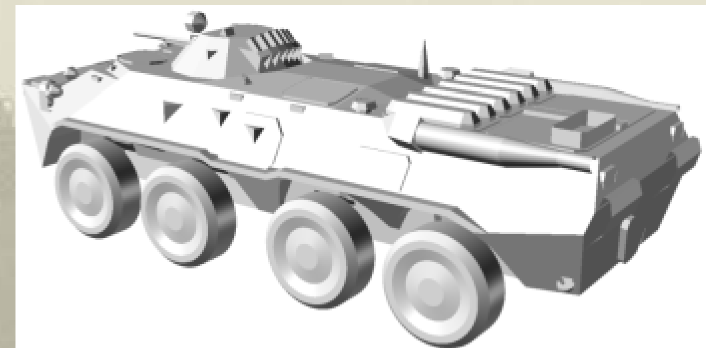


Dimension	PTS	Model	|Δ|
Overall Width (m)	3.18	3.165	**0.015**
Height to top of hull (m)	1.69	1.7	**0.01**
Height to top of turret (m)	2.08	2.077	**0.03**
Overall Length (m)	6.69	6.72	**0.03**

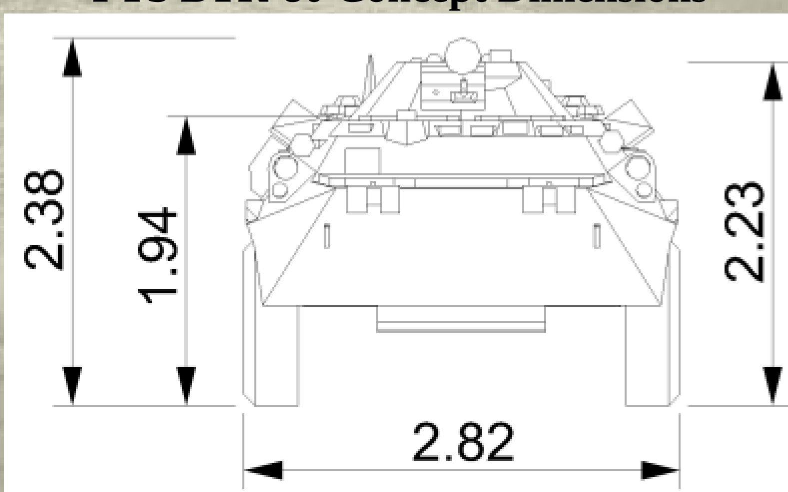
BTR-80 Concept Design

- 3-D model of BTR-80 concept design is shown below.
- Geometry is based off of a VTC model, and verified with approved data.





PTS BTR-80 Concept Dimensions



Dimension	PTS	Model	|Δ|
Overall Width (m)	2.82	2.95	**0.13**
Height to top of hull (m)	1.94	1.94	**0.0**
Height to top of turret (m)	2.23	2.235	**0.005**
Overall Height (m)	2.38	2.41	**0.03**
Overall Length (m)	7.58	7.65	**0.07**

Precision Target Signatures
Deliverables

- **LRIP Targets**
  - **15 T-72**
  - **15 BMP-2**
  - **15 BTR-80**
- **“Dial-A-Signature” IR Kit**
  - **45 IR Signature Kits**
- **Reduce Cost of Targets**
  - **< $20K for Production**
  - **Potentially < $15K if high rate production**

Precision Scoring

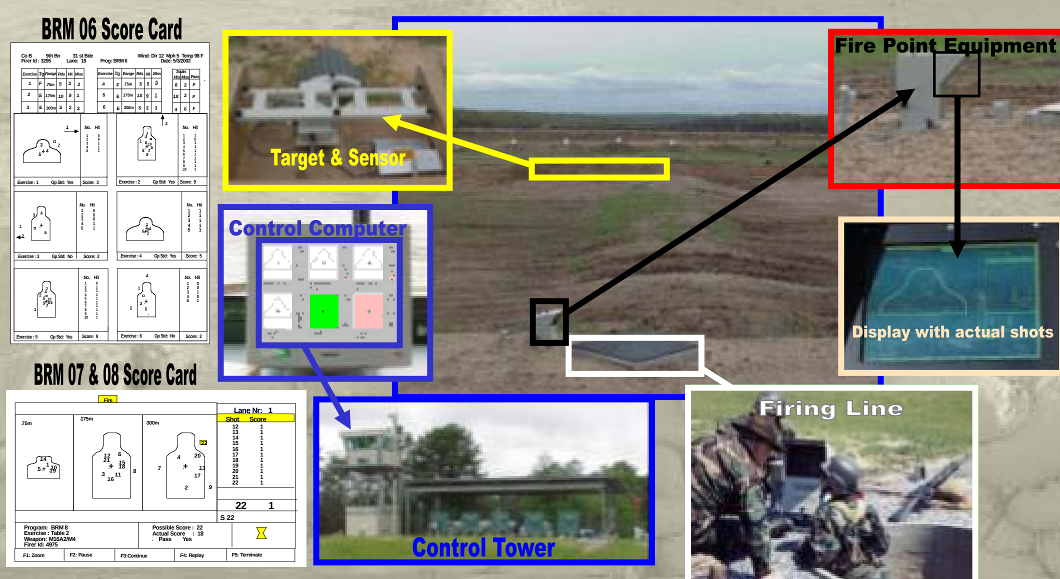
TMO
Targets Management Office

Known Distance (KD) and Field Fire ranges on Army installations are being modernized with Precision Scoring technology that provides more efficient marksmanship training time.

Both DoD and FMS

Key advantages and features:

- Immediate feedback on firing point display.
- Instructors can identify and correct trainee problems immediately.
- Printer score cards provide each shooter with a shot-by-shot performance record.
- Lanes can be operated by a central control computer or individually at the firing point.



- Currently Precision Scoring ranges are being used for basic rifle marksmanship tables BRM 06 thru BRM 14.
- Grouping and zeroing can be accessed at any time to allow individuals to adjust weapon sights.
- LOMAH technology has been applied to training for various weapon types using 5.56mm to 120mm ammunition.

Precision Scoring

Currently Precision ranges are being used for Rifle Grouping/Zeroing, Down Range Feedback, Field Fire, Qualification Firing, Auto Burst Firing, Protective Mask Firing, Night Fire, Suppressive Fire Training, Sniper Training, "Quick Kill" Training, and Moving Target Engagements, all in single shot slow, single shot rapid, and/or automatic fire burst modes.

Summary

- **Providing the T&E and Training Communities with Low Cost Validated Target and Scoring Alternatives**
- **Meeting Required Schedules**
- **Ready to Meet Any Customer's Needs**

Low Cost
T&E and Training Targets
Ready!

RT LOGIC
an Integral Systems Company

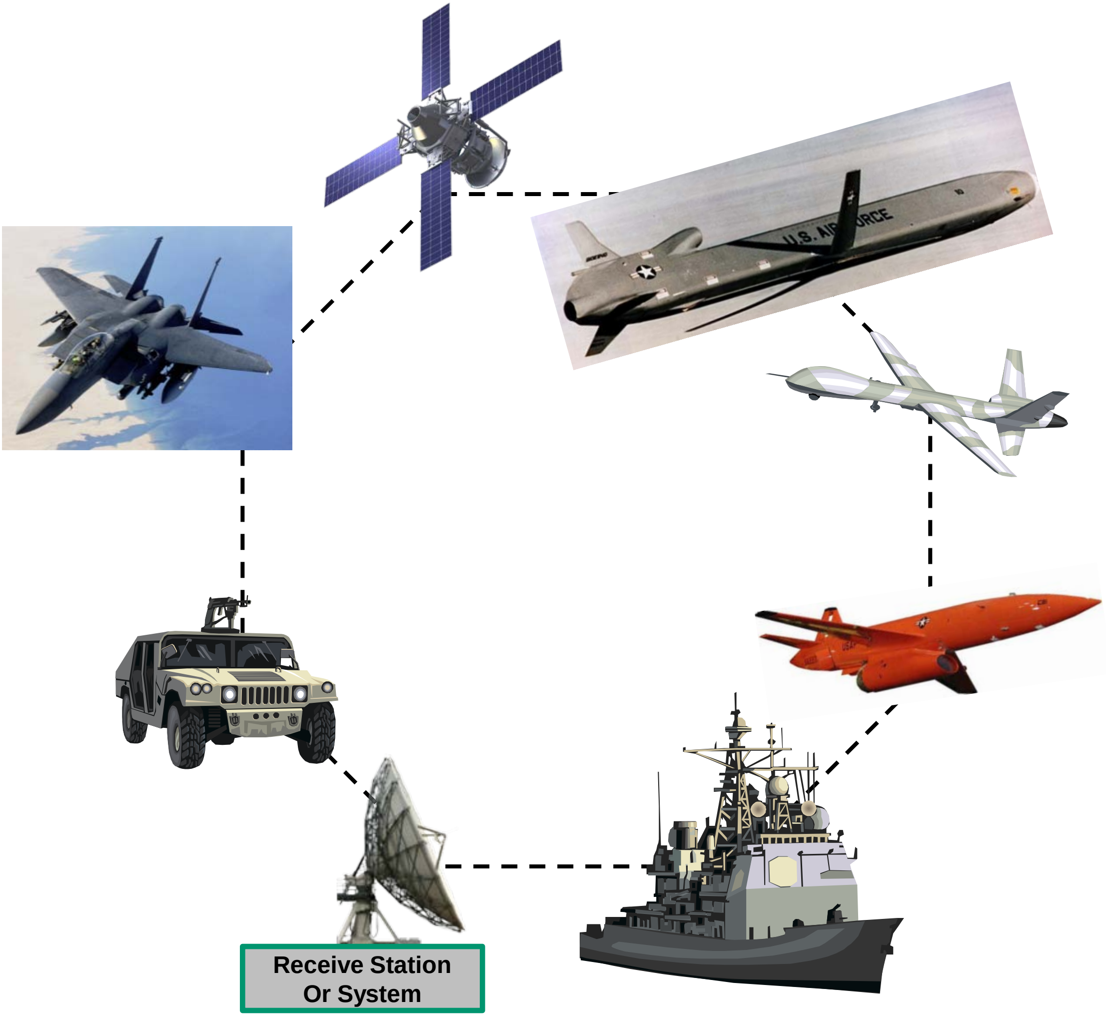
Channel Simulators to Test RF Communication Links for Targets, UAVs and Ranges

RT Logic, Steve Williams

National Defense Industrial Association

47th Annual Targets, UAVs and Range Operations Symposium & Exhibition

22 October, 2009



Whenever transmitters and receivers are in motion with respect to each other…

- Special COMMS test needs exist…
  - Doppler shift
  - Range delay
  - Range attenuation
  - Noise
  - Interference
  - Etc.

Dependent on flight path and ground locations.

Nominal conditions
Worst-case conditions

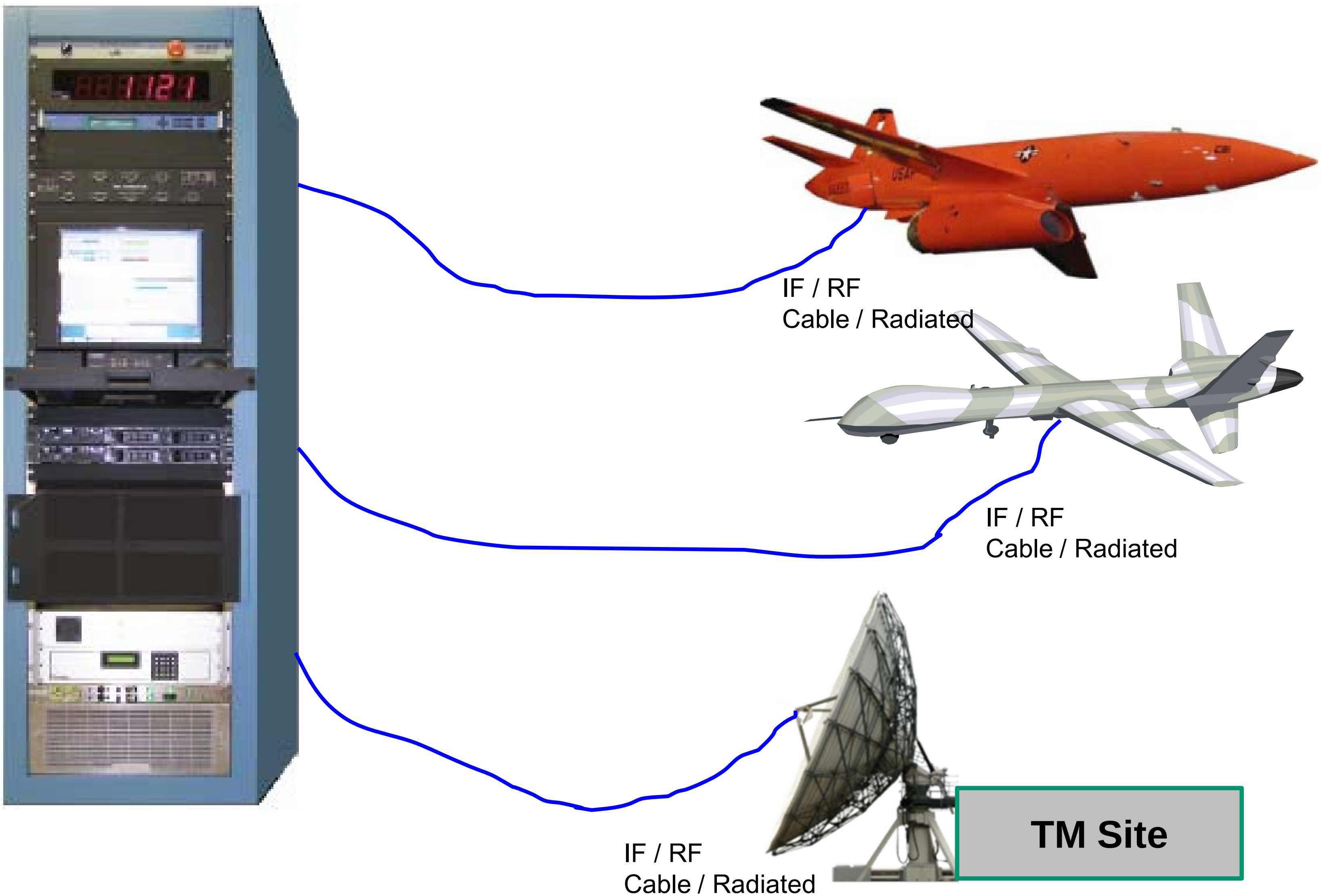
- When testing…
  - RF Hardware
  - Digital Hardware
  - Analog Hardware
  - Software
  - Firmware
  - Processes
  - Etc.

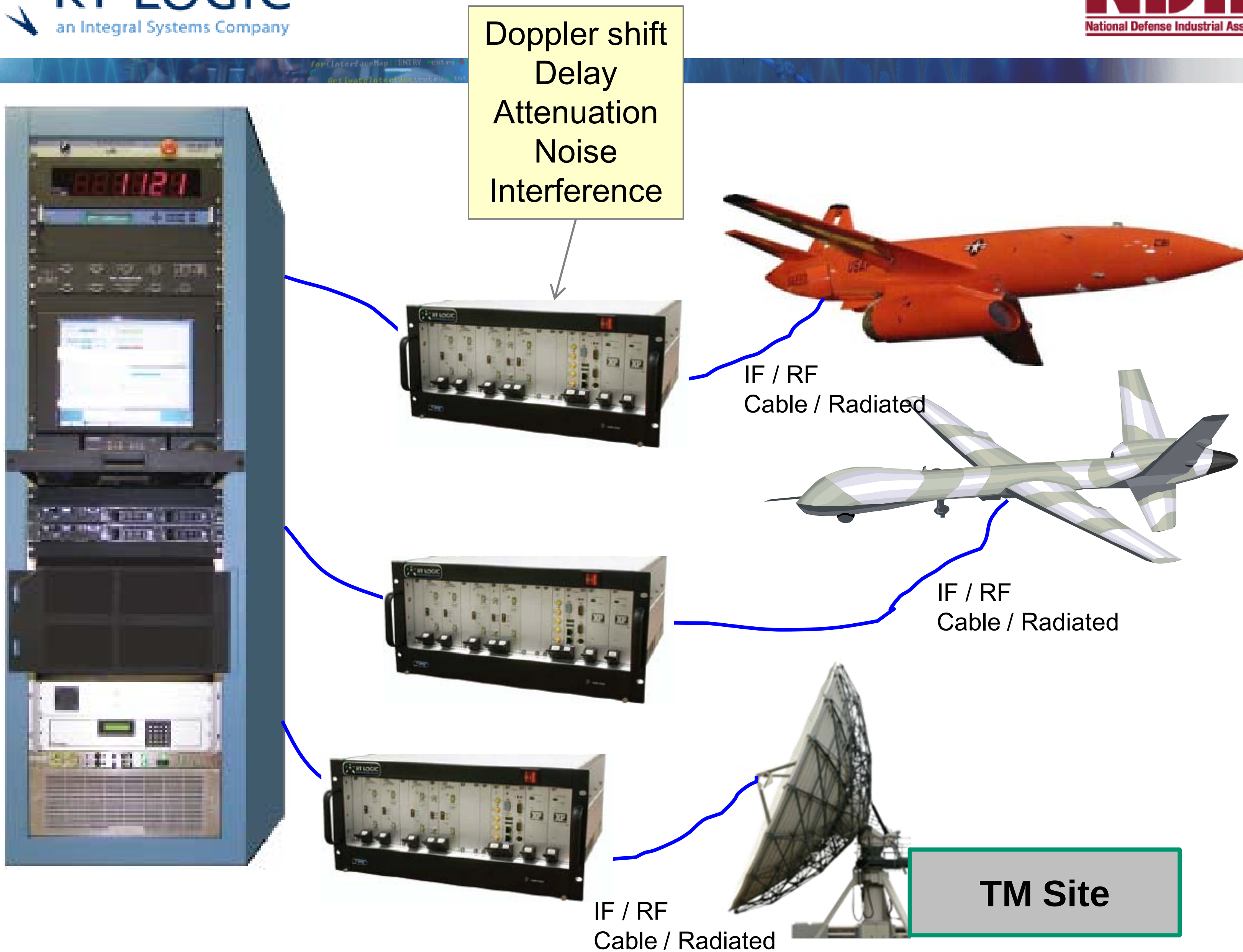
Initial development tests
Regression tests
Compliance tests
Stress tests

- Strong need for thorough, economic and fast testing
  - Run often to detect problems as early as possible

- Doppler shift, delay, attenuation, noise and interference generation is difficult & time-consuming
  - Must know and understand flight paths
  - Must be physics-compliant
  - Must be phase-continuous, smooth, highly interpolated
  - Must have high resolution control and output

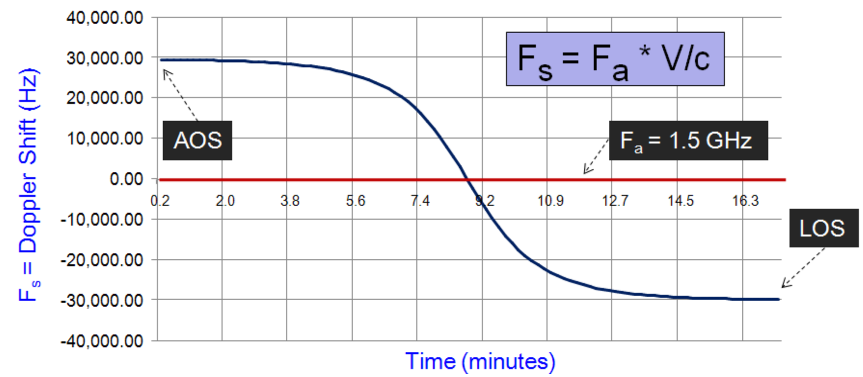
- Channel Simulators to the rescue
  - Create Doppler shift, delay, attenuation, noise and interference on test signals

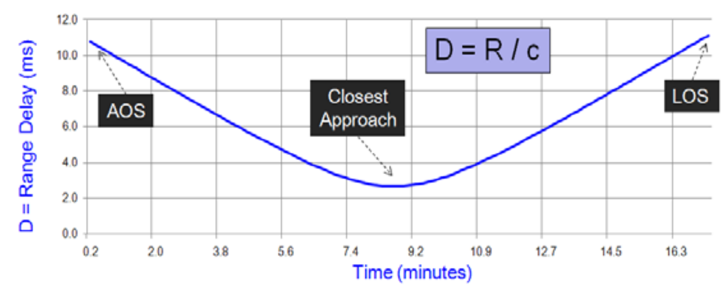

IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
TM Site

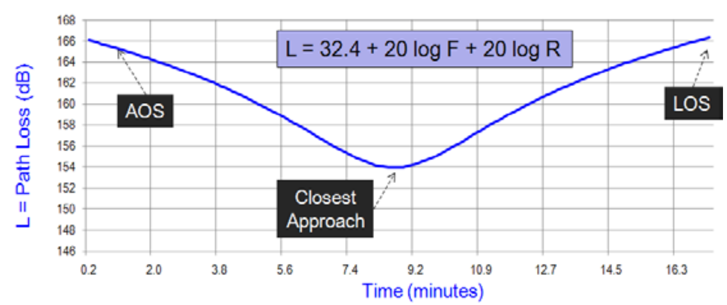

Doppler shift
Delay
Attenuation
Noise
Interference
IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
TM Site

- Channel Simulator requirements are non-trivial, but relatively straight-forward for SATCOM applications.

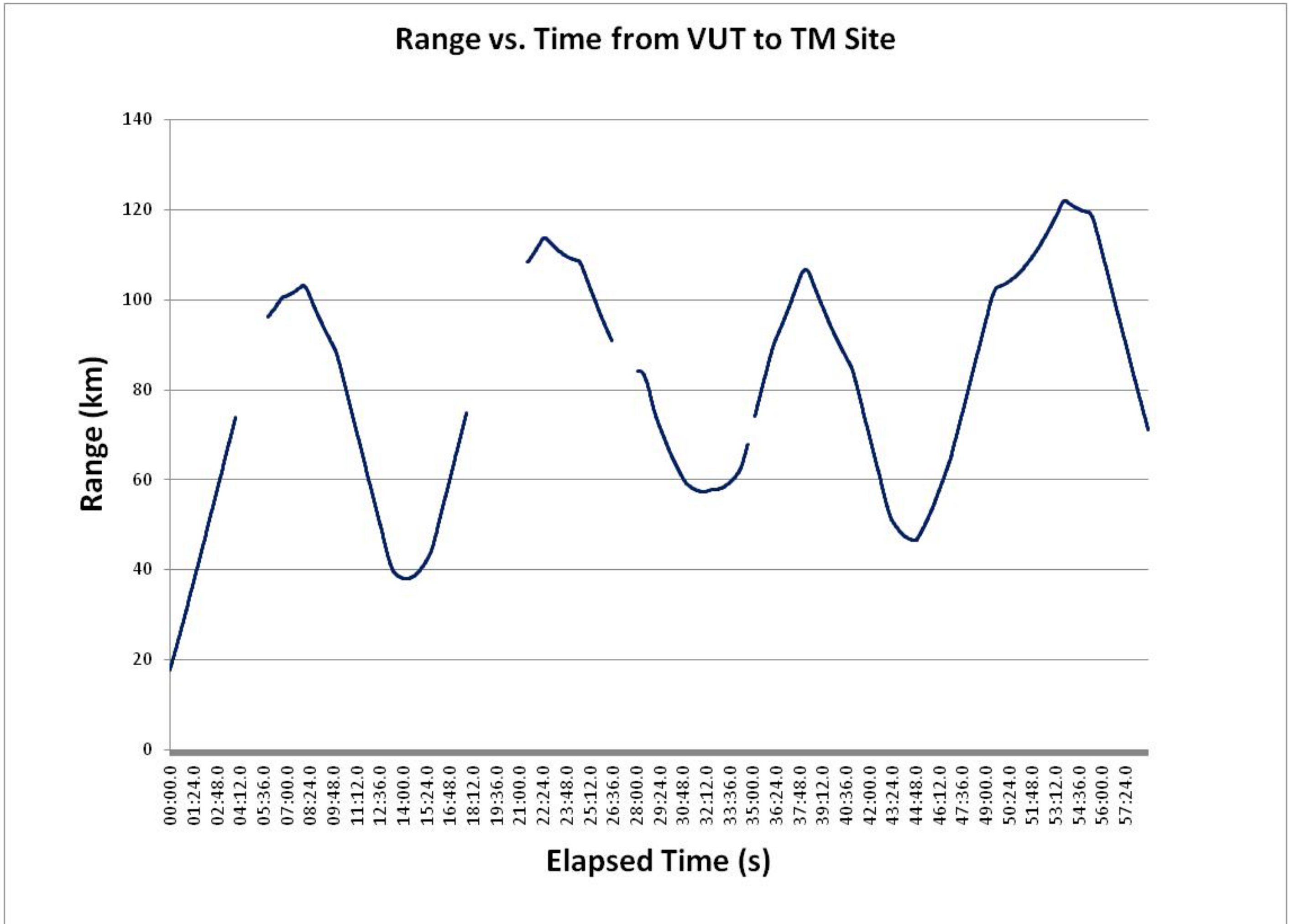
- Much higher complexities exist with more complicated motion relationships
  - Example: Targets, UAVs and Ranges





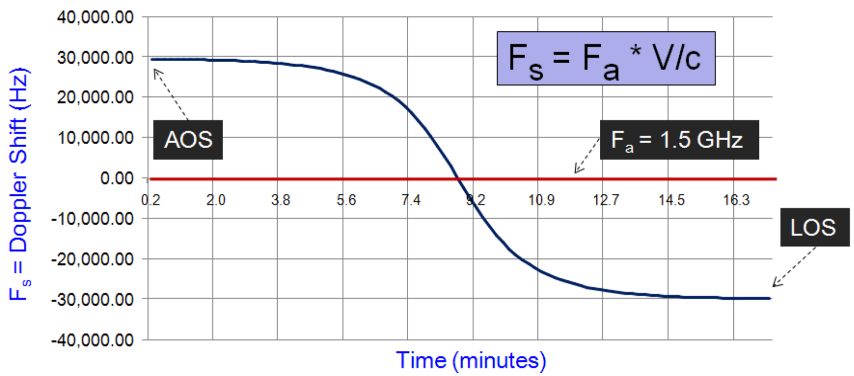


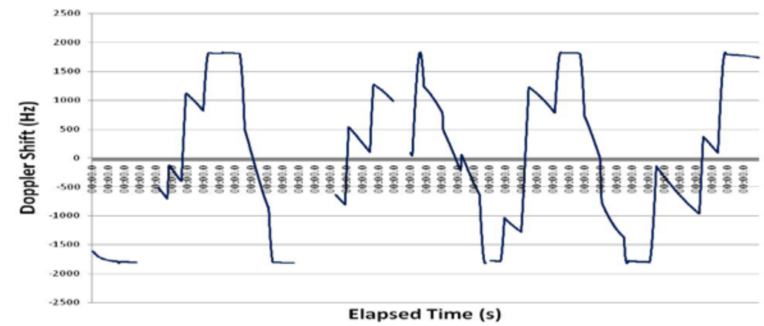
• Range vs. Time between a Vehicle Under Test (VUT) and a TM site

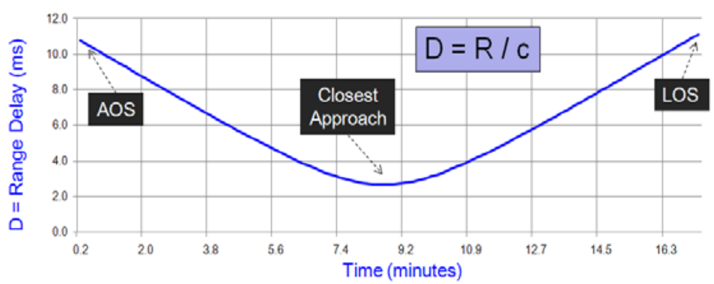


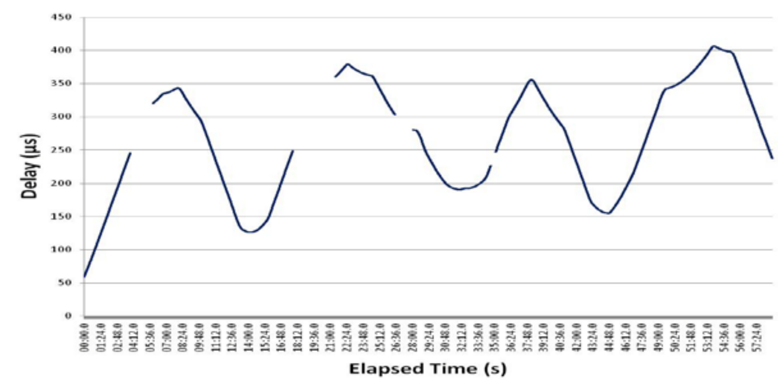
LEO Satellite Case

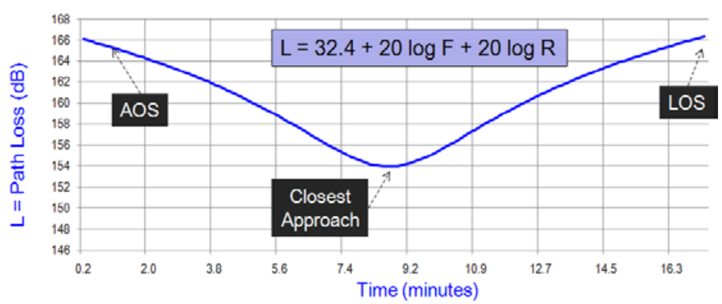
UAV/Target/Aircraft Case

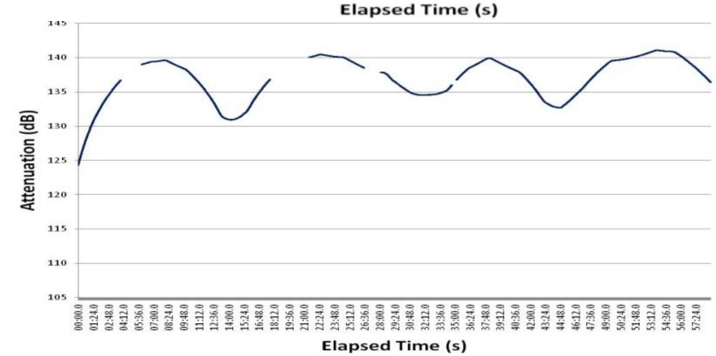




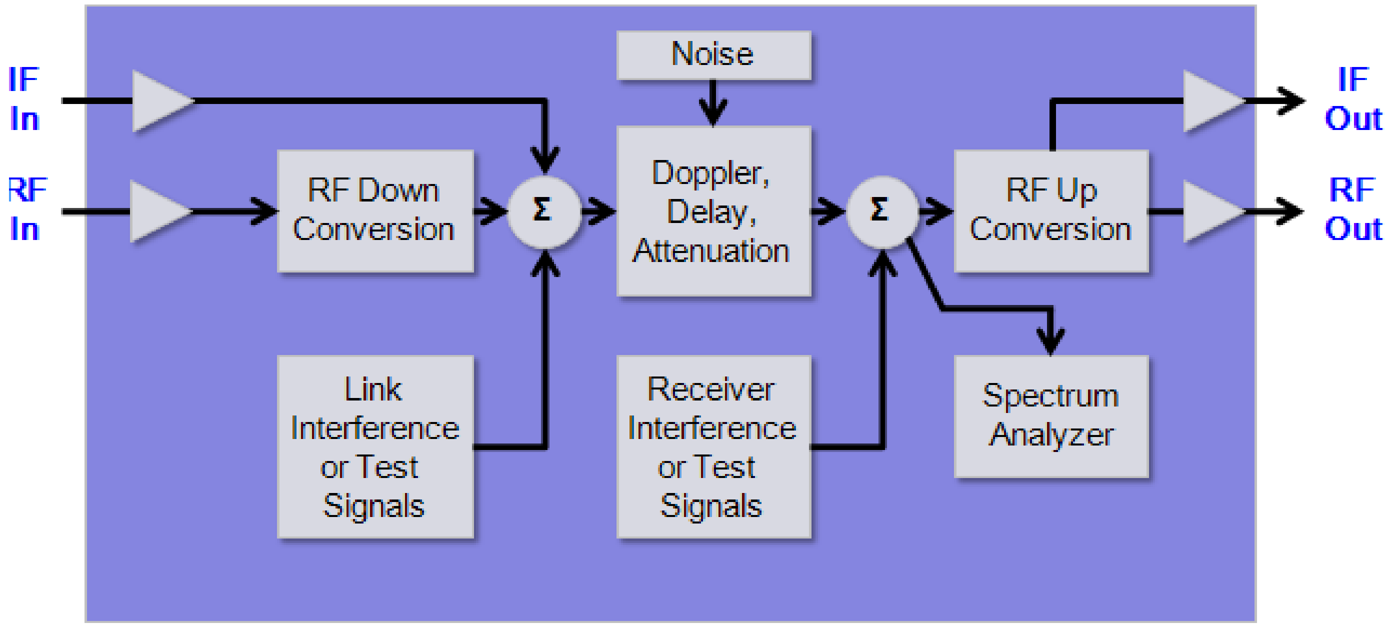




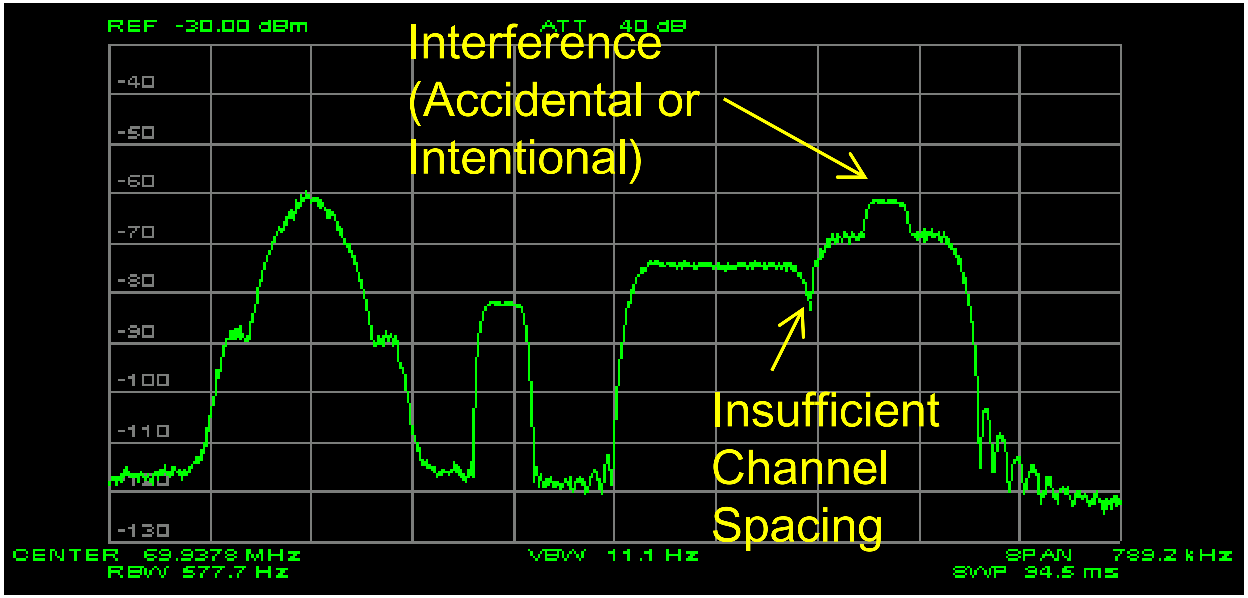




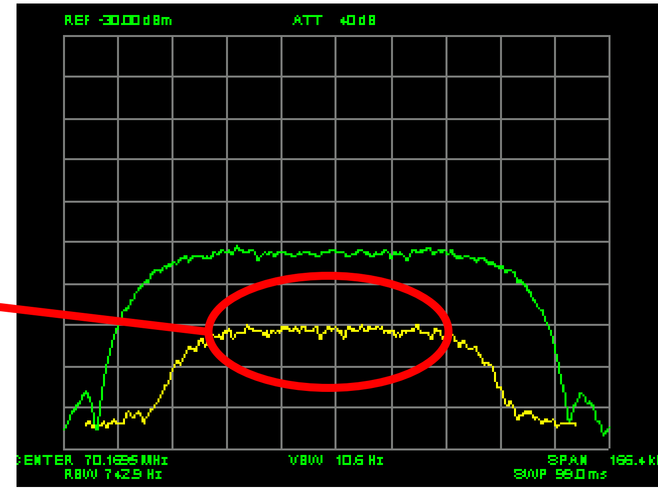
- Key Channel Simulator Capabilities
  - Specs, phase-continuous and physics-compliant
  - Modular to accommodate multiple projects and test scenarios
  - Easily reconfigurable
  - Standard inputs / output
  - IF (cable), RF (cable), RF (near-field), RF (far-field)

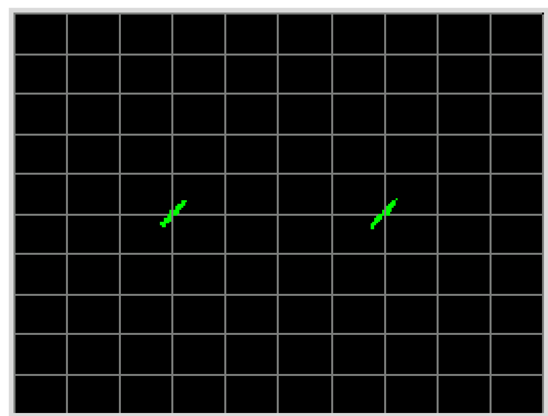


- Signal Generator Capabilities
  - Multiple independent signals
    - Modulation type
    - Data rate
    - Frequency offset
    - Amplitude
    - Etc.

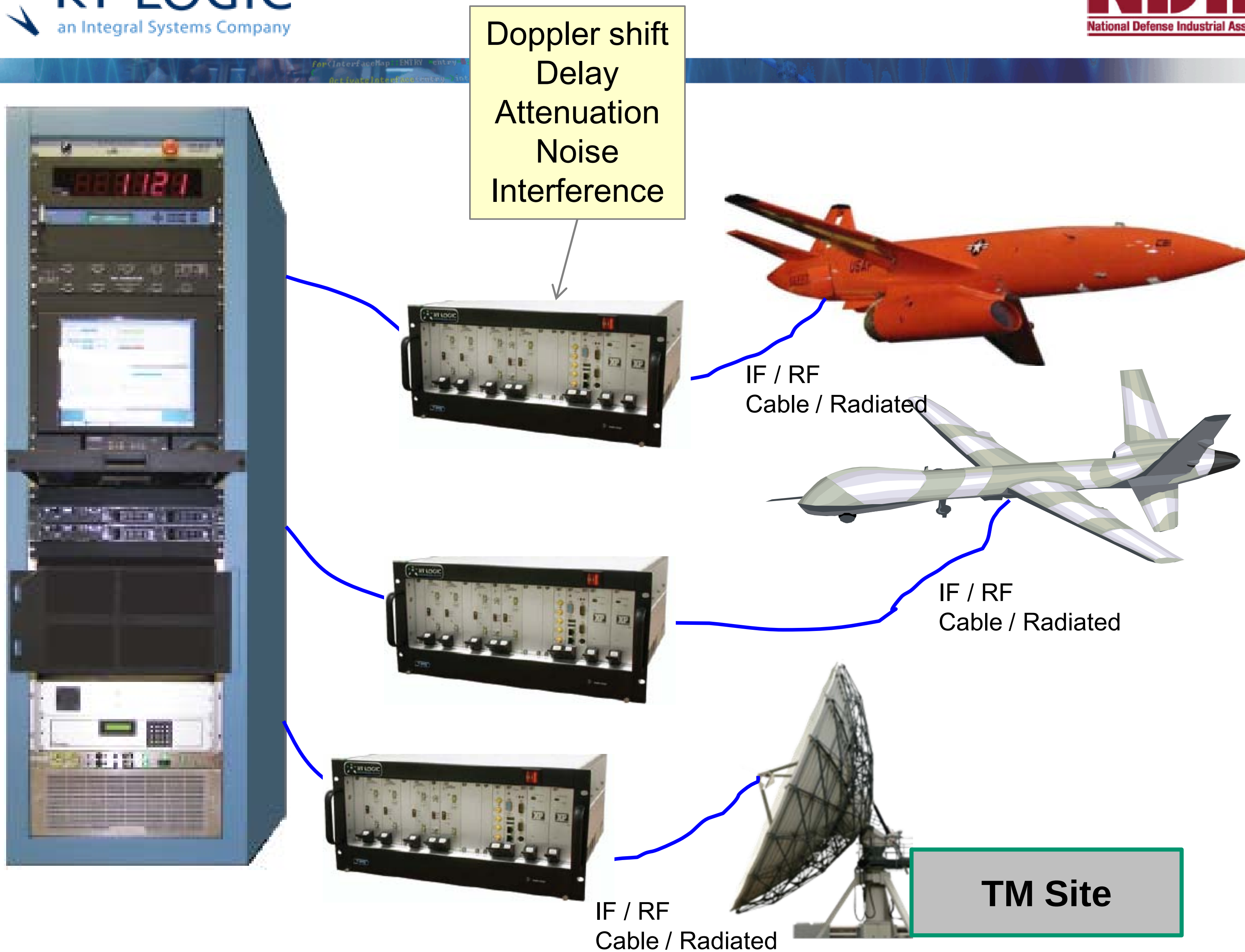


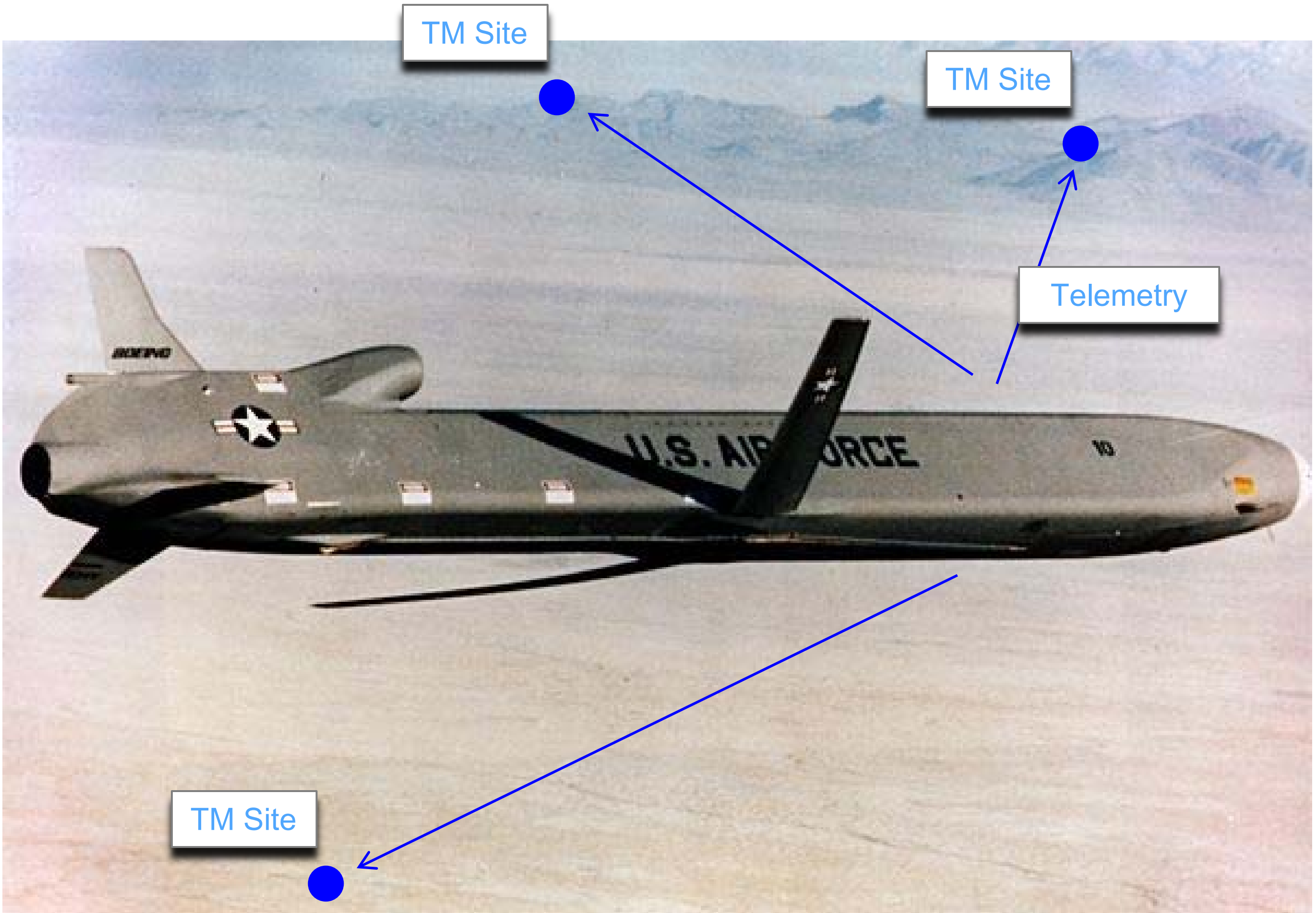
- Spectrum Analysis Capabilities
  - Spectrum, Constellation, Spectrogram
  - Modulation Analysis
  - Interference Analysis
  - Monitoring, Alarms



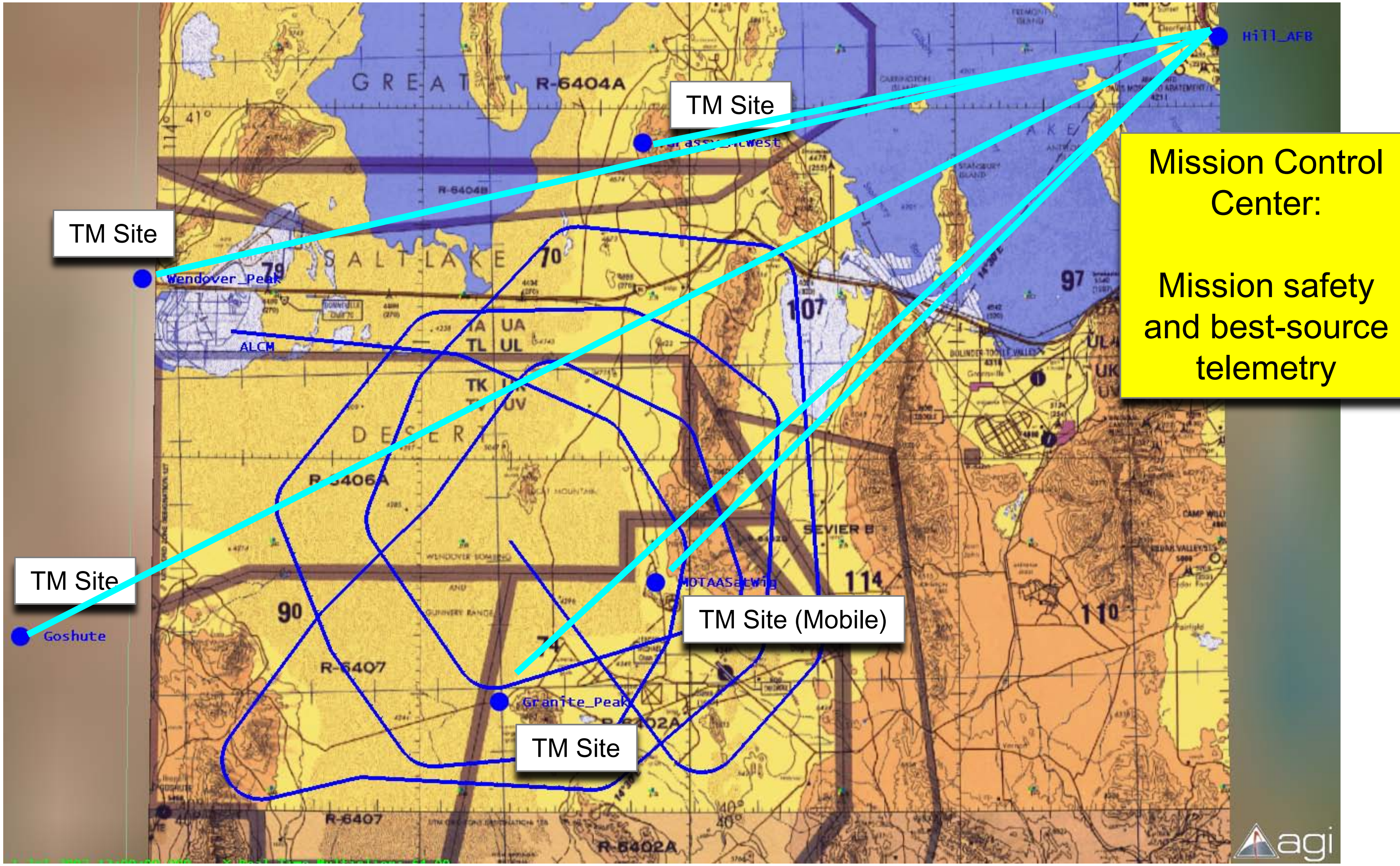


Date/Time	Modulation...	Symbol Rate(Ksps)	Center Freq(MHz)	C/No(dB/Hz)	Eb/No(dB/Hz)	BER	C/I(dB)	Carrier
2009-02-19 06:41:03	BPSK	100.000	70.168184	69.82	19.82	----	19.82	UNKNO

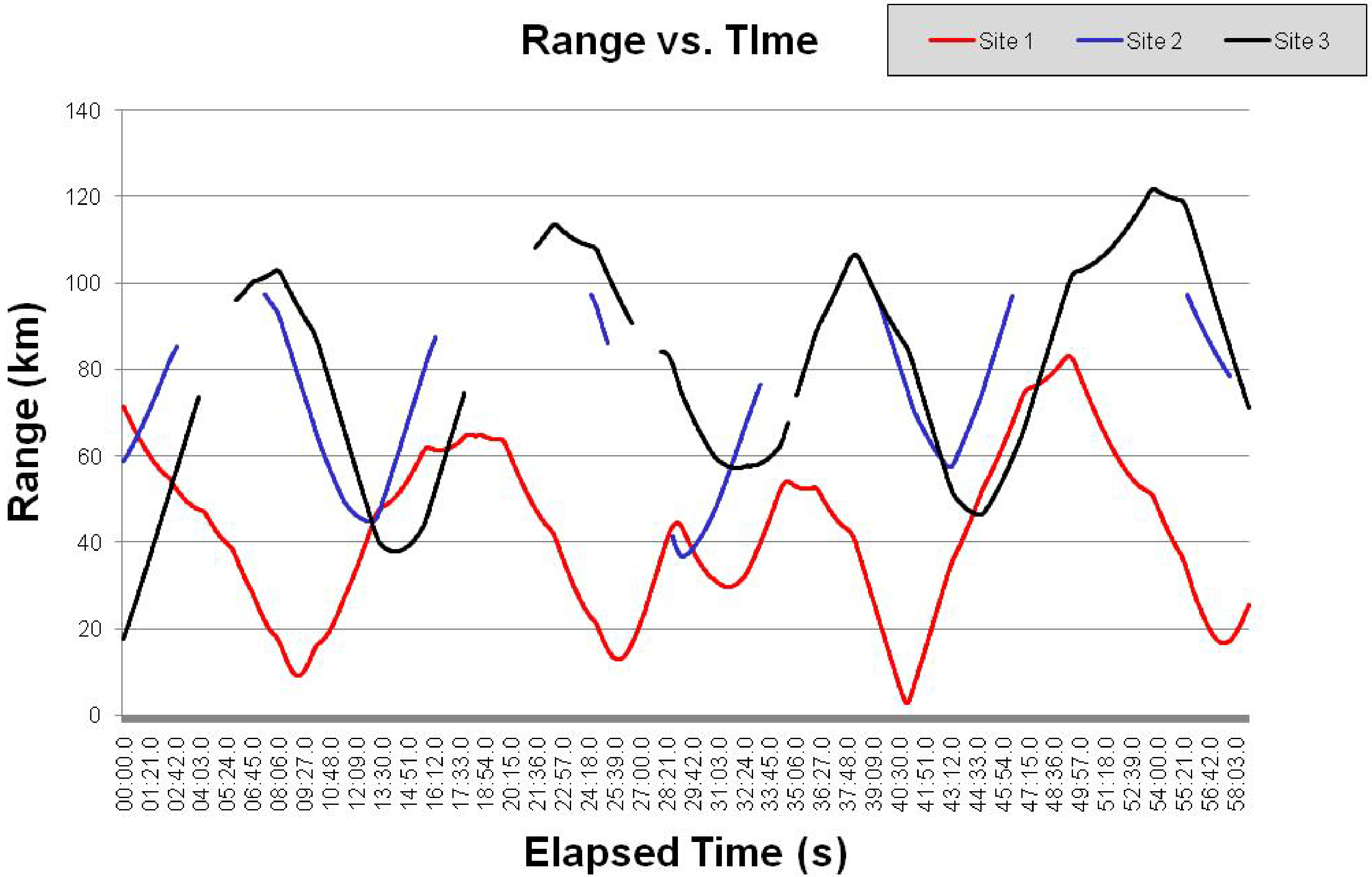

Doppler shift
Delay
Attenuation
Noise
Interference
IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
IF / RF
Cable / Radiated
TM Site

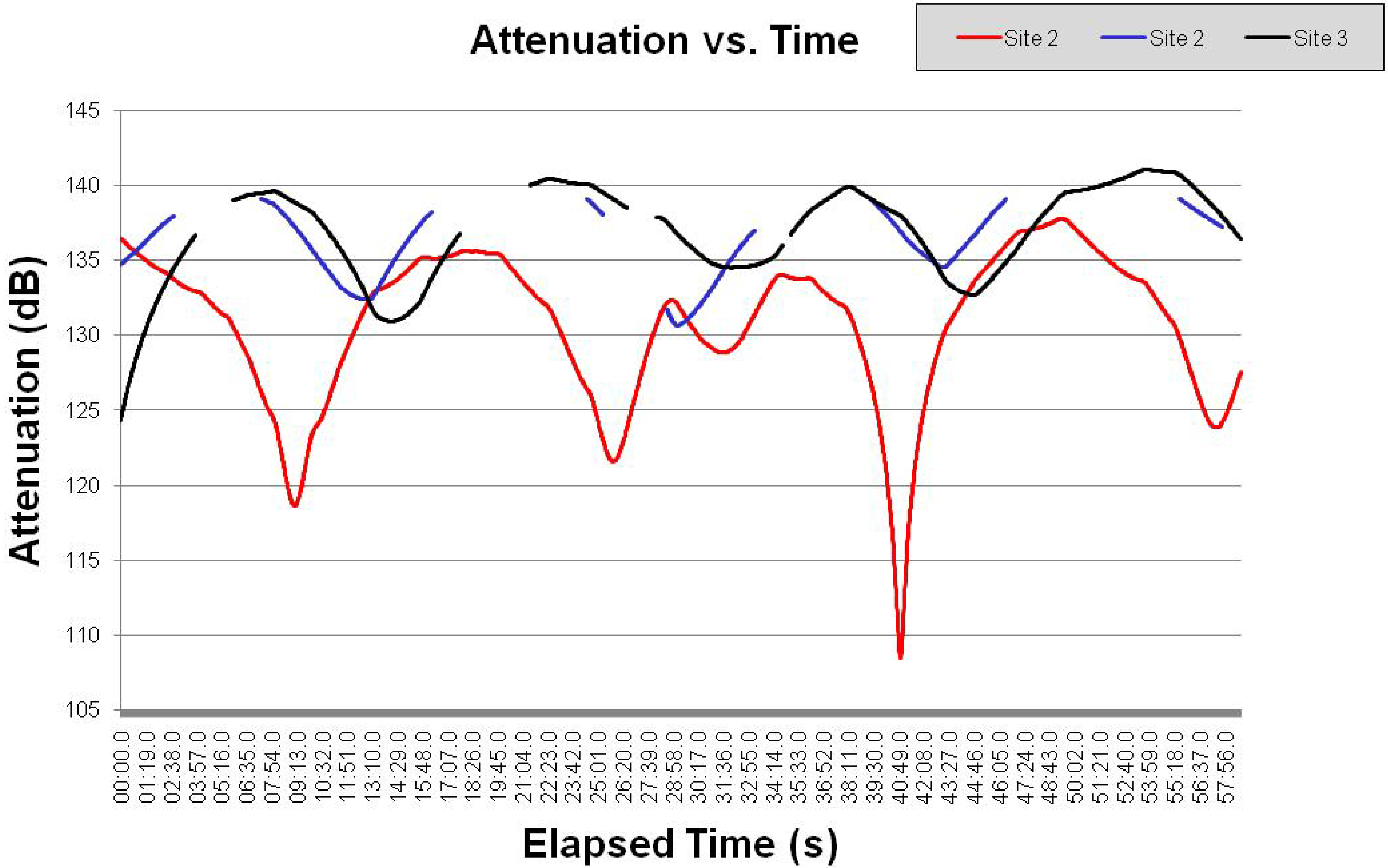


Boeing Photo

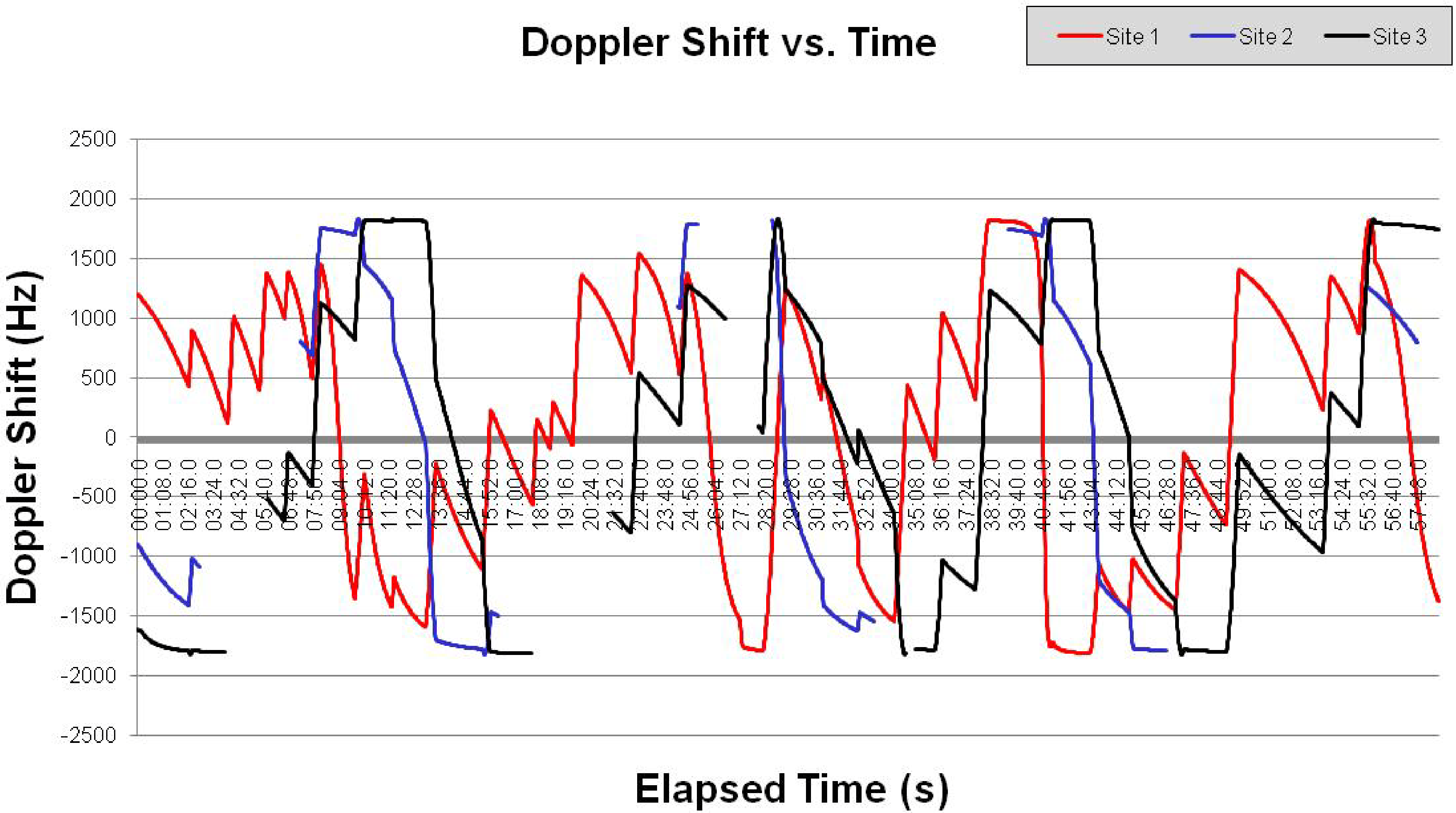

TM Site
TM Site
TM Site
TM Site (Mobile)
TM Site
Hill_AFB
Wendover_Peak
Goshute
Granite_Peak
ALCM
Mission Control Center:

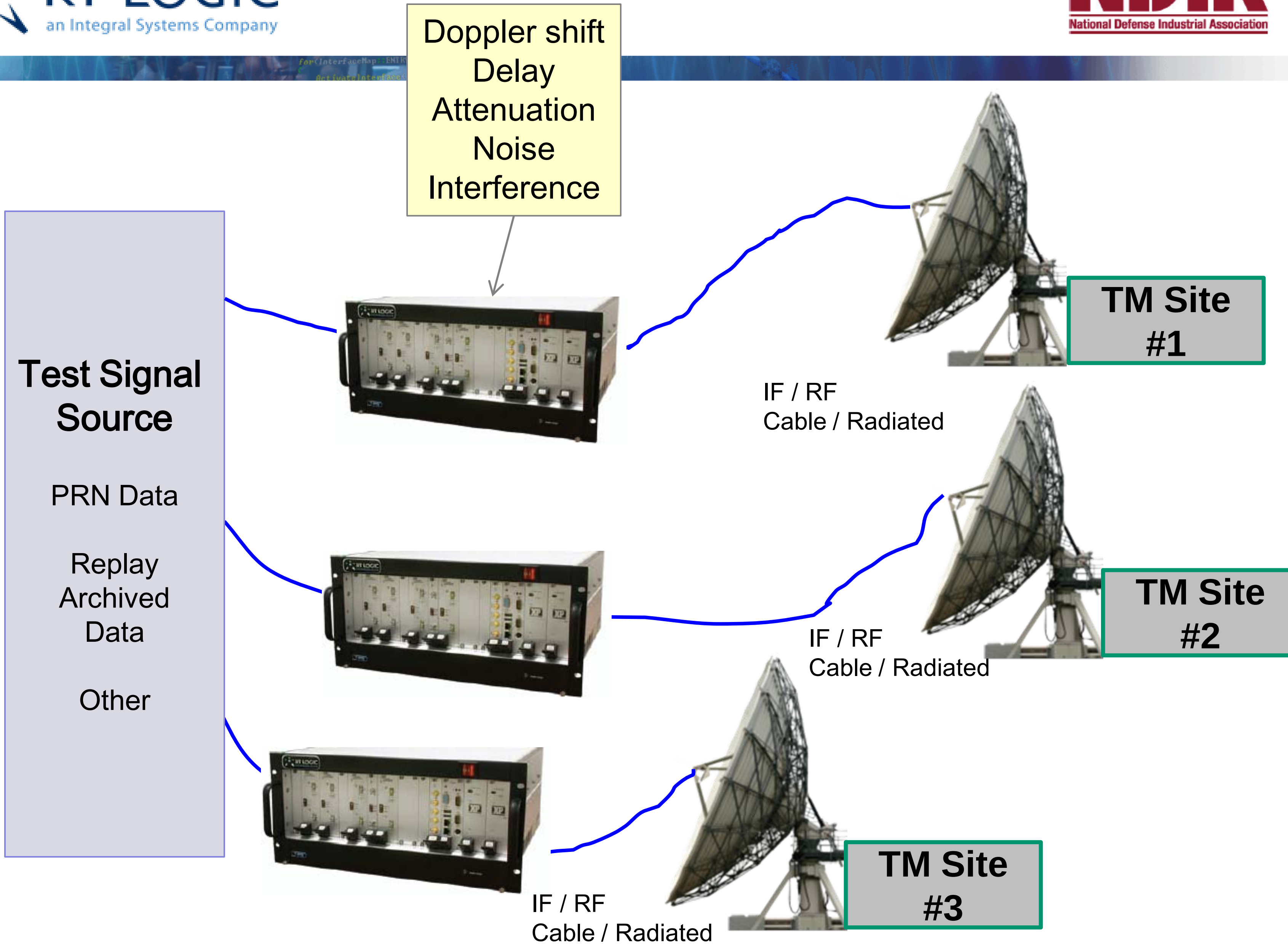
Mission safety and best-source telemetry

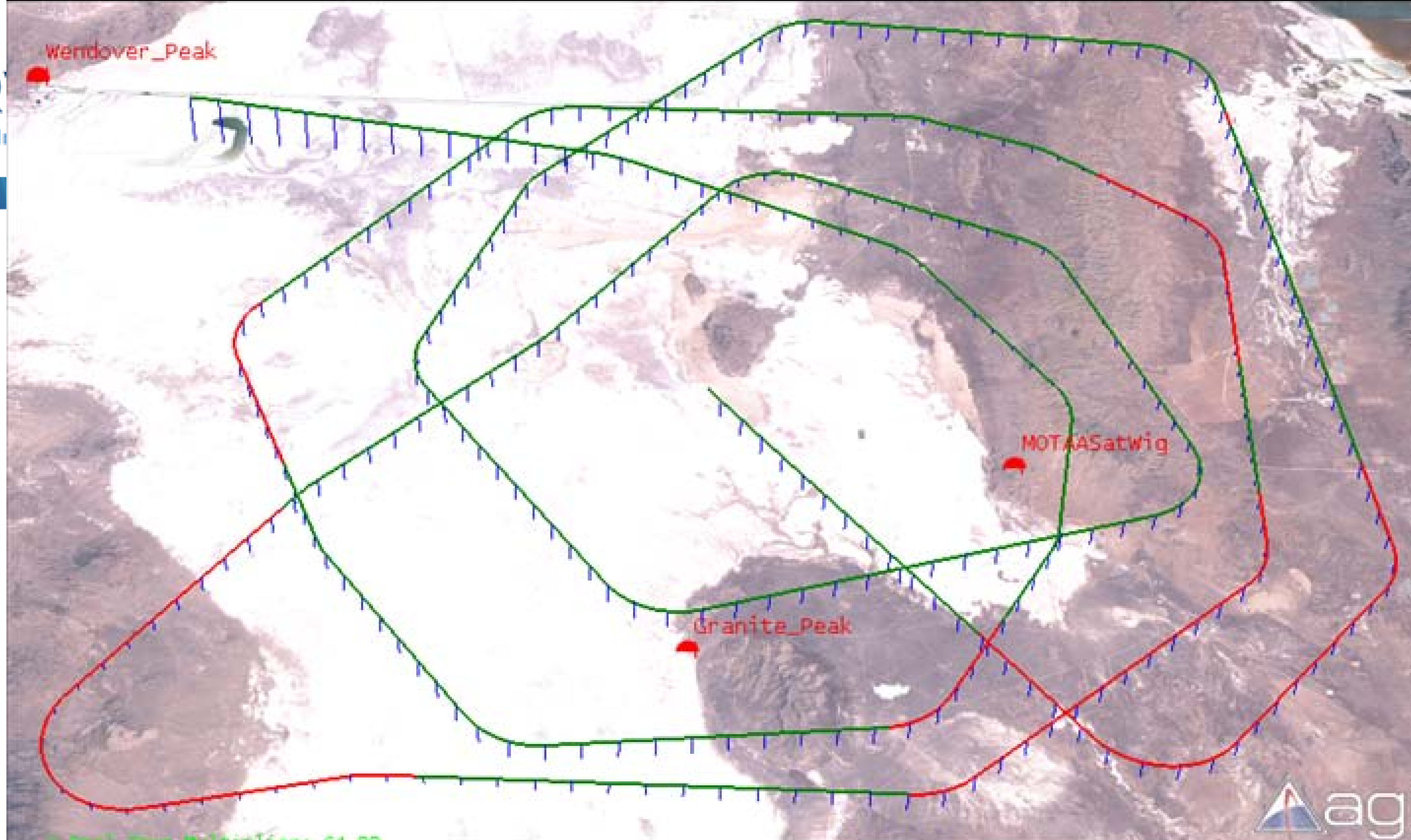

Range vs. TIme
Site 1
Site 2
Site 3
Range (km)
140
120
100
80
60
40
20
0
00:00.0
01:21.0
02:42.0
04:03.0
05:24.0
06:45.0
08:06.0
09:27.0
10:48.0
12:09.0
13:30.0
14:51.0
16:12.0
17:33.0
18:54.0
20:15.0
21:36.0
22:57.0
24:18.0
25:39.0
27:00.0
28:21.0
29:42.0
31:03.0
32:24.0
33:45.0
35:06.0
36:27.0
37:48.0
39:09.0
40:30.0
41:51.0
43:12.0
44:33.0
45:54.0
47:15.0
48:36.0
49:57.0
51:18.0
52:39.0
54:00.0
55:21.0
56:42.0
58:03.0
Elapsed Time (s)

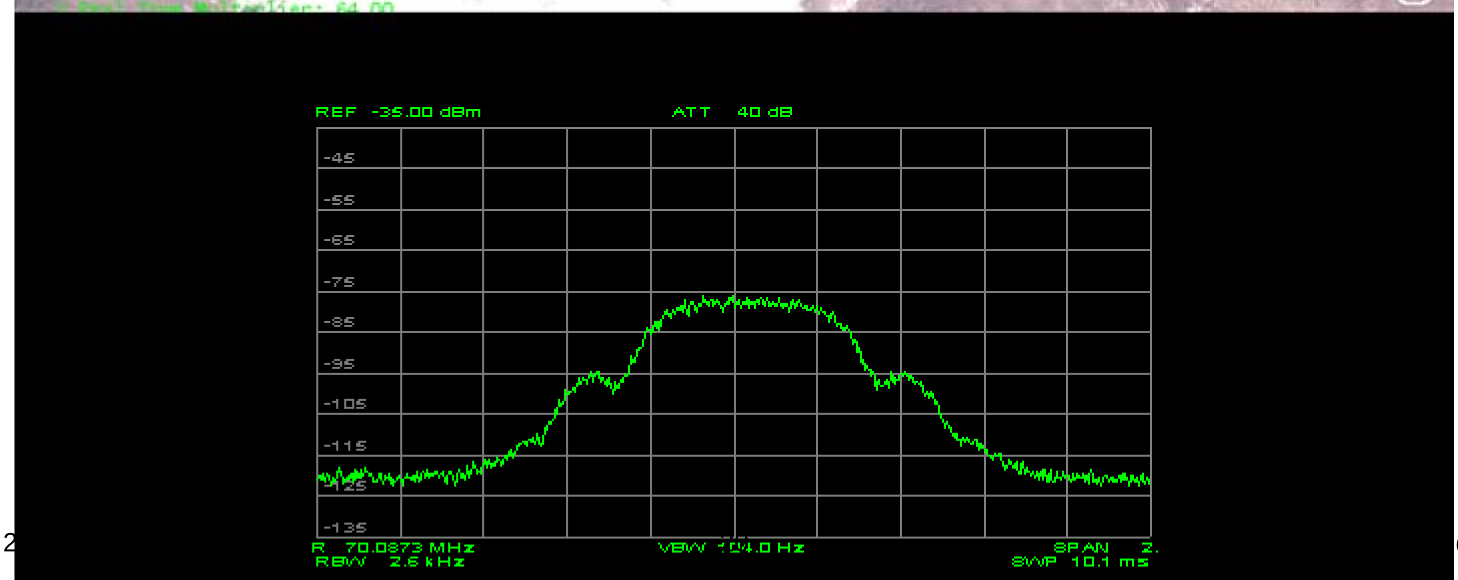


Attenuation vs. Time
Site 2
Site 2
Site 3
Attenuation (dB)
145
140
135
130
125
120
115
110
105
00:00.0
01:19.0
02:38.0
03:57.0
05:16.0
06:35.0
07:54.0
09:13.0
10:32.0
11:51.0
13:10.0
14:29.0
15:48.0
17:07.0
18:26.0
19:45.0
21:04.0
22:23.0
23:42.0
25:01.0
26:20.0
27:39.0
28:58.0
30:17.0
31:36.0
32:55.0
34:14.0
35:33.0
36:52.0
38:11.0
39:30.0
40:49.0
42:08.0
43:27.0
44:46.0
46:05.0
47:24.0
48:43.0
50:02.0
51:21.0
52:40.0
53:59.0
55:18.0
56:37.0
57:56.0
Elapsed Time (s)


Doppler Shift vs. Time
Site 1
Site 2
Site 3
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
Doppler Shift (Hz)
Elapsed Time (s)


Doppler shift
Delay
Attenuation
Noise
Interference
Test Signal Source
PRN Data
Replay Archived Data
Other
IF / RF
Cable / Radiated
TM Site #1
IF / RF
Cable / Radiated
TM Site #2
IF / RF
Cable / Radiated
TM Site #3


Wendover_Peak
MOTAASatWig
Granite_Peak
agi


REF -35.00 dBm
ATT 40 dB
-45
-55
-65
-75
-85
-95
-105
-115
-125
-135
R 70.0873 MHz
RBW 2.6 kHz
SPAN 2.
SWP 10.1 ms

- Summary
  - Thorough and realistic tests, nominal and worst-case
    - Flight COMMS systems
    - Ground COMMS systems
    - Ranges

RF Hardware | Software
Digital Hardware | Firmware
Analog Hardware | Processes

  - Key Values
    - Drives in quality
    - Improves system and mission assurance
    - Save time, saves cost, prevents over-design and under-design
  - Additional Information
    - Steve Williams, RT Logic, swilliams@rtlogic.com, 719-598-2801
    - RT Logic Booth #05