Sensor-Unmanned Vehicle
Tactical Network Topology (TNT)
Experiments:
Introduction to DNOC

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Compiled of joint presentations with Dr. Dave Netzer, TNT Director
Background: NPS Field Experimentation Program, STAN, and TNT Experiments

OBJECTIVES:

• Provide opportunity for NPS students and faculty to demonstrate and evaluate their latest technologies in an operational environment and provide operational community the opportunity to utilize and experiment with these technologies.

• Take advantage of operational experience of NPS students.

• Provide Military and National Laboratories, DoD Contractors, and other universities opportunity to test and evaluate latest S&T in operational environment; small, focused field experiments with well-defined measures of performance.

HISTORY:

• Began in FY02 – use of UAVs for improved capability of downed pilot rescue

• Jan. 03 - combined field experimentation program with CW2 Chris Manuel’s Surveillance and Target Acquisition Network Project (STAN) – quarterly field experiments began July 03

• FY05 STAN transitioned to USSOCOM programs MAI and JTCITS and NPS TNT (Tactical Network Topology)

PRIMARY SUPPORT:

• CDTEMS (Congressional Funding): FY03 = $1M, FY04=$2M, FY05=$1.75M

• USSOCOM: FY05 = $1.96M (Light Reconnaissance Vehicle), FY06 (J MUST)
FY05 TNT Team

NPS:  
- FY 04: 23 Thesis Students, 22 Faculty  
- FY05:  22 Thesis Students, 31 Faculty  
(to date) Course Projects: IS, OR, CS Students  
- Joint (SOF, Army, Navy, AF, MC) with OP Experience

CIRPAS  
- UAV Field, Flt. Support

IS Dept.  
- Networks: Performance, Architecture, (GIGA Lab) Vulnerability Assessment, DoS  
Collaboration; 3D Terrain, Targeting

OR Dept.  
- M&S, MOPs, Human Systems  
Integration, Insurgency Analysis

CS Dept.  
- Networks, Encryption, DoS

DA Dept.  
- CONOPS, Mission Analysis

MAE Dept.  
- Avionics and Controls, UAVs  
- AUVs, Undersea Sensor Grids & Coms

ECE Dept.  
- Covert Networks, IED Detection and Jamming, Smart Antennas, LPI/LPD

Met Dept.  
- Local Meteorology, Radar Threat, EO Performance

Meyer Instit. - Systems Engineering, MMALV

Instit. for M&S - Red Team Intent

CDTEMS  
- Funding

AF Force Protection Battelab: Sensor Cluster

ONR/NRL 113: Experiment Support

MIT/ ONR : EWall Collaboration and Data Fusion Testbed

Virginia Tech: Antennas

USSOCOM:  
- Funding, UAVs, UGVs,  
- Requirements  
- Contractor Team Mgmt.

USASOC: SOF Personnel

A.F. Big Safari: Funding

Office of Force Transformation:  
Funding, Wolf PAC, TACSAT

VC-6: TERN UAV Flight Support

SPAWAR: GIG-EF

LLNL: Cooperative Research  
UWB: Coms, Radar, Sensors  
IED and Tracking  
Radiation Detection  
Voice Recognition

AFSOC: UAV Operations

Camp Roberts ANG : Vehicles, Small Arms

NAVSOCC: NAVBOARD

DLI: Language, Team Support

Inter-4:  
- Tacticomp, NAVBOARD, UWB

Redline Communications: OFDM/ 802.16

Mesh Dynamics – Multi-Radio Mesh

ITT: Mesh

SAVY: RFID

CenGen: SecNet-11 for MANET

GENEX Technologies: Sensors & UAV Payloads

Fortress Technologies: Encryption

PowerWAN: Power Grid WAN

Rajant: BreadCrumb

Flarion: 802.20/OFDM Mobile Coms

Media Group: NOC Architecture

Evidenced Based Research: C2

MCTSSA: Ruggedized PDA, Radio Coms
TNT Wireless Plug-and-Play Testbed: Delivering Tactical and Global Reach to Experimentation and Training Sites
**Availability**

**Facilities**

- **NPS Campus**
- **Beach Laboratory and Monterey Bay**
- **Ft. Hunter Liggett** 165,500 Acres
- **Camp Roberts** 42,784 Acres

**NPS/CIRPAS**

**MOUT, Old Ft. Ord**

100 mi 802.16/OFDM Backbone
NPS Air Assets

CIRPAS

GCS (2)
Predator (2)
Altus ST
AN/MPQ-64 Sentinel Air Surveillance and Target Acquisition/Tracking Radar

GNAT 750 (2)
Pelican Surrogate UAV (2)
UV 18-A Twin Otter

TERN and FROG (3)
(Plus multiple TERNS provided by SOCOM – flown by VC-6)

Tethered Balloons

Small and Micro UAVs
802.16/OFDM Backbone

33 Mbps, 5 ms latency, ~100 mi

Longest leg ~38 mi
First Step: Network-Aware Self-Organizing Grid Nodes
Video Sensor is aware of SOF operator networking P2P status, i.e. capability to transfer video through his networking gear.
Network-aware air mesh nodes

**TNT 05-1, Nov 2004**
MESH Topology

- A-170 Airship
- Network camera, Rajant Breadcrumb and 802.11b
- Camera GPS Tracker SA
- Self forming/healing
- Tethered Balloons: Network camera, Polo, small laptop, Freeway, GPS, 6 hr batteries

**TNT 05-2 Feb 05**

- Improved Camp Roberts TOC
- Cypress Sea Approaching USCGC HAWKSBILL - Radiatiod Detection
- VC-6 with TERN UAVs
- TERN Network Payload
- Balloon Payload

**NA Sea Nodes**

- Paid for Cypress Sea, Pelican, Pelican video
- Resolution Target for EO Performance Prediction

**TNT 05-2 Feb 05**
Above and Below Water Situational Awareness for Combat Diver

- NPS NOC
- 802.16/OFDM VoIP
- Surrogate UAV
- Shore Image
- ARIES AUV
- 802.11b or Mesh
- Mine Location and Image
- Cypress Sea with SA
- NAVBOARD
- NA enables seamless SA
Second Step: Enabling Shared Understanding and Collaboration
Agent-EWall integration creates network-centric memory mechanism for developing shared understanding of SA events.
Plug-and Play TNT Testbed

TNT GIG-EF reach to C2 Centers

Ship-to-Ship Ad-Hoc Mesh

Target Ship Enters Monterey Bay; Collaboration with TACSAT for Ship ID

Radiation Awareness: Collaboration with LLNL for Radiation Analysis via the TNT
Third Step:

- Learning the network integration constraints
- Deriving policies for on-demand civil-military sensor-unmanned vehicle networking
- Exploring collaboration and data sharing models for Humanitarian, Tactical, and Network Operation Centers
Learning constraints: UAV surveillance perimeter for the SOF-Humanitarian Operations Area
Larger (still feasible) perimeter but lower video quality
Extending the Mesh by the UWB links enabling IED Tracking and Motion Detection Through Walls and Metal Structures

LLNL UWB Thru-Wall Motion Detection

Motion detection by camera with UWB link thru 3 walls into TNT mesh

Breathing Detection: LLNL UWB Radar thru wall
Looking inside the building via the UAV: UWB solution
UWB sensor link joins the Mesh
Grid of NOCs: introducing set of network operation centers cooperatively providing feedback to the mobile nodes
CENETIX GIGA-Lab NOC: Long-term data collection and management gateway to the testbed
Deployable NOC at Camp Roberts:
Rapid Network Operations Feedback to
Air and Ground Nodes
Mobile Light Reconnaissance Vehicle and Surface Boat NOCs